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Corvallis Plant Materials Center

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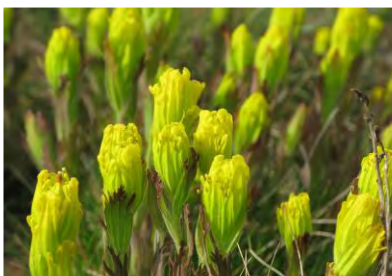
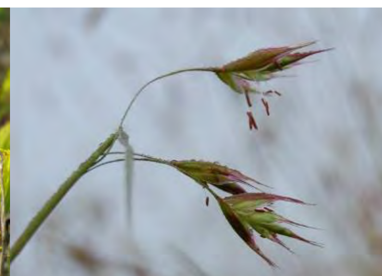

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INTRODUCTION

Corvallis PMC Service Area of western Washington, western Oregon, and northwestern California

Since 1957, the Corvallis Plant Materials Center (PMC) has selected and developed conservation plants and planting technology to solve resource concerns critical to the Pacific Northwest.

A unit of the USDA Natural Resources Conservation Service (NRCS), the PMC works in partnership with local, state, federal and private organizations to develop new technology in plant propagation and establishment, seed production, re-vegetation, restoration and erosion control. Plant specialists test and release new plant sources used to restore and protect streamside areas, wetlands, uplands, cropped lands and critical wildlife habitats. A vast majority of the work focuses on native grasses, forbs and shrubs.

The Corvallis PMC service area includes the northern Pacific Coast Range, Willamette Valley and Puget Sound, as well as the Olympic, Cascade and Siskiyou Mountains.

Genecology of Prairie Junegrass (*Koeleria macrantha*): Interim Report

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Introduction

Koeleria macrantha (Ledeb.) J.A. Schultes (prairie junegrass) is a highly variable, moderately long-lived, cool season perennial bunchgrass that grows 15 to 60 cm (0.5 to 2 ft) tall. It is adapted to a wide variety of climates and soils and is an important component of many native plant communities. The North American distribution of this circumpolar species ranges from eastern Alaska, down through California into Mexico, and east to Alabama, Delaware, and Ontario (Gonzalves and Darris 2008, Ogle et al. 2006).

One of the most important uses of *Koeleria macrantha* is in seed mixes for restoration of native prairie, savanna, coastal scrub, chaparral, and open forest habitats across much of North America. Good drought tolerance and fibrous roots also make it beneficial for revegetation and erosion control on mined lands, over septic systems, and on construction sites, burns, and other disturbed areas. Active growth begins early in spring, providing good forage for livestock, deer, antelope, and elk. Declining palatability during seed formation rebounds in late summer when there is adequate moisture. Bighorn sheep and mountain goats graze this species from rocky soils at high elevation. It provides feed for upland game birds, small mammals, and numerous grasshoppers and leafhoppers. *Koeleria macrantha* may also be cultivated for forage or fodder, and is used as a low input turfgrass (e.g. golf courses) and an ornamental grass. There is at least one turf variety and additional ones are being bred by private seed companies. Two native germplasms selected for roadside planting, prairie restoration, and landscaping have been released from the Elsberry Plant Materials Center in Elsberry, Missouri. Native Americans used the seeds to make flour for bread and mush. They also fashioned paint brushes and brooms from the leaves (Gonzalves and Darris 2008, Ogle et al. 2006).

There is a need for greater genetic knowledge of *Koeleria macrantha* to ensure adapted populations are used for restoration and revegetation projects. The objectives of this study are: (1) to explore genetic variation in putative adaptive traits in this species from a wide range of source environments in the Pacific Northwest; (2) to explore the relationships between genetic variation in putative adaptive traits and the climates of the source environments; and (3) to develop seed transfer guidelines to ensure adapted populations for restoration. Most information will be generated from two common garden studies conducted on separate contrasting environments in Oregon. These studies are a joint effort between the USDA Forest Service Pacific Northwest Research Station and the USDA Natural Resources Conservation Service in Oregon.

Methods and Materials

Population sampling

Seed was collected by USDA Forest Service employees and collaborators from endemic stands of *Koeleria macrantha* during the summers of 2003 to 2006. Populations came from Oregon, Washington, and adjacent areas of Idaho, primarily east of the Cascade Mountains. Two families (maternal parents) were sampled from each of 114 populations, while only a single family was sampled from 12 populations, for a total of 240 families from 126 populations.

Locations and growing conditions

Common garden studies were established in 2008 at two contrasting sites in Oregon: the USDA Natural Resources Conservation, Plant Materials Center, Corvallis, Oregon, and Oregon State University's Agricultural Experiment Station at Powell Butte, Oregon. The two locations offer very different environments. The Corvallis site is west of the Cascades in the Willamette Valley, and has milder winters and greater precipitation than the Powell Butte site which is east of the Cascades in central Oregon near Prineville.

The Corvallis site is at an elevation of 69 m (225 ft) and located at 44.6251 north latitude, -123.2168 west longitude. The soil type is a well-drained Willamette silt loam on uniform, level ground (USDA Natural Resources Conservation Service 2010). Because the site is within 120 km (75 mi) of the Pacific Ocean, the climate has a distinct maritime influence, modified by the Coast Range Mountains of Oregon. The average annual precipitation is 1,040 mm/yr (41 in/yr) with 70% falling from November through March. Measurable precipitation occurs 150-160 days a year. Average annual snowfall is 15 cm/yr (6 in/yr). The highest average maximum temperature is 27°C (81°F) in July and August and the lowest average minimum temperature is 1°C (33°F) in January. The average annual growing degree days is 2,121 (base 50°F) (Western Region Climate Center 2010).

Soils are lighter textured and climatic conditions semiarid and more continental at Powell Butte compared to Corvallis. The Powell Butte site is located at 44.2530 north latitude, -120.9478 west longitude at an elevation of 975 m (3,200 ft). The soil type is a well-drained Buckbert ashy sandy loam on uniform, somewhat rocky, level ground (USDA Natural Resources Conservation Service 2010). The average annual precipitation is 262 mm/yr (10.3 in/yr) with monthly averages near 25 mm (1 in) in winter and 13 mm (0.5 in) in summer. Average annual snowfall is 507 mm/yr (20 in /yr). Measurable precipitation occurs 70-80 days a year. The highest average maximum temperature is 30°C (86°F) in July and August and the lowest average minimum temperature is -6°C (21°F) in December and January. The average annual growing degree days is 1,506 (base 50°F) (Western Region Climate Center 2010).

Plant establishment and management

Prairie junegrass seeds were germinated in Petri dishes in spring of 2008, seedlings transplanted into 115 cc (7 cu. in.) Ray Leach cone shaped containers (plugs), and plants grown in a greenhouse in Corvallis, Oregon, by the USDA Forest Service. Seedlings were trimmed to control growth over the summer until ready to be planted in late summer and fall. Both the Corvallis and Powell Butte study sites were prepared by plowing or disking and harrowing during the summer of 2008. The experimental design at each location was a randomized block design with a single plant from each of 240 families randomly assigned to planting spots in a replication. There were ten replications at each site for a total of 2,400 individual plant plots per site.

The time of transplanting and the treatment of the plants differed between the Corvallis and Powell Butte sites. Two weeks prior to planting at Corvallis, medium textured, Douglas-fir bark mulch was applied (blown on) to the study site at an average thickness of 6 cm (2 in.) to help control weeds. Plugs were then transplanted into a weed-free planting bed on October 21, 2008. The spacing is 90 cm (36 in.) between rows and 60 cm (24 in.) within rows. Each block or replication consists of 12 rows with 20 plants per row (240 plants) and there are 10 blocks. At the time of transplanting, each plug received 6 g (0.21 oz) slow release fertilizer [Apex® 14-14-14 (14-6-11.6 elemental) with a release period of 5 months at 16°C (60°F)] in the bottom of the 13 cm (5 in.) deep planting hole. All holes were made with planting dipples to create depressions similar in dimension to the container plugs. A single outside border row of known families was planted to offset environmental edge effects. To aid in fall establishment, approximately 1/2 inch of water was applied by sprinkler irrigation system the day after planting and again a week later. No supplemental water was applied thereafter or in subsequent years. No herbicides were applied to the study site. All weed control is manual. To control stem and leaf rust diseases (*Puccinea* spp.) in 2009 only, the fungicide Quilt® (azoxystrobin and propiconazole) was applied on May 18, 2009, at the rate of 20 oz of product per acre (Syngenta Crop Protection Inc. 2009). No fungicides were applied in 2010 in order to evaluate possible variation in susceptibility to rust among families at Corvallis.

At the Powell Butte site, plugs were transplanted to the plot area on August 27, 2008. The spacing was 60 cm (24 in.) between rows and 50 cm (20 in.) within rows. Unlike Corvallis, no fertilizer or bark mulch was applied to the plants or plot area. However, each plant was watered with a hose. Supplemental water was also applied afterwards by sprinkler irrigation to aid in establishment during the fall. No irrigation water was applied thereafter. Each block or replication consists of 6 rows with 40 plants per row (240 plants) and there are 10 blocks. The long replications were oriented to account for a gradient in moisture from a nearby irrigation ditch. The replications were oriented to be either in or out of an area that had been previously burned as part of a previous study on bitterbrush. A single outside border row was added to offset environmental edge effects. Like Corvallis, all weed control is manual so no herbicides were applied. Unlike Corvallis no fungicides were applied for disease control. The study area was fenced to exclude wildlife and livestock, and rodents were actively controlled.

Traits measured

Plants were measured for a variety of traits including growth, morphology, phenology, and fecundity in 2009 and 2010. A list of traits sampled is given in Table 1.

Statistical analyses

Statistical methodology follows procedures used in previous genecological studies for mapping genetic variation across the landscape (Campbell 1979, 1986; Erickson et al. 2004; St.Clair et al. 2005). The general procedure considers differences among populations in traits and how population differences may or may not be related to the environments of the source locations. Large population differences related to the environments of source locations that make sense from the perspective of plant adaptation are indicative of traits that may be important for adaptation and should be considered when delineating seed zones or seed transfer guidelines.

We first consider differences between the two test sites. Analyses of variance are done to test differences between test sites and among populations, and to evaluate population x environment interactions. The model for the analysis of variance is:

$$Y_{ijk} = \mu + S_l + B_{k(l)} + P_j + F_{i(j)} + S_l P_j + S_l F_{i(j)} + e_{ijk}$$

where Y_{ijkl} is the plot mean performance of the i^{th} family (F) from the j^{th} population (P) in the k^{th} replication (B) at the l^{th} test site, μ is the overall experimental mean, and e is the experimental error consisting of the pooled interactions of both sources and families by replications. Test sites, populations and families are treated as random effects. Differences among test sites, populations, families within populations and the interactions of test site with populations or families within populations were tested for significance using PROC GLM of the SAS statistical package (SAS Institute Inc. 1999). Population differences were tested using a Satterthwaite approximation of an F-value utilizing the family within population and site x population mean squares (Snedecor and Cochran 1980). Family differences and site x population interaction were tested against the site x family interaction. Site x family interaction was tested against the experimental error term. Variance components are obtained using PROC MIXED. The importance of the population x environment interaction will be also be evaluated by considering the magnitude of the correlation of population means between test sites.

Analyses of variance were also done within each test site. The model for the analysis of variance is:

$$Y_{ijk} = \mu + B_k + P_j + F_{i(j)} + e_{ijk}$$

where Y_{ijk} is the plot mean performance of the i^{th} family (F) from the j^{th} population (P) in the k^{th} replication (B), μ is the overall experimental mean, and e is the experimental error consisting of the pooled interactions of both populations and families by replications. Differences among populations and families within populations were tested for significance using PROC GLM of the SAS statistical package (SAS Institute Inc. 1999). Population differences were tested using families within populations as the error term, and family differences were tested against the experimental error term. Variance components were obtained using PROC MIXED.

Principle component analyses were done using PROC PRINCOMP. The same traits measured at different test sites may be considered as different traits. When traits are highly correlated, only one trait will be chosen for input into the principle component analysis. Traits with low population variation will not be included in the principle component analysis.

Regression models were determined relating trait variation (both individual traits and composite traits from the principle components) to environmental variation as measured by climate and geographic variables. Lack of fit to the models was tested using variation among families within populations as pure error (Neter and Wasserman 1974). Significant lack of fit may be due to unaccounted site factors, such as soils, biotic interactions, or microclimate, to non-uniform patterns of gene flow, or to local patterns of variation that differ from the broad-scale, overall pattern of variation. Geographic variation based on this model was illustrated using GIS and the grid algebra functions in ARC/INFO (see St.Clair et al. 2005).

Different classifications systems will be compared to evaluate options for seed movement guidelines, including ecoregions, conifer seed zones, watersheds, plant associations, and soil types (see Erickson et al. 2004). For each trait, including principle components, analysis of variance on family means will be performed using the model:

$$Y_{ijk} = \mu + Z_k + P_{j(k)} + F_{i(jk)}$$

where Y_{ijk} is the mean of the two plants from the i^{th} family in the j^{th} population in the k^{th} zone, μ is the overall mean, Z_k is the effect of the zone, $P_{j(k)}$ is the effect of the population within a zone, and $F_{i(jk)}$ is the effect of the family within a population. Lack of fit to the classification model will be tested by the significance of the p value for population within classes. Components of variance will be estimated for population with and without the classification in the model as a fixed effect. The percentage of population variance accounted for by the classification system will be calculated as:

$$(\sigma^2_P - \sigma^2_{P/Z}) / \sigma^2_P \times 100$$

Results and Discussion

Traits at Corvallis were significantly different from traits at Powell Butte (Table 2). Plants at Corvallis were larger and had earlier phenology in both 2009 and 2010 (Table 3). Plants at Powell Butte flowered profusely compared to plants at Corvallis in 2009, but plants in Corvallis had a higher inflorescence number in 2010. Variation among populations for size traits was much greater when plants were grown at Corvallis in both years, and plants grown at Powell Butte had generally higher variation among populations in phenology traits for both years (Table 3). The percentage of the total phenotypic variation (populations, families, and residual) that was found within populations was high for most traits, especially crown width, leaf width, leaf ratio, and dates of heading and bloom.

The population x site interaction was significant for most traits (Table 2). Correlations of population means between test sites were higher in 2009 than in 2010, and correlations between years within sites were generally high (Table 4). Populations that had wide crowns, more flowers, wide leaves, upright habit, and later phenology at one site were generally the same as those at the other site.

Traits that had large population variation and were correlated with climates at the source locations are biomass, crown width, inflorescence number, leaf width, leaf ratio, heading date and bloom date (Tables 3 and 5). As might be expected, leaf width is strongly correlated with leaf ratio (r=-0.73), and bloom date is strongly correlated with heading date (r=0.93) though only moderately correlated with maturation date (r=0.46). These traits are generally correlated with temperatures, precipitation, and aridity (as measured by the heat moisture index which is a function of the ratio of temperature to precipitation). Regression equations of traits on source climates used various combinations of temperature, precipitation or aridity variables. Regression models were used to map patterns of variation for biomass, inflorescence number, leaf ratio and bloom date (Figure 1). R^2 values ranged from 0.29 to 0.36. Although the magnitudes and nature of the relationships between the source climates and traits differ somewhat between the four traits, general patterns of variation emerge. Populations from the Columbia Basin have lower biomass, narrower leaves, fewer inflorescences, and later phenology when grown together in a common environment. Populations from the Blue Mountains have greater biomass, wider leaves, more inflorescences, and earlier phenology. Populations from the northern Great Basin are similar to the Columbia Basin in having narrow leaves and lower biomass, but are more similar to the Blue Mountains in having earlier phenology and more inflorescences. The few populations from western Oregon have wider leaves and many inflorescences. From an adaptation perspective, we expect narrow leaves from areas of greater aridity, less precipitation, and warmer summer temperatures, and we expect earlier phenology from areas with colder winter temperatures (i.e., quicker responses to springtime warming). The general patterns that emerge from this preliminary analysis are largely congruent with large-scale ecoregions, suggesting that Omernick's Level III ecoregions may be useful for seed zones.

It should be emphasized that this is a preliminary analysis. We still need to more fully explore the relationships among traits and reduce the number of uncorrelated traits through principal component analysis. Variation in stem and leaf rusts (*Puccinia* spp.) will be further explored. Although spring rust infection was suppressed in 2009 with an application of fungicide, fall rust occurred at Corvallis with wide differences in infection rates between plants. As expected, the Corvallis site was more prone to stem and leaf rusts compared to the Powell Butte site. Fungicides were not used at Corvallis in 2010. A small percentage of plants at Corvallis appeared to spread laterally below ground, either from lateral tillers buried in the soil or short rhizomes. This characteristic did not occur at Powell Butte.

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Table 1. Traits measured in common garden studies of *Koeleria macrantha* established in Corvallis and Powell Butte, Oregon.

Trait	**Units**	**Time of measurement**	**Description**
Aboveground biomass	g	July	Dry weight sampled at maturity cut 1 cm above ground level
Fall regrowth biomass[1]	Score of 1-9	September to November	Evaluate abundance of foliage regrowth after clipping
Crown width	cm	Late July to August	Width of the base of the plant measured at its widest diameter
Inflorescence number	count	June	Number of inflorescences (to nearest 5 or 10 when numbers are high)
Culm length	cm	At maturity prior to harvest (July)	Base of crown to top of a lead culm (minus spike length)
Spike length	cm	At maturity prior to harvest (July)	On a lead culm
Leaf length	cm	May-June	Length of typical fully-emerged leaf
Leaf width	mm	May-June	Width of typical fully-emerged leaf when flattened
Leaf ratio	Ratio	Derived	Ratio of leaf length to leaf width
Plant form	Score of 1-9	June	Rated from 1=prostrate to 9=upright after heading
Spread	Score of 1-9	July	Evaluation of apparent lateral spread of tillers through the soil
Rust disease	Score of 1-9	June and fall	Evaluation of apparent susceptibility to rust (*Puccinia* spp.)
Heading date	Days since Jan 1	March-May	Date when first spike has emerged and base extended 1 cm beyond leaf collar or leaf sheath
Bloom date	Days since Jan 1	Mid April to mid June	Date of first anther extrusion from any spike
Maturation date	Days since Jan 1	Early to late July	Date of first seed ripening as evidenced by start of shatter or hardening seeds[2]

[1]Was not recorded at Powell Butte in 2010
[2]At Corvallis in 2009 only, maturity was recorded when 50% of the seedheads reached maturity, rather than just the first spike.

Table 2. Results from analyses of variance over both sites and both years.

Trait	F-ratio Year	Site	pop	Year*Site	Site*pop	Year*pop
Biomass	2383.21***	70.69***	9.97***	368.53***	9.15***	6.68***
Regrowth	740.81***	30.93***	4.37***	NA	0.98	2.44***
Crown wid.	245.86***	53.71***	1.63**	13.8***	1.19	1.03
Inflor. num.	1068.1***	19.44***	4.11***	2074.04***	2.63***	2.13***
Culm length	586.3***	122.75***	2.19***	421.62***	2.57***	1.13
Spike length	500.83***	9.64**	3.69***	410.91***	2.51***	1.38**
Leaf length	301.47***	30.78***	5.5***	64.42***	1.46*	1.2
Leaf width	1727.38***	12.76**	6.52***	257.86***	1.3	1.36**
Leaf ratio	2780.53***	3.98	4.62***	300.85***	1.48*	1.29*
Plant form	258.83***	428.15***	2.46***	526.64***	2.19***	2.41***
Head. date	7058.15***	3610.78***	6.45***	13722.3***	3.63***	3.4***
Bloom date	282.18***	3351.85***	4.76***	1463.21***	1.87***	1.36**
Matur. date	163.4***	2209.93***	1.18	404.87***	1.18	1.06

* < 0.05 ** < 0.01 *** < 0.001

Table 3. Trait means and percentage of total variance at a site attributed to populations for *Koeleria macrantha* grown at Corvallis and Powell Butte, Oregon.

	Corvallis				Powell Butte			
	2009		2010		2009		2010	
Trait	Per. Pop. Var.	Mean	Per. Pop. Var.	Mean	Per. Pop. Var.	Mean	Per. Pop. Var.	Mean
Biomass	38.0%	65.8	52.0%	119.3	15.0%	56.6	10.9%	80.2
Regrowth	27.2%	5.0	32.5%	3.7	1.7%	3.0	NA	NA
Cro. wid.	26.9%	12.1	0.7%	18.6	7.4%	10.7	8.1%	14.8
Infl. num.	22.2%	12.0	17.0%	85.2	7.2%	72.1	13.0%	61.4
Culm len.	3.4%	51.3	22.6%	50.2	3.8%	47.5	7.8%	36.3
Spike len.	23.5%	11.3	11.3%	9.2	7.6%	9.9	13.3%	9.8
Leaf len.	10.1%	21.9	16.4%	24.6	10.1%	20.6	12.2%	21.6
Leaf width	26.6%	3.4	7.6%	2.5	23.3%	3.0	12.1%	2.6
Leaf ratio	11.1%	6.6	5.3%	10.6	14.4%	7.1	10.1%	9.2
Plant form	16.9%	4.8	15.9%	4.5	11.2%	5.1	7.3%	6.4
Head. date	18.7%	126.4	32.0%	88.9	31.9%	134.8	32.8%	140.5
Blo. date	1.4%	145.5	25.5%	131.2	35.4%	158.4	39.2%	163.9
Mat. date	0.9%	177.4	29.4%	163.4	2.3%	191.4	2.4%	194.2

Table 4. Correlations of population means between sites within years and between years within sites.

Trait	Btwn. site w/in year 2009	Btwn. site w/in year 2010	Btwn. year w/in site Corvallis	Btwn. year w/in site Powell Butte
Biomass	0.76	0.32	0.89	0.63
Regrowth	0.50	NA	0.64	NA
Crown wid.	0.59	0.27	0.29	0.71
Inflor. num.	0.47	0.15	0.50	0.49
Culm length	0.39	0.34	0.57	0.68
Spike len.	0.53	0.53	0.75	0.73
Leaf length	0.71	0.62	0.71	0.77
Leaf width	0.85	0.68	0.70	0.82
Leaf ratio	0.73	0.63	0.65	0.75
Plant form	0.62	0.09	0.62	0.46
Head. date	0.72	0.61	0.80	0.82
Bloom date	0.37	0.68	0.53	0.90
Matur. date	0.12	0.26	0.33	0.07

Table 5. Correlations between traits measured at Corvallis and select climate variables[1] of seed sources.

Trait	MAT	MWMT	MCMT	MAP	AHM	SHM	NFFD	FFP
Biomass	0.18	-0.04	0.38	0.25	-0.24	-0.05	0.23	0.13
Regrowth	0.05	-0.14	0.22	0.22	-0.31	-0.21	0.13	0.09
Crown width	-0.09	-0.23	0.17	0.16	-0.26	-0.22	-0.06	-0.05
Inflor. num.	0.29	0.09	0.47	0.14	0.00	0.07	0.27	0.19
Culm length	-0.03	-0.09	0.06	0.03	-0.06	-0.02	-0.06	-0.11
Spike length	0.21	0.10	0.21	-0.15	0.15	0.23	0.08	-0.05
Leaf length	0.08	0.00	0.10	0.15	-0.23	-0.14	0.14	0.10
Leaf width	-0.25	-0.35	0.02	0.32	-0.45	-0.42	-0.15	-0.13
Leaf ratio	0.38	0.44	0.06	-0.29	0.43	0.45	0.28	0.23
Plant form	0.00	-0.10	0.21	-0.05	0.04	-0.04	-0.01	-0.05
Heading date	0.28	0.13	0.35	0.26	0.05	0.20	0.20	0.11
Bloom date	0.33	0.16	0.40	0.23	0.09	0.25	0.20	0.08
Matur. date	0.12	0.00	0.31	0.29	-0.06	-0.04	0.13	0.11

[1] Key to climate variables: MAT=mean annual temperature, MWMT=mean warmest month temperature, MCMT=mean coldest month temperature, MAP=mean annual precipitation, AHM=annual heat:moisture index [(MAT+10)/(MAP/1000)], SHM=summer heat:moisture index [(MWMT+10)/(MSP/1000)], NFFD=number of frost-free days, FFP=frost-free period. Temperatures are in ˚C and precipitation is in mm.

A. B.

C. D.

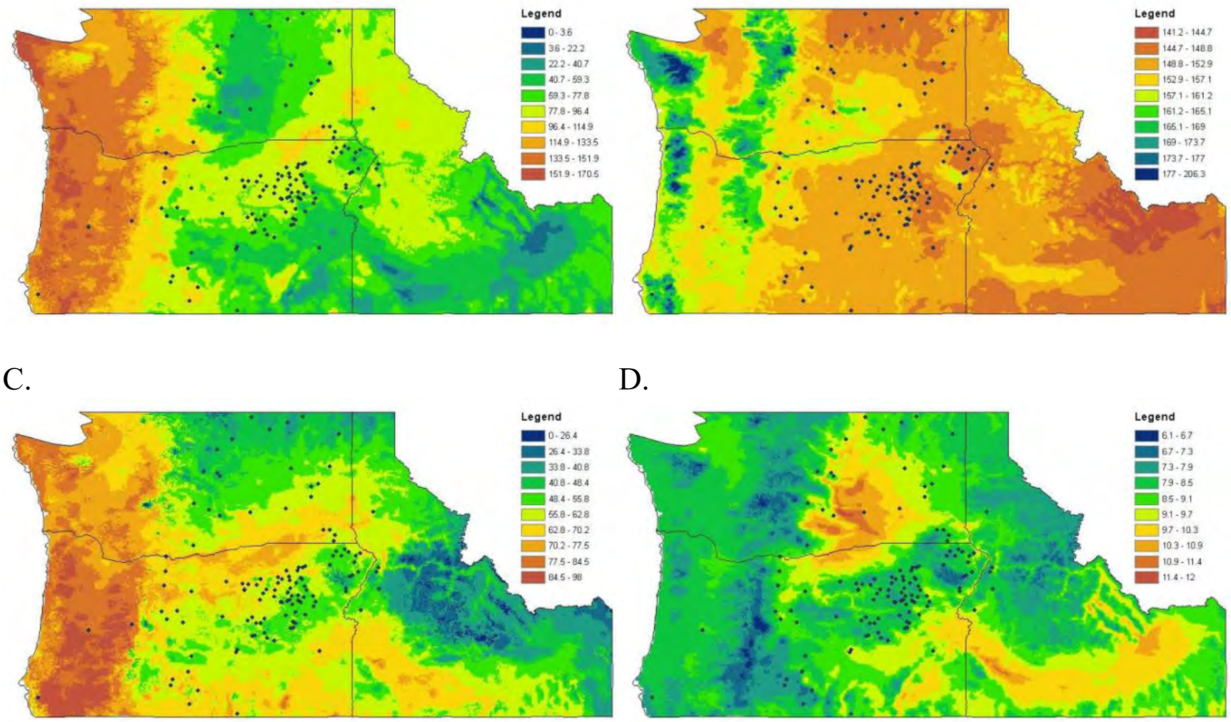


Figure 1. Geographic variation in *Koeleria macrantha* and regression equations used to model variation for (A) biomass, (B) bloom date, (C) inflorescence number, and (D) leaf ratio. Regression models are: biomass = 84.43 - 2.38 * TD - 1.18 * AHM + 0.149 * SHM + 0.93 * NFFD - 0.87 * FFP, bloom date = 163.89 + 0.01 * MAP + 0.04 * SHM - 0.08 * FFP + 0.49 * EMT, inflorescence number = -498.08 - 0.09 * DD<0 + 0.07 * DD<18 + 0.74 * NFFD + 0.18 * EREF, leaf ratio = -1.74 + 0.02 * AHM + 0.02 * NFFD - 0.16 * EMT.

Effects of Scarification and Cold-moist Stratification on Seed Germination of Big Deervetch (*Lotus crassifolius*)

Annie Young-Mathews and Dale C. Darris
ORPMC Study Number: 56-locr-fs (1999-2001)

Key words: dormancy, germination pre-treatment, *Lotus crassifolius*, restoration

Abstract

Lotus crassifolius is a deep-rooted, perennial legume that can be used for erosion control and native area restoration in the Pacific Northwest, USA. However, large-scale use of this species has been limited by a lack of commercial availability of seed and seed dormancy issues that have resulted in poor establishment from direct seeding. The purpose of this study was to investigate the type of seed dormancy in this species, and to assess which combination of treatments would maximize germination, in order to facilitate seed production and restoration plantings. We carried out three laboratory experiments on different seed lots to test four lengths of mechanical seed coat scarification (0, 5, 10 and 15 seconds in a Forsburg seed scarifier) and six periods of cold-moist stratification (0, 30, 60, 90, 120 and 150 days). Our results indicated that the best germination was attained by mechanically scarifying seed for 10 seconds followed by cold-moist stratifying for at least 60 days, thus suggesting that this species possesses combinational seed dormancy (both physical and physiological dormancy). For revegetation projects, late fall or winter planting of scarified *L. crassifolius* seed should allow natural cold-moist stratification to occur outdoors over winter, thus maximizing germination in the first year of restoration.

Introduction

Big deervetch (*Lotus crassifolius* [Benth.] Greene) is a perennial legume that is native to western Oregon, western Washington, and northwestern California, USA (USDA-NRCS 2011). It is an early seral species with the potential for use in critical area erosion control, revegetation, big game forage, wildlife habitat, and restoration of native plant communities in the Pacific Northwest (Young-Mathews and Darris 2011). This rhizomatous species is relatively long-lived and produces deep tap roots, making it particularly useful for erosion control on road cuts and in logged areas.

However, use of *L. crassifolius* for restoration and conservation projects has been limited by two major factors. First, seed is not commercially available, except from wild seed collectors, which has generally made it prohibitively expensive for use in most restoration projects. Secondly, this species has exhibited poor seed germination and establishment, whether direct-seeded outdoors in the fall, or spring sown in containers in a greenhouse.

Fall seeding of many species provides for natural cold-moist stratification (moist chilling) over winter that can overcome embryo or physiological dormancy. However, anecdotal observations indicate poor results with *L. crassifolius*, suggesting that there may be other types of dormancy inhibiting germination. Many legume species have a physical dormancy imposed by a water-impermeable or 'hard' seed coat, but germination can often be improved by some method of artificial softening of the seed coat such as mechanical or acid scarification, hot water treatment, brief exposure to high temperatures, or percussion (Baskin and Baskin 1998). Combinational dormancy is a class of seed dormancy that includes both physical and physiological dormancy (Baskin and Baskin 2004). Several species in the Fabaceae family are known to possess this class of seed dormancy, including *Cercis canadensis, Lotus tenuis, Lupinus sulphureus* ssp. *kincaidii*, *Medicago truncatula*, and *Trifolium subterraneum,* requiring both scarification and stratification to germinate (Baskin and Baskin 1998, Kaye and Kuykendall 2001, Clua and Gimenez 2003, Bolingue et al. 2010). It is unknown whether *L. crassifolius* also belongs to this class of seed dormancy.

The purpose of this study was to investigate the type of seed dormancy inhibiting germination of *L. crassifolius* by evaluating the effects of two common seed conditioning treatments, scarification and stratification, alone and in combination. The scope of this study was limited to the use of mechanical abrasion of the seed coat with sandpaper and cold-moist stratification for several different lengths of time. Results will help develop a germination protocol for container propagation, as well as improve sowing methods for revegetation projects and seed production fields.

Methods

Three germination experiments were carried out using three different seed lots. Prior to initiation of the study, seed was stored under ambient room temperature and humidity. Experiment 1 was run in 1999 on bulked seed collected in 1996 and 1998 from multiple populations in the Willamette National Forest (elevation 490–1200 m, Cascade Range of Oregon). Treatment factor A consisted of four levels of scarification: 0, 5, 10, and 15 seconds in a Forsburg seed scarifier using 220-grit sandpaper. Treatment factor B consisted of four periods of stratification (moist chilling): 0, 30, 90, and 120 days. Due to a shortage of seed for this experiment, each replication of the 0-day stratification treatment contained 25 instead of 100 seeds. Experiments 2 and 3 were carried out in 2001; Exp. 2 used seed from a bulk of collections made in 1999 from the Willamette National Forest at various elevations (lot SNC-00-213) and Exp. 3 used seed from a single population collected in 2000 from the Rigdon Ranger District in Lane County, OR, at approximately 1200 m elevation (lot SNC-00-209). For both Exp. 2 and 3, treatment factor A consisted of two levels of scarification (0 and 15 seconds), while treatment factor B consisted of five periods of stratification (0, 60, 90, 120, and 150 days).

The moist chilling and germination for all experiments were conducted by the Oregon State University Seed Laboratory, Corvallis, OR, following standard germination protocols. Moist chilling was achieved by placing the seed in moist, rolled germination paper (towels) in a dark refrigerator at 4°C. Based on typical protocols, seeds were not surface disinfected or treated with a fungicide. All seed samples were placed in germination trays and set in a germinator on the same day. Day length was set at 8 hours light/16 hours dark with alternating temperatures of 25/15°C. Germination data were taken at 7, 14, and 21 days. Normal seedling, abnormal seedling, and final hard seed counts were recorded. Tetrazolium (TZ) tests were also run following standard protocols (ISTA 1996) on each scarified and un-scarified seed lot for Exp. 2 and 3 to determine total viability (but not on Exp. 1 due to a lack of seed).

Experimental design was a replicated factorial with two factors, chilling and scarification, and four replications of 100 seeds each. Statistical analysis consisted of two-way ANOVAs to test for treatment and interaction effects, and multiple means comparisons using the Tukey honestly significant difference (HSD) tests at the $P = 0.05$ level of significance in Statistix 8.1. Analyses were run on percent germination of normal and abnormal seedlings. One outlier data point in Exp. 1 (rep 1, 10-sec scarification, 30-day chill) was excluded from the data set in order to meet the assumption of normality for the ANOVAs.

Results and Discussion

Results of Exp. 1 indicated that germination of normal seedlings was affected by both scarification ($F = 89.24$, $P < 0.001$) and stratification ($F = 189.55$, $P < 0.001$), and there was a significant interaction between the two factors ($F = 11.52$, $P < 0.001$). The highest germination rates resulted from at least 5 seconds of scarification and at least 90 days of moist chilling (Figure 1). The best overall treatment appeared to be 10 seconds of scarification with 90 days chill, although it was not statistically different from the 5- and 15-sec scarification treatments for the 90-day or the 10- and 15-sec scarification for the 120-day stratification periods. The length of stratification also affected the percentage of abnormal seedlings ($F = 32.76$, $P < 0.001$), with the 120-day stratification period producing more abnormal seedlings (8.7±2.9%) than shorter stratification periods (5.3±1.8, 3.6±1.3, and 1.7±2.0% respectively for 90-, 30- and 0-day periods). This increase in abnormal seedlings appeared to be the result of fungal growth in germination trays maintained for longer periods of time, so some of these seeds may have produced normal seedlings under natural conditions.

Experiments 2 and 3 were then carried out in order to further refine the stratification period needed for optimal germination. Combined results of these experiments showed that normal seedling germination was again affected by both scarification ($F = 510.50$, $P < 0.001$) and stratification ($F = 409.88$, $P < 0.001$), and that there was again a significant interaction between the two factors ($F = 33.92$, $P < 0.001$), while seed lot was not a significant factor ($F = 0.49$, $P = 0.49$). The best germination rates were for seed scarified for 15 seconds and stratified for at least 60 days (Figure 2). Among scarified seed, there was no significant difference in germination for stratification periods from 60 to 150 days, indicating that by 60 days most physiological dormancy had already been overcome.

The highest observed total germination (normal plus abnormal seedlings) in Exp. 2 was 85.0±2.4%, and for Exp. 3 it was 88.8±4.6%, both for scarified seed that was stratified for 150 days. These numbers actually slightly exceeded the TZ test viability results of 78 and 86% for the scarified seed used in Experiments 2 and 3, respectively, indicating that all dormancy was broken by this combination of treatments. Stratification for 150 days without scarification,

Figure 1. Effects of mechanical scarification and stratification time on germination of *Lotus crassifolius* seeds from a seed lot of mixed origin (Exp. 1). Data represent normal seedlings only, vertical lines indicate ± 1 standard deviation, and means labeled with the same capital letter are not significantly different at $P = 0.05$ in Tukey HSD comparisons.

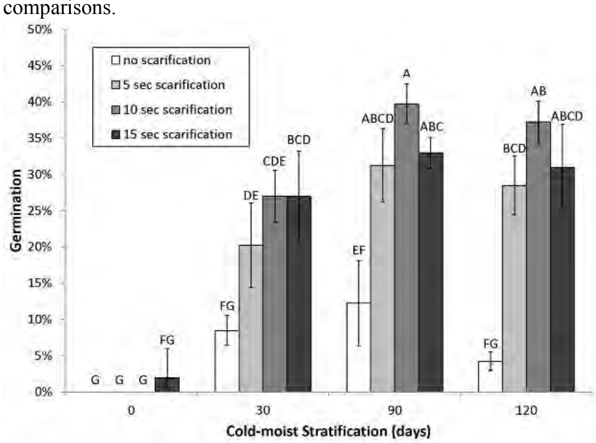
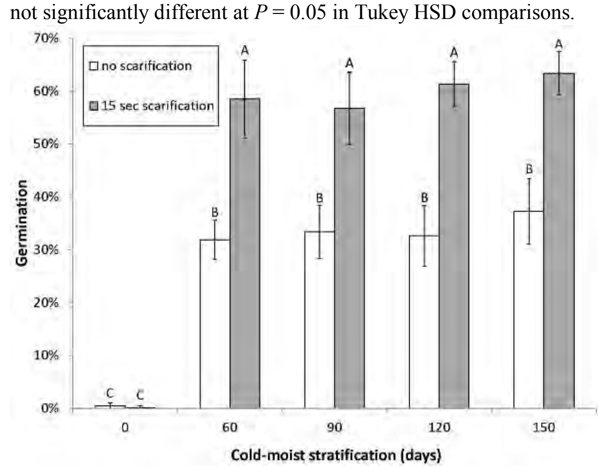


Figure 2. Effects of mechanical scarification and stratification time on germination of *Lotus crassifolius* seeds from two seed lots (Exp. 2 & 3). Data represent normal seedlings only, vertical lines indicate ± 1 standard deviation, and means labeled with the same capital letter are not significantly different at $P = 0.05$ in Tukey HSD comparisons.



however, resulted in total germination of only 50.0±3.4% in Exp. 2 and 43.5±1.0% in Exp. 3, compared with non-scarified TZ viability of 87 and 88%, respectively. Thus, stratification alone overcame less than 60% of seed dormancy, presumably due to a lingering effect of the impermeable seed coat. However, seed that was scarified and then stratified also produced more abnormal seedlings than non-scarified, stratified seed (23.2 vs. 9.8%, respectively, $F = 31.83$, $P < 0.001$), perhaps due to damage to the embryo during the scarification process, so scarification times should be limited to the minimum time needed to sufficiently nick the hard seed coat.

Conclusions

According to our findings, *Lotus crassifolius* seed appears to possess combinational dormancy, as it exhibited characteristics of both physical and physiological dormancy. In order to maximize germination, seed should be scarified a moderate amount (10 seconds) with fine grit sandpaper or other scarification method, and cold-moist stratified for at least 60 days. For revegetation projects in the Pacific Northwest, fall planting of scarified *L. crassifolius* seed should allow natural cold-moist stratification to occur outdoors over winter, with seedlings germinating in the spring when environmental conditions permit. Seed production fields could be similarly fall-sown with scarified seed, or established in the spring from seed that was scarified and cold-moist stratified for at least 60 days under controlled conditions.

Acknowledgements

We would like to thank Dale Brown, formerly of the Oregon State University Seed Laboratory, for assistance and facilities used in this study. David Doede, Forest Geneticist with the USDA-FS, helped with some analysis as part of a larger study of the genetic variation among populations of *Lotus crassifolius*. Partial funding for this project was provided to the Plant Materials Center by the US Forest Service.

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The effect of planting date, soil texture, and age of wood on the survival and growth of cuttings of coyotebrush (*Baccharis pilularis*) and Indian plum (*Oemleria cerasiformis*)

ORPMC-T-0802-RI (2007-2008)
Project Summary – November 22, 2011
Peter Gonzalves, Dale Darris and Annie Young-Mathews

Introduction

Coyotebrush and Indian plum are popular species for hedgerow, riparian and wildlife plantings, especially for pollinator enhancement projects due to their late and early bloom periods, respectively. However, ideal conditions for rooting live stakes of these species had not been established at the time of this trial. The purpose of this study was to determine ability of unrooted cuttings of coyotebrush and Indian plum to survive and grow from current year and two-year-old wood on two soils when planted at different times.

Coyotebrush (*Baccharis pilularis* DC.) is a common, drought tolerant, evergreen shrub native to the West Coast, from northern Mexico through California to western Oregon. The shrubs are prostrate to erect, usually less than 10 ft tall, and grow in coastal bluff to oak woodland habitats at elevations up to 5,000 ft. Coyotebrush is useful in hedgerows and pollinator plantings because its abundant blooms, rich in pollen and nectar, appear in late summer to fall when other flower resources are scarce.

Indian plum (*Oemleria cerasiformis* [Torr. & A. Gray ex Hook. & Arn.] Landon) is a fast-growing, deciduous, native shrub to small tree 6–16 ft tall. Its native range extends from California to western Oregon, Washington and British Colombia. It grows in moist open forests, clearings and riparian areas, as well as drier forests, chaparral and coastal scrub habitats up to 5,000 ft in elevation. Indian plum flowers are a good early-season nectar source for hummingbirds and other native pollinators, and the fruits provide food for wildlife.

Materials and Methods

This trial was simultaneously conducted at two sites: field 7-6 of the Corvallis PMC Schmidt Farm (a Woodburn silt loam soil, moderately well-drained) and field 1 at the Oregon State University East Farm (a Chapman loam soil, well-drained). The parent material for the coyotebrush was originally collected in February 2002 in Corvallis, OR (accession 9079229), and the Indian plum parent material was collected in February 2000 from McLagan Road in Linn County, OR (accession 9079204).

The study was set up as a split plot, completely randomized design. Coyotebrush stakes were harvested and planted in November and December 2007 and January and February 2008, while Indian plum stakes were harvested and planted in December 2007 and February 2008. At each planting date, both current year and two-year-old wood cuttings were taken as separate treatments. Plots consisted of three live stakes from a single parent (clone), and each treatment was replicated three times. Live stakes were cut into 30- to 36-inch lengths and were planted at a depth of 20 to 24 inches, with at least 2 to 4 nodes left exposed above the soil line. Cuttings were not treated with rooting hormone, nor did they receive supplemental irrigation or fertilizer. Measurements were taken mid growing season 2008, including survival, vigor (measured on a subjective scale from 0 to 5, with 5 being the highest rating), height and maximum shoot length. The effects of soil type, age of cutting, and planting date on survival, vigor, height and shoot length of each species were analyzed using ANOVA and Tukey HSD multiple comparison tests at the $\alpha = 0.05$ confidence level in Statistix 8.2.

Results and Discussion

A summary of the coyotebrush data is presented in Table 1, while the Indian plum data are summarized in Table 2. Survival and vigor of coyotebrush cuttings showed significant interactions among all three experimental factors (soil type, age of cutting, and planting date) in ANOVA tests. Cutting height and maximum shoot length, however, did not vary according to any of the experimental factors.

On the moderately well-drained silt loam soil, there were no significant effects of either cutting age ($F = 0.68$, $p = 0.42$) or planting date ($F = 1.11$, $p = 0.37$) on survival. Likewise on the silt loam soil, vigor showed no significant differences for either cutting age ($F = 2.21$, $p = 0.16$) or planting date ($F = 2.01$, $p = 0.15$).

However, on the well-drained loam soil, cuttings from current year wood had better survival than two-year-old wood (mean 27.8 and 0%, respectively, $F = 32.6$, $p < 0.01$). For current year cuttings on the well-drained loam, planting date significantly affected survival ($F = 7.43$, $p = 0.01$), with better survival in Dec and Feb than Jan, while Nov was intermediate (Table 1).

Table 1. Coyotebrush data from 2007-2008 rooting trial at the Corvallis PMC showing mean ± standard deviation for all three treatments: soil type, age of cutting, and planting date.

Soil Type	Cutting age	Planting date	Survival (%)		Vigor (rating scale 0-5)		Height (cm)		Max Shoot Length (cm)	
mod-drained silt loam	current year	Nov	33.3±33.5	abc*	2.3±2.4	ab	25.5±8.8	a	20.7±7.1	a
		Dec	0	c	0	c	NA		NA	
		Jan	0	c	0	c	NA		NA	
		Feb	11.0±19.1	bc	0.4±0.8	bc	10.6	a	9.3	a
	two-year-old	Nov	0	c	0	c	NA		NA	
		Dec	0	c	0	c	NA		NA	
		Jan	11.0±19.1	bc	0.2±0.4	bc	5.3	a	5.3	a
		Feb	11.0±19.1	bc	0.3±0.6	bc	8.0	a	8.0	a
well-drained loam	current year	Nov	11.0±19.1	bc	0.6±1.0	bc	13.7	a	9.3	a
		Dec	44.3±19.6	ab	0.7±0.4	bc	5.7±1.7	a	1.3±0.9	a
		Jan	0	c	0	c	NA		NA	
		Feb	55.7±19.7	a	2.9±0.7	a	18.9±6.5	a	11.0±6.7	a
	two-year-old	Nov	0	c	0	c	NA		NA	
		Dec	0	c	0	c	NA		NA	
		Jan	0	c	0	c	NA		NA	
		Feb	0	c	0	c	NA		NA	

*Means within a column followed by the same letter are not significantly different at α=0.05 level in Tukey HSD tests.

Indian plum cutting survival was better for current year cuttings than two-year-old cuttings (Table 2, $F = 7.14$, $p = 0.02$), but did not differ according to soil type ($F = 0.00$, $p = 0.99$). Survival also tended to be better for plantings in December than February, though the difference wasn't statistically significant ($F = 3.19$, $p = 0.09$). Vigor, height and maximum shoot length of the cuttings that survived did not vary significantly according to any of the experimental factors.

Table 2. Indian plum data from 2007-2008 rooting trial at the Corvallis PMC showing mean ± standard deviation for two treatments: age of cutting and planting date (soil type was not a significant factor).

Cutting age	Planting date	Survival (%)		Vigor (rating scale 0-5)		Height (cm)		Max Shoot Length (cm)	
current year	Dec	27.7±25.2	a*	0.5±0.5	a	6.3±2.1	a	3.1±2.4	a
	Feb	5.5±13.5	ab	0.1±0.3	a	4.7	a	1.0	a
two-year-	Dec	0	b	NA		NA		NA	
	Feb	0	b	NA		NA		NA	

old					

*Means within a column followed by the same letter are not significantly different at α=0.05 level in Tukey HSD tests.

Conclusions

Overall survival for both species was fairly low for all treatments, reflecting the difficulty in propagating these species from winter dormant woody cuttings. Based on this experiment, live stakes of coyotebrush should be taken on current year wood in either February or December (especially if planted on well-drained loams). Live stakes of Indian plum should also be taken on current year wood, and tended to do better if planted earlier in the winter (i.e., December).

Demonstration of native upland, woodland, wet prairie and marsh grasses and select introduced grasses and forbs

ORPMC-T-0105-OT (2001 – 2014)

Summary

The purpose of this study is to demonstrate the growth habit and flowering of native wetland, forest and upland grasses, forbs and grass-like plants in a garden planting at the Corvallis PMC. It is also a demonstration of the growth of select introduced grasses, grass-like plants, and forbs that can be useful for on-farm conservation practices. This demonstration garden is meant to serve as a plant identification resource for NRCS field office personnel, SWCD staff, and other visitors to the Corvallis PMC. There are a total of 62 species in separate plots, each labeled with common and scientific names. Figures 1 to 4 depict the demo garden in various stages of bloom in late spring 2010 and 2008. Table 1 gives a full list of all species included in the demo garden as of February 2012.

Figure 3. Demo garden behind ORPMC main office, June 11, 2010.

Figure 5. Demo garden native forbs in bloom, June 11, 2010.

Figure 4. Example signage on Willamette Valley daisy (*Erigeron decumbens*).

Figure 6. Grasses and sedges, May 19, 2008.

Table 1. Arrangement of forbs, grasses and grass-like plants in the Corvallis PMC demonstration garden.

Threatened & Endangered/Nectar Forbs

Nelson's checkermallow	*Sidalcea nelsoniana*
Cusick's checkermallow	*Sidalcia cusickii*
Kincaid's lupine	*Lupinus sulphureus*
Curtus' aster	*Aster curtus*
Willamette Valley daisy	*Erigeron decumbens*
shaggy horkelia	*Horkelia congesta*
peacock larkspur	*Delphinium x pavonaceum*
dwarf checkermallow	*Sidalcea virgata*
meadow checkermallow	*Sidalcea campestris*
Bradshaw's lomatium	*Lomatium bradshawii*
milkweed	*Asclepias speciosa*
grand collomia	*Collomia grandiflora*
pearly everlasting	*Anaphalis margaritacea*
goldenrod	*Solidago canadensis*

Upland Prairie Grasses

pine bluegrass	*Poa secunda*
Roemer's fescue	*Festuca roemeri*
California oatgrass	*Danthonia californica*
prairie junegrass	*Koeleria macrantha*
California brome	*Bromus carinatus*
California fescue	*Festuca californica*
slender wheatgrass	*Elymus trachycaulus*
Lemmon's needlegrass	*Achnatherum lemmonii*
western needlegrass	*Stipa occidentalis*
native red fescue	*Festuca rubra*

Moist Woodland Grasses

Hall's bentgrass	*Agrostis hallii*
Harford's melica	*Melica harfordii*
blue wildrye	*Elymus glaucus*
Alaska brome	*Bromus sitchensis*
Columbia brome	*Bromus vulgaris*
sand fescue	*Festuca ammobia*
western fescue	*Festuca occidentalis*
Alaska oniongrass	*Melica subulata*
nodding trisetum	*Trisetum cernuum*

Wet Prairie Grasses

tufted hairgrass	*Deschampsia cespitosa*
meadow barley	*Hordeum brachyantherum*
western panicgrass	*Dichanthelium acuminatum*
spike bentgrass	*Agrostis errata*
annual hairgrass	*Deschampsia danthonioides*
slender hairgrass	*Deschampsia elongata*

Marsh Grasses

American sloughgrass	*Beckmannia syzigachne*
tall mannagrass	*Glyceria elata (striata)*
western mannagrass	*Glyceria occidentalis*
slimheaded mannagrass	*Glyceria leptostachya*
reed mannagrass	*Glyceria maxima*
rice cutgrass	*Leersia oryzoides*
false mannagrass	*Torreyochloa pallida var. pauciflora*
bluejoint	*Calamagrostis canadensis*
nodding semaphoregrass	*Pleuropogon refractus*
shortawn foxtail	*Alopecurus aequalis*

Upland Prairie Forbs

narrow leaf mule-ears	*Wyethia angustifolia*
western yarrow	*Achillea millefolium*
Oregon sunshine	*Eriophyllum lanatum*
Hall's aster	*Symphyotrichum hallii*

Pasture Legumes

white clover	*Trifolium repens*
vetch	*Vicia spp.*
alfalfa	*Medicago sativa*

Pasture & Other Grasses

tall fescue, endophyte free	*Schedonorus phoenix*
tall fescue, with endophyte	*Schedonorus phoenix*
perennial ryegrass	*Lolium perenne*
annual ryegrass	*Lolium multiflorum*
intermediate ryegrass	*L. perenne x L. multiflorum*
tall fescue x ryegrass	*S. phoenix x L. perenne*
triticale, sterile 'Quickguard'	*Triticosecale rimpaui*
wheat x wheatgrass	*Triticum x Agropyron*
orchardgrass	*Dactylis glomerata*
creeping red fescue	*Festuca rubra var. rubra*
chewings fescue	*Festuca rubra commutata*
timothy	*Phleum pratense*

Wet Prairie Forbs

denseflower willowherb	*Epilobium densiflorum*
western buttercup	*Ranunculus occidentalis*
common cammas	*Camassia quamash*
barestem lomatium	*Lomatium nudicaule*
bigleaf lupine	*Lupinus polyphyllus*

Marsh Forbs

Oregon saxifrage	*Saxifraga oregana*
marsh seedbox	*Ludwigia palustris*
plantainleaf buttercup	*Ranunculus alismifolius*
calicoflower	*Downingia*

Marsh Sedges & Rushes

slough sedge	*Carex obnupta*
woollyfruit sedge	*Carex lasiocarpa*
panicled bulrush	*Scirpus microcarpus*
swordleaf rush	*Juncus ensifolius*
Bolander's rush	*Juncus bolanderi*

EFFECTS OF NITROGEN FERTILIZER TIMING AND RATES ON SEED PRODUCTION OF ROEMER'S FESCUE (*FESTUCA ROEMERI*)

D. Darris and A. Young-Mathews, USDA-NRCS Corvallis Plant Materials Center

Introduction

Roemer's fescue (*Festuca roemeri* [Pavlick] Alexeev) is a native bunchgrass that belongs to the sheep fescue-Idaho fescue-hard fescue complex (Stace et al. 1992). Roemer's fescue is recommended for revegetation of upland prairies and oak savannas west of the Cascade Mountains from British Columbia to northwestern California (Darris et al. 2007). Although it is a useful restoration species, there is little information available on seed production practices.

Members of the red fescue complex (chewings, creeping red, and slender red fescues) and closely related sheep fescue complex (hard, sheep, and Idaho fescues) are commonly grown for turf seed in the Willamette Valley of Oregon, and there is over 40 years of data available from research conducted by Oregon State University. According to this research, optimal fine fescue seed yields were obtained with spring (mid-February to late March) application of 30 to 70 lb N/acre (Gingrich et al. 2003). Fall (October) application of 15 to 30 lb N/acre to stimulate fall growth is optional, but the guide states that "nitrogen in the soil should be adequate for fall growth" (Gingrich et al. 2003). The purpose of this study was to determine the optimal timing and rates of nitrogen fertilization for seed production of Roemer's fescue.

Materials and Methods

An existing field of Roemer's fescue (Hyslop Farm field 5-11, Corvallis, OR) was used for this study. The field was 140 x 62.5 ft, with rows running north-south at 12-inch row spacing. The field was sown in October of 2007 for a carbon banded seeding trial with diuron herbicide applied immediately after sowing. Any residual carryover of diuron is expected to have dissipated by the start of this experiment in October 2009. The seed used to sow the field was harvested in 2004 from a mix of 47 accessions in a common garden study at the Corvallis Plant Materials Center; these accessions were originally collected throughout western Washington, western Oregon and northwestern California in 2001-2002. The field was fertilized once in March 2008 (the year prior to the study) at a rate of 50 lb N/acre. A standard regime of weed and disease control was used during this experiment. Outlook® herbicide (dimethenamid-p) was applied in the fall for volunteer and annual grass control and Banvel® (dicamba) was applied in the spring for broadleaf weed control. Residue was removed with a flail type forage harvester after each seed harvest. Rust was controlled with Quilt® fungicide (azoxystrobin and propiconazole) as needed. No irrigation water or other practices were applied.

Fertilizer was applied to plots according to 14 treatments (Table 1) as granular nitrogen sulfate (33-0-0-12) using an 8-ft wide Gandy type drop spreader. All rates are actual N/acre. Each plot was 8 ft wide and 16 ft long. In 2010, seed was harvested on July 8 from the middle of the plots with a 6-ft wide flail-vac seed stripper. Harvest occurred parallel to the seeded rows along the long axis of each plot. Plots with excessive lodging were hand-harvested in 1-m^2 subplots. In 2011, all seed was hand-harvested from 1-m^2 subplots on July 15 (mechanical harvest was not possible due to excessive lodging). Seed was cleaned and conditioned before recording plot yields. Lodging was scored prior to harvest on July 8, 2010 and July 15, 2011 on a scale from 1 to 10, with 1 being no lodging (plants completely upright) and 10 being the most lodging (plants flat). The experimental design was a randomized complete block with four replications. Data analysis consisted of ANOVA and Tukey HSD means comparisons performed in Statistix 8.1. An outlier (treatment 9, rep 2) was omitted from the 2010 data set in order to meet the assumptions of normality of variances for the ANOVA.

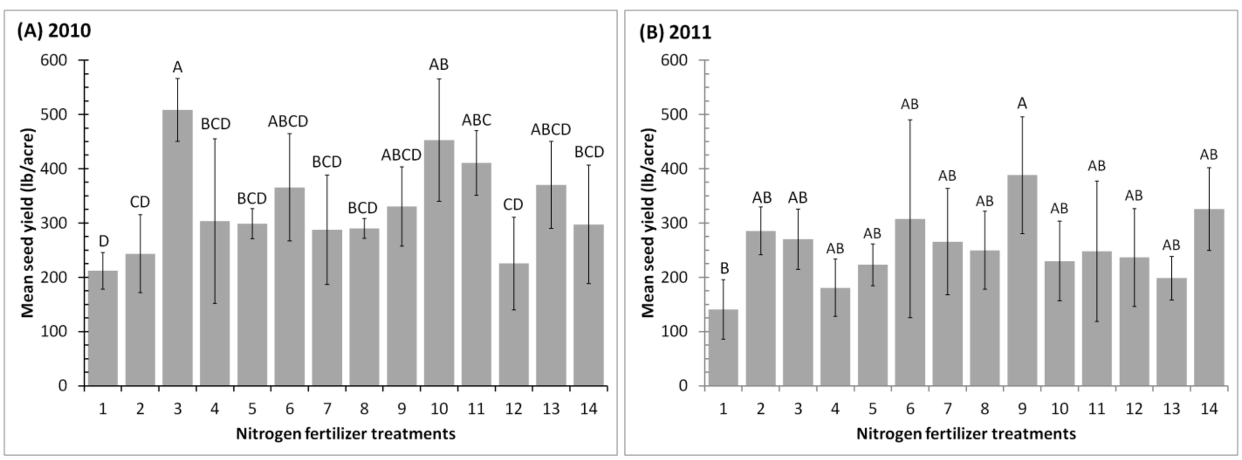
Results and Discussion

Mean seed yield of Roemer's fescue according to the 14 nitrogen fertilization treatments is given in Figure 1. Seed yield was significantly affected by treatments in both 2010 ($P < 0.001$) and 2011 ($P = 0.036$). In 2010, application of 50 lb N/ac in February (Trt. 3) and split application of 25 lb N/ac in October plus 75 lb N/ac in February (Trt. 10) had higher seed yields than the control (Trt. 1) and many other treatments. Plots that received early spring fertilizer were noticeably greener and healthier looking. Nitrogen fertilization treatments also had a significant effect on lodging scores in 2010 ($P < 0.001$); plots that received the highest early spring (February and March) N rates (Trts. 6, 7, 10, 11, and 12) had higher lodging scores than the control (Trt. 1) and plots that only received fall (Trt. 2) or late spring (April) fertilization (Trts. 5, 8, 13, and 14) (data not shown). This may have been because fall fertilization rates were too low or fall-applied N was no longer available to the plant by the time fertile tiller formation began, and April application may have come too late after tillers had already formed, so tiller height and lodging were not affected.

Table 2. Nitrogen fertilization rates and timing for Roemer's fescue study at Hyslop Farm, Corvallis, 2010 and 2011.

Treatment	Year 1	Year 2
1	Control (no fertilizer)	Control (no fertilizer)
2	25 lb/ac 28-Oct-09	25 lb/ac 2-Nov-10
3	50 lb/ac 24-Feb-10	50 lb/ac 7-Mar-11
4	50 lb/ac 22-Mar-10	50 lb/ac 4-Apr-11
5	50 lb/ac 28-Apr-10	50 lb/ac 2-May-11
6	75 lb/ac 24-Feb-10	75 lb/ac 7-Mar-11
7	75 lb/ac 22-Mar-10	75 lb/ac 4-Apr-11
8	75 lb/ac 28-Apr-10	75 lb/ac 2-May-11
9	25 lb/ac 28-Oct-09 + 50 lb/ac 24-Feb-10	25 lb/ac 2-Nov-10 + 50 lb/ac 7-Mar-11
10	25 lb/ac 28-Oct-09 + 75 lb/ac 24-Feb-10	25 lb/ac 2-Nov-10 + 75 lb/ac 7-Mar-11
11	25 lb/ac 28-Oct-09 + 50 lb/ac 22-Mar-10	25 lb/ac 2-Nov-10 + 50 lb/ac 4-Apr-11
12	25 lb/ac 28-Oct-09 + 75 lb/ac 22-Mar-10	25 lb/ac 2-Nov-10 + 75 lb/ac 4-Apr-11
13	25 lb/ac 28-Oct-09 + 50 lb/ac 28-Apr-10	25 lb/ac 2-Nov-10 + 50 lb/ac 2-May-11
14	25 lb/ac 28-Oct-09 + 75 lb/ac 28-Apr-10	25 lb/ac 2-Nov-10 + 75 lb/ac 2-May-11

Figure 7. Seed production of Roemer's fescue at Hyslop Farm, Corvallis in 2010 (A) and 2011 (B) according to 14 nitrogen fertilization treatments. Mean ± 1 SD; within each year, means marked with the same letter indicate no significant difference at α = 0.05 level in Tukey HSD tests.



By 2011, the stands had begun to decline and overall mean seed yield was significantly lower than in 2010 (253±98 vs. 329±114 lb/ac, respectively; $P < 0.001$). There was also substantial plant and seed loss to predation by voles and mice. The only significant treatment effect in 2011 was that split application of 25 lb N/ac in November plus 50 lb N/ac in early March (Trt. 9) had higher seed yields than the control (Trt. 1). In 2011, fertilization treatments again significantly affected lodging scores ($P < 0.001$), with patterns similar to those seen in 2010 (data not shown). Interestingly, an ANOVA of the effects of total pounds nitrogen applied on lodging scores showed that application rates of 75 and 100 lb N/ac had more lodging than 0 to 50 lb N/ac (mean lodging scores for applications rates of 100, 75, 50, 25 and 0 lb N/ac were 4.6, 4.0, 2.2, 1.0 and 1.0, respectively; $P < 0.001$). Thus higher N application rates, especially in the early spring, appear to lead to increased lodging which makes direct harvest (i.e., straight combining or seed stripping) difficult and may reduce seed yields.

Conclusions

Our results suggest that optimum seed yields of Roemer's fescue can be obtained by applying 50 to 75 lb N/ac in late February to early March, either alone or as a split application with 25 lb N/ac in the fall (late October to early November). However, total application rates of 75 to 100 lb N/ac are likely to increase lodging and make direct combining and seed stripping more difficult.

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Hedgerow live stake observational planting

2011 Project Summary – November 8, 2011

Dale Darris and Annie Young-Mathews

The purpose of this observational planting was to evaluate the establishment success of a number of native hedgerow species planted from live stakes in the mid-spring without any subsequent irrigation. The planting was installed on field 7-13 of the Corvallis PMC Schmidt Farm on March 4, 2011. Live stakes were cut into 30- to 36-inch lengths from one- to three-year-old wood from the Willamette Valley germplasm cutting blocks on field 7-4. Plots consisted of 3 live stakes of each species planted in a triangle, with 3-ft within row spacing and 2-ft between row spacing. Stakes were planted at a depth of 20 to 24 inches, with at least 2 to 4 nodes left exposed above the soil line. Data were collected on October 7, 2011, including survival, vigor, height, maximum shoot length, and number of shoots on each stake.

The table below summarizes the averages of the three stakes for each species. Pacific ninebark, rose spirea, common snowberry and redosier dogwood showed the best survival, vigor and shoot growth. On the other hand, cuttings of salmonberry and Lewis' mock orange had poor survival, vigor and shoot growth, while twinberry honeysuckle, Indian plum and red elderberry did not establish at all in this study. Most of the latter species are known to exhibit poor to fair establishment success from cuttings, slips, whips or live stakes even under ideal conditions, so it's not surprising they didn't perform well here. Establishment of twinberry honeysuckle, however, is usually fair to good, so perhaps the late planting date didn't allow the cuttings sufficient time to root in moist soils before summer arrived. Fall planting of live stakes of all of these species is probably preferable for maximum root and shoot growth during the first year of establishment.

Scientific name	Common name	survival	vigor (scale 0-9, 9 is high)	height (cm)	maximum shoot length (cm)	number of shoots
Physocarpus capitatus	Pacific ninebark	100%	7.7	77.7	71.3	5.0
Spiraea douglasii	rose spirea	100%	8.7	68.0	58.3	2.7
Symphoricarpos albus	common snowberry	100%	4.0	43.3	32.7	3.7
Cornus sericea	redosier dogwood	67%	5.5	52	44	3
Rubus spectabilis	salmonberry	33%	2	23	9	2
Philadelphus lewisii	Lewis' mock orange	33%	1	12	6	2
Lonicera involucrata	twinberry honeysuckle	0	0	0	0	0
Oemleria cerasiformis	Indian plum	0	0	0	0	0
Sambucus racemosa	red elderberry	0	0	0	0	0

EFFECTS OF NITROGEN FERTILIZER TIMING AND RATES ON SEED PRODUCTION OF JACKSON-FRAZIER GERMPLASM MEADOW BARLEY (*HORDEUM BRACHYANTHERUM*)

D. Darris and A. Young-Mathews, USDA-NRCS Corvallis Plant Materials Center

Introduction
Jackson-Frazier Germplasm meadow barley (*Hordeum brachyantherum* Nevski) is a source identified natural germplasm that was released in 2007 by the USDA-NRCS Corvallis Plant Materials Center. It is a native bunchgrass intended for quick cover in wetland restoration plantings, erosion control, and wildlife habitat along streambanks, waterways, shorelines, and ditch bottoms at low elevations in western Oregon, primarily in the Willamette Valley (Darris 2007). There are currently no published data available on fertilizer recommendations for seed production of this species. The purpose of this study was to determine the optimal timing and rates of nitrogen fertilizer application for seed production of meadow barley.

Materials and Methods
An existing field of Jackson-Frazier Germplasm meadow barley (Hyslop farm field 5-1, Corvallis, OR; accession # 9056373) was used for this study. The field was 132 x 62.5 ft, with rows running north-south at 12-inch row spacing. The field was sown in October of 2007 for a carbon banded seeding trial with diuron herbicide applied immediately after sowing. Any residual carryover of diuron is expected to have dissipated by the start of this study in October 2009. The field was fertilized once in March 2008 (the year prior to the study) at a rate of 50 lb N/acre. A standard regime of weed and disease control was used during this experiment. Outlook® herbicide (dimethenamid-p) was applied in the fall for volunteer and annual grass control and Banvel® (dicamba) was applied in the spring for broadleaf weed control. Residue was removed with a flail type forage harvester after seed harvest. Rust was controlled with Quilt® fungicide (azoxystrobin and propiconazole) as needed. No irrigation water or other practices were applied.
Fertilizer was applied to plots according 14 treatments (Table 1) as granular nitrogen sulfate (33-0-0-12) using an 8-ft wide Gandy type drop spreader. All rates are actual N/acre. Each plot was 8 ft wide and 16 ft long. Seed was hand-harvested from 1-m^2 subplots on July 5-9, 2010 (excessive lodging prevented mechanical harvest). Seed was cleaned and conditioned before recording plot yields. Lodging was scored on July 5, 2010 on a scale from 1 to 10, with 1 being no lodging (plants completely upright) and 10 being the most lodging (plants flat). The experimental design was a randomized complete block with four replications. Data analysis consisted of ANOVA and Tukey HSD means comparisons performed in Statistix 8.1.

Table 3. Nitrogen fertilizer treatments for meadow barley seed production study, Hyslop Farm, Corvallis, 2010.

Treatment	N application rate & timing
1	Control (no fertilizer)
2	25 lb/ac 28-Oct-09
3	50 lb/ac 24-Feb-10
4	50 lb/ac 22-Mar-10
5	50 lb/ac 28-Apr-10
6	75 lb/ac 24-Feb-10
7	75 lb/ac 22-Mar-10
8	75 lb/ac 28-Apr-10
9	25 lb/ac 28-Oct-09 + 50 lb/ac 24-Feb-10
10	25 lb/ac 28-Oct-09 + 75 lb/ac 24-Feb-10
11	25 lb/ac 28-Oct-09 + 50 lb/ac 22-Mar-10
12	25 lb/ac 28-Oct-09 + 75 lb/ac 22-Mar-10
13	25 lb/ac 28-Oct-09 + 50 lb/ac 28-Apr-10
14	25 lb/ac 28-Oct-09 + 75 lb/ac 28-Apr-10

Results and Discussion
Mean seed production for each treatment is summarized in Figure 1. ANOVA revealed no significant effect of nitrogen treatments on seed yield. Treatments 3 and 6, February application of 50 and 75 lb N/ac, respectively, appeared to have the highest seed yields, but variation was too large to give significant differences. The unfertilized control (Trt. 1), the 25 lb/ac October application (Trt. 2), and the 50 lb/ac April application (Trt. 5) appeared to have the lowest yields.
Nitrogen treatments did, however, have a significant effect on lodging scores (Table 2, $P < 0.001$). Plots that received no fertilizer, October only, and April fertilizer (Trts. 1, 2, 5, 8, 13, 14) had significantly less lodging than all other treatments, presumably because the N was applied too early (Oct) or too late (Apr) to affect tiller growth. Plots that received 75 lb/ac N in March (Trts. 7 and 12) tended to have the highest lodging scores, so if direct mechanical harvest is planned (i.e., direct combining or seed stripping), high rates of nitrogen later in the spring should be avoided.

Figure 8. Seed production of Jackson-Frazier Germplasm meadow barley under 14 N fertilizer treatments. Bars represent mean ± 1 SD; ANOVA showed no significant differences among treatments.

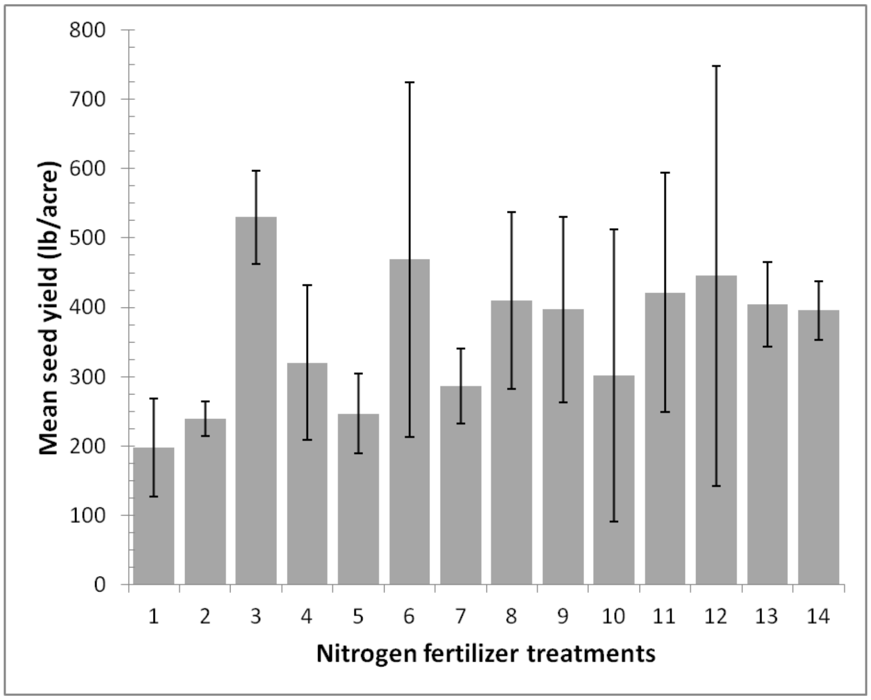

Table 4. Tukey HSD comparison of meadow barley lodging scores (1-10 scale, with 10 high) by nitrogen fertilization treatment.

Treatment	Mean	Homogeneous Groups
7	9.50	A
12	9.25	A
10	8.75	AB
11	8.75	AB
6	8.50	AB
9	7.75	AB
4	7.50	AB
3	7.00	B
14	2.75	C
8	2.75	C
5	2.00	C
13	1.75	C
1	1.00	C
2	1.00	C

Conclusions

Although variation within and among treatments was too great to give conclusive results, there was a trend toward higher seed yields with February applications of 50-75 lbs N/acre, so this is the recommended rate until further tests can be conducted. Split N application in the fall and spring appeared to have similar results to spring-only applications. High N rates (75 lb/ac) are not recommended in March if seed is going to be harvested mechanically without swathing, as this can lead to higher rates of lodging and inaccessible seedheads.

References

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The effect of scarification and stratification on the germination of two populations of Lemmon's needlegrass (*Achnatherum lemmonii*)

Dale Darris, Meghan Hemmingway, and Annie Young-Mathews

Study Number: ORPMC-T-1104

8 February 2012

Introduction

Seed of Lemmon's needlegrass (*Achnatherum lemmonii*) appears to possess some type of dormancy, but the mechanism of dormancy is not understood. Fall sowing which allows over-wintering of the seed outdoors under cold moist conditions sometimes results in good germination and emergence, suggesting that the dormancy may be physiological or embryo-related in some seed lots. However, since fall sowing has also resulted in almost complete failures using the same techniques but different populations or seed lots, other mechanisms may be involved. It is possible there may be insufficient stratification during some winters (not cold enough soil temperatures for long enough periods). Alternately, the seed hull or seed coat may also impose a physical seed dormancy which needs to be overcome by mechanical or biochemical degradation of one or both outer integuments. One way to overcome such physical dormancy would be with some type of seed coat scarification. If the seed possesses both physical and physiological dormancy (classified combinational dormancy), then a scarification treatment combined with cold moist stratification may improve germination rates. The purpose of this experiment was to investigate the class of seed dormancy that might be present in two populations of Lemmon's needlegrass by testing the effect of several scarification and stratification treatments, alone and in combination.

Materials and Methods

One seed lot for each of two populations of Lemmon's needlegrass was used in the experiment. Accession 9079236 was originally collected in 2002 from a population at Butterfly Meadow (about 1000 ft elevation) in Starker Forests, Benton County, OR; the seed used (lot SCO-77-236) was a bulk of small lots produced at the Corvallis PMC from 2003 to 2009. Accession 9079429 was originally collected in 2005 from a population at North Bank Habitat Management Area east of Acorn Lane (900 ft elevation) in Douglas County, OR by Roseburg BLM staff; the seed lot used (SG3-09-RB429) was harvested from a seed increase field at the PMC in 2009. All lots were harvested and cleaned by PMC staff using the same methods.

The treatments were: (1) control, (2) seed nicked crosswise once with a scalpel, penetrating both the hull (held tightly to the seed) and the seed coat, (3) seed soaked in 50% dilute solution of sulfuric acid for 15 minutes, (4) seed soaked in 50% dilute solution of sulfuric acid for 30 minutes, (5) seed cold-moist stratified at 2-5°C for 60 days, (6) seed cold-moist stratified at 2-5°C for 100 days, (7) seed nicked & 60-day cold moist stratification, (8) seed nicked & 100-day cold moist stratification, (9) 15-min acid soak & 60-day cold moist stratification, (10) 15-min acid soak & 100-day cold moist stratification, (11) 30-min acid soak & 60-day cold moist stratification, and (12) 30-min acid soak & 100-day cold moist stratification.

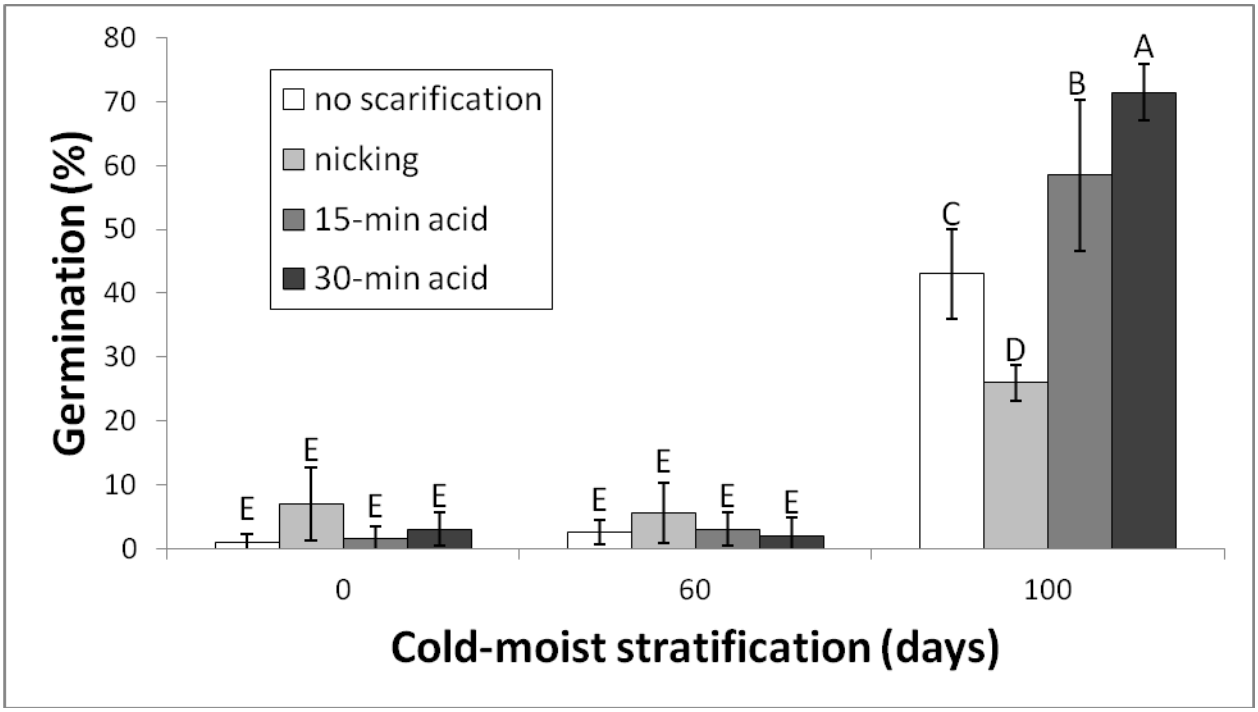
The experimental design was a two-factor randomized complete block with 4 replications (blocks) of 50 seeds each. Factor A, scarification, had four levels (no scarification, nicking, 15-min acid, and 30-min acid), while factor B, stratification, had three levels (0-day, 60-day and 100-day). The 100-day stratification treatments (6, 8, 10, and 12) began on 28 February 2011, followed by the 60-day stratification treatments (5, 7, 9, and 11) on 6 April 2011. Stratification was conducted at 2-5°C in complete darkness, with germination boxes placed inside sealed cardboard boxes to exclude all light. Germination for all treatments began on 7 June 2011 and was conducted in a growth chamber set at 16°C days/10°C nights with a 16-hour day length. (Seedlings of both populations have emerged in late winter outdoors, suggesting cool temperatures may be required for germination, hence the lower than normal temperature settings for the growth chamber.) Stratification and germination were conducted using distilled water, standard germination paper, and germination boxes; the seed was not surface disinfected. Germination counts were recorded on days 0 (for stratified treatments), 7, 14, 21, 28 and 35. Only normal seedlings were recorded (and disposed of) on days 0, 7, 14, 21 and 28. No abnormal seedlings (seedlings missing either a radical or shoot) were noted on the final day (35). Moldy seed counts of three types (white, grey and black) were noted at day 0 for stratified treatments and day 35 for all treatments. Germination and tetrazolium (TZ) viability tests of both seed lots were run according to standard protocols by the Oregon State University Seed Laboratory in Corvallis. Statistical analyses of percent germination consisted of ANOVAs and Tukey HSD all pair-wise comparisons tests of means performed in Statistix 8.1.

Results and Discussion

When the entire data set was analyzed as a whole, accession, scarification treatment and stratification treatment were all significant factors ($P < 0.01$), as well as the two-way interactions between accession-stratification and scarification-stratification, so the seed lots were analyzed separately to better understand the effects of the different treatments.

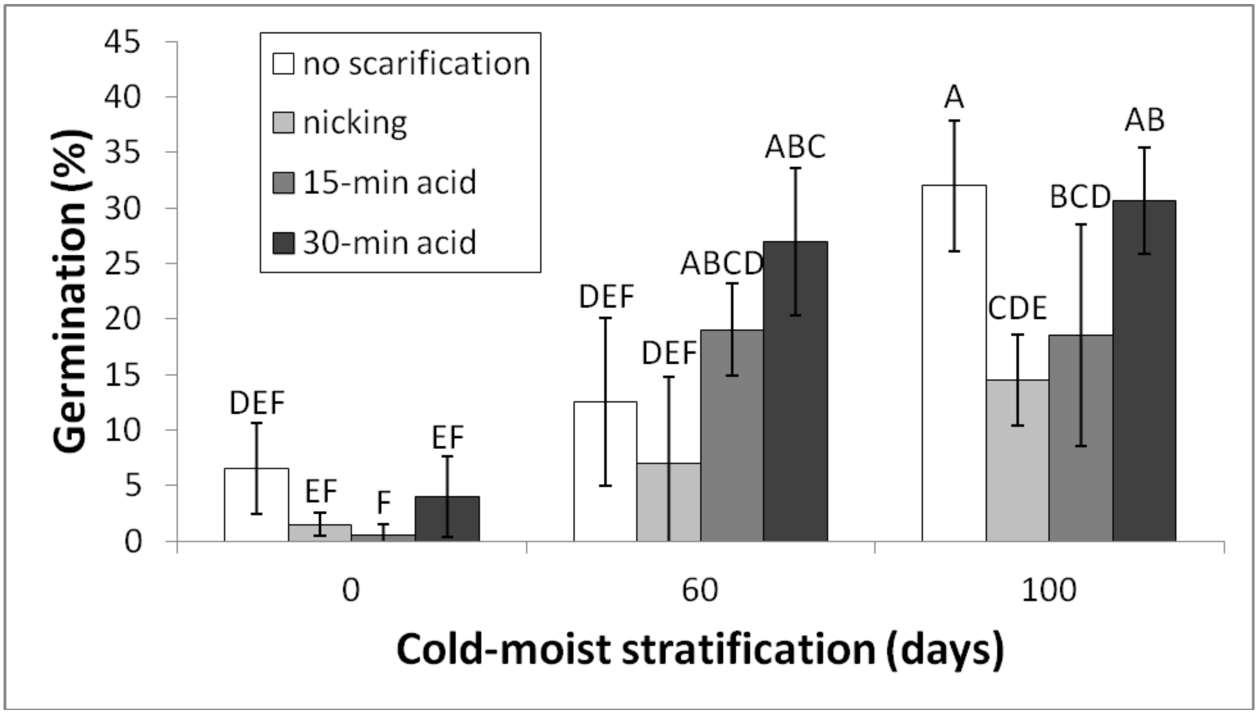
For lot SCO-77-236, both scarification and stratification treatments significantly affected germination rates, and there was a significant interaction between scarification and stratification ($P < 0.0001$ for all three factors). A Tukey HSD test revealed that the best germination resulted from a 30-minute acid scarification followed by 100 days of cold-moist stratification (Figure 1). The next best treatment was 15-min acid scarification with 100-day stratification, and the third best was with no scarification and 100-day cold-moist chilling. The seed coat nicking with 100-day stratification had worse germination than all three of the above, but better than any of the treatments with only 60-day or no cold-moist stratification. The OSU Seed Lab reported 8% germination at 35 days after an 8-week pre-chill, which is similar to our results for the 60-day chill treatments. TZ tests for this seed lot gave a viability of 65%, but our best treatment (30-min acid with 100-day chill) was actually higher at 71.5±4.4%, so we can be fairly confident that all seed dormancy was overcome with this treatment. These results suggest that this population of Lemmon's needlegrass had combinational seed dormancy, meaning it possessed both physical seed coat dormancy and intermediate or deep physiological dormancy (germination testing of excised embryos and treatment with gibberellic acid would be required in order to determine the exact type of physiological dormancy [Baskin and Baskin 2004]).

Figure 9. Mean germination of Lemmon's needlegrass lot SCO-77-236 according to three cold-moist stratification periods and four seed coat scarification methods. Vertical bars indicate ± 1 standard deviation from the mean, and means labeled with the same letter are not significantly different at the α=0.05 level in a Tukey HSD test.



Lot SG3-09-RB429 had much lower over-all germination than the previous lot, suggesting that our treatments may not have overcome all of the seed dormancy. Again, both scarification and stratification treatments significantly affected germination rates ($P < 0.0001$), and there was a significant interaction between scarification and stratification ($P < 0.01$). Tukey HSD means comparisons are presented in Figure 2, but interpreting these results is more difficult for this lot. Stratification had an obvious positive effect on germination, with the best rates at 100-day chilling (23.9%), followed by 60-day (16.4%) and no chilling (3.1%). These results coincide with the OSU Seed Lab reported germination of 18% at 35 days after an 8-week pre-chill. Scarification results, however, seemed to vary by stratification treatment. At 60 days of chill, the 30-min acid scarification resulted in higher germination than the non-scarified seed, but after 100 days of chill, the two were not significantly different. It is unclear why this occurred, but one possible explanation could be that mold growing on the seeds during stratification may have broken down the physical dormancy imposed by the impermeable seed coat even in the treatment with no scarification. In all cases, nicking the seed coat appeared to be detrimental to germination rates, perhaps due to some sort of damage to the embryo caused by this method of cutting the hull and seed coat. TZ tests for this lot showed a viability of 65%, which means that even the best treatments (100-day chill with 30-min acid or no scarification) only overcame about half of the dormancy. Further testing of this and other seed lots may be required in order to assess whether longer cold-moist stratification periods or different methods of acid or other scarification may be able to completely break the seed dormancy.

Figure 10. Mean germination of Lemmon's needlegrass lot SG3-09-RB429 according to three cold-moist stratification periods and four seed coat scarification methods. Vertical bars indicate ± 1 standard deviation from the mean, and means labeled with the same letter are not significantly different at the α=0.05 level in a Tukey HSD test.



In a related non-replicated observational trial, seeds from both lots were stratified for 100 days in the dark (with either nicking or no scarification) and then moved to a germination chamber in the dark for 7 days. They germinated at equal or higher rates as seed exposed to light periodically during stratification (for weekly monitoring) and daily for the first 7 days in the germination chamber. These observations suggest that Lemmon's needlegrass seed does not have a light requirement for germination, and may actually germinate better in the dark.

Another interesting and unexpected observation was the difference in germination during the cold-moist stratification period between the two populations and among the different treatments. Lot SG3-09-RB429 had significantly more relative germination (day 0 germ/total germ = 22.6%) following stratification than lot SCO-77-236 (2.0%, $P < 0.0001$). Within lot 429, the stratification treatment significantly affected relative day 0 germination ($P < 0.0001$), with 40.4% relative germination at day 0 after 100-day stratification, but only 4.8% after 60-day stratification. For lot 236, the 30-min acid with 100-day stratification treatment had more relative day 0 germination (9.0%) than any other treatment (0 – 3.5%, $P = 0.01$). These data show that Lemmon's needlegrass is able to germinate in the dark at low temperatures (2-5°C), and suggest that certain lots may have less physiological dormancy than others, meaning that stratification may only need to occur for somewhere between 60 and 100 days for certain lots/populations.

Conclusions

Although results between the two populations tested were mixed, at least one population of Lemmon's needlegrass could be classified as having combinational dormancy (both physical seed coat dormancy and physiological embryo dormancy). The other population, however, appeared to possess some degree of physiological dormancy, but no clear signs of physical dormancy. In either case, 100 days of cold moist stratification improved germination rates, and soaking in 50% sulfuric acid for 30 minutes was either beneficial or caused no decrease in germination, so both treatments should be considered for improved stand establishment.

References

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Pugh Farm 2005 Grass Waterway Seeding Trial – Notes on October 12, 2011

History

The waterway native grass trial was originally broadcast seeded and raked in on 9/26/2005. Plots were located in the bottom of the waterway only. They were 9' wide by 15' long and sown at a rate of 200 to 600 seeds/sq ft, depending on species and seed size. Eleven native wetland grasses (9 as single species plots and 2 in a mix: annual hairgrass + rice cutgrass) and 3 introduced grasses (red fescue + ryegrass in a mix, and 'Seaside' bentgrass alone) were planted. There were 3 replications of each species or mix. Jute netting was applied over the seeding. Side slopes were sown to red fescue. The red fescue slopes were mowed and fertilized and the grass plots mowed, but not every year.

A narrow large rill (1-1.5 ft wide and a few inches deep) cut through the bottom of each plot as the result of a heavy rainstorm as early as Sept 30, 2005, before any grasses could establish to resist being eroded out from the concentrated flow. On October 18, 2006, the large rill in each plot was reseeded with the same species in each plot except for grasses that failed to establish at all the first time (Canada bluejoint, weak alkaligrass, tall mannagrass, slender spiked mannagrass). Species which failed completely the first time were not reseeded but instead planted with a mixture of meadow barley and tufted hairgrass. Rice cutgrass also failed to establish, but the annual hairgrass in the same plots established well. The seeded "rill" area was covered with woven plastic-straw netting. By June of 2007 most of the reseeding did not appear to establish in the rill, suggesting seed was again washed or flooded out at the lowest portion of the channel. As a third attempt to vegetate the "rill", existing grasses in the plots were not mowed off in 2007 in order to allow for potential natural reseeding that same fall.

By June 2008, the best original plots were 'Seaside' bentgrass, tufted hairgrass, spike bentgrass, and meadow barley. The slender hairgrass plots that were rated high in 2007 had a much lower rating in 2008 due to the species natural short life span and apparent low reseeding. None of the seeded grass species appeared to be invading the red fescue side slopes or adjacent cropland. The 'Seaside' bentgrass was the only species to show some vegetative spread into the low end of the red fescue side slopes. It was also spreading into the "rill".

October 12, 2011, Observations

Overall, the bottom of the waterway is well stabilized with a mixture of native grasses and 'Seaside' bentgrass. Remnants of the "rill" that first cut into the bottom of the channel before the grasses could establish is still observable. The most common native grasses are tufted hairgrass and meadow barley, being well intermixed along the entire stretch of the original study area. This is probably due to natural spread and the abundant over seeding of failed plots with these two grasses in the fall 2006. Few weedy broadleaf species are present in the waterway bottom. None of the native grasses are invading the red fescue on the side slopes. 'A survey of the adjacent crop field (first 50-100 ft on the east side of waterway) failed to detect a single grass plant of any species sown, not even 'Seaside' bentgrass which is the most prolific spreading species in the waterway. A back furrow between the top outside edge of the waterway and the farm field forms a clear dividing line between the two land uses. There are few grassy or broadleaf weeds in the red fescue side slopes aside from sow thistle.

<u>'Seaside' bentgrass</u>, an introduced species, is by far the most abundant grass up and the down the study area and in some sections it forms a thick, continuous monoculture without open ground or gaps. Monotypic stands or patches several feet or more across appear within and outside its original plot locations. It has only crept slightly (1-2 ft) up the side slopes into the red fescue. This may be due to the application of Poast herbicide on the red fescue keeping it in check.

‘Seaside’ may have the potential to be weediest grass species used in the study, but appears will contained within the waterway under current management practices in the waterway and on the adjacent cropland. Of all the species evaluated, the stoloniferous growth habit coupled with intermediate flood tolerance probably makes it the most suitable grass evaluated in this study for erosion control in a similar waterway or ditch, presuming it can be kept ”in place” and not invade adjacent cropland.

Tufted hairgrass is the second most abundant grass and the plants form numerous small to large clumps or tufts up and down the waterway. Plot stands were highly ranked in this study through 2008 and some original plots are still discernible. The species is well established in the bottom but the stout, dense clumps act as islands in some areas, channeling water to either side. This sometimes leaves a small area or gap of bare ground around or in between larger plants. The species strong bunch type habit and channeling effect may make it less suitable for similar waterways with flashy peak flows or strong gradients unless mixed with other species.

Meadow barley is the third most abundant grass and was highly ranked in this study through 2008, but original plots are no longer obvious. While it is a bunchgrass like tufted hairgrass, the clumps are smaller, less rigid, and more diffuse, and appear less likely to channel water, especially if sown at high rates. This species is also flood tolerant, quick and easy to establish, and thus appears more suitable for waterways than tufted hairgrass. While it may live 10 years or more on moist uplands without competition, its longevity appears shorter or more variable under conditions of disturbance or competition, including waterways and floodplains. Therefore, meadow barley should be allowed to reseed itself every third year.

Spike bentgrass was a highly ranked species in this waterway study through 2008. It may be the 4^{th} most abundant grass still present, but original plots are now mixed with other species and only one plot is readily discernible. Although finer textured and with a smaller bunch type form, it has some traits similar to meadow barley (easy to establish, short-lived, some flood tolerance, ability to reseed itself) in this setting which could make it useful in a mix with meadow barley.

Western sloughgrass is the only other originally sown grass that is readily identifiable. A short-lived (1-4 years) bunchgrass with an intermediate rate of establishment, it prefers seasonal flooding to permanently moist or wet ground. A limited number of plants occur only in the deepest part of the waterway, particularly in the large “rill” or small eroded channel. It did not establish well from the beginning, and may only be an option in very low gradient, slow moving water courses where other wetland grasses won’t persist.

Minor amounts of slender hairgrass are suspected and may still be present, but ID was not undertaken without visible seed heads. While the species established readily in this study, it may only function as annual or biennial cover, similar to annual hairgrass under similar situations. Annual hairgrass also did well the first year then it completely dropped out.

In the final group are those remaining grasses that failed to establish well from the start. The red fescue + annual ryegrass mix never established well in the bottom of the waterway and few plants or volunteers of either species may be left from the original plots. Finally, while a few plants of other original grasses may be also present, none are readily observable. This includes tall mannagrass, rice cutgrass, Canada bluejoint, weak alkaligrass, and slender spiked mannagrass. Under conditions and methods similar to those of this study, these species would not be recommended at this time.

Scouler's willow live stake planting trial (ORPMC-T-1105)
2011 Project Summary – October 17, 2011
Dale Darris and Annie Young-Mathews

Introduction

The rooting and establishment success of wetland species propagated vegetatively by hardwood cuttings (i.e., slips, whips, live stakes, poles, and posts) depends on a number of factors, including the quality of the source material, timing of harvest and installation, site preparation, and planting method. Smaller slips and whips can often be manually pushed into the ground, but if the ground is too hard it may be necessary to make pilot holes for the cuttings. Two commonly employed methods of making a pilot hole are to push/pound in a steel bar, or to use a 'waterjet stinger,' a high pressure water pump with a hose, handle and specially designed steel tip that hydro-drills planting holes. The waterjet stinger has the potential advantage of creating a moist/saturated environment and eliminating air pockets around the cuttings. The purpose of this study was to compare the growth and survival of Scouler's willow live stakes planted into pilot holes made with either a waterjet stinger or a steel bar.

Scouler's willow (*Salix scouleriana* Barratt ex Hook.) is a common, native, wetland shrub found throughout western North America. It is a robust, erect, multi-stemmed shrub reaching 6–40 ft high that grows in dry to moist forests, meadows, springs, and swamps in lowland to mid-montane habitats (0–11,500 ft elevation). Scouler's willow is useful in stream bank stabilization and riparian restoration projects, especially on shadier, drier, more upland sites where other willows might not do as well, and can be installed using hardwood cuttings or live bundles/fascines.

Materials and methods

This trial was located on field 7-13 of the Corvallis PMC Schmidt Farm. Plant material used was accession 9079568 from a cutting block on PMC field 7-4. The original parent material was collected in January 2008 from Finley National Wildlife Refuge, Benton County, OR. Stakes were harvested and planted on 17 February 2011 by attendees of the *Plant Selection and Propagation for Beneficial Habitat Workshop*. Live stakes were cut into 30- to 36-inch lengths from one- to three-year-old wood of 17 parent plants. Plots consisted of 3 live stakes from a single parent (clone) planted in a triangle, with 3-ft within row spacing and 2-ft between row spacing. The plots alternated between the two methods of planting: "P" pilot holes made with a steel bar, and "S" holes made with a waterjet stinger (Fig. 1). Stakes were planted at a depth of 20 to 24 inches; the top 6 to 8 inches of most cuttings were removed after planting to avoid having too much of the stake aboveground, but at least 2 to 4 nodes were left exposed above the soil line. No irrigation or fertilizer was applied. Initial data were collected on 7 October 2011, including survival, vigor, height, maximum shoot length, and number of shoots on each stake. Plots will be evaluated again near the end of the 2012 growing season.

Figure 1. Diagram showing the 17 plots, with 3 cuttings per plot. "P"=steel bar pilot holes, "S"=waterjet stinger pilot holes.

P	P	S	P	P	S	P	P	S	P	P	S	P	P	S	P	P	S	P	P	S	P	P	S	P	P
P	S	S	P	S	S	P	S	S	P	S	S	P	S	S	P	S	S	P	S	S	P	S	S	P	

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Results and discussion

A summary of 2011 data collected for the two planting methods is presented in Table 1. Overall survival was good at about 90%, and vigor (measured on a subjective scale from 0 to 9, with 9 being the highest rating) was just above medial at 5.3 and 6.0 for the waterjet stinger and steel bar pilot holes, respectively. When tested using analysis of variance (ANOVA), none of the measured traits showed significant differences between treatments at the p=0.05 level (data not shown). At least for this species in this trial, it appears that neither planting method is superior to the other for initial establishment of the live stake cuttings. However, there are wide ranges and large standard deviations for most measurements, indicating that establishment success tended to vary among the 17 parental clones from which the cuttings were taken. This was visually apparent when data were being collected, as certain plots looked much better than others. In order to account for the different rooting abilities of the parental clones, cuttings from each parent would have to be planted with both pilot hole methods, but time and space constraints did not allow for that in the current study.

Table 1. 2011 results of Scouler's willow live stake planting trial at the Corvallis PMC showing mean ± standard deviation and ranges for the two planting methods, waterjet stinger and steel bar pilot holes.

	Waterjet stinger		Steel bar pilot holes	
	Mean ± Std Dev	Range	Mean ± Std Dev	Range
Survival	91.7% ± 28.2%	0 - 100%	88.9% ± 32.0%	0 - 100%
Vigor	5.3 ± 2.4	0 - 9	6.0 ± 2.7	0 - 9
Height (cm)	65.9 ± 18.3	34 - 98	65.5 ± 16.7	21 - 88
Maximum shoot length (cm)	55.2 ± 19.5	28 - 98	56.2 ± 15.6	19 - 79
Number of shoots	6.6 ± 3.2	0 - 13	6.3 ± 3.4	0 - 14

Conclusions

Based on observations and data collected so far, establishment success and growth of Scouler's willow live stakes don't appear to be affected by the method of pilot hole drilling, so practitioners can use either steel bar or waterjet stinger pilot holes, depending on what equipment they have available.

Effects of post-harvest residue management on seed production of Roemer's fescue (*Festuca roemeri*)

Study # ORPMC-T-1007 (2010 – 2011)
Project Summary prepared on March 29, 2012
by Dale Darris and Annie Young-Mathews

Introduction

Roemer's fescue (*Festuca roemeri* [Pavlick] Alexeev) is a native bunchgrass that is recommended for revegetation of upland prairies and oak savannas in the Pacific Northwest. Although it is a useful restoration species, there is little information available on seed production practices. Members of the fine fescue complex (Chewings, creeping red, and slender red fescues) and closely related sheep fescue complex (hard, sheep, Idaho and Roemer's fescues) are commonly grown for turf seed in the Willamette Valley of Oregon. According to research conducted at Oregon State University, seed yield and quality were maintained in Chewings fescue (*Festuca rubra* L. ssp. *commutata* Gaudin) seed crops without burning when most of the post-harvest straw and stubble were removed by baling and then vacuuming or raking up remaining residue (Chastain et al. 1999, Young et al. 1998). In the same study, however, there were no nonthermal management practices that produced acceptable seed yields in creeping red fescue (*Festuca rubra* L. ssp. *rubra*) fields. More recent work has shown mixed results dependent on age of stand and a newer red fescue classification: Chewings (*Festuca rubra* L. ssp. *fallax* (Thuill.) Nyman) vs. slender creeping red (*Festuca rubra* L. var. *littoralis* Vasey) vs. strong creeping red (*Festuca rubra* L. ssp. *rubra*) (Chastain et al. 2011). The objective of this study was to determine the effects of different post-harvest residue management practices (low, medium and high mowing heights with residue removal versus open field burning) on the following year's seed production of Roemer's fescue.

Materials and Methods

Plant material used: The experiment was conducted on a field of Northwest Maritime Germplasm Roemer's fescue (accession 9079484, PVGOR 101) at the Corvallis Plant Materials Center (PMC) Schmidt Farm that was sown in October 2006 (medium mow reps 2 and 3) and October 2007 (all other treatments). The field was fertilized annually in March with 50 lb N/acre (150 lb/acre 33-0-0-12), and treated annually in October with Outlook® (dimethylamid-p) herbicide and Banvel® (dicamba) in the spring as needed.

Experimental design: The experimental design was completely randomized with three replicates per treatment. Plots were 4 x 100 ft consisting of four-row beds on 12-inch spacing. Four treatments were examined: control (no mowing or residue removal), low mow (1.5- to 2.5-inch mowing height with residue and stubble mostly removed), high mow (5- to 6-inch mowing height with residue and stubble partly removed), and burn (3- to 4.5-inch mowing height but residue and stubble left and then burned). The burn treatment was analogous to "residue and stubble open-burned with full straw load" used in similar research. There was also a fifth observational treatment of medium mow (3- to 4.5-inch mowing height with residue and stubble partly removed), but it was not included in statistical analyses as that part of the field was planted a year earlier than the rest (2006). Age of stand can affect seed yields and the medium mow plots were not randomized.

Treatment implementation: Seed was harvested from all plots with a seed stripper on July 10, 2010. Post-harvest residue was mowed and removed from low, medium and high mow treatments with a flail forage harvester on August 25, 2010. Burn plots were also mowed on this date, but residue was left on the surface to simulate a windrow or swath; these plots were burned on September 8, 2010. One of the control plots was incorrectly mowed and subsequently burned, resulting in four burn plots and two controls. Therefore, one of the control plots was sampled twice.

Figure 11. Roemer's fescue field at the Corvallis PMC following residue management treatments in October 2010.

Data collection and analysis: All plots were scored for insect damage, injury, vigor/recovery, and culm (fertile tiller) abundance on a scale from 1 to 9 (9 as highest or most) on April 27, 2011. Plots were windrowed on July 12, 2011 and combined on July 28, 2011. Seed yield data were collected from 30-ft strips (120 ft^2) of uniform plant density in each plot. Effects of treatments on seed yield, insect damage, injury, vigor, and culm abundance were tested using ANOVA and Tukey HSD means comparisons in Statistix 8.1.

Results and Discussion

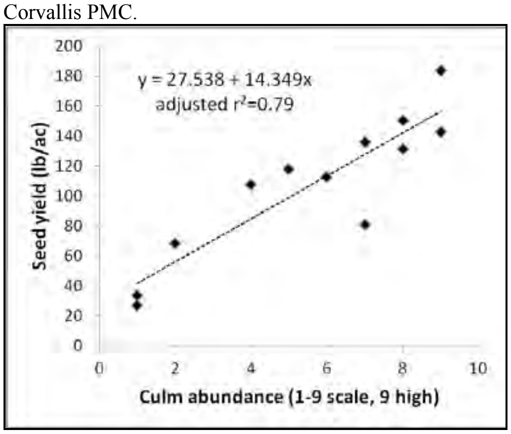
Results of seed yields and plot scoring for all four treatments, plus the observational fifth treatment, are given in Table 1. All mowed and burned treatments had higher seed yields than the un-mowed control (*F*=13.9, *P*=0.0015). Although the treatments did not differ significantly among mowing height and burning, the low mow and burned plots tended to have the highest seed yields. Residue treatments also affected culm (fertile tiller) abundance scores (*F*=29.6, *P*=0.0001); the low mow had the most culms, followed by the burn and high mow, with the control having the least. In fact, there was a direct positive correlation between culm abundance score and seed yield (*P*=0.0001; Figure 1), so the higher yields in the low mow and burned plots in large part appear to be due to the greater abundance of culms on those plants. Other variables affecting seed yield such as percent seed set, seed weight, the number of spikelets per panicle, and the number of florets per spikelet could also have played a role, but were not measured.

Table 5. Results of 2011 study on post-harvest residue management of Roemer's fescue at the Corvallis PMC.

Treatment	seed yield	insect damage	injury	vigor/ recovery	culm abundance
	(lb/ac)	(scored on 1-9 scale, with 9 high/most)			
control	42.9 b[¥]	2.7 ab	1.0 a	7.3 a	1.3 c
low mow	152.6 a	5.0 a	1.7 a	8.0 a	8.7 a
high mow	102.0 a	3.7 ab	1.0 a	7.7 a	5.3 b
burn	133.1 a	2.3 b	2.0 a	7.0 a	7.0 ab
med. mow	78.7	3.7	1.0	7.3	5.7

[¥]Means in columns followed by the same letter are not significantly different in Tukey HSD tests (*P* = 0.05).

Figure 12. Relationship between Roemer's fescue seed yield and culm abundance scores in 2011 post-harvest residue management study at the Corvallis PMC.



Residue treatments also affected insect damage scores (F=4.31, P=0.04); low mow plots had the most insect damage while burned plots had the least (Table 1). Most of the observed damage was suspected to be from feeding grass sawfly larvae, as the stems appeared to have been clipped off near the base (often at an angle), although armyworm damage is also similar (Hollingsworth 2011). Damage may have been greater in the low mow plots simply because they had a greater abundance of young foliage and more culms to attract insects to those rows. Therefore, yields may have been disproportionately reduced by insects under this treatment. In contrast, burn plots had the least amount of damage but a high abundance of culms (and recovery of foliage was not significantly less). Despite the small size of the plots and close proximity of treatments, burning may have reduced insect numbers or the desirability of such plots as habitat. The direct effect of insect damage on yield was not quantitatively assessed.

Residue management treatments did not significantly affect crop injury or vigor/recovery scores ($P > 0.05$, Table 1), so presumably observed differences in seed yield were not due to any direct damage to the plants from the residue management treatments.

Although it is only one year of data, results were similar to those of Chewings fescue, where mechanical removal of residue and stubble achieved seed yields similar to open field burning (Chastain et al. 1999, Young et al. 1998). Yields in this experiment are substantially lower than other fine fescues grown for seed in western Oregon, but Northwest Maritime Germplasm was not bred or hybridized, and yields of Roemer's fescue typically decline on their own by age three. A repeat study is needed on a younger field and other germplasm.

Conclusions

If it is not possible to do open field burns on Roemer's fescue seed production fields, comparable seed yields can still be obtained by mowing stubble low (1.5 to 2.5 inches tall) and removing all residue using a forage harvester or other method.

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CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Jenny Freitag

November 30, 2010

THE 2010 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
WEST EUGENE WETLANDS

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement in the spring of 2002 with the Bureau of Land Management (BLM) to perform seed germination trials and seed increase of native wetland and wet prairie species.

Figure 1. Bumblebee on *Orthocarpus bracteosus* at the Corvallis PMC, May, 2010.

The West Eugene Wetlands (WEW) program has been collecting wild seed and sowing it in wetland restoration projects. Some species have been difficult to establish or have very high labor costs associated with hand collection. The PMC agreed to research and document seed propagation techniques for these species and to evaluate their potential for agronomic seed increase.

In 2010, this agreement was renewed. Six species from previous agreements were discontinued. Seed increase was renewed on 29 of the species from the 2009 contract. This agreement will be amended and renewed through 2011.

Activities in 2010 included establishing and maintaining seed increase plantings, seed harvesting and seed cleaning.

II. Accessions Included in 2010 Agreement

Table 1. Accessions included in 2010 agreement with Eugene District of the BLM.

Species	Common name	Code	Accession #	Activity in 2010[1]
Agoseris grandiflora	bigflower agoseris	AGGR	9079571	pxn,sfp
Carex feta	greensheath sedge	CAFE4	9079315	pxn, sfp
Carex tumulicola	splitawn sedge	CATU3	9079291	sfp
Castilleja tenuis	hairy Indian paintbrush	CATE26	9079254	pxn, sfp
Cicendia quadrangularis	Oregon timwort	CIQU3	9079254	pxn, sfp
Dichanthelium acuminatum	western panicgrass	DIACF	9079303	pxn,sfp
Dodecatheon hendersonii	Henderson's shootingstar	DOHE	9079615	pxn
Downingia elegans	elegant calicoflower	DOEL	9079432	pxn, sfp
Downingia yina	Cascade calicoflower	DOYI	9079433	pxn, sfp
Eleocharis obtusa	blunt spikerush	ELOB2	9079434	sfp
Eleocharis palustris	common spikerush	ELPA3	9079435	sfp
Eryngium petiolatum	coyote thistle	ERPE	9079431	pxn, sfp
Galium trifiduum	threepetal bedstraw	GATR2	9079317	pxn, sfp
Gentiana sceptrum	king's scepter gentian	GESC	9079311	sfp
Gratiola ebracteata	bractless hedgehyssop	GREB	9079436	pxn, sfp
Juncus tenuis	poverty rush	JUTE	9079626	pxn, sfp
Lasthenia glaberrima	smooth goldfields	LAGL3	9079293	pxn, sfp
Lotus formosissimus	seaside bird's-foot trefoil	LOFO2	9079294	pxn, sfp
Lupinus bicolor	miniature lupine	LUBI	9079250	pxn, sfp
Madia glomerata	mountain tarweed	MAGL	9079437	pxn, sfp
Montia linearis	narrowleaf minerslettuce	MOLI4	9079295	pxn, sfp
Myosotis laxa	bay forget-me-not	MYLA	9079253	pxn, sfp
Navarettia intertexta	needleleaf navarretia	NAIN2	9079378	pxn, sfp
Nemophila menziesii	baby blue eyes	NEME	9079379	pxn, sfp

Table 1. Accessions included in 2010 agreement with Eugene District of the BLM (cont.).

Species	Common name	Code	Accession #	Activity in 2010[1]
Orthocarpus bracteosus	rosy owlclover	ORBR	9079502	pxn, sfp
Phlox gracilis	slender phlox	PHGR	9079299	pxn, sfp
Rorippa curvisiliqua	curvepod yellowcress	ROCU	9079257	pxn, sfp
Saxifraga oregano	Oregon saxifrage	SAOR2	9079296	sfp
Veronica peregrina	neckweed	VEPE2	9097439	pxn, sfp

1- sfp= seed increase, pxn= container production,

III. Germination Trials

Each of the species in this year's agreement has been successfully grown by the PMC in previous years. Treatments used to produce the plants for seed increase in 2010 are listed below.

Figure 2. *Downingia yina* growing in conetainers in Corvallis PMC greenhouse, February 2010.

Table 2. Plant production for the Eugene BLM WEW agreement at the Corvallis PMC in 2010.

Species	Amt used (g)	Number of units produced	Treatment
Agoseris grandiflora	4	400	Heated greenhouse
Carex feta	4	400	Heated greenhouse
Castilleja tenuis	1	400	90 days stratification, Heated greenhouse
Cicendia quadrangularis	1	400	Heated greenhouse
Dicanthelium acuminatum	98	3000	Heated greenhouse
Downingia elegans	1	500	Heated greenhouse
Downingia yina	1	400	Heated greenhouse

Table 2. Plant production for the Eugene BLM WEW agreement at the Corvallis PMC in 2010 (cont).

Species	**Amt used (g)**	**Number of units produced**	**Treatment**
Galium trifidum	1	400	Heated greenhouse
Gratiola ebracteata	2	100	Heated greenhouse
Juncus tenuis	6	2400	Heated greenhouse
Lasthenia glaberrima	3	400	Heated greenhouse
Lotus formosissimus	6	300	90 days stratification, Heated greenhouse
Lupinus bicolor	40	500	Scarification/inoculation, Heated greenhouse
Madia glomerata	18	400	Heated greenhouse (80°F)
Montia linearis	10	300	Seeded to field, winter
Myosotis laxa	5	400	Heated greenhouse
Navarretia intertexta	43	500	Lathhouse winter, Heated greenhouse
Nemophila menziesii	11	400	Seeded to field, winter
Orthocarpus bracteosus	1	400	90-days stratification, Heated greenhouse
Phlox gracilis	4	400	Lathhouse winter, Heated greenhouse
Rorippa curvisiliqua	2	300	Heated greenhouse
Veronica peregrina	1	400	Heated greenhouse

IV. Field Plantings

Two new 0.1 acre fields were installed this year, *Juncus tenuis* and *Dicanthelium acuminatum*. Both fields were established on weed fabric from plugs grown in the greenhouse, and were planted out in the spring. The *J. tenuis* was harvested by hand and the seeds were laid in a tub in an open-air shed to dry. *D. acuminatum* was harvested with the seed stripper and the seeds were also laid in a tub in an open-air shed to dry. The seed stripper pulled some tillers from the plants, but not enough to cause damage, and the plants did not appear to be damaged from the tractor tires. Both fields yielded a good harvest for the first year of production. Production is expected to increase next year. The *J. tenuis* plugs suffered some damping off in the seedling stage; more plugs will be grown in the fall of 2010 to expand the production field to the contracted size.

Figure 2. Harvesting *Dicanthelium acuminatum* with seed stripper at Corvallis PMC, August 2010.

Seed increase of many annual species was performed this year using weed fabric techniques. Three 15’ X 170’ sheets of weed fabric were stapled down onto a field that had been previously sprayed with glyphosate herbicide. Small squares were cut out of the weed fabric in order to transplant the cone-tainer plants. The squares were cut slightly larger than the size of the cones. The weed fabric is reused from year to year, and it is necessary to periodically move the site to a fresh field due to compaction and nutrient loss. Last year, the plot was moved to a new site and the annuals were moved with it. The perennials remained for one year on the old site to allow for time to grow new plugs. This year, new perennial plots of *Lotus formosissimus*, and *Agoseris grandiflora* were installed in the new location. Plugs of *Eryngium petiolatum* were grown in the spring to be transplanted to the perennial plot, but due to slow growth they were not transplanted. They will be transplanted in the spring of 2011.

Figure 3. Transplanting *Navarettia intertexta* at Corvallis PMC, March 2010.

Small, battery-powered hand vacuums were used twice a week to collect seed of *Veronica peregrina* and *Lasthenia glaberrima*. The seeds were swept and vacuumed and the material placed in bags in an open greenhouse to dry, and then cleaned with small air-screen machines. *Phlox gracilis, Lupinus bicolor, Lotus formosissimus, Gallium trifidum*, *Phlox gracilis*, *Navarettia intertexta*, *Rorippa curvisiliqua*, *Madia glomerata*, *Downingia elegans*, *Downingia yina*, *Myosotis laxa*, *Montia linearis*, and *Nemophila menziesii* were harvested once. The seeds were swept and vacuumed, and then the seeds were cleaned with a small air-screen machine. The entire *N. intertexta* and *M. laxa* plants were pulled from the ground and run through a big brush machine to separate seeds from the plants prior to cleaning the seeds.

The field plot of *A. grandiflora* was vigorous and flowered profusely in its first year at the new site. When ripe, the seed heads opened and were harvested individually by hand. Heads were harvested once every day. This new plot was placed inside a wind fence which prevented the seeds from blowing away, allowing us to harvest the crop only once per day, whereas last year it was often done twice daily.

Figure 4. PMC workers hand-harvesting the plot of *Agoseris grandiflora* inside wind fence at Corvallis PMC, July 2009.

In the spring of 2008 a small field of *Deschampsia elongata* was established using a precision cone seeder. On the PMC farm this grass behaves as a biennial. This year (its third year) only a few weak plants came back, as was expected. The plot was harvested by hand. Seeds were dried in an open shed and then fed through a brush machine and an air-screen machine.

V. Seed Increase Tubs

Some perennial species were maintained in tubs in the PMC shadehouse. Plants were monitored daily for disease and pests as well as seed maturity. Plantings were watered overhead as needed.

***Carex feta* -** This tub was established with seedlings sown in the spring of 2004. In the summer of 2010 a new planting was transplanted into an artificial pond at the PMC. As expected, very little seed was produced this year, but next year a full crop is expected and the tub production will be discontinued.

***Carex tumulicola* -** This tub was established from cone-tainers seeded in 2003. Seed heads were clipped when mature. When over 80% of seed heads were ripe at the same time, the entire tub was cut back and all the clippings were dried in a greenhouse on a tarp. Production was moderate.

Carex vesicarius - This tub was discontinued in the winter of 2009 and the plants were recovered by the West Eugene Wetlands crew.

Gentiana sceptrum - This tub was established from seedlings sown in the winter of 2003. Plants were transplanted into the tub in late summer of 2004. Seeds from the tub were collected when capsules began to turn papery and tan. Some seed predation has been exhibited for the past several years, but not enough to seriously affect the harvest.

Table 3. Recorded collection and cleaning times for seed increase tubs and plots.

Species	Harvest dates	Harvest time	Cleaning time	Amount of seed produced
Agoseris grandiflora	July 19 – Aug 23	5 hours	1 hour	1691 g
Carex feta	July 6 (pool), Sept 15 (pond)	1.5 hours	30 min	54 g
Carex tumulicola	July 19	15 min	15 min	59 g

Table 3. Recorded collection and cleaning times for seed increase tubs and plots (cont.).

Species	Harvest dates	Harvest time	Cleaning time	Amount of seed produced
Castilleja tenuis	June 21 - 29	45 min	30 min	61 g
Cicendia quadrangularis	June 2	20 min	15 min	55 g
Deschampsia elongata	June 29	30 min	2 hours	325 g
Downingia elegans	August 20	1 hour	2 hours	1221 g
Downingia yina	August 19	1 hour	2 hours	1208 g
Eleocharis obtusa	August 5	20 min	2 hours	50 g
Eleocharis palustris	July 1	15 min	1 hour	28 g
Galium trifidum	October 8	1 hour	1 hour	730 g
Gentiana sceptrum	Aug 30–Sept 10	2 hours	45 min	37 g
Gratiola ebracteata	June 14	15 min	30 min	85 g
Juncus tenuis	August 9	2 hours	45 min	573 g
Lasthenia glaberrima	June 14–July 19	3 hours	1 hour	1117 g
Lotus formosissimus	August 9	1 hour	1 hour	344g
Lupinus bicolor	July 14	1 hour	30 min	2132 g
Montia linearis	May 14-June 14	1 hour	30 min	521 g
Madia glomerata	October 12	2 hours	3 hours	9 lbs
Myosotis laxa	August 24	1 hour	2 hours	922 g
Navarretia intertexta	September 10	1 hour	2 hours	720 g
Nemophila menziesii	July 23	1 hour	2 hours	1322 g
Dichanthelium acuminatum	August 18	1 hour	2 hours	3765 g
Orthocarpus bracteosus	June 21- 29	1 hour	15 min	37 g
Phlox gracilis	July 27	2 hours	1.5 hours	1720 g
Rorippa curvisiliqua	July 18	1 hour	1 hour	1610 g
Saxifraga oregana	June 14	30 min	15 min	39 g
Veronica peregrina	June 14 - July 14	2 hours	1 hour	1860 g

***Saxifraga oregana* -** This tub was established in 2004. Plants flowered in early spring and seeds were collected by hand from June 3 through June 9. Seed production was stable this year.

***Perideridia oregana* -** This tub was discontinued in the winter of 2009 and the plants were recovered by the West Eugene Wetlands crew.

***Eleocharis obtusa* and *Eleocharis palustris* -** This tub was established in 2008 from plants overwintered in 2007. ELPA and ELOB were planted in blocks next to each other in the same tub. The *Eleocharis obtusa* declined dramatically in vigor this year. The plants were small and weak, producing only one small harvest. In previous years it has had two healthy harvests. The bed is expected to die out completely. We recommend discontinuing this species; it seems likely that adequate harvests could be made from monocultures in the wild. The *Eleocharis palustris* flowered and seeds were harvested in July. The plants were very healthy and dense, and a little more seed was produced than last year, but the majority of the tub was filled with vegetative growth. We recommend that this species be discontinued as well. We were unable to provide the correct conditions for a larger harvest.

Figure 6. *Dicanthelium acuminatum* seedlings in the greenhouse at the Corvallis Plant Materials Center, May 2010

Ranunculus alismaefolius - This tub was discontinued in the winter of 2009 and the plants were recovered by the West Eugene Wetlands crew.

Additional 2010 Seed Increase Notes

Some species produced seed while in conetainers. *Gratiola ebracteata* flowered in their cone-tainers. Small battery-powered grass clippers were used to cut *G. ebracteata* like a mini- swather. Seeds were dried in an open greenhouse. Mature *Cicendia quadrangularis* capsules were cut and dried in an open greenhouse. Capsules are separated from the seed using hand screens.

The *Castilleja tenuis* and *Orthocarpus bracteosus* crops were harvested from the cone-tainers this year. Last year, experiments were performed planting both species with various host plants in pots and into the ground. It was determined that more seed could be harvested with greater ease if the plants were left in the conetainers until harvest. This year, experiments were done to determine if pruning would increase production in the containers. More branching was stimulated, however the resulting stems and their flowers were likely to be smaller than those of plants that had not been pruned. At the end of the growing season, a visual assessment of the different treatments showed that pruning did not necessarily increase seed production. A small portion of each species was planted with a host grass, sand fescue, to determine if the host would increase vigor and production of the plants. Plants of both species with the host were smaller and less vigorous than those without the host. It may be that the *Orthocarpus* and *Castilleja* are supplied with all the needed nutrients in their small cones, eliminating the benefit of a host, and the addition of a grass only served to make nutrients less available.

VI. Plant Materials Delivery

Seed was requested for delivery in late September in order to be available for fall sowing on restoration sites. Some plantings were still producing seed at this time. Seeds from plantings that had completed seed production for the season were picked up by BLM staff on September 1st and 15th, 2010. All remaining seed lots are being stored at the PMC seed storage facilities until requested.

Table 4. Seed delivered to BLM staff in the fall of 2010.

Species	Amount of seed produced	Date delivered	Notes
Agoseris grandiflora	1691 g	15-Sept	
Carex feta	54 g	15-Sept	
Carex tumulicola	59 g	1-Sept	
Castilleja tenuis	61 g	1-Sept	
Cicendia quadrangularis	55 g	1-Sept	
Deschampsia elongata	325 g	1-Sept	
Dicanthelium acuminatum	8.3 lbs	15-Sept	
Downingia elegans	1221 g	1-Sept	
Downingia yina	1208 g	1-Sept	
Eleocharis obtusa	50 g	15-Sept	
Eleocharis obtusa	287 g	15-Sept	Produced in 2009
Eleocharis obtusa	385 g	1-Sept	Produced in 2009
Eleocharis palustris	28 g	1-Sept	
Gallium trifiduum	111 g	1-Sept	Produced in 2009
Gentiana sceptrum	37 g	15-Sept	
Gratiola ebracteata	85 g	1-Sept	
Juncus tenuis	573 g	1-Sept	
Lasthenia glaberrima	1117 g	1-Sept	
Lotus formosissimus	344 g	1-Sept	
Lupinus bicolor	2132 g	1-Sept	
Madia glomerata	2042 g	1-Sept	Produced in 2009
Montia linearis	521 g	1-Sept	
Myosotis laxa	922 g	15-Sept	
Navarretia intertexta	720 g	15-Sept	
Nemophila menziesii	1322 g	1-Sept	
Orthocarpus bracteosus	37 g	1-Sept	
Perideridia oregana	73 g	1-Sept	Produced in 2009
Phlox gracilis	1720 g	1-Sept	
Pyrrocoma racemosa	49 g	21-Sept	Produced in 2009
Rorippa curvisiliqua	1610 g	15-Sept	
Saxifraga oregana	39 g	1-Sept	
Veronica peregrina	1860 g	1-Sept	

Table 5. Seeds in storage at the Corvallis PMC.

Species	**Weight**	**Year Produced**
Galium trifiduum	730 g	2010
Madia glomerata	9 lbs	2010

CORVALLIS PLANT MATERIALS CENTER
USDA NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

January 30, 2012

THE 2011 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
WEST EUGENE WETLANDS

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement in the spring of 2002 with the Bureau of Land Management (BLM) to perform seed germination trials and seed increase of native wetland and wet prairie species.

Figure 1. Seaside bird's-foot trefoil (*Lotus formosissimus)* at the Corvallis PMC, June 12, 2011.

The West Eugene Wetlands (WEW) program has been collecting wild seed and sowing it in wetland restoration projects. Some species have been difficult to establish or have very high labor costs associated with hand collection. The PMC agreed to research and document seed propagation techniques for these species and to evaluate their potential for agronomic seed increase.

In 2011, this agreement was renewed. Three species from previous agreements were discontinued. Seed increase was renewed on 29 of the species from the 2009 contract. This agreement will be amended and renewed through 2012.

Activities in 2011 included establishing and maintaining seed increase plantings, seed harvesting and seed cleaning.

II. Accessions Included in 2011 Agreement

Table 1. Accessions included in 2011 agreement with Eugene District of the BLM.

Species	Common name	Code	Accession	Activity in 2011[1]
Agoseris grandiflora	bigflower agoseris	AGGR	9079571	Sfp, dlv
Carex tumulicola	splitawn sedge	CATU3	9079291	Sfp, dlv
Castilleja tenuis	hairy Indian paintbrush	CATE26	9079254	Sfp, pxn, dlv
Cicendia quadrangularis	Oregon timwort	CIQU3	9079312	Sfp, pxn, dlv
Dichanthelium acuminatum	western panicgrass	DIAC2	9079303	Sfp, dlv
Dodecatheon hendersonii	Henderson's shootingstar	DOHE	9079615	Sfp, dlv
Downingia elegans	elegant calicoflower	DOEL	9079432	Sfp, pxn, dlv
Downingia yina	cascade calicoflower	DOYI	9079433	Sfp, pxn, dlv
Eryngium petiolatum	coyote thistle	ERPE7	9079431	Sfp, dlv
Galium trifidum	threepetal bedstraw	GATR2	9079317	Sfp, pxn, dlv
Gentiana sceptrum	king's scepter gentian	GESC	9079311	Sfp, dlv
Gratiola ebracteata	bractless hedgehyssop	GREB	9079436	Sfp, pxn, dlv
Lasthenia glaberrima	smooth goldfields	LAGL3	9079293	Sfp, pxn, dlv
Lotus formosissimus	seaside bird's-foot trefoil	LOFO2	9079294	Sfp, dlv
Lupinus polycarpus	miniature lupine	LUPO3	9079250	Sfp, dlv
Madia glomerata	mountain tarweed	MAGL2	9079437	Sfp, dlv
Montia linearis	narrowleaf minerslettuce	MOLI4	9079295	Sfp, dlv
Myosotis laxa	bay forget-me-not	MYLA	9079253	Sfp, pxn, dlv
Navarretia intertexta	needleleaf navarretia	NAIN2	9079378	Sfp, pxn, dlv
Navarretia willamettensis	Willamette navarretia	NAWI	9109145	Sfp, dlv
Nemophila menziesii	baby blue eyes	NEME	9079379	Sfp, dlv
Orthocarpus bracteosus	rosy owl's-clover	ORBR	9079502	Sfp, pxn, dlv
Phlox gracilis	slender phlox	PHGR16	9079299	Sfp, dlv
Rorippa curvisiliqua	curvepod yellowcress	ROCU	9079257	Sfp, pxn, dlv
Saxifraga oregana	Oregon saxifrage	SAOR2	9079296	Sfp, dlv
Veronica peregrina	neckweed	VEPE2	9097439	Sfp, pxn, dlv

1- sfp= seed increase, pxn= container production, dlv= delivered plant materials

III. Plant Production

Each of the species in this year's agreement has been successfully grown by the PMC in previous years. We have found that some species perform better when directly sown and others do better when grown in a greenhouse and then transplanted out as plugs into the

seed increase plots. *Nemophila menziesii, Lupinus polycarpus, Madia glomerata,* and *Phlox gracilis* seeds were directly sown into weed fabric in late February. PMC staff did not want to crawl on the fabric on the chilly March days, so a new technique was developed. Using funnels perched on PVC pipes, the PMC staff could sprinkle seed in the funnel held over the holes in the weed fabric. This method was faster and more comfortable. Vermiculite was also dropped through the funnel to cover the seed and retain moisture.

Other annual species were sown into cone-tainers, grown in the greenhouse in late winter, and then transplanted out into the seed increase plots in March.

Figure 2. PMC staff, Jenny Freitag and Meghan Hemingway demonstrating the new technique for sowing seeds of annuals on weed fabric.

Table 2. Plant production for the Eugene BLM WEW agreement at the Corvallis PMC in 2011.

Species	**Amt used (g)**	**Number of units produced**	**Treatment**
Castilleja tenuis	1	400	3 months cold, Heated greenhouse
Cicendia quadrangularis	1	400	Heated greenhouse
Downingia elegans	1	500	Heated greenhouse
Downingia yina	1	400	Heated greenhouse
Galium trifidum	1	100	Heated greenhouse
Gratiola ebracteata	2	500	Heated greenhouse
Juncus tenuis	1	400	Heated greenhouse
Lasthenia glaberrima	3	400	Heated greenhouse
Lupinus polycarpus	10	300	Scarification, Heated greenhouse
Madia glomerata	10	400	Heated greenhouse
Myosotis laxa	5	400	Heated greenhouse
Navarretia intertexta	5	400	2 wks cold, Heated greenhouse
Orthocarpus bracteosus	1	400	3 months cold, Heated greenhouse
Rorippa curvisiliqua	2	300	Heated greenhouse
Veronica peregrina	1	400	Heated greenhouse

IV. Field Plantings

Two 0.1-acre fields of *Juncus tenuis* and *Dicanthelium acuminatum* were installed last year. Both fields were established on weed fabric from plugs grown in the greenhouse, and were planted out in the spring of 2010. More transplants of *J. tenuis* were grown and put in the field in the spring 2011. The field grew to mammoth proportions this year. It seemed to thrive with the extended wet period in the summer of 2011. It was harvested using the "moon rover" (a self-propelled swather) and material was laid to dry on tarps in a shed. Once it was dry, material was fed through a brush machine and cleaned using an air screen machine. The plants in the *D. acuminatum* field were also very large this year, which made harvesting very difficult. It was harvested with the seed stripper, but the foliage was so thick that the machine couldn't vacuum up all the seeds that were on the fabric. The leaves were cut down using a sickle-bar mower and then raked off the field. The seed stripper was then able to harvest more seed, but many seeds remained on the fabric. A generator and two shop-vacs were used to collect the rest of the seed. All this labor yielded an impressive 38 lbs of seed!

The *Carex feta* seed increase plot is located in the PMC simulated ponds. They are seasonally flooded to mimic the natural habitat of the species. 2011 was the second growing season for these plants and they produced an average amount of seed. Seedheads were cut from the plants using rice knives when the seeds were mature, but before they had shattered. Plant material was dried in a greenhouse, threshed using a small brush machine, and then cleaned by air screen machine.

Seed increase of many annual species was performed this year using weed fabric techniques. Three 15 by 170 ft sheets of weed fabric were stapled down onto a field that had been previously sprayed with glyphosate herbicide. Small squares were cut out of the weed fabric in order to transplant the cone-tainer plants. The squares were cut slightly larger than the size of the cones. The weed fabric is reused from year to year.

Figure 3. PMC staff, Tyler Ross and Mary Beuthin, weeding seed increase plots, June 10, 2011.

Small, battery-powered hand vacuums were used twice a week to collect seed of *Veronica peregrina* and *Lasthenia glaberrima*. The seeds were swept and vacuumed and the material placed in bags in an open greenhouse to dry, and then cleaned with small air-screen machines. *Phlox gracilis, Lupinus bicolor, Lotus formosissimus, Rorippa curvisiliqua*, *Madia glomerata*, *Montia linearis*, and *Nemophila* *menziesii* were harvested once. The seeds were swept and vacuumed, and then the seeds were cleaned with a small air-screen machine. The *Navarretia intertexta, Downingia elegans*, *Downingia yina*, *Eryngium petiolatum*, *Gallium trifidum*, and *Myosotis laxa* plots were harvested by pulling or cutting entire plants, then feeding them into a brush machine to separate seeds from the plants prior to cleaning the seeds. These plots were also swept and vacuumed to recover the seed that had shattered onto the fabric. The *N. intertexta* plot still contained *N. willamettensis* plants even though new, separate collections of the two species were made in 2010. It is possible that *N. willamettensis* plant volunteered in the plot, even though the plots are thoroughly weeded prior to transplanting. *N. willamettensis* plants were flagged while they were flowering (when they could be correctly identified), and were harvested separately.

Figure 4. Baby blue eyes (*Nemophilia menziesii*) with a native pollinator at the Corvallis PMC, June 16, 2010.

The field plot of *Agoseris grandiflora* overwintered and emerged in 2011. The plants began to look very vigorous and leafy, but then were covered with powdery mildew. This did not kill the plants, but it did lower seed production. When ripe, the seed heads opened and were harvested individually by hand. Heads were harvested once every day. This plot is placed inside a wind fence which prevented the seeds from blowing away, allowing us to harvest the crop only once per day, whereas last year it was often done twice daily. *Phlox gracilis* also became covered with powdery mildew. The majority of the phlox plants died as a result of the mildew, but some plants were able to produce a small amount of seed.

V. Seed Increase Tubs

Some perennial species were maintained in tubs in the PMC shadehouse. Plants were monitored daily for disease and pests as well as seed maturity. Plantings were overhead watered as needed.

The *Carex tumulicola* tub was established from cone-tainers seeded in 2003. Seed heads were clipped when mature. When over 80% of seed heads were ripe at the same time, the entire tub was cut back and all the clippings were dried in a greenhouse on a tarp. Production was moderate.

Gentiana sceptrum plants were transplanted into the tub in late summer of 2004. Seeds from the tub were collected when capsules began to turn papery and tan. Some seed predation by seed weevils has been observed for the past several years, but not enough to seriously affect the harvest.

The *Saxifraga oregana* tub was established in 2004. Plants flowered in early spring and seeds were collected by hand on June 15. Stems were dried in a greenhouse on a tarp, and cleaned using an air screen machine.

Table 3. Harvest dates and yields for seed increase tubs and plots.

Species	Code	Date Harvested	2011 Yield
Agoseris grandiflora	AGGR	Sept 4	1231 g
Carex tumulicola	CATU3	July 27	43 g
Castilleja tenuis	CATE26	July 27	1 g
Cicendia quadrangularis	CIQU3	May 10	1 g
Dichanthelium acuminatum	DIAC2	Aug 31	38 lbs
Downingia elegans	DOEL	Aug 24	881 g
Downingia yina	DOYI	Aug 24	926 g
Eryngium petiolatum	ERPE7	Sept 30	7 lbs
Galium trifidum	GATR2	Oct 10	1100 g
Gentiana sceptrum	GESC	Aug 20 Sept 15	193 g
Gratiola ebracteata	GREB	June 15	40 g
Lasthenia glaberrima	LAGL3	Jun3 17	1836 g
Lotus formosissimus	LOFO2	Aug 3	1064 g
Lupinus polycarpus	LUPO3	July 19-Aug 1	1798 g
Madia glomerata	MAGL2	Sept 30	1803 g
Montia linearis	MOLI4	June 15-24	1210 g
Myosotis laxa	MYLA	Aug 9	1005 g
Navarretia intertexta	NAIN2	Aug 9	438 g
Navarretia willamettensis	NAWI	Aug 1	26 g
Nemophila menziesii	NEME	July 20	967 g
Phlox gracilis	PHGR16	July 8	58 g
Rorippa curvisiliqua	ROCU	Aug 8	3 lbs
Saxifraga oregana	SAOR2	June 15	8 g
Veronica peregrina	VEPE2	June 30	1436 g

Additional 2011 Seed Increase Notes
Some annual species show no increase in seed production when transplanted into a field and can live out their life cycle while in cone-tainers. *Gratiola ebracteata* plants flowered in their cone-tainers. Small battery-powered grass clippers were used to cut *G. ebracteata* like a mini-swather. Seeds were dried in an open greenhouse. Mature *Cicendia quadrangularis* capsules were cut and dried in an open greenhouse. Capsules are separated from the seed using hand screens.

The *Castilleja tenuis* and *Orthocarpus bracteosus* crops were harvested from the cone-tainers this year. Last year, experiments were performed planting both species with various host plants in pots and into the ground. It was determined that more seed could be harvested with greater ease if the plants were left in the cone-tainers until harvest. This year, experiments were done to determine if pruning would increase production in the containers. More branching was stimulated, but the resulting stems and their flowers were likely to be smaller than those of plants that had not been pruned. At the end of the growing season, a visual assessment of the different treatments showed that pruning did not necessarily increase seed production. A small portion of each species was planted with a host grass, sand fescue (*Festuca ammobia*), to determine if the host would increase vigor and production of the plants. Plants of both species with the host were smaller and less vigorous than those without the host. It may be that the *Orthocarpus* and *Castilleja* are supplied with all the needed nutrients in their small cones, eliminating the benefit of a host, and the addition of a grass only served to make nutrients less available. The seed used to grow these plants is getting old. The *C. tenuis* and *O. bracteosus* seeds had low germination, low survival and low vigor. This seed lot should be replaced with new seed. The *O. bracteosus* plants flowered, but did not produce seed in 2011.

VI. Plant Materials Delivery
Seed was requested for delivery in late September in order to be available for fall sowing on restoration sites. Some plantings were still producing seed at this time. Seeds from plantings that had completed seed production for the season were picked up by BLM staff in September 2011. All remaining seed lots are being stored at the PMC seed storage facilities until requested.

Table 4. Seeds in storage at the Corvallis PMC.

Species	Code	Seed Lot	Bulk Amount
Eryngium petiolatum	ERPE7	SG1-11-EB431	7 lbs
Galium trifidum	GATR	SG1-11-EB317	1100 g
Gentiana sceptrum	GESC	SG1-11-EB311	193 g
Madia glomerata	MAGL	SG1-11-EB437	1803 g
Navarretia willamettensis	NAWI	SG1-11-EB154	13 g

Table 5. Seed delivered to BLM staff in the fall of 2011.

Species	Code	Seed Lot	Bulk Amount
Agoseris grandiflora	AGGR	SG1-11-EB571	1231 g
Carex tumulicola	CATU3	SG1-11-EB291	43 g
Castilleja tenuis	CATE26	SG1-11-EB254	1 g
Cicendia quadrangularis	CIQU3	SG1-11-EB312	1 g
Dichanthelium acuminatum	DIAC2	SG1-11-EB303	38 lbs
Downingia elegans	DOEL	SG1-11-EB432	881 g
Downingia yina	DOYI	SG1-11-EB433	926 g
Galium trifidum	GATR2	SG1-10-EB317	730 g
Gentiana sceptrum	GESC	SG1-10-EB311	37 g
Gratiola ebracteata	GREB	SG1-11-EB436	40 g
Lasthenia glaberrima	LAGL3	SG1-11-EB293	1836 g
Lotus formosissimus	LOFO2	SG1-11-EB294	1064 g
Lupinus polycarpus	LUPO3	SG1-11-EB250	1798 g
Madia glomerata	MAGL2	SG1-10-EB437	9 lbs
Montia linearis	MOLI4	SG1-11-EB295	140 g
Myosotis laxa	MYLA	SG1-11-EB253	1005 g
Navarretia intertexta	NAIN2	SG1-11-EB378	438 g
Nemophila menziesii	NEME	SG1-11-EB379	967 g
Phlox gracilis	PHGR16	SG1-11-EB299	58 g
Rorippa curvisiliqua	ROCU	SG1-11-EB257	3 lbs
Saxifraga oregana	SAOR2	SG1-11-EB296	8 g
Veronica peregrina	VEPE2	SG1-11-EB439	1436 g

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

January 30, 2010

THE 2010 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
Medford District

I. Brief Background of Project

Figure 1. Drew's silky lupine (*Lupinus adsurgens)* seed increase field, Corvallis Plant Materials Center, May 28, 2010.

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Medford District of the Bureau of Land Management (BLM) in 2004 to provide native plant materials for ecological restoration. The agreement was continued in 2010. It was agreed that the PMC would maintain seed increase fields of two legumes, and five forbs.

II. Accessions Involved

Accessions included for the Medford District BLM in 2010 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for Medford District BLM cooperative agreement with Corvallis Plant Materials Center in 2010.

Species	Common name	Code	Accession #	Activity in 2010[1]
Clarkia rhomboidea	diamond clarkia	CLRH	9079595	sfp
Eriogonum umbellatum	sulfur buckwheat	ERUM	9079425	sfp
Iris douglasiana	Douglas Iris	IRDO	9079417	sfp
Lupinus adsurgens	Drew's silky lupine	LUAD	9079426	sfp
Polemonium carneum	royal Jacob's ladder	POCA4	9079424	pxn
Potentilla glandulosa	sticky cinquefoil	POGL9	9079427	sfp
Rupertia physoides	forest scurf peas	RUPH3	9079323	sfp
Sisyrinchium bellum	western blue-eyed grass	SIBE	9079420	sfp

1- sfp= seed increase, trl= germination research trials, pxn=plant production, dlv=plant materials delivery

III. Experimental Propagation

There was no experimental propagation this year for this project.

IV. Field Seed Increase

Container plants of *L. adsurgens* and *R. physoides* that were grown in the winter of 2008/2009 were transplanted out into fields that had been covered with weed fabric in early March. Some of the lupines did not thrive after transplanting. It was not known if the plants died or went dormant. Vacant holes in the weed fabric that were replanted with new seed in the spring of 2010. Slugs damaged some of the seedlings, but many grew. The existing plants of lupine and the *Rupertia* grew rapidly in the spring and summer. Plants were covered with flowers and seed production seemed high. As pods shattered, seeds began to accumulate on the weed fabric. After all the pods had shattered, the weed fabric was swept. Sweeping pushes some seeds into the weed fabric holes and these seeds were recovered by vacuuming each hole after the fabric had been swept.

Figure 2. Seeds of scurf-peas (*Rupertia physoides*) on weed fabric.

Figure 2. Sticky cinquefoil (*Potentilla glanduosa*) and Douglas iris (*Iris douglasiana*) seed increase field at the Corvallis Plant Materials Center, May 28, 2010.

Table 2. Yields from seed increase fields at the Corvallis Plant Materials Center in 2010.

Species	Accession #	Harvest date	Method	Field size (ac)	Yield
Eriogonum umbellatum	9079425	8-Jul	hand	<0.1	1 lb
Potentilla glandulosa	9079427	19-Jul	hand	<0.1	9 lbs
Sisyrinchium bellum	9079420	25-Jun	hand	<0.1	56 g
Clarkia rhomboidea	9079595	3-Aug	moon rover	0.1	28 lbs
Iris douglasiana	9079417	7/5-7/20	hand	<0.1	26 g
Lupinus adsurgens	9079426	21-Aug	vac weed fabric	0.15	22 lbs
Rupertia physoides	9079323	20-Aug	vac weed fabric	0.15	11 lbs

The *Eriogonum umbellatum* plants flowered early in 2010. This spring was quite cool and wet and the weather appeared to affect the seed production of the buckwheat. The plants were covered with flowers, as usual, but the flowers seemed to rot and fall off. The sparse seed was collected by hand. The *Potentilla glandulosa* field flowered later than usual and these plants appear to be in their prime. Seed production was very high for this little plot! Plots of *Sisyrinchium bellum* and *Iris douglasiana* were established in March of 2008 using transplants that were grown in 2007. The iris finally flowered in 2010.

Plants still have not reached their adult size, but are growing steadily. The *S. bellum* plot flowered poorly this year. It was not clear if this decline in production was due to weather or lack of fertilization. All of the forb fields will be fertilized in the spring of 2011 (after fields have been weeded). Each of these small forb plots were hand harvested multiple times during the harvest season.

A new field of *Clarkia rhomboidea* was sown in the fall of 2008. This field flowered and was harvested in the summer of 2009. A large amount of seed shattered across the field and germinated in the fall of 2009. It was decided to let this second generation field produce seed in 2010. The field was surprisingly full of clarkia seedlings and very few weeds were present. The 2009 field had been directly combined (material was not cut and dried before running it through the combine) which left a sticky residue inside the combine. This year, PMC staff tried to "swath" the field with the moon rover, move the material to tarps inside a shed to dry, then feed the dried (non-sticky) material through a combine. This method was more labor intensive, due to the handling of all the swathed material, but it was very effective and the dried material was not a problem in the combine.

Figure 4. Diamond clarkia (*Clarkia rhomboidea*) flower.

V. Container Plant Production.

Containers of *Polemonium carneum* were kept in the PMC shadehouse throughout the growing season. They flowered and a minimal amount of seed was collected from them.

VI. Delivery of Plant Materials

There were no seed deliveries made to BLM staff this year, but one seed lot was sent to a private grower who will establish large seed production fields. Another seed lot was sent to a researcher who needed seed of species from serpentine soils.

Table 3. Seed delivered for the Medford District BLM cooperative agreement with Corvallis Plant Materials Center in 2010.

Species	Code	Origin	Seed lot	Weight
Clarkia rhomboidea	**CLRH**	Buckhorn	SG1-09-MB595	4 lbs
Achnatherum lemmonii	**ACLE**	Granite	SGO-05-MB398	75 g

Some seed still remains at the PMC and will stored in the seed cooler until requested by the BLM. Table 4 shows the seed inventory for large amounts of seed in storage or for smaller lots of species we are currently working with. Table 5 displays seed lots that are very small wild collections and other small lots of species that the PMC is not currently working with anymore. These seed lots should be reviewed and decisions should be made about how to best use the seed. The seed is aging and should be used before it is non-viable. Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed, SCO indicates unknown generation of seed that we initially received). The middle numbers of a seed lot indicates which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (MB is for Medford BLM) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 4. Current seed in storage at Corvallis Plant Materials Center, December 30, 2010.

Scientific Name	Accession #	Origin	seed lot	Seed in storage Produced by PMC	Provided by BLM
Rupertia physoides	9079323	E Evans Creek	SG2-10-MB323	11 lbs	
Poa secunda	9079394	Hyatt lake	SG2-09-MB394	261 lbs	
Achnatherum lemmonii	9079398	Granite	SCO-07-MB398	180 g	
Iris douglasiana	9079417	Box O	SG1-10-MB417	26g	72 g
Penstemon roezlii	9079419	Box O	SG1-08-MB419	202g	
Penstemon roezlii	9079419	Box O	SG1-08-MB419	194g	
Sisyrinchium bellum	9079420	Box O	SG1-09-MB420	290g	8g
Sisyrinchium bellum	9079420	Box O	SG1-10-MB420	56g	
Eriogonum umbellatum	9079425	Grizzly Peak	SG1-09-MB425	1585g	5g
Lupinus adsurgens	9079426	I-5 Merlin Exit	SG1-08-MB426	228g	1 g
Lupinus adsurgens	9079426	I-5 Merlin Exit	SG1-10-MB426	17 lbs	
Potentilla glandulosa	9079427	Soda Mt	SG1-07-MB427	24 g	5 g
Potentilla glandulosa	9079427	Soda Mt	SG1-08-MB427	295 g	
Potentilla glandulosa	9079427	Soda Mt	SG1-09-MB427	2.5 lbs	
Potentilla glandulosa	9079427	Soda Mt	SG1-10-MB427	9 lbs	
Clarkia rhomboidea	9079595	Buckhorn	SG1-09-MB595	1 lb	
Clarkia rhomboidea	9079595	Buckhorn	SG2-10-MB595	28 lbs	

Table 5. Small or older lots of discontinued species in storage at the Corvallis Plant Material Center, December 30, 2010.

Scientific Name	Accession #	Origin	seed lot	Seed in storage Produced by PMC	Provided by BLM
Lomatium macrocarpum	9079325	Pelton Rd	wild collected		129 g
Festuca romerii	9079326	Indigo Creek	SCO-07-MB326	1 lb	
Festuca romerii	9079326	Indigo Creek	SCO-05-MB326	1 lb	
Xerophyllum tenax	9079385	35-9-11 Biscuit	wild collected		226g
Scirpus microcarpus	9079386	Parsnip lakes	wild collected		33g
Juncus tenuis	9079388	Obenchain Rd	wild collected		13 g
Cimicifuga elata	9079390	Grizzly Mt	wild collected		12 g
Darlingtonia californica	9079391	Biscuit fire	wild collected		4g
Achnatherum lemmonii	9079398	Granite	SCO-07-MB398	180 g	
Festuca californica	9079399	Anatuvak	SCO-04-MB499		836g
Penstemon roezlii	9079419	Box O	SG1-08-MB419	202g	
Penstemon roezlii	9079419	Box O	SG1-08-MB419	194g	
Tritilia hyacinthina	9079421	Box O	wild collected		8g
Festuca elmeri	9079422	Gall's Creek	SG1-06-MB422	24 g	26g
Polemonium carneum	9079424	Grizzly Peak	SG1-08-MB424	4g	1g

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Figure 1. Douglas iris (*Iris douglasiana*) seed increase field, Corvallis Plant Materials Center, May 28, 2011.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement with the Medford District of the Bureau of Land Management (BLM) in 2004 to provide native plant materials for ecological restoration. The agreement was continued in 2011. It was agreed that the PMC would maintain seed increase fields of two legumes and four forbs.

II. Accessions Involved

Accessions included for the Medford District BLM in 2011 are listed in Table 1. This table also displays activities performed by PMC staff. Activities in 2011 included maintenance and harvest of seed increase fields of two legumes and four forbs.

Table 1. Accessions involved for Medford District BLM cooperative agreement with Corvallis Plant Materials Center in 2011.

Species	Common name	Code	Accession #	Activity in 2011[1]
Clarkia rhomboidea	diamond clarkia	CLRH	9079595	-
Eriogonum umbellatum	sulphur-flower buckwheat	ERUM	9079425	sfp
Iris douglasiana	Douglas iris	IRDO	9079417	sfp
Lupinus adsurgens	Drew's silky lupine	LUAD	9079426	sfp
Polemonium carneum	royal Jacob's ladder	POCA4	9079424	pxn
Potentilla glandulosa	sticky cinquefoil	POGL9	9079427	sfp
Rupertia physodes	forest scurfpea	RUPH3	9079323	sfp
Sisyrinchium bellum	western blue-eyed grass	SIBE	9079420	sfp

1- sfp= seed increase, pxn=plant production,

III. Field Seed Increase

In 2009, *L. adsurgens* and *R. physodes* plants were transplanted into fields covered with weed fabric. Some of the lupines did not thrive in 2010 after transplanting. It was not known if the plants died or went dormant. Holes in the weed fabric where plants had died were replanted with new seed in the spring of 2011. Slugs and mice damaged some of the seedlings, but many grew. The existing plants of lupine and the *Rupertia* grew rapidly in the spring and summer. Plants were covered with flowers and seed production seemed high. An unusual amount of queen bumblebees congregated on the *Rupertia* plot this year. This species usually attracts many different species of pollinators, but on some days the plot was covered with only large queen bumblebees of various species.

Figure 2. Scurfpea (*Rupertia physodes*) plants growing in weed fabric at the Corvallis Plant Materials Center, May 30, 2011.

The lupine plants appeared to flower later than usual this year. The flower stalks also had large portions where seed pods did not form. This is thought to be from cool, rainy weather during pollination. The lupine field was harvested a month later than usual due to continued flowering in the summer. As pods shattered,

Figure 3. Drew's silky lupine (*Lupinus adsurgens*) seed increase field at the Corvallis Plant Materials Center, June 15, 2011.

seeds began to accumulate on the weed fabric. After all the pods had shattered, the weed fabric was swept. Sweeping pushes some seeds into the weed fabric holes and these seeds were recovered by vacuuming each hole. Because the lupine field was harvested much later, seeds were lying on the fabric longer, and mice may have eaten some. Seed caches were found while harvesting the field and the yield seemed low compared to the amount of pod formation noted.

Table 2. Yields from seed increase fields at the Corvallis Plant Materials Center in 2011.

Species	**Harvest date**	**Method**	**Field size (ac)**	**Yield**
Eriogonum umbellatum	19-Jul	hand	<0.1	11 lbs
Potentilla glandulosa	11-Jul	hand	<0.1	11.5 lbs
Sisyrinchium bellum	5-Jul	hand	<0.1	370 g
Iris douglasiana	7/20-8/1	hand	<0.1	3 lbs
Lupinus adsurgens	20-Sep	vac weed fabric	0.15	12 lbs
Rupertia physodes	17-Aug	vac weed fabric	0.15	32 lbs

This spring and summer were quite cool and wet, but the *Eriogonum umbellatum* plants were covered with flowers. Rain in July caused the seeds to begin to mold on the plant, but luckily did not affect the seed production. Seeds were cut from the plants and dried in a greenhouse. The *Potentilla glandulosa* field flowered later than usual; these plants appear to be at prime production, and yields continue to increase every year. Seed production was very high for this little plot! Plots of *Sisyrinchium bellum* and *Iris douglasiana* were established in March of 2008 using transplants that were grown in 2007. The iris finally flowered in 2010, but really wasn't mature until 2011. The *S. bellum* plot was fertilized this year and seemed to rebound from its poor production in 2010. All of the forb fields will be fertilized in the spring of 2012 (after fields have been weeded). Each of these small forb plots were hand harvested multiple times during the seed production season.

IV. Container Plant Production

Containers of *Polemonium carneum* were kept in the PMC shade house throughout the growing season. They flowered and a minimal amount of seed was collected from them.

V. Delivery of Plant Materials

There were no seed deliveries this year.

Some seed remains at the PMC and will be stored in the seed cooler until requested by the BLM. Table 4 shows the seed inventory for large amounts of seed in storage or for smaller lots of species we are currently working with. Table 5 displays seed lots that are very small wild collections and other small lots of species that the PMC is not currently working with anymore. These seed lots should be reviewed and decisions should be made about how best to use the seed. The seed is aging and should be used before it is non-viable. Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed, SCO indicates unknown generation of seed that we initially received). The middle numbers of a seed lot indicate which year the seed was produced. The last portion of the seed lot describes which project the seed is for (MB is for Medford BLM) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 4. Current seed in storage at Corvallis Plant Materials Center, December 30, 2011.

			Seed in storage	
Scientific Name	**Origin**	**seed lot**	**Produced by PMC**	**Provided by BLM**
Rupertia physodes	E Evans Creek	SG2-10-MB323	11 lbs	
Rupertia physodes	E Evans Creek	SG2-11-MB323	32 lbs	
Poa secunda	Hyatt lake	SG2-09-MB394	261 lbs	
Achnatherum lemmonii	Granite	SCO-07-MB398	180 g	
Iris douglasiana	Box O	SG1-10-MB417	26g	72 g
Iris douglasiana	Box O	SG1-11-MB417	3 lbs	
Penstemon roezlii	Box O	SG1-08-MB419	202g	
Penstemon roezlii	Box O	SG1-08-MB419	194g	
Sisyrinchium bellum	Box O	SG1-09-MB420	290g	8g
Sisyrinchium bellum	Box O	SG1-10-MB420	56g	
Sisyrinchium bellum	Box O	SG1-11-MB420	370 g	
Eriogonum umbellatum	Grizzly Peak	SG1-09-MB425	1585g	5g
Eriogonum umbellatum	Grizzly Peak	SG1-10-MB425	0.5 lbs	
Eriogonum umbellatum	Grizzly Peak	SG1-11-MB425	10 lbs	
Lupinus adsurgens	I-5 Merlin Exit	SG1-08-MB426	228g	1 g
Lupinus adsurgens	I-5 Merlin Exit	SG1-10-MB426	17 lbs	
Lupinus adsurgens	I-5 Merlin Exit	SG1-11-MB426	12 lbs	
Potentilla glandulosa	Soda Mt	SG1-07-MB427	24 g	5 g

Table 4. Current seed in storage at Corvallis Plant Materials Center, December 30, 2011 (Con't).

			Seed in storage	
Scientific Name	**Origin**	**seed lot**	**Produced by PMC**	**Provided by BLM**
Potentilla glandulosa	Soda Mt	SG1-08-MB427	295 g	
Potentilla glandulosa	Soda Mt	SG1-09-MB427	2.5 lbs	
Potentilla glandulosa	Soda Mt	SG1-10-MB427	9 lbs	
Potentilla glandulosa	Soda Mt	SG1-11-MB427	11.5 lbs	
Clarkia rhomboidea	Buckhorn	SG1-09-MB595	1 lb	
Clarkia rhomboidea	Buckhorn	SG2-10-MB595	28 lbs	

Table 5. Small or older lots of discontinued species in storage at the Corvallis Plant Materials Center, December 30, 2011.

			Seed in storage	
Scientific Name	**Origin**	**seed lot**	**Produced by PMC**	**Provided by BLM**
Lomatium macrocarpum	Pelton Rd	wild collected		129 g
Festuca romeri	Indigo Creek	SCO-07-MB326	1 lb	
Festuca romeri	Indigo Creek	SCO-05-MB326	1 lb	
Xerophyllum tenax	35-9-11 Biscuit	wild collected		226 g
Scirpus microcarpus	Parsnip lakes	wild collected		33 g
Juncus tenuis	Obenchain Rd	wild collected		13 g
Cimicifuga elata	Grizzly Mt	wild collected		12 g
Darlingtonia californica	Biscuit fire	wild collected		4 g
Achnatherum lemmonii	Granite	SCO-07-MB398	180 g	
Festuca californica	Anatuvak	SCO-04-MB499		836 g
Penstemon roezlii	Box O	SG1-08-MB419	202 g	
Penstemon roezlii	Box O	SG1-08-MB419	194 g	
Triteleia hyacinthina	Box O	wild collected		8 g
Festuca elmeri	Gall's Creek	SG1-06-MB422	24 g	26 g
Polemonium carneum	Grizzly Peak	SG1-08-MB424	4 g	1 g

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Figure 1**.** California oatgrass **(***Danthonia californica*) plant in flower at the Corvallis Plant Materials Center, June 20, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Roseburg District of the Bureau of Land Management (BLM) in 2005 to provide native plant materials for ecological restoration. Over the past five years, numerous species have been added and dropped from the agreement.

Activities in 2010 included maintenance and harvest of nine seed increase fields (four grasses, three forbs and two legumes) and plant production of one forb.

II. Accessions Involved

Accessions included for the Roseburg District of the BLM in 2010 are listed in Table 1. This table also displays activities performed by the PMC staff.

Table 1. Accessions involved for Roseburg District BLM cooperative agreement with Corvallis Plant Materials Center in 2010.

Species	Common name	Symbol	Accession	Activity in 2010[1]
Eriogonum nudum	barestem buckwheat	ERNU3	9079489	sfp
Eriophyllum lanatum	wooly sunflower	ERLAA	9079490	sfp
Sisyrinchium bellum	blue-eyed grass	SIBE	9079491	pxn,sfp
Lupinus albifrons	silver lupine	LUAL4	9079492	sfp
Lotus micranthus	small-flowered deervetch	LOMI	9079493	sfp
Festuca californica	California fescue	FECA	9079494	sfp
Danthonia californica	California oatgrass	DACA	9079415	sfp
Danthonia californica	California oatgrass	DACA	9079428	sfp
Achnathrum lemmonii	Lemmon's needlegrass	ACLE8	9079429	sfp

1- sfp= seed increase, pxn=plant production, dlv=plant materials delivery

III. Field Seed Increase Activities

The *Danthonia californica* seed increase fields that were sown in the fall of 2007 finally matured this year. Both fields were incredibly thick and seed heads were almost waist high. Fields were swathed and combined. The area of the *Achnathrum lemmonii* field that was sown in the fall of 2007 flowered this year. The plants looked wispy and weak. This portion of the field will be taken out. The plants that were started from plugs in 2006 are producing well and remain robust.

In early March, *Lotus micranthus* seeds were directly sown (by hand) into a field that had been covered with weed fabric. Holes had been cut in the fabric and seeds were planted into the holes. Only about 50% of the holes contained flowering plants this year. Slugs can be a major problem when the seedlings begin to emerge. The field was hand weeded twice and harvested once at the end of September. Dead plants were pulled out and the seed on the fabric was swept and collected into barrels.

There was a considerable amount of clover present in the *Eriophyllum lanatum* field and many of plants died over the winter. This field was four years old and likely at the end of its lifespan. Plugs of *Sisyrinchium bellum* were grown throughout the winter of 2009/2010 and planted out into a field covered with weed fabric in late March. The plugs grew more during the cool, wet spring and about 30% of the plants flowered in July. Upon closer inspection by BLM staff, this field appears to be predominately *Sisyrinchium hookerii,* not *S. bellum.* Seeds were collected by hand in late summer.
The large *Lupinus albifrons*, *Festuca californica* and *Eriogonum nudum* fields that were sown in the fall of 2009 grew slowly during the winter and spring. The *F. californica* field looks very nice, with thick rows of healthy plants. This species rarely flowers its

first year, so it was not surprising that it didn't flower in 2010. The *L. ablifrons* field is very spotty, but plants will grow to be quite large, so it will look much more filled in 2011. It is also expected to flower for the first time in 2011. The field was slightly weedy, but the lupine seedlings were hardy and did not seem affected by the weeds. Weedy *L. rivularis* (which is common in the PMC fields) plants were pulled out as well as stork's bill geranium. These two plants are the only ones that have seed that cannot be cleaned out of a *L. albifrons* seed lot.

The *E. nudum* field was disappointingly weedy this year. There were many seedlings germinating in the field, but were almost impossible to see due to the weed presence. The field was not weeded because PMC staff thought they would cause more damage to the seedlings by attempting to weed. But in early June, buckwheat plants were the size of a baseball and visible among the weeds. The cool, wet spring set back many harvest dates which created a window of time where the PMC staff could go in and weed the buckwheat field. Most of the weeds were low-growing, spreading annuals. Weeds were pulled and rolled up like carpet, leaving the buckwheat plants behind. The worst sections of the field were weeded first and by mid-summer, the entire half acre was weeded. It was an incredible amount of work, but removing annual weeds in year one is

Figures 2 and 3.Very weedy bare stem buckwheat (*Eriogonum nudum*) seed increase field at the Corvallis Plant Materials Center, May 14, 2010.

essential to having a clean field in later years. The buckwheat plants continued to grow throughout the summer, even though no irrigation was applied and fields were very dry. Another large flush of growth happened soon after the first rains in September. The field is almost filled in and the plants look great. A few managed to flower, but it was too late in the year for plants to set viable seed. Both the lupine and the buckwheat fields were infested with trefoil plants in the fall. Fields were walked and glyphosate was applied using spot applicators to each trefoil plant. These plants must be removed from the field or they will take over the crop.

Table 2. Seed yields for the Roseburg District BLM cooperative agreement with the Corvallis Plant Materials Center in 2010.

Species	Accession	Field size (ac)	Date harvested	Method	Yield
Sisyrinchium bellum	9079491	0.1	August 24	hand	1 lb
Lotus micranthus	9079493	0.1	Sept 14	sweep weed fabric	7 lbs
Danthonia californica	9079415	0.48	July 4, 13	swath/combine	170 lbs
Danthonia californica	9079428	0.23	July 6, 19	swath/combine	28 lbs
Achnathrum lemmonii	9079429	0.04	June 24	seed stripper	2.3 lbs

Figure 4. Blue-eyed grass (*Sisyrinchium bellum*) at the Corvallis Plant Materials Center, July 20, 2010.

Following harvest, all grass fields were mowed with a Brady chopper to remove residue. All established grass fields were sprayed in late October with Outlook®, a non-selective pre-emergent herbicide.

IV. Container Plant Production

Figure 5. *Sisyrinchium hitchcockii* (left) can be distinguished from *Sisyrinchium bellum* (right) by its more reddish-purple petals, smaller yellow "eye" in the center, and its petals are three times longer than wide, whereas *S. bellum* petals are two times longer than wide.

The new *S. bellum* field was established using transplants. On October 15th, 2009 seed was sown into plug trays filled with moistened media (Sunshine #1, a special peat-based soil-less mix) and lightly covered with fine vermiculite. Trays were placed outside in a lathhouse for natural stratification. This species appears to need natural stratification and outdoor winter conditions for germination. Large sheets of clear plastic were draped over the plugs so they weren't damaged by the pounding rain. Sheets were removed in late December when the seedlings began to germinate. One tray was brought into a warm greenhouse after 90 days of cold moist stratification and this tray had much lower germination than ones left to germinate outside. This suggests that these seeds may prefer to germinate at cool temperatures. After no more germination was observed outside (January), all trays were brought into a warm greenhouse to grow. Seedlings grew quickly and the roots filled the cell by mid March. Then the heat in the greenhouse was turned off and plants were slowly transitioned to outdoor temperatures, and transplanted into the field in late March.

V. Delivery of Plant Materials

A portion of one of the *D. californica* seed lots was picked up by Craig Edminster of Pacific Northwest Natives who will be using the seed to establish a large seed increase field.

Table 3. Seed Deliveries in 2010 for the Roseburg District BLM cooperative agreement with Corvallis Plant Materials Center.

Species	Seed lot	Weight Bulk	PLS	Purity	TZ
Danthonia californica	SG3-10-RB415	54 lbs	49 lbs	97.76%	94%

All seed that was not delivered will remain in the Corvallis PMC seed storage facilities until requested. Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed (generation 1). The middle numbers of a seed lot notes which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (RB is for Roseburg BLM) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 4. Seeds in storage at the Corvallis Plant Materials Center for the Roseburg District BLM cooperative agreement in 2010.

Species	Lot number	Weight	Total per accession
Eriogonum nudum	SWC-06-RB489	99 g	
Eriogonum nudum	SG1-08-RB489	22 lbs	22 lbs
Eriophyllum lanatum	SWC-06-RB490	234 g	
Eriophyllum lanatum	SG1-08-RB490	48.5 lbs	
Eriophyllum lanatum	SG1-09-RB490	40 lbs	98.5 lbs
Sisyrinchium bellum	SG1-09-RB491	0.5 lbs	
Sisyrinchium bellum	SG1-10-RB491	1 lb	1.5 lbs
Lotus micranthus	SWC-06-RB493	11 g	

Table 4. Seeds in storage at the Corvallis Plant Materials Center for the Roseburg District BLM cooperative agreement in 2010 (con't).

Species	Lot number	Weight	Total per accession
Lotus micranthus	SG1-08-RB493	1.7 lbs	
Lotus micranthus	SG2-09-RB493	10 lbs	
Lotus micranthus	SG3-10-RB493	7 lbs	18.7 lbs
Festuca californica	SWC-06-RB494	4 g	4g
Silene hookeri	SWC-06-RB495	23 g	
Silene hookeri	SG1-07-RB495	72 g	95 g
Danthonia californica	SG2-07-RB415	100g	
Danthonia californica	SG2-08-RB415	8 lbs	
Danthonia californica	SG2-09-RB415	50 lbs	
Danthonia californica	SG2-10-RB415	116 lbs	174 lbs
Danthonia californica	SG2-07-RB428	39 g	
Danthonia californica	SG2-08-RB428	4 lbs	
Danthonia californica	SG2-09-RB428	7.5 lbs	
Danthonia californica	SG2-10-RB428	28 lbs	39.5 lbs
Elymus elymoides	SG1-06-RB416	5 lbs	
Elymus elymoides	SG1-07-RB416	12 lbs	
Elymus elymoides	SG2-09-RB416	57 lbs	74 lbs
Lupinus rivularis	SG1-06-RB430	475 g	
Lupinus rivularis	SG2-08-RB430	6 lbs	
Lupinus rivularis	SG2-09-RB430	180 lbs	187 lbs
Achnathrum lemmonii	SG2-07-RB429	213 g	
Achnathrum lemmonii	SG2-09-RB429	6 lbs	
Achnathrum lemmonii	SG2-10-RB429	2.3 lbs	8.8 lbs

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Figure 1**.** Bare-stem buckwheat **(***Eriogonum nudum*) seed increase field at the Corvallis Plant Materials Center, June 20, 2011.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement with the Roseburg District of the Bureau of Land Management (BLM) in 2005 to provide native plant materials for ecological restoration. Over the past six years, numerous species have been added and dropped from the agreement. In 2011, eight new species (one grass, two sedges, a legume, and four forbs) were added.

Activities in 2011 included maintenance and harvest of eight seed increase fields (four grasses, two forbs and two legumes), germination trials, plant production of three species (two sedges and one grass), and establishment of six new seed increase fields (one sedge, one grass, a legume, and three forbs). Many of the new species are annuals and also produced seed this year.

II. Accessions Involved

Accessions included for the Roseburg District of the BLM in 2011 are listed in Table 1. This table also displays activities performed by the PMC staff.

Table 1. Accessions involved for Roseburg District BLM cooperative agreement with Corvallis Plant Materials Center in 2011.

Species	Common name	Symbol	Accession	Activity in 2011[1]
Eriogonum nudum	barestem buckwheat	ERNU3	9079489	sfp
Sisyrinchium hitchcockii	Hitchcock's blue-eyed grass	SIHI4	9079491	sfp
Lupinus albifrons	silver lupine	LUAL4	9079492	sfp
Lotus micranthus	small-flowered deervetch	LOMI	9079493	sfp
Festuca californica	California fescue	FECA	9079494	sfp
Danthonia californica	California oatgrass	DACA3	9079415	sfp
Danthonia californica	California oatgrass	DACA3	9079428	sfp
Achnatherum lemmonii	Lemmon's needlegrass	ACLE8	9079429	sfp
Gilia capitata	bluehead gilia	GICA5	9109062	sfp
Madia elegans	common madia	MAEL	9109065	sfp
Madia gracilis	grassy tarweed	MAGR3	9109061	trl,sfp
Carex densa	dense sedge	CADE8	9109063	trl, pxn
Carex gynodynama	Wonderwoman sedge	CAGY3	9109064	trl, pxn
Achnatherum lemmonii	Lemmon's needlegrass	ACLE8	9109066	pxn
Clarkia amoena	farewell to spring	CLAM	9109121	sfp
Lupinus bicolor	miniature lupine	LUBI	9109067	sfp

1- sfp= seed increase, pxn=plant production, trl=germination trial

III. Experimental Propagation

Three of the new species had never been propagated before at the PMC. Germination trials were set up for these species. Seeds were counted out in 100 seed sets and placed in plastic germination boxes on moistened germination paper. Boxes were placed in either a warm growth chamber set at 70°F days and 50°F nights, or a walk-in cooler set at a constant 38°F. After 45 days or 90 days in the cooler, the boxes were removed and placed in the warm growth chamber.

The *Madia* seeds that received cold treatments germinated in the cooler after three weeks. It was apparent from the treatments that the seeds need to be in cool temperatures to germinate. Very little germination occurred in the warm treatment, even after 90 days. Both species of *Carex* only germinated in the warm temperatures. *Carex densa* seeds are non-dormant and will germinate readily in warm temperatures without a cold treatment. *C. gynodynama* seeds need a full 90-day cold treatment followed by warm temperatures to germinate.

Table 2. Germination trials performed for Roseburg District BLM cooperative agreement with Corvallis Plant Materials Center in 2011.

Species	Treatment	Rep	Germ %	Average	Notes
Madia gracilis	warm	1	20		
Madia gracilis	warm	2	11	14	
Madia gracilis	warm	3	10		
Madia gracilis	45 day cold	1	80		
Madia gracilis	45 day cold	2	78	82	Germination occurred within 30 days in the cooler
Madia gracilis	45 day cold	3	89		
Madia gracilis	90 day cold	1	75		Germination occurred within 30 days in the cooler
Madia gracilis	90 day cold	2	82	76	
Madia gracilis	90 day cold	3	70		
Carex densa	warm	1	63		
Carex densa	warm	2	58	65	
Carex densa	warm	3	73		
Carex densa	45 day cold	1	41		
Carex densa	45 day cold	2	43	40	
Carex densa	45 day cold	3	37		
Carex densa	90 day cold	1	58		
Carex densa	90 day cold	2	52	55	
Carex densa	90 day cold	3	56		
Carex gynodynama	warm	1	1		
Carex gynodynama	warm	2	3	2	
Carex gynodynama	warm	3	3		
Carex gynodynama	45 day cold	1	89		These boxes were mistakenly left in the cooler for 90 days.
Carex gynodynama	45 day cold	2	90	88	
Carex gynodynama	45 day cold	3	84		
Carex gynodynama	90 day cold	1	91		
Carex gynodynama	90 day cold	2	89	87	
Carex gynodynama	90 day cold	3	82		

IV. Field Seed Increase Activities

Field establishment:

Some new annual species were brought to the PMC in the fall of 2010. Only one, *Clarkia amoena*, was chosen for direct sowing in the fall. This species comes up quickly after being sown and needs to overwinter in order to flower in the following summer. The seeds do not shatter easily and fields usually are very uniform in maturity, so this species doesn't need to be grown on weed fabric. Slugs decimated some areas of the field before slug bait could be applied. The field was monitored for slug damage the entire winter, and slug bait was applied when slugs or damage was observed.

The other new annual species did not need to overwinter in order to flower and they needed to be grown on weed fabric due to very uneven maturity and easy seed shattering. These species, *Lupinus bicolor, Madia gracilis, Madia elegans,* and *Gilia capitata*, were directly sown (by hand) into a field that had been covered with weed fabric. Holes had

Figure 2. PMC staff, Jenny Freitag and Meghan Hemingway demonstrating the new technique for sowing seeds of annuals on weed fabric.

been cut in the fabric and seeds were planted into the holes. PMC staff did not want to crawl on the fabric on the chilly March days, so a new technique was developed. Using funnels perched on PVC pipes, the PMC staff could sprinkle seed in the funnel held over the holes in the weed fabric. This method was faster and more comfortable. Slugs were an issue when the seedlings begin to emerge. Slug bait was applied to the field twice after seeds were sown. The slug damage in the lupine and both *Madia* plots was extensive.

The *Danthonia californica* seed increase fields that were sown in the fall of 2007 are still producing well. Both fields were incredibly thick and seed heads were almost waist high. Last year, the fields were swathed and combined. This technique worked well, but it didn't recover all the stem seeds. This year, the field was initially seed stripped when the seeds in the florets were mature (July 8), then, about two weeks later, the stems were swathed and combined a week later after they had dried. Once the stems were dry, the seeds were easily removed by the combine. The 0.48 acre field yielded 66.5 lbs of florets and 163 lbs of stem seeds. This method is time consuming, but is offset by the increase in yields.

Table 3. Field establishment in 2011 for the Roseburg District BLM cooperative agreement with Corvallis Plant Materials Center.

Species	Method	Seeding rate	Date	Area
Clarkia amoena	cone-seeder	2 lbs/ac	Sept 30, 2010	0.04 ac
Gilia capitata	by hand into weed fabric	1.4 lbs/ac	March 8	0.1 ac
Madia elegans	by hand into weed fabric	11 lbs/ac	March 8	50 sq ft
Madia gracilis	by hand into weed fabric	2 lbs/ac	March 9	0.02 ac
Lupinus bicolor	by hand into weed fabric	2 lbs/ac	March 1	0.02 ac
Achnatherum lemmonii	mechanical transplanter	n/a	October 5	0.07 ac
Carex densa	mechanical transplanter	n/a	October 5	0.02 ac

The plants that were started from plugs in 2006 are still growing well and remain robust. The wet late spring/early summer did not help the seed production on early maturing species, like the needlegrass. Many of the seeds were empty as if they had not been pollinated. This field was hand harvested.

In early March, *Lotus micranthus* seeds were directly sown (by hand) into a field that had been covered with weed fabric. Holes had been cut in the fabric and seeds were planted into the holes. Slugs can be a major problem when the seedlings begin to emerge. Slug bait was applied to the field twice after seeds were sown. This appeared to help and about 70% of the holes had plants that reached maturity. Due to the wet growing season, many of the plants had powdery mildew and looked less vigorous than in previous years. The field was hand weeded twice and harvested once at the end of September. Dead plants were pulled out and the seed on the fabric was swept and collected into barrels.

Plugs of *Sisyrinchium bellum* were grown throughout the winter of 2009-2010 and planted out into a field covered with weed fabric in late March. The plugs grew more during the cool, wet spring and about 30% of the plants flowered in July of 2010. Upon closer inspection by BLM staff, this field was determined to be predominately

Figure 4. Blue-eyed grass (*Sisyrinchium bellum*) at the Corvallis Plant Materials Center, July 20, 2010.

Sisyrinchium hitchcockii, not *S. bellum.* The field grew amazingly well this year and was covered in flowers. It was difficult to find a *S. bellum* plant in the field. Most of the capsules ripened simultaneously, so the field was harvested one time using the "moon rover". Some seed remained on the fabric and was swept up using the seed stripper. All the cut material was spread out on tarps in the sun to dry and then was fed through a combine for cleaning. This small field produced 62 lbs of seed!

The large *Lupinus albifrons* and *Eriogonum nudum* fields that were sown in the fall of 2009 were expected to flower in 2011. Last year the fields were spotty, but at the end of the season the plants were getting large and the gaps were filling in. The lupines and buckwheat emerged in the spring and quickly began to wilt and rot, most likely due to the wet field conditions. The field also became very weedy. In late May, instead of weeding the entire fields, little circles were weeded around individual plants and the rest of the fields were sprayed with glyphosate using a backpack sprayer. Most of the lupines did not recover from the root rot and only a few plants flowered. The field was plowed under in the fall. The buckwheat plants that survived the wet season managed to flower in July as the ground dried out. The "moon rover" was used to harvest the plants in the areas that had a full stand of plants. The other areas were harvested by hand. Material was laid on tarps to dry and was fed through a combine for cleaning.

Table 4. Seed yields for the Roseburg District BLM cooperative agreement with the Corvallis Plant Materials Center in 2011.

Species	**Field size (ac)**	**Harvest Date**	**Method**	**Yield**
Sisyrinchium hitchcockii	0.1	July 28	moon rover/ combine	62 lbs
Lotus micranthus	0.1	Sept 14	sweep weed fabric	6 lbs
Danthonia california	0.48 ac	July 8	seed stripper swath/combine	230 lbs
Danthonia california	0.23 ac	July 8	swath/combine	33 lbs
Achnatherum lemmonii	0.04 ac	July 5	hand	7 lbs
Eriogonum nudum	0.4 ac	Aug 8	moon rover/ combine	36 lbs
Festuca californica	0.23 ac	June 29	seed stripper	11.5 lbs
Gilia capitata	0.1 ac	Aug 12	hand	19 lbs
Madia elegans	50 sqft	Aug 5-26	hand, sweep weed fabric	0.5 lbs
Madia gracilis	0.02 ac	Aug 5-26	hand, sweep weed fabric	3.8 lbs
Clarkia amoena	0.04 ac	Aug 19	moon rover/ combine	7.5 lbs
Lupinus bicolor	0.02 ac	Aug 1-15	hand, sweep weed fabric	0.5 lb

In the fall of 2009 a field of *Festuca californica* was sown. It did not flower in 2010, but did in 2011. Rain was plentiful during pollination. The field appeared to have a large amount of seed, but upon close inspection, many of the seeds were not filled. The field was seed stripped in late June. Following harvest, all grass fields were mowed with a Brady chopper to remove residue. All established grass fields were sprayed in late October with Outlook®, a non-selective pre-emergent herbicide.

Figure 4. *Clarkia amoena* seed increase field at the Corvallis Plant Materials Center, July 20, 2011.

Overall, the Clarkia field was fairly filled in and as the plants grew rapidly in the spring, the field was one large stand that was difficult to walk through. The field was weeded twice by hand in the spring and was harvested using the "moon rover". Material was laid on tarps to dry and was fed through a combine for cleaning.

Figure 4. Bluehead gilia (*Gilia capitata*) flowers have blue pollen, causing pollinators to have blue pollen sacs.

The *G. capitata* plot was full of plants and flowered in July. Seeds did not shatter as expected, so the field was harvested by hand when the capsules were mature. Material was laid on tarps to dry and was fed through a combine for cleaning. All forb fields on the PMC farm are monitored for pollinator activity. PMC staff noticed that bees pollinating these flowers had blue pollen sacs. These bees were incredibly difficult to photograph. PMC summer employee, Austin Booth, was able to photograph the bees as they were collecting the blue pollen.

Both *Madia* fields were spotty and only a half to a quarter of the holes contained plants. This was mostly due to the slug damage. As the seeds ripened, they were shaken from the plants, and then vacuumed off the fabric. Late in the season, the entire plants were cut, laid on tarps, and seed remaining on the fabric was vacuumed.

Few *L. bicolor* plants made it to maturity, but those that did were vigorous and produced a large amount of seed. Because there were so few plants, the ripe pods were harvested by hand every other day.

Figure 4. *Madia elegans* seed increase field at the Corvallis Plant Materials Center, July 25, 2011.

IV. Container Plant Production

The new *Carex densa* field was established using transplants. On June 20, 2011 seed was sown into plug trays filled with moistened media (Sunshine #1, a special peat-based soil-less mix) and lightly covered with fine vermiculite. Trays were placed outside in a shadehouse. Seedlings emerged within three weeks and grew slowly over the summer. They were transplanted into a field in early October using a mechanical transplanter. The field was irrigated once before fall rains began.

C. gynodynama and *A. lemmonii* seeds were sown into plug trays on May 15, 2011. Trays were covered with plastic bags and placed in a walk-in cooler until July 15, 2011. Trays of *C. gynodynama* seeds were supposed to remain in the cooler for 90 days, but were mistakenly taken out early, resulting in very poor germination. Seedlings were transplanted into new plug trays. The trays containing seeds that did not germinate were placed back in the cooler for another 90 days, and will be taken out in January. *A. lemmonii* seedlings germinated within three weeks and grew slowly over the summer. They were transplanted into a field in early October using a mechanical transplanter. The field was irrigated once before fall rains began.

V. Delivery of Plant Materials

There were no deliveries made for this project in 2011.

All seed that was not delivered will remain in the Corvallis PMC seed storage facilities until requested. Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed, i.e. generation 1). The middle numbers of a seed lot note which year the seed was produced. The last portion of the seed lot describes which project the seed is for (RB is for Roseburg BLM) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 5. Seeds in storage at the Corvallis Plant Materials Center for the Roseburg District BLM cooperative agreement in 2011.

Species	Lot number	Weight	Total per accession
Eriogonum nudum	SWC-06-RB489	99 g	
Eriogonum nudum	SG1-08-RB489	26 lbs	
Eriogonum nudum	SG1-11-RB489	33 lbs	59 lbs
Eriophyllum lanatum	SWC-06-RB490	234 g	
Eriophyllum lanatum	SG1-08-RB490	48.5 lbs	
Eriophyllum lanatum	SG1-09-RB490	40 lbs	98.5 lbs
Sisyrinchium hitchcockii	SG1-09-RB491	0.5 lbs	
Sisyrinchium hitchcockii	SG1-10-RB491	1 lb	
Sisyrinchium hitchcockii	SG1-11-RB491	62 lbs	63.5 lbs
Lotus micranthus	SWC-06-RB493	11 g	
Lotus micranthus	SG1-08-RB493	1.7 lbs	
Lotus micranthus	SG2-09-RB493	10 lbs	
Lotus micranthus	SG3-10-RB493	7 lbs	
Lotus micranthus	SG3-11-RB493	6 lbs	24.7 lbs
Festuca californica	SWC-06-RB494	4 g	
Festuca californica	SG2-11-RB494	11.5 lbs	11.5 lbs
Silene hookeri ssp hookeri	SWC-06-RB495	23 g	
Silene hookeri ssp hookeri	SG1-07-RB495	72 g	95 g
Danthonia californica	SG2-07-RB415	100g	

Table 5. Seeds in storage at the Corvallis Plant Materials Center for the Roseburg District BLM cooperative agreement in 2011. Con't.

Species	**Lot number**	**Weight**	**Total per accession**
Danthonia californica	SG2-08-RB415	8 lbs	
Danthonia californica	SG2-09-RB415	61 lbs	
Danthonia californica	SG2-10-RB415	116 lbs	
Danthonia californica	SG2-11-RB415	230 lbs	415 lbs
Danthonia californica	SG2-07-RB428	39 g	
Danthonia californica	SG2-08-RB428	4 lbs	
Danthonia californica	SG2-09-RB428	7.5 lbs	
Danthonia californica	SG2-10-RB428	28 lbs	
Danthonia californica	SG2-11-RB428	33 lbs	72.5 lbs
Elymus elymoides	SG1-06-RB416	5 lbs	
Elymus elymoides	SG1-07-RB416	12 lbs	
Elymus elymoides	SG2-09-RB416	75 lbs	92 lbs
Lupinus rivularis	SG1-06-RB430	475 g	
Lupinus rivularis	SG2-08-RB430	11 lbs	
Lupinus rivularis	SG2-09-RB430	176 lbs	188 lbs
Achnatherum lemmonii	SG2-07-RB429	213 g	
Achnatherum lemmonii	SG2-09-RB429	6 lbs	
Achnatherum lemmonii	SG2-10-RB429	2.3 lbs	
Achnatherum lemmonii	SG2-11-RB429	7 lbs	15 lbs
Gilia capitata	SG1-11-RB062	19 lbs	19 lbs
Madia elegans	SG1-11-RB065	0.5 lbs	0.5 lbs
Madia gracilis	SG1-11-RB063	3.8 lbs	3.8 lbs
Clarkia amoena	SG1-11-RB121	7.5 lbs	7.5 lbs
Lupinus bicolor	SG1-11-RB067	0.5 lbs	0.5 lbs

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

December 2, 2010

THE 2010 LASSEN VOLCANIC NATIONAL PARK ANNUAL REPORT:
Visitors' Center Landscape and Disturbed Lands Project

Figure 1**.** Satin lupine (*Lupinus obtusilobus*) growing in the PMC greenhouse, May 20, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Lassen Volcanic National Park in 2009 to provide additional native plant materials for planting around the new Visitors' Center and in the restoration of historically disturbed lands in the park. It was agreed that the PMC would produce a minimum of 16,875 container plants including: 1000 grass plugs, 3700 sedge and rush plugs, 4100 trees, and 7575 containers of shrubs. Three small deliveries of plants will occur in 2009, 2010 and 2011 to spread out the labor of planting nearly17,000 containers. The optimal transplanting conditions at the Park exist in late September and early October. With this limited time to transplant, staggering the deliveries over three years will make the project more successful. Activities in 2010 included the collection and vegetative propagation of one shrub species and production (by seed) of two tree, one shrub, one legume, 12 forb, and two sedge species. Over 9000 plants were produced and delivered to the park this year.

II. Accessions Involved

Table 1. Accessions involved in the Visitors Center Landscape Project in 2010.

Species	Common name	Code	Accession	Activity in 2010[1]
Abies magnifica	California red fir	ABMA	9079570	Pxn
Arctostaphylos patula	greenleaf manzanita	ARPA6	9079630	Pxn
Pinus jefferyi	Jeffery pine	PIJE	9079583	Pxn
Aster alpigenus	alpine aster	ASAL3	9079628	Pxn, Trl
Balsamorhiza sagittata	arrowleaf balsamroot	BASA3	9079635	Pxn
Silene sp	catchfly	SILEN	9079637	Pxn, Trl
Carex nigricans	black sedge	CANI2	9079581	Pxn, Trl
Carex straminformus	Shasta sedge	CAST	9079506	Pxn
Castilleja sp	paintbrush sp.	CASTI2	9079638	Pxn, Trl
Anaphalis margaritacea	pearly everlasting	ANMA	9079632	Pxn
Senecio aronicanoides	rayless ragwort	SEAR4	9079640	Pxn, Trl
Lupinus obtusilobus	satin lupine	LUOB	9079501	Pxn
Hieracleam albiflorium	white hawkweed	HIAL2	9079631	Pxn, Trl
Penstemon cinicola	ash penstemon	PECI2	9079634	Pxn, Trl
Hackelia sp	stickseed	HACKE	9079639	Pxn, Trl
Penstemon gracilentus	slender penstemon	PEGR4	9079636	Pxn, Trl
Wyethia mollis	wooly mule-ears	WYMO	9079546	Pxn
Erigeron sp	fleabane	ERIGE2	9079629	Pxn, Trl

1-pxn=produced plants, dlv=delivered plant materials, col= collected plant materials, trl=conducted trials

III. Experimental Propagation

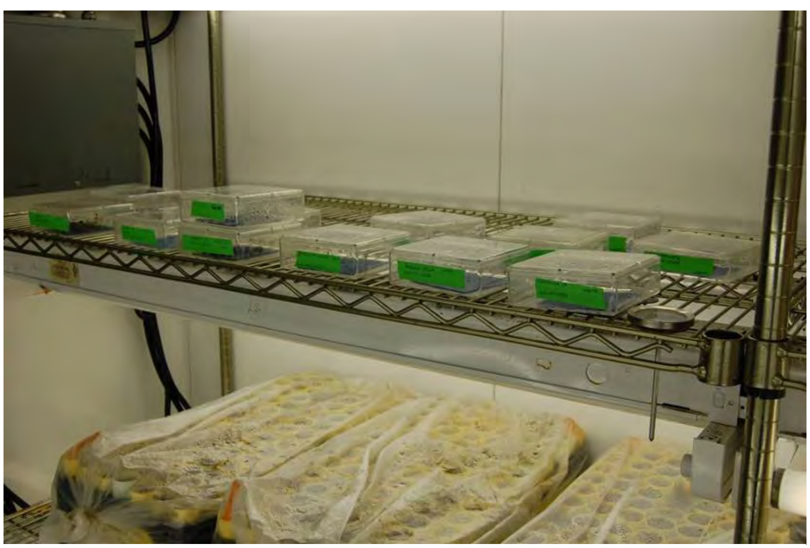
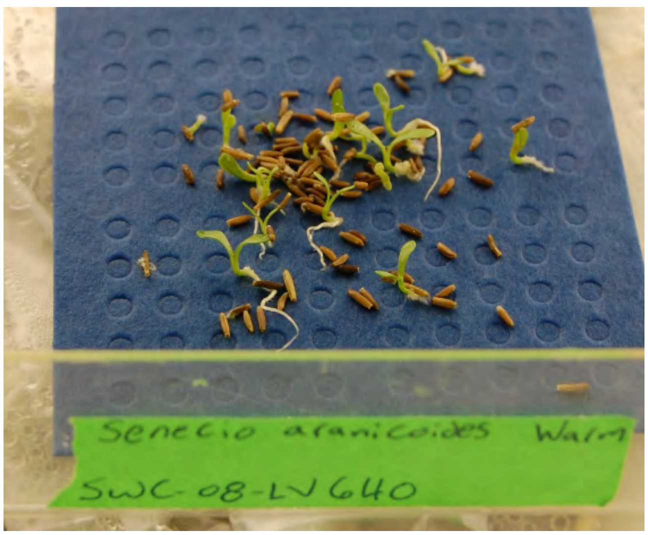


Figure 2. Germination trials in the warm growth chamber at the PMC.

Many of the forb species that the PMC staff were supposed to produce this year had never been propagated previously at the center. Seeds of these species were counted out in 100 seed sets and placed in plastic germination boxes on moistened germination paper. Boxes were placed in either a warm growth chamber set at 70° days and 50° nights, or a walk in cooler set at a constant 38°. After 90 days in the cooler, the boxes were removed and placed in the warm growth chamber.

Table 2. Results of germination trials for the Visitors' Center agreement at the PMC in 2010.

	Germination Percent	
	Warm	90 days cold/moist stratification
Aster alpigenus	40	74
Silene sp	1	40
Castilleja sp	1	50
Senecio aronicanoides	60	66
Hieracleam albiflorium	16	62
Penstemon cinicola	1	8
Hackelia sp	0	12
Penstemon gracilentus	11	33
Erigeron sp	34	80



Many of the species needed a cold period to break dormancy. These species had no or very little germination when placed directly in the warm growth chamber. Other species such as the *Senecio* benefited slightly from the cool treatment, but overall the seeds are not dormant and can be sown and germinated at warm temperatures.

Figure 3. Rayless ragwort (*Senecio aronicanoides*) seeds germinating.

IV. Plant Propagation*Arctostaphylos patula* cuttings were collected at the Park by PMC staff on October 14-15, 2009. Staff collected 4000 cuttings from the Park. Target material were stems that were at least six inches long, non-branching, this season's growth, and free of diseases. Cuttings were packed with moistened vermiculite and stored in a walk-in cooler (38°F) until January 3, 2010. Half of the cuttings (approximately 2000) were prepared for rooting by stripping the leaves from the lower 4 inches, making a fresh basal cut, dipping the base in an 0.8% IBA rooting powder, and sticking them into moist vermiculite in 4" deep propagation flats.Flats were placed on heat mats set at 70° F in a heated greenhouse and lightly watered weekly or as needed. Due to space limitations on the heat mats, cuttings were propagated in two rounds. The second round of cuttings was started in early March. Both rounds of cuttings looked rotten and the leaves fell off. Very few cuttings rooted. During the second round, some cuttings were stuck in perlite rather than vermiculite. The cuttings in the perlite seemed healthier and did not rot. The perlite retains less moisture and this appeared to be better for the cuttings, a higher percent of rooting occurred in the perlite and this method will be used in 2011. After cuttings were sufficiently rooted, they were transplanted into D40 cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients) and placed in a heated greenhouse. The rooted cuttings grew slowly at first, and then in late June began to grow quite tall. The manzanita plants out grew the D-40's in August and had to be watered twice a day to keep them from wilting.

Figure 4. Greenleaf Manzanita (*Arctostaphylos patula*) cuttings rooting in the PMC greenhouse, January 15, 2010.

On December 2nd, 2009, seeds of Jeffrey pine and red fir were spread out on moistened germination paper in plastic germination boxes and placed in a walk-in cooler. Seeds were monitored weekly for germination; no germination was observed. After 30 days in the cooler, the boxes were moved to a growth chamber set at 70° (F) days/ 50° (F) nights and 12 hours of day light. Within a few days, seeds began to germinate. Germinating seeds were transplanted into racks of D40 cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients) and placed in a greenhouse set at moderate temperatures (70° (F) days/ 50° (F) nights).

Figure 5. Greenleaf Manzanita (*Arctostaphylos patula*) plants from cuttings in the PMC shadehouse, August 20, 2010.

Mule's ears and balsamroot are tap rooted plants that go dormant in the late summer months. From previous work done at the PMC, the staff has seen that these species are usually dormant during the preferred transplanting period for this project. The PMC staff wanted to try growing these species in deep propagation flats during the spring and summer and then remove the dormant tubers from the flats before shipping and only send the plants without all the cone-tainers and media (this saves space and shipping costs). Seeds of these species were sown on January 15 into 5" X 14" X 14" propagation flats filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients) and covered with a thick layer of vermiculite. The flats were placed in plastic bags and left in a walk-in cooler for 90 days. After 90 days the seedlings were germinating and the trays were unwrapped and placed in a heated greenhouse. Flats remained in the greenhouse until late June and then were moved to an outdoor shadehouse. The plants grew well in the summer but surprisingly never went dormant. As delivery time neared, the plants were watered less in hopes of forcing them to go dormant. Some plants went dormant, but many still had green leaves when they were dumped out of the flats and packed in moist vermiculite for shipment to the Park. This method of propagation and shipping was very easy for the PMC staff, but it created an urgency to plant them as soon as possible once they were delivered to the park and they required special handling (refrigeration).

Figure 6. Wooly mule's ears (*Wyethia mollis*) growing in deep flats in the PMC shadehouse, August 20, 2010.

The PMC was contracted to grow rabbitbrush and seeds were provided by the park from collections that were made by previous park employees. The seeds were sown into cone-tainers and germinated quickly. As the plants grew, they did not look like rabbitbrush, but a positive identification couldn't be made. Plants quickly filled their cone-tainers and were transplanted into D-40 containers. Soon after they were transplanted, they went through another flush of growth and really began to look like an *Aster* sp. Some plants soon flowered. Pictures were take and sent to park staff that identified the plants as being *Aster alpigenis*.

All other forbs were sown in two rounds: one in March for all the species that required stratification and all others in early May. Seeds were sown into racks of Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients) Flats were placed in a heated greenhouse. Species that needed stratification were placed in plastic bags and left in a walk-in cooler for 90 days. After 90 days the trays were unwrapped and placed in an outdoor shadehouse.

V. Delivery of Plant Materials

On September 20, 2010, PMC staff traveled to the park to deliver the plants. The pines were delivered to the Manzanita Lake area and all the other species were unloaded at the planting site at the Visitors' Center.

Table 3. Plants Delivered to Lassen Volcanic National Park, September 20, 2010, for the Visitors' Center agreement.

Species	# of plants	size
Abies magnifica	347	D40
Arctostaphylos patula	360	D40
Pinus jefferyi	1480	D40
Aster alpigenus	849	D40
Aster alpigenus	263	cones
Balsamorhiza sagittata	67	cones
Silene sp	84	cones
Carex nigricans	294	cones
Carex straminformus	199	cones
Castilleja sp	7	cones
Anaphalis margaritacea	548	cones
Senecio aronicanoides	532	cones
Lupinus obtusilobus	287	cones
Hieracleam albiflorium	35	cones
Penstemon cinicola	56	cones
Hackelia sp	5	cones
Penstenmon gracilentus	77	cones
Wyethia mollis	3570	loose tubers
Erigeron sp	93	cones
	9153	

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

December 30, 2011

THE 2011 LASSEN VOLCANIC NATIONAL PARK ANNUAL REPORT:
Visitors' Center Landscape and Disturbed Lands Project

Figure 1**.** Satin lupine (*Lupinus obtusilobus*) growing in the PMC shadehouse, July 10, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement with Lassen Volcanic National Park in 2009 to provide additional native plant materials for planting around the new Visitors' Center and in the restoration of historically disturbed lands in the Park. It was agreed that the PMC would produce a minimum of 16,875 container plants including: 1000 grass plugs, 3700 sedge and rush plugs, 4100 trees, and 7575 containers of shrubs. Three small deliveries of plants occurred in 2009, 2010 and 2011 to spread out the labor of planting nearly17,000 containers. The optimal transplanting conditions at the Park exist in late September and early October. With this limited time to transplant, staggering the deliveries over three years will make the project more successful. Activities in 2011 included the collection and vegetative propagation of four shrub species and production (by seed) of 4 tree, 9 shrub, 6 legume, 2 rush, 14 forb, 6 grass and 3 sedge species. Over 8700 plants were produced and delivered to the Park this year. The PMC has successfully produced the plants needed for this project. However, the agreement may be extended if the Park needs additional plant material.

II. Accessions Involved

Table 1. Accessions involved in the Visitors Center Landscape Project in 2011.

Species	Common name	Code	Accession	Activity in 2011[1]
Abies magnifica	red fir	ABMA	9079570	pxn, dlv
Amelanchier utahensis	Utah serviceberry	AMUT	9109092	trl, pxn, dlv
Anaphalis margaritacea	pearly everlasting	ANMA	9079411	pxn,dlv
Arctostaphylos nevadensis	pinemat manzanita	ARNE	9079498	pxn,dlv
Arctostaphylos patula	greenleaf manzanita	ARPA6	9079630	pxn,dlv
Arnica dealbata	whitneya	ARDE11	9109095	
Arnica mollis	hairy arnica	ARMO4	9109100	trl, pxn, dlv
Balsamorhiza sagittata	balsamroot	BASA3	9079635	pxn,dlv
Calamagrostis canadensis	bluejoint	CACA4	9109082	trl, pxn, dlv
Calocedrus decurrens	incense cedar	CADE27	9109078	pxn,dlv
Caltha leptosepala	marsh marigold	CALE4	9109087	trl, pxn, dlv
Carex nebrascensis	Nebraska sedge	CANE2	9109084	trl, pxn, dlv
Carex sp (dry)	sedge	CAREX	9109083	trl, pxn, dlv
Carex sp (wet)	sedge	CAREX	9109106	trl, pxn, dlv
Castilleja applegatei	wavyleaf paintbrush	CAAP4	9109094	trl, pxn, dlv
Ceanothus prostratus	mahala mat	CEPR	9109114	trl, pxn, dlv
Ceanothus velutinus	tobaccobrush	CEVE	9109113	trl, pxn, dlv
Chrysolepis sempervirens	bush chinquapin	CHSE11	9079112	trl
Ericameria nauseosa	rubber rabbitbrush	ERNA10	9109080	trl, pxn, dlv
Cirsium scariosum	dwarf thistle	CISC2	9109098	pxn,dlv
Danthonia californica	California oatgrass	DACA3	9109108	pxn,dlv
Deschampsia sp.	hairgrass	DESCH	9109105	pxn,dlv
Glyceria striata	fowl mannagrass	GLST	9109085	pxn,dlv
Hordeum brachyantherum	meadow barley	HOBR2	9109107	pxn,dlv
Juncus effusus	tall rush	JUEF	9109086	pxn,dlv
Juncus sp. (dry)	rush	JUNCU	9109102	pxn,dlv
Lupinus angustifolius	narrowleaf lupine	LUAN4	9109109	pxn,dlv
Lupinus arbustus	longspur lupine	LUAR6	9109096	pxn,dlv
Lupinus lepidus	Pacific lupine	LULE2	9109099	pxn,dlv
Lupinus obtusilobus	satin lupine	LUOB	9109111	pxn,dlv
Lupinus obtusilobus	silvery lupine	LUOB	9079501	pxn,dlv
Lupinus polyphyllus	bigleaf lupine	LUPO2	9109091	pxn,dlv
Luzula comosa	Pacific woodrush	LUCO6	9109104	trl, pxn, dlv
Panicum acuminatum	western panicgrass	DIAC2	9109081	pxn,dlv
Pedicularis groenlandica	elephanthead	PEGR2	9109088	trl, pxn, dlv
Penstemon gracilentus	slender beardtongue	PEGR4	9079636	trl, pxn, dlv

Table 1. Accessions involved in the Visitors Center Landscape Project in 2011. (Con't)

Species	Common name	Code	Accession	Activity in 2011[1]
Penstemon newberryi	mountain pride	PENE3	9109101	trl, pxn, dlv
Perideridia sp.	yampah	PERID	9109089	
Phacelia procera	tall phacelia	PHPR2	9109097	trl
Phyllodoce breweri	Brewer's mtn heather	PHBR4	9109110	trl
Pinus jeffreyi	Jeffrey pine	PIJE	9079583	pxn,dlv
Prunus emarginata	bitter cherry	PREM	9109093	trl
Senecio triangularis	arrowleaf groundsel	SETR	9109090	trl, pxn, dlv
Trifolium longipes	longstalk clover	TRLO	9109103	trl, pxn, dlv
Tsuga mertensiana	mountain hemlock	TSME	9109079	pxn
Wyethia mollis	woolly mule-ears	WYMO	9079546	pxn,dlv

1-pxn=produced plants, dlv=delivered plant materials, col= collected plant materials, trl=conducted trials

III. Experimental Propagation

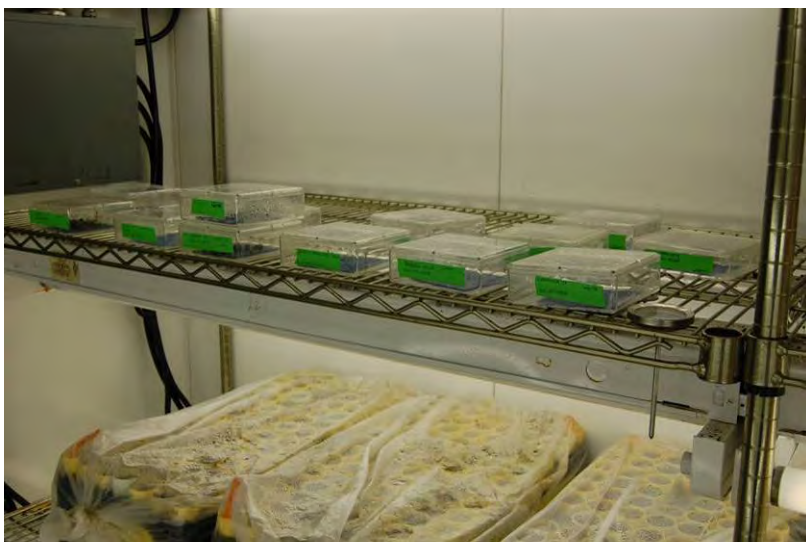


Figure 2. Germination trials in the warm growth chamber at the PMC.

Many of the forb species that the PMC staff was supposed to produce this year had never been propagated previously at the center. Seeds of these species were counted out in 100 seed sets and placed in plastic germination boxes on moistened germination paper. Boxes were placed in either a warm growth chamber set at 70°F days and 50°F nights ("warm" treatment), or a walk in cooler set at a constant 38°F for 90 days, followed by the warm growth chamber ("cold" treatment). Boxes that received the warm treatment but showed little or no germination were then placed in the cooler for 90 days.

Table 2. Results of germination trials for the Visitors' Center agreement at the PMC in 2011.

Species	Treatment	Average germ %
Trifolium longipes	Warm	17
Trifolium longipes	90 days cold	15
Trifolium longipes	Warm + cold	8
Carex sp. wet	Warm	67
Carex sp. wet	cold	48

Table 2. Results of germination trials for the Visitors' Center agreement at the PMC in 2011. (Con't)

Species	Treatment	Average germ %
Carex sp. dry	Warm	30
Carex sp. dry	cold	39
Ericamerica nauseosa	Warm	62
Ericamerica nauseosa	2 wks cold	82
Ericamerica nauseosa	90 days cold	78
Calamagrostis canadensis	Warm	48
Calamagrostis canadensis	cold	35
Carex nebrascensis	warm	3
Carex nebrascensis	cold	4
Caltha leptosepala	Warm	0
Caltha leptosepala	cold	0
Caltha leptosepala	Warm +cold	78
Pedicularis groenlandica	Warm	0
Pedicularis groenlandica	cold	0
Pedicularis groenlandica	Warm+cold	54
Castilleja applegatei	Warm	2
Castilleja applegatei	cold	60
Phacelia procera	Warm	0
Phacelia procera	cold	0
Phacelia procera	Overwinter outside	0
Arnica mollis	Warm	56
Arnica mollis	cold	67
Penstemon newberryi	Warm	0
Penstemon newberryi	cold	0
Penstemon newberryi	Warm +cold	8
Luzula comosa	Warm	70
Luzula comosa	warm then 50	88
Luzula comosa	warm then outside	83
Penstemon gracilentus	warm	6
Penstemon gracilentus	cold	0
Penstemon gracilentus	Warm +cold	14
Phyllodoce breweri	warm	0
Phyllodoce breweri	60 days cold	48
Phyllodoce breweri	cold	37

Many of the species needed a cold period to break dormancy. These species had no or very little germination when placed directly in the warm growth chamber (*Phyllodoce breweri, Castilleja applegatei*). Seeds of other species (*Arnica mollis, Calamagrostis canadensis, Carex* sp.) are not dormant and can be sown and germinated at warm temperatures. *Luzula comosa* germinated best when exposed to a short (1-2 weeks) warm period, but was then moved to a cooler location to germinate. *Ericamerica nauseosus* seeds benefited slightly from a short cool period (2 weeks)followed by warm temperatures. *Penstemon gracilentus, Pedicularis groenlandica, Caltha leptosepala,* and *Penstemon newberryi* seeds exhibited no germination in the warm or cold treatments. After three months in the warm, treatments were placed in the cooler for three months and then returned to the warm temperatures. Germinants were noticed in all of these species following the return to the warm temperatures (see Table 2 for warm+cold data). This would suggest that these seeds need a warm treatment prior to the cold treatment in order to germinate. However, when these seeds were sown in soil in cone-tainers and placed in the cooler for three months, all of these species had good germination in the cone-tainers once they were moved to a warm location. These seeds had no warm treatment prior to cold treatment, yet showed high germination. It is possible that these species have a seed coat that needs to break down before germination can occur. Microbial activity in the soil could help break down the seed coat during stratification, which is why germination was observed in the cone-tainers after a cold treatment, but not in the germination box.

IV. Plant Propagation

Arctostaphylos patula, Actostaphylos nevadensis, Ceanothus velutinus, Ceanothus prostratus, and *Chrysolepis sempervirens* cuttings were collected at the Park by PMC staff on October 14-15, 2010. Staff collected about 4000 cuttings from the Park. Target materials were stems that were at least six inches long, non-branching, this season's growth, and free of diseases. Cuttings were packed with moistened vermiculite and stored in a walk-in cooler (38°F) until January 5, 2011. The cuttings were prepared for rooting by stripping the leaves from the lower 4 inches, making a fresh basal cut, dipping the base in an 0.8% IBA rooting powder, and sticking them 4" deep into moist vermiculite in propagation flats. Some of the *Chrysolepis sempervirens* and *Ceanothus velutinus* cuttings were also scarred with a blade down the side of the stem. Flats were placed on heat mats set at 70° F in a heated greenhouse and lightly watered weekly or as needed. The *C. prostratus* cutting rooted within two months and were transplanted into D40 cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients) and placed in a heated greenhouse. Within a month the transplants had turned brown and were dying. They were inspected and found to have massive root damage. It was concluded that the plants have sensitive roots and do not tolerate disturbance. If cuttings are propagated again, they should be rooted directly in the D40 cone-tainers that they will be delivered in to avoid transplanting. Most of the *C. velutinus* cuttings produced a lot of callus and some grew roots. The *A. patula* and *A. nevadensis* cuttings became infested with fungus gnat larvae during the third month of rooting. Many manzanita cuttings were producing roots at this time and suffered damage and disease as a result of the larvae. Flats were sprayed with predatory nematodes to reduce the larval populations. This helped prevent more damage, but many cuttings were lost prior to nematode application. After cuttings had rooted they were transplanted to D40 cone-tainers filled with moistened media. Survival after transplanting was low and plants continued to die throughout the growing season. Plants looked chlorotic and some were treated with a micronutrient solution containing iron. Plants treated with the micronutrients greened up within a week, but no difference in survival was observed. The plants that were not treated began to greenup a month later. No *Chrysolepis sempervirens* cuttings rooted.

On December 1st, 2010, seeds of Jeffrey pine, red fir, incense cedar, and mountain hemlock were spread out on moistened germination paper in plastic germination boxes and placed in a walk-in cooler at 38°F. Seeds were monitored weekly for germination, but no germination was observed in the first four weeks. After 30 days in the cooler, the hemlock, cedar and fir boxes were moved to a growth chamber set at 70°F days/ 50°F nights and 12 hours of light. Within a few days, seeds of all species began to germinate. Germinating seeds were transplanted into racks of D40 cone-tainers filled with moistened media (Sunshine #4 amended with a balanced slow-release fertilizer and micronutrients) and placed in a greenhouse set at moderate temperatures (70°F days/ 50°F nights). Almost all of the fir and cedar seedlings survived, but a large percentage of the hemlock seedlings never fully developed roots and died. The pine seeds were removed from the cooler after 60 days, placed in the growth chamber and the seedlings were transplanted into D40 cone-tainers in the same manner as the other tree species. The pine seedlings had very high survival and grew well throughout the growing season.

Figure 3. Incense cedar (*Calocedrus decurrens*) seedlings in the PMC shadehouse in early summer. The trees grew quickly and were almost 3 feet tall by September.

Woolly mule-ears and balsamroot are tap-rooted plants that go dormant in the late summer months. From previous work done at the PMC, the staff has seen that these species are usually dormant during the preferred transplanting period for this project. The PMC staff developed a technique of germinating and growing the seeds in deep propagation flats during the spring and summer, then removing the dormant tubers from the flats before shipping. This technique saves space and shipping costs as the plants are sent without all the cone-tainers and media. Seeds of these species were sown on February 25 into 5 by 14 by 14-inch propagation flats filled with moistened media (Sunshine #4 amended with a balanced slow-release fertilizer and micronutrients) and covered with a thick layer of vermiculite. The flats were placed in plastic bags and left in a walk-in cooler for 90 days. After 90 days the seedlings were germinating and the trays were unwrapped and placed in a heated greenhouse. Flats remained in the greenhouse until late June, and then were moved to an outdoor shade house. Seedlings suffered from damping off this year and were treated with a copper spray. As plants were growing they appeared to be going dormant, but upon closer inspection it was found that they had a form of stem rot. They were sprayed again with the copper solution as needed throughout the growing season. Some plants went dormant at the end of summer, but many still had green leaves when they were dumped out of the flats and packed in moist vermiculite for shipment to the Park. This method of propagation and shipping was very easy for the PMC staff, but it meant that they needed to be planted as soon as possible upon delivery to the Park, and they required special handling and refrigeration.

Figure 4. Rooted cuttings of pinemat manzanita (*Arctostaphylos nevadensis*) in the PMC shade house.

All other forbs were sown in two rounds: one in March for all the species that required stratification (*Penstemon gracilentus, Pedicularis groenlandica, Caltha leptosepala, Penstemon newberryi, Phyllodoce breweri, Castilleja applegatei, Carex nebrascensis,* *Danthonia californica, Calamagrostis canadensis*, *Senecio triangularis Arnica mollis, Luzula comosa, Panicum acuminatum,* and *Trifolium longipes*). All other species were sown in early May (*Deschampsia* sp., *Glyceria striata, Hordeum brachyantherum, Juncus effusus, Juncus* sp. (dry)*, Lupinus angustifolius, Lupinus arbustus, Lupinus lepidus, Lupinus obtusilobus,* and *Lupinus polyphyllus*). Seeds were sown into racks of Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #4 mix amended with a balanced slow-release fertilizer and micronutrients). Flats were placed in a heated greenhouse. Lupine seeds were scarified prior to sowing. Species that needed stratification were placed in plastic bags and left in a walk-in cooler for 90 days. After 90 days the trays were unwrapped and placed in an outdoor shade house.

Table 3. Plant production for Lassen Volcanic National Park in 2011.

Species	**Start date**	**Treatment**	**Number Produced**
Abies magnifica	15-Dec	30 day cold	41
Amelanchier utahensis	25-Feb	90 day cold	43
Anaphalis margaritacea	25-Apr	Warm GH	98
Arctostaphylos nevadensis	5-Jan	cuttings	29
Arctostaphylos patula	5-Jan	cuttings	152
Arnica mollis	25-Feb	90 day cold	159
Balsamorhiza sagittata	25-Feb	90 day cold	15
Calamagrostis canadensis	25-Feb	90 day cold	639
Calocedrus decurrens	15-Dec	30 day cold	136
Caltha leptosepala	25-Feb	90 day cold	196
Carex nebrascensis	25-Feb	90 day cold	569
Carex sp. (dry)	25-Feb	90 day cold	292
Carex sp. (wet)	25-Feb	90 day cold	681
Castilleja applegatei	25-Feb	90 day cold	21
Ceanothus prostratus	5-Jan	cuttings	40
Ceanothus velutinus	15-Dec	cutting	40
Chrysolepis sempervirens	5-Jan	cuttings	0
Ericameria nauseosa	25-Feb	2 weeks cold	44
Cirsium scariosum	25-Apr	Warm GH	2
Danthonia californica	25-Feb	90 day cold	267
Deschampsia sp.	25-Apr	Warm GH	680
Glyceria striata	25-Apr	Warm GH	385
Hordeum brachyantherum	25-Apr	Warm GH	66
Juncus effusus	25-Apr	Warm GH	195
Juncus sp. (dry)	25-Apr	Warm GH	182
Lupinus angustifolius	27-May	Scarified, warm GH	104
Lupinus arbustus	27-May	Scarified, warm GH	64
Lupinus lepidus	27-May	Scarified, warm GH	10
Lupinus obtusilobus	27-May	Scarified, warm GH	350

Table 3. Plant production for Lassen Volcanic National Park in 2011. (Con't)

Species	**Start date**	**Treatment**	**Number Produced**
Lupinus polyphyllus	27-May	Scarified, warm GH	195
Luzula comosa	25-Feb	90 day cold	278
Panicum acuminatum	25-Feb	90 day cold	143
Pedicularis groenlandica	25-Feb	90 day cold	85
Penstemon gracilentus	25-Feb	90 day cold	196
Penstemon newberryi	25-Feb	90 day cold	98
Phyllodoce breweri	25-Feb	90 day cold	0
Pinus jeffreyi	15-Dec	60 day cold	1505
Prunus emarginata	15-Dec	2wk warm, 90day cold	0
Senecio triangularis	25-Apr	Warm GH	64
Trifolium longipes	25-Feb	90 day cold	161
Tsuga mertensiana	15-Dec	30 day cold	0
Wyethia mollis	25-Feb	90 day cold	515

No germination occurred in seeds of *Prunus emarginata, Phacelia procera,* and *Phyllodoce brewerii.* The *Arnica delbata* seed lot was determined to contain no viable seed when it was cleaned.

All plants grew well all summer in the shade house. Some plants had minor issues with diseases. Rusts were noticed on the *Senecio triangularis* plants and were treated with sulfur dust. Many lupines died in mid August from a possible form of root rot. It is not totally understood what is happening with these plants. They were treated with a copper fungicide when the disease was first noticed. This seemed to help, but did not eliminate the problem. The *Lupinus polyphyllus* plants were not affected by the root rot.

All of the grasses, sedges, and rushes were trimmed to 2-inches prior to delivery. This makes stacking and handling the racks of cone-tainers easier, and can help reduce water stress after transplanting.

V. Delivery of Plant Materials

On September 26, 2011, PMC staff traveled to the Park to deliver the plants. The pines were delivered to the Manzanita Lake area and all the other species were unloaded at the planting site at the Visitors' Center.

Figure 4. PMC staff showing their excitement over delivering the plants to the Park, September 27, 2011.

Table 4. Plants delivered to Lassen Volcanic National Park, September 20, 2010, for the Visitors' Center agreement.

Species	Code	Size	Number
Abies magnifica	ABMA	D-40	41
Arctostaphylos nevadensis	ARNE	D-40	29
Arctostaphylos patula	ARPA6	D-40	152
Calocedrus decurrens	CADE27	D-40	136
Ceanothus prostratus	CEPR	D-40	40
Ceanothus velutinus	CEVE	D-40	40
Ericameria nauseosa	ERNA10	D-40	44
Pinus jeffreyi	PIJE	D-40	1505
Amelanchier utahensis	AMUT	stubby	43
Anaphalis margaritacea	ANMA	stubby	98
Arnica mollis	ARMO4	stubby	159
Calamagrostis canadensis	CACA4	stubby	639
Caltha leptosepala	CALE4	stubby	196
Carex nebrascensis	CANE2	stubby	569
Carex sp. (dry)	CAREX	stubby	292
Carex sp. (wet)	CAREX	stubby	681
Castilleja applegatei	CAAP4	stubby	21
Cirsium scariosum	CISC2	stubby	2
Danthonia californica	DACA3	stubby	267
Deschampsia sp.	DESCH	stubby	680
Glyceria striata	GLST	stubby	385

Table 4. Plants delivered to Lassen Volcanic National Park, September 20, 2010, for the Visitors' Center agreement. (Con't).

Species	Code	Size	Number
Hordeum brachyantherum	HOBR2	stubby	66
Juncus effusus	JUEF	stubby	195
Juncus sp. (dry)	JUNCU	stubby	182
Lupinus angustifolius	LUAN4	stubby	104
Lupinus arbustus	LUAR6	stubby	64
Lupinus lepidus	LULE2	stubby	10
Lupinus obtusilobus	LUOB	stubby	300
Lupinus obtusilobus	LUOB	stubby	50
Lupinus polyphyllus	LUPO2	stubby	195
Luzula comosa	LUCO6	stubby	278
Panicum acuminatum	DIAC2	stubby	143
Pedicularis groenlandica	PEGR2	stubby	85
Penstemon gracilentus	PEGR4	stubby	196
Penstemon newberryi	PENE3	stubby	98
Senecio triangularis	SETR	stubby	64
Trifolium longipes	TRLO	stubby	161
Wyethia mollis	WYMO	tubers	515

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December 20, 2010

THE 2010 MOUNT RAINIER NATIONAL PARK ANNUAL REPORT:
Steven's Canyon Road Revegetation Project

Figure 1. High elevation blue wildrye (*Elymus glaucus*) seed increase field at the Corvallis PMC, June 10, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement with the National Park Service (NPS) in 2007 to provide native plant materials for ecological restoration along Steven's Canyon Road following road construction. It was agreed that the PMC would establish and maintain seed increase fields of three grasses (five accessions). The PMC will deliver 195 lbs (PLS) of upper elevation grasses and 135 lbs (PLS) of lower elevation grasses. This project was expected to be complete in 2009, but construction has been delayed until 2011.The project should be completed by the fall of 2011 and all seed will be delivered to the park then. All seed production goals were exceeded for this contract in 2009 except for the high elevation blue wildrye. This field was maintained and harvested again in 2010.

II. Accessions Involved

Accessions included for the Steven's Canyon Road revegetation project in 2010 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for the Steven's Canyon Road revegetation project in 2010.

Species	Common Name	Code	Accession Number	Activity in 2010[1]
Upper Elevation				
Elymus glaucus	blue wildrye	ELGL	9079518	sfp
Festuca rubra	red fescue	FERU	9079519	-
Bromus carinatus	california brome	BRCA5	9079531	-
Lower Elevation				
Elymus glaucus	blue wildrye	ELGL	9079520	-
Festuca rubra	red fescue	FERU	9079521	-

1- sfp= seed increase, col= collected plant materials

III. Field Seed Increase Activities

The high elevation blue wildrye field is located at another research farm that is about five miles from the PMC's main farm. Moving equipment between the farms can be complicated and time consuming, so this year the blue wildrye was harvested using the "moon rover". It is a self-propelled swather with a conveyor belt to move cut material off the field to be stuffed into large collection bags. It is a small machine that can be loaded onto a trailer and driven over to the other farm. This is much easier than trying to drive a swather and a combine across town. Harvesting with the moon rover means that all the collected material has to be laid on tarps in a shed to dry. Once dry, the material was pitch-forked into a stationary combine.

Table 3. Seed Harvested for Steven's Canyon Road Revegetation Project at Corvallis Plant Materials Center in 2010.

Species	Accession Number	Field size	Harvest date	Method	Yield
Upper Elevation					
Elymus glaucus	9079518	0.3	July 1	moon rover	30 lbs

2010 Field Seed Production Notes:
The blue wildrye field was fertilized in October 2009 with 25 lbs/ac nitrogen (N), and in February 2010 with 50 lbs/ac N plus 15 lbs/ac sulfur (S). Weed control within the plots was mainly performed by hand-hoeing and rouging, and broadleaf herbicides. Field borders were cultivated periodically throughout the year. The high elevation blue wildrye field was mowed with a flail chopper after harvest.

V. Container Plant Production.

No containerized production occurred for this project in 2010.

VI. Delivery of Plant Materials.

No materials were delivered in 2009. Seed that was produced in 2008, 2009, and 2010 will be kept in the seed storage facilities at the PMC.

Table 5. Seed currently in storage as of December 30, 2010 for the Steven's Canyon Rd revegetation project at the PMC.

Species	Code	Seed lot	Bulk Amount in Storage	PLS Wt	Purity	Germ
Lower Elevation						
Elymus glaucus	ELGL	SG1-08-MR520	30 lbs		98.68	68
	ELGL	SG1-09-MR520	129 lbs		99.02	87
Festuca rubra	FERU	SG1-08-MR521	6 lbs			
	FERU	SG1-09-MR521	186 lbs			
Upper Elevation						
Elymus glaucus	ELGL	SG1-09-MR518	44 lbs		98.92	94
Elymus glaucus	ELGL	SG1-10-MR518	30 lbs		99.55	97
Festuca rubra	FERU	SG1-09-MR519	134 lbs		99.12	90
Bromus carinatus	BRCA5	SG2-09-MR531	142 lbs			

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December 10, 2010

THE 2010 MOUNT RAINIER NATIONAL PARK ANNUAL REPORT:
Nisqually Entrance Revegetation Project

I. Brief Background of Project

Figure 1. Blue wildrye (*Elymus glaucus*) increase field for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center, May 5, 2010.

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Mount Rainier National Park in 2008 to provide native plant materials for the ecological restoration of the Nisqually Entrance road construction area. It was agreed that the PMC would produce a minimum of 120 lbs (PLS) of *Elymus glaucus*, 200 lbs (PLS) of *Bromus carinatus*, and 35 lbs (PLS) of *Festuca rubra*. The construction project is expected to be completed in 2011. The PMC met seed production goals in 2010.

Activities in 2010 included maintenance and harvest of three seed increase fields.

II. Accessions Involved

Accessions included for the Nisqually Entrance are listed in Table 1. This table also displays activities performed by PMC staff in 2010.

Table 1. Accessions involved for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center in 2010.

Species	Common name	Symbol	Accession number	2010 Activity[1]
Elymus glaucus	blue wildrye	ELGL	9079593	sfp
Bromus carinatus	California brome	BRCA5	9079592	sfp
Festuca rubra	red fescue	FERU	9079594	sfp

1- col=wild seed collection, pxn= plant production sfp= seed field production,

III. Seed Increase

All three seed increase fields were very vigorous and flowered profusely. These fields were some of the most productive and weed-free fields on the PMC farm. Fields were walked multiple times during the growing season to locate and remove perennial grasses. Broadleaf herbicides were applied in April.

Table 2. Seed Harvested for the Nisqually Entrance Revegetation Project at Corvallis Plant Materials Center in 2010.

Species	Accession Number	Field Size (ac)	Harvest date	Method	Yield
Bromus carinatus	9079592	0.5	7/4- 7/13	swath/combine	261 lbs
Blue wildrye	9079593	0.3	7/9-7/15	swath/combine	156 lbs
Festuca rubra	9079594	0.2	7/5	seed strip	61 lbs

IV. Delivery of Plant Materials

There were no deliveries made in 2010. Seed that was produced this year will remain in storage until requested.

Table 3. Seed in storage in 2010 for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center.

Species	Seed lot	Bulk Wt	PLS Wt	Purity	Germination
Bromus carinatus	SG1-09-MR592	13 lbs			
Bromus carinatus	SG2-10-MR592	261 lbs	251 lbs	99.49%	97%

Elymus glaucus	SG1-10-MR593	156 lbs	133 lbs	99.51%	86%
Festuca rubra	SG1-09-MR594	5 lbs			
Festuca rubra	SG1-10-MR594	61 lbs	50 lbs	98.64%	82%

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USDA NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

December 10, 2011

THE 2011 MOUNT RAINIER NATIONAL PARK ANNUAL REPORT:
Nisqually Entrance Revegetation Project

I. Brief Background of Project

Figure 1. Blue wildrye (*Elymus glaucus*) increase field for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center, May 5, 2010.

The Corvallis Plant Materials Center (PMC) entered into an agreement with Mount Rainier National Park in 2008 to provide native plant materials for the ecological restoration of the Nisqually Entrance road construction area. It was agreed that the PMC would produce a minimum of 120 lbs (PLS) of *Elymus glaucus*, 200 lbs (PLS) of *Bromus carinatus*, and 35 lbs (PLS) of *Festuca rubra*. The construction project was expected to be completed in 2011. The PMC met seed production goals in 2010. Seed will be stored at the PMC seed storage facilities until requested by the Park.

Activities in 2011 included seed storage.

II. Accessions Involved

Accessions included for the Nisqually Entrance are listed in Table 1. This table also displays activities performed by PMC staff in 2011.

Table 1. Accessions involved for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center in 2011.

Species	Common name	Symbol	Accession number	2011 Activity[1]
Elymus glaucus	blue wildrye	ELGL	9079593	-
Bromus carinatus	California brome	BRCA5	9079592	-
Festuca rubra	red fescue	FERU2	9079594	-

1- col=wild seed collection, pxn= plant production sfp= seed field production,

III. Delivery of Plant Materials

There were no deliveries made in 2011. Seed will remain in storage until requested.

Table 3. Seed in storage in 2011 for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center.

Species	Seed lot	Bulk Wt	PLS Wt	Purity	Germination
Bromus carinatus	SG1-09-MR592	13 lbs			
Bromus carinatus	SG2-10-MR592	261 lbs	251 lbs	99.49%	97%
Elymus glaucus	SG1-10-MR593	156 lbs	133 lbs	99.51%	86%
Festuca rubra	SG1-09-MR594	5 lbs			
Festuca rubra	SG1-10-MR594	61 lbs	50 lbs	98.64%	82%

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December 20, 2010

THE 2010 OLYMPIC NATIONAL PARK ANNUAL REPORT:
Elwha River Ecosystem and Fisheries Restoration

Figure 1.Blue wildrye (*Elymus glaucus)* seed increase field at the Corvallis PMC, June 4, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Olympic National Park in 2004 to provide native plant materials for the ecological restoration of Lake Mills and Lake Aldwell following the removal of two high head dams on the Elwha River. Current plans estimate that the dams will be removed in 2012. The PMC has agreed to produce 4355 lbs of four grass species, 450 lbs of two sedge species, and 430 lbs of three forbs.

Activities in 2010 included wild seed collection of four grasses, establishment, maintenance and harvest of seed production fields including two grasses, one forb and two sedges. Details are provided below.

II. Accessions Involved

Accessions included for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement are listed in Table 1. This table also displays activities performed by PMC staff in 2010.

Table1. Accessions involved and activities performed in 2010 for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis Plant Materials Center.

Species	Common name	Symbol	Accession number	2010 Activity[1]
Carex deweyana	Dewey's sedge	CADE9	9079330	Sfp
Carex pachystachya	thick-headed sedge	CAPA14	9079329	Sfp
Eriophyllum lanatum	wooly sunflower	ERLA	9079441	Sfp, Col
Elymus glaucus	blue wildrye	ELGL	9079334	Sfp,Col
Bromus complex	Brome complex	BR sp	9079332	Sfp,Col
Deschampsia elongata	slender hairgrass	DEEL	9079335	Col
Agrostis exerata	spiked bentgrass	AGEX	9079401	Col

1- sfp= seed increase, trl= production research trial, pxn= plant production, col= collected plant materials from park,

III. Native Seed and Plant Collections

Two trips were made to the Elwha River this year, one in late July and another in early August. This year was the last year of major seed collection for the grasses. The PMC has enough seed to establish all the fields to complete the contract requirements, however, the fields will be established based on estimates of when the seed will be needed. Species that produce seed the first year and are short-lived will be put into production closer to the dam removal date.

Table 2. Native seed collections performed in 2010 for Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis Plant Materials Center.

Species	Symbol	Accession number	Dates	Amount
Elymus glaucus	ELGL	9079334	August 10-12	15.5 lbs
Bromus complex	BR sp	9079332	July 20-22	5.5 lbs
Deschampsia elongata	DEEL	9079335	July 20-22, Aug10-12	1 lb
Agrostis exerata	AGEX	9079401	July 20-22, Aug10-12	1 lb

IV. Experimental Propagation

There was no experimental propagation in 2010.

V. Field Production Activities

Large grass seed production fields of *Bromus* and *Elymus* were established in the fall of 2009. These fields were walked numerous times during the spring and early summer to remove weedy perennial grasses. The fields were relatively weed-free by harvest time.

This was the first growing season for these plants, therefore they have not reached their peak seed production. The spring and summer of 2010 was very wet and cool, but it did not seem to affect the growth or seed production of the fields.


Figure 2. Thick-headed sedge (*Carex pachystachya*) seed increase field at the Corvallis PMC, May 20, 2010.

The *C. pachystachya* field still appears healthy and vigorous. The "moon rover" was used again this year to harvest the seed. This method seems to produce the highest yields.

The *C. deweyana* plot was very small this year and seeds from these plants were harvested by hand.

Table 3. Seed harvest in 2010 for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis PMC.

Species	Area	Date(s)	Method	Yield
Elymus glaucus	2.1	July12, 20	swath/combine	495 lbs
Bromus carinatus	1.6	July 2, 7	swath/combine	502 lbs
Carex deweyana	0.001	June 24	Hand	2 lbs
Carex pachystachya	0.22	July 8	moon rover	15 lbs
Eriophyllum lanatum	0.15	Sept 14, 30	swath/combine	30 lbs

Most of the seed production fields are multi-aged because they were established at various times. The *E. lanatum* field has two sections, one that was established in the spring of 2009 using transplants and one that was seeded in the fall of 2009. The older section flowered again this year and was harvested using the combine. The new portion of the *E. lanatum* field was very weedy and the PMC staff decided to use a Hiniker Flail Mower/Shredder to mow down the field instead of attempting to weed or spot spray the field. This piece of equipment cuts and "vacuums" all residue laying on the ground surface. Residue is shot out into a wagon that is pulled behind the mower and can be dumped offsite. This form of "weed control" was chosen because the annual weeds would be killed or reduced to 2" tall, and all of the seeds that were about to be produced by the weeds were removed from the field. The *E. lanatum* plants were mowed also, but were not harmed by the cutting. The field was mowed in early summer and early fall to remove the weeds. Oregon sunshine plants looked very healthy heading into winter and almost all the weeds had been killed by the mowing. This weed control method was quite effective at removing the large amount of weed seed that would have been germinating in the spring of 2011.

Figure 3. Oregon sunshine (*Eriophyllum lanatum*) seed production field after being mowed using the Hiniker flail mower to remove annual weeds that were about to drop seed.

Field Production Notes for 2010:

Weed control in all fields was primarily performed by hand (mainly to remove exotic perennial grasses) and by spot application of glyphosate. Fields were walked many times during the year, especially at times when weedy perennial grasses look very different than the crop (late September and April). Weeds were wiped with herbicide using spot applicators. Field borders were tilled. Broadleaf herbicides (Bison and Banvel) were applied to grass fields in February and May. The sedge and grass fields were fertilized in February. After harvest, all fields were mowed using the Hiniker Flail Mover/Shredder. Grass fields that were over one year old received an application of a pre-emergent herbicide in October.

New field establishment:

Three acre fields of brome and blue wildrye are needed for this project. These fields were partially established in 2009 and the seed collected in 2010 was used to complete the three-acre fields. Even though the PMC staff was able to collect 15 lbs of seed this year, not all of it was used to sow the fields. A large portion of it will remain in storage as a back-up in case there are any problems with the fields or if more seed production is needed.

In early October, fields were sown using the PMC's precision cone seeder. This was a very slow way to plant these fields, but the planter is extremely accurate and seed is not wasted. In addition to the two grass fields, the Oregon sunshine field was also expanded. Within two weeks the seedlings had emerged in all three fields. Usually, *E. lanatum* seeds do not germinate in the fall. Slugs are a problem in new fields and slugicide was applied to the *E. lanatum* field. The grass fields were not affected by slugs.

Table 4. Seed increase field establishment for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis PMC, October 2010.

Species	Accession Number	Date seeded	Seeding rate	Field Size (ac)	Total size
Elymus glaucus	9079334	1-Oct	5 lbs/ ac	0.9	3.1
Bromus complex	9079332	1-Oct	7 lbs/ ac	0.65	2.25
Eriophyllum lanatum	9079441	1-Oct	4 lbs/ ac	0.2	0.5
Carex deweyana	9079330	23-Sep	transplant	0.14	0.2
Carex pachystachya	9079329	24-Sep	transplant	0.25	0.5
					6.55

Instead of direct sowing sedge fields, the PMC staff prefers to establish the fields using transplants. Sedge seedlings don't emerge until late spring. This gives the weeds, which germinate in March, quite a head start. Also, the sedge seedlings can only grow for a couple months before the summer drought begins. Irrigation can help this problem, but it also creates a perfect environment for summer germinating weeds, most of which are very fast growing, unlike the sedges. Sedges are slow growing, but once they are established, they are very tough and long-lived. Plugs were grown during the summer and just before the fall rains started, a mechanical transplanter was used to establish large fields of *C. deweyana* and *C. pachystachya.*

Figure 4. Thick-headed sedge (*Carex pachystachya*) and Dewey's sedge (*Carex deweyana*) plugs growing in the PMC shadehouse, July 24, 2010.

VI. Container Plant Production

In order to have plugs ready for fall transplanting, sedge seeds were sown in early summer into15,000 Ray Leach “stubby” cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix) and lightly covered with fine vermiculite. Seeded flats of *C. pachystachya* were placed in polyethylene bags and moved into a walk-in cooler (36-38^{o} F) for six weeks. After stratification, they were moved to a warm greenhouse. *C. pachystacha* seeds have higher and more uniform germination if cold stratified for 6 weeks prior to being placed in warm environment. *C. deweyana* seeds do not seem to benefit from this treatment, so seeds were sown and placed in a warm greenhouse. Cone-tainers of both species were moved outdoors in early July as the greenhouse became too warm for the plants. They remained in the shadehouse until they were transplanted into fields in late September. They were trimmed twice during the growing season to aid in watering during the hottest months of the summer. Usually PMC staff use battery-powered hand trimmers to cut back excessive growth of container plants, but this method wasn’t efficient for the amount of sedges in the shadehouse. Creative summer workers built a raised track for the push mower to ride along and the racks of cone-tainers could be placed beneath it. Many racks could be cut at a time and all the plants in both shadehouses (approximately 25,000 plants) could be cut in a day.

Figure 5. Raised track built for trimming plants in racks of conetainers.

VII. Delivery of Plant Materials

There were no deliveries made to the Park in 2010. All seed will remain in the Corvallis PMC seed storage facilities until requested.

Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot notes which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (ER is for Elwha River) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 5. Seed in storage at the Corvallis PMC, December 5, 2010.

Scientific name	Common name	Seed lot	Amount
Forbs			
Achillea millefolium	yarrow	SG1-06-ER349	50 lbs
Artemisia suksdorfii	coastal wormwood	SG1-08-ER400	2 lbs
Artemisia suksdorfii	coastal wormwood	SG1-09-ER400	2 lbs
Eriophyllum lanatum	Oregon sunshine	SG1-09-ER441	17 lbs
Eriophyllum lanatum	Oregon sunshine	SG2-10-ER441	30 lbs
Grasses, sedge, and rushes			
Agrostis exerata	spiked bentgrass	SG1-07-ER401	18 lbs
Bromus complex	brome species	SG1-06-ER332	195 lbs
Bromus complex	brome species	SG1-07-ER332	71 lbs
Bromus complex	brome species	SG1-10-ER332	502 lbs
Carex deweyana	Dewey's sedge	SG1-06-ER330	0.5 lbs
Carex deweyana	Dewey's sedge	SG1-07-ER330	1 lb
Carex deweyana	Dewey's sedge	SG1-08-ER330	2 lbs
Carex deweyana	Dewey's sedge	SG1-09-ER330	26 g
Carex deweyana	Dewey's sedge	SG1-10-ER330	2 lbs
Carex pachystachya	thick-headed sedge	SG1-05-ER329.	1 lb
Carex pachystachya	thick-headed sedge	SG1-06-ER329	6.5 lbs
Carex pachystachya	thick-headed sedge	SG1-07-ER329	12 lbs
Carex pachystachya	thick-headed sedge	SG1-08-ER329	59 lbs
Carex pachystachya	thick-headed sedge	SG1-09-ER329	22 lbs
Carex pachystachya	thick-headed sedge	SG1-10-ER329	15 lbs
Deschampsia elongata	slender hairgrass	SG1-05-ER335	21 lbs
Deschampsia elongata	slender hairgrass	SG1-06-ER335	90 lbs
Deschampsia elongata	slender hairgrass	SG1-07-ER335	20 lbs
Elymus glaucus	blue wildrye	SG1-06-ER334	52 lbs
Elymus glaucus	blue wildrye	SG1-07-ER334	142 lbs
Elymus glaucus	blue wildrye	SG1-10-ER334	495 lbs

CORVALLIS PLANT MATERIALS CENTER
USDA NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
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December 20, 2011

THE 2011 OLYMPIC NATIONAL PARK ANNUAL REPORT:
Elwha River Ecosystem and Fisheries Restoration

Figure 1.Oregon Sunshine (*Eriophyllum lanatum)* seed increase field at the Corvallis PMC, June 27, 2011.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement with Olympic National Park in 2004 to provide native plant materials for the ecological restoration of Lake Mills and Lake Aldwell following the removal of two high head dams on the Elwha River. Dam removal began this year! The PMC has agreed to produce 4,355 lbs of four grass species, 450 lbs of two sedge species, and 430 lbs of three forb species.

Activities in 2011 included maintenance and harvest of seed production fields including two grasses, one forb and two sedges. Older seed lots were tested for germination and delivered to Park staff. Preliminary seed mixes were developed and shipped to the Park for use in areas that are exposed due to dam removal. Details are provided below.

II. Accessions Involved
Accessions included for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement are listed in Table 1. This table also displays activities performed by PMC staff in 2011.

Table 1. Accessions involved and activities performed in 2011 for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis Plant Materials Center.

Species	**Common name**	**Symbol**	**Accession number**	**2011 Activity**[1]
Carex deweyana	Dewey's sedge	CADE9	9079330	Sfp, Dlv
Carex pachystachya	thick-headed sedge	CAPA14	9079329	Sfp, Dlv
Eriophyllum lanatum	wooly sunflower	ERLA6	9079441	Sfp, Dlv
Elymus glaucus	blue wildrye	ELGL	9079334	Sfp, Dlv
Bromus complex	Brome complex	BR sp	9079332	Sfp, Dlv
Deschampsia elongata	slender hairgrass	DEEL	9079335	Dlv
Achillea millefolium	yarrow	ACMI2	9079349	Dlv
Artemisia suksdorfii	coastal wormwood	ARSU4	9079400	Dlv
Agrostis exarata	spike bentgrass	AGEX	9079401	Dlv

1- sfp= seed increase, dlv= delivered plant materials

III. Native Seed and Plant Collections

No seed was collected from the Park this year. PMC staff have been collecting seed for this project since 2004, and a sufficient amount of wild seed is in storage to increase the amount of seed needed by the Park.

IV. Field Production Activities

Large grass seed production fields of *Bromus* and *Elymus* were established in the fall of 2009 and 2010. This was the first growing season for a portion of each of the two fields, therefore they have not reached their peak seed production. The older sections of the fields are fully mature and are in their prime production years. The spring and summer of 2011 was very wet and cool, but it did not seem to affect the growth of these species. The plants did not have rust, smut or other fungal diseases. The weather was a problem during the harvest of the brome field. As the brome field was maturing, PMC staff noticed a large amount of unfilled seed; this was most likely due to rain during pollination. In late June, the majority of the seeds on the plants were beginning to shatter, although the seed maturity was highly variable across the field. The field was swathed, which causes even more seed shatter. While the seed lay drying in swaths two huge rainstorms moved through and dislodged most of the filled seed from the swaths. Heavy summer rain storms are very rare in the Willamette Valley, which makes it an ideal place to farm grass seed. These storms ruined many early maturing grass seed crops. After almost two weeks of rain, the swaths needed another week to dry out again before they could be combined. The swaths were starting to mold, but luckily, the weather cooperated at the end of July so the field could be combined and was not a total loss. The combine recovered some seed off the field (possibly 25% of what was produced), but under the swaths, handfuls of seed could be picked up off the ground. This "perfect storm" of events has led the PMC staff to develop a new harvest technique for the brome in 2012. The brome will be harvested by direct combining instead of being cut into swaths that lay in the field to dry. Direct combining means that the field will be cut and combined at the same time, but the field will be cut when the field is a little over-ripe rather than as it is maturing. In late June, the PMC farm can still experience rain or high winds, which can knock seed off the swaths as they lay in the field drying. Direct combining will reduce these dangers.

Table 2. Seed harvest in 2011 for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis PMC.

Species	**Area (ac)**	**Date(s)**	**Method**	**Yield**
Elymus glaucus	3.1	July14 / July-26-29	swath/combine	2,163 lbs
Bromus carinatus	2.25	June 30 / July22-25	swath/combine	468 lbs
Carex deweyana	0.2	July 5-8	Hand	4 lbs
Carex pachystachya	0.5	June 29-July 5	moon rover	74 lbs
Eriophyllum lanatum	0.3	August 31	swath/combine	74 lbs

The weather can dramatically affect seed harvest, and while some species will fail due to the weather, others will thrive. The blue wild rye field ripens later than the brome and consequently, was not impacted by the summer rain storm. The field was swathed, and then combined 12 days later. The swaths were very thick and the combine had to drive slowly to prevent clogs. It took four days to combine the 3+ acres. Combining slowly paid off in the end, since the field produced 2,163 lbs of seed! The field will most likely produce the same amount or more in 2012.

Figure 2. Blue wildrye (*Elymus glaucus*) seed increase field after swathing, July 24, 2011.

The older *C. pachystachya* field still appears healthy and vigorous. The "moon rover" was used again this year to harvest this portion of the field. This method seems to produce the highest yields. The new section of the field was hand harvested because it was too sparse for machine harvests.

The *C. deweyana* plot was expanded in the fall of 2010. The new plants grew vigorously and produced a fair amount of seed for their first growing season. The field was hand harvested on two occasions.

Figure 3. Thick-headed sedge (*Carex pachystachya*) plugs were transplanted into a seed increase field in October 2010 and flowered in June 2011.

The *E. lanatum* field has two sections. One was established in the spring of 2009 using transplants and one was direct seeded in the fall of 2009. The area that was established using transplants is relatively weed-free compared to the section that was direct seeded in the fall of 2010. This section was hand weeded multiple times, yet the field was still covered with annual broadleaf weeds. The field was swathed during a hot week, which helped loosen the seed. The field was combined immediately after swathing. The PMC staff has worked with this species for many years and has found ways to clean weeds from the seed lots. Most of the weed seeds that were present in the field were removed using specialty seed cleaning machines. This field is in great shape, other than the weeds, and should continue to produce a large amount of seed in future years.

V. Field Production Notes for 2011

Weed control in all fields was primarily performed by hoeing and by spot application of glyphosate. Fields were walked many times during the year, especially at times when weedy perennial grasses look very different than the crop (late September and April). Weeds were wiped with herbicide using spot applicators. Field borders were tilled. Broadleaf herbicides (Bison and Banvel) were applied to grass fields in April. The sedge and grass fields were fertilized in March. The *E. lanatum* field was not fertilized due to the amount of weeds present in the field. *E. lanatum* is more competitive in a low-nutrient environment and fertilizing the field would most likely result in larger, thriving weeds. After harvest, all fields were mowed using the Hiniker flail mower/shredder. Grass fields that were over one year old received an application of a pre-emergent herbicide in October.

VI. New Field Establishment

In early October 2010, the Oregon sunshine field was expanded by direct seeding. Within two weeks the seedlings had emerged. Usually, *E. lanatum* seeds do not germinate in the fall. Slugs were a huge problem and slugicide was applied to the *E. lanatum* field. Despite repeated applications of slugicide, very few seedlings survived. PMC staff hoped a spring flush of seedlings would emerge, since this species usually germinates in the spring, but it did not happen. The field was plowed under.

VII. Delivery of Plant Materials

Park staff came to the PMC to visit the fields and also pick up older seed lots. Some of these seed lots are over six years old. Usually, grass seed loses viability within five years of harvest. Each seed lot was tested in 2011 and compared with the tests of the seed in the year it was harvested. Surprisingly, many of the lots maintained high viability. The five-year-old blue wildrye seed lot had the highest rate of decline of all the seed lots that were tested. These results will be helpful in determining how much older seed can be used in future years as the dams are being removed.

Table 3. Selected older seed lots tested for decline in viability.

Species	Year produced	Germination when harvested	Current germ	Percent decline
Achillea millefolium	2006	?	90%	< 10%
Artemisia suksdorfii	2007	?	40%	estimate 20%
Bromus complex	2006	95%	82%	13%
Deschampsia elongata	2005	83%	76%	7%
Deschampsia elongata	2006	79%	73%	6%
Elymus glaucus	2006	95%	35%	60%

Table 4. Older seed lots picked up by park staff on June 14, 2011

Species	Seed lot	Amt (lbs)
Carex pachystachya	SG1-06-ER329	6.4
Elymus glaucus	SG1-06-ER334	52
Bromus complex	SG1-06-ER332	39
Deschampsia elongata	SG1-05-ER335	52
Deschampsia elongata	SG1-06-ER335	58
Achillea millefolium	SG1-06-ER349	24
Artemisia suksdorfii	SG1-06-ER400	2
	total	233.4

The removal of the dams began in the fall of 2011. There is some area around the lake shore that has been exposed. This area will be seeded in the winter of 2011 with trial seed mixes. It is not fully understood how these species will work together in a mix; some of the slower to establish species, such as the *Carex* spp., might be outcompeted by the rapid growing brome and blue wildrye. Slender hairgrass should be a great companion to the sedges; it comes up quickly but is not a very competitive plant. It should allow the sedges to become established. Slender hairgrass is a species that occurs in disturbed areas, but usually doesn't persist as more competitive species move in. As the sedges become more dominant, the slender hairgrass will probably move out as succession occurs. A separate forb mix was also made to study how well these species establish without the presence of the grasses. The details of these mixes are summarized in Table 5.

Table 5. Seed mixes designed for trials for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement.

Mix 1: Forbs	lbs/ac	PLS lbs used	bulk lbs used	seeds per sq.ft.
ACMI2	1	0.5	0.7	69
ERLA6	4	2	4	66
ARSU4	0.5	0.25	0.5	42
total	5.5	2.75	5.2	177
Mix 2: Aggressive grass mix				
Brome	8	4	4.3	15
ELGL	12	6	6.3	36
total	20	10	10.6	51
Mix 3: Slow grasses/sedges				
CADE9	1	0.5	0.73	17
CAPA14	2	1	1.31	36
DEEL	2	1	1.38	120
AGEX	1	0.5	0.52	114
total	6	3	3.94	287
Mix 4: All species				
ACMI2	0.14	0.07	0.09	10
ERLA6	1	0.5	0.98	14
ARSU4	0.1	0.05	0.2	12
Brome	5	2.5	2.74	10
ELGL	5	2.5	2.63	16
CADE9	0.25	0.13	0.19	4
CAPA14	0.5	0.25	0.33	10
DEEL	0.14	0.07	0.09	10
AGEX	0.1	0.05	0.52	10
total	12.23	6.12	7.77	96

PMC seed storage facilities are running at maximum capacity after this year's harvest. Seed will remain at the PMC until requested by the Park. Seed inventory is summarized in Table 6. Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot note the year in which the seed was produced. The last portion of the seed lot describes which project the seed is for (ER is for Elwha River) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 6. Seed in storage at the Corvallis PMC, December 5, 2011.

Species	Common name	Seed lot	Amount
Achillea millefolium	yarrow	SG1-06-ER349	10 lbs
Artemisia suksdorfii	coastal wormwood	SG1-07-ER400	2 lbs
Artemisia suksdorfii	coastal wormwood	SG1-09-ER400	2 lbs
Eriophyllum lanatum	Oregon sunshine	SG1-09-ER441	17 lbs
Eriophyllum lanatum	Oregon sunshine	SG2-10-ER441	30 lbs
Eriophyllum lanatum	Oregon sunshine	SG2-11-ER441	
Agrostis exarata	spike bentgrass	SG1-07-ER401	18 lbs
Bromus complex	brome species	SG1-06-ER332	156 lbs
Bromus complex	brome species	SG1-07-ER332	71 lbs
Bromus complex	brome species	SG1-10-ER332	497 lbs
Bromus complex	brome species	SG1-11-ER332	468 lbs
Carex deweyana	Dewey's sedge	SG1-06-ER330	0.5 lbs
Carex deweyana	Dewey's sedge	SG1-07-ER330	1 lb
Carex deweyana	Dewey's sedge	SG1-08-ER330	2 lbs
Carex deweyana	Dewey's sedge	SG1-09-ER330	26 g
Carex deweyana	Dewey's sedge	SG1-10-ER330	2 lbs
Carex deweyana	Dewey's sedge	SG1-11-ER330	4 lbs
Carex pachystachya	thick-headed sedge	SG1-05-ER329.	1 lb
Carex pachystachya	thick-headed sedge	SG1-06-ER329	6.5 lbs
Carex pachystachya	thick-headed sedge	SG1-07-ER329	14 lbs
Carex pachystachya	thick-headed sedge	SG1-08-ER329	59 lbs
Carex pachystachya	thick-headed sedge	SG1-09-ER329	22 lbs
Carex pachystachya	thick-headed sedge	SG1-10-ER329	15 lbs
Carex pachystachya	thick-headed sedge	SG1-11-ER329	74 lbs
Deschampsia elongata	slender hairgrass	SG1-05-ER335	52 lbs
Deschampsia elongata	slender hairgrass	SG1-06-ER335	16 lbs
Deschampsia elongata	slender hairgrass	SG1-07-ER335	20 lbs
Elymus glaucus	blue wildrye	SG1-06-ER334	52 lbs
Elymus glaucus	blue wildrye	SG1-07-ER334	142 lbs
Elymus glaucus	blue wildrye	SG1-10-ER334	495 lbs
Elymus glaucus	blue wildrye	SG1-11-ER334	2163 lbs

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

December 30, 2010

THE 2010 GOLDEN GATE NATIONAL PARK ANNUAL REPORT:
Marin Headlands Revegation Project

Figure 1. California oatgrass (*Danthonia californica*)seed increase field at the Corvallis PMC, June 1, 2010.

I. Brief Background of Project

In 2009, The Corvallis Plant Materials Center (PMC) entered into a new agreement with Golden Gate National Park to provide native plant materials for ecological restoration following road construction in the Marin Headlands. The PMC has agreed to produce 250 pounds of two grasses.

Activities in 2010 included containerized production of 30,600 grass plugs, and establishment, maintenance and harvest of two grass seed increase fields.

II. Accessions Involved

Accessions included for the restoration of Marin Headlands are listed in Table 1. This table also displays activities performed by PMC staff in 2010.

Table 1. Accessions involved for the restoration in the Marin Headlands project with the Corvallis Plant Materials Center in 2010.

Species	Common name	Code	Accession	Activity in 2010[1]
Danthonia californica	California oatgrass	DACA	9079621	sfp
Nassella lepida	Foothill's needlegrass	NALE	9079622	sfp

1- col=wild seed collection, pxn= plant production sfp= seed field production,

III. Container Plant Production

Seed was delivered to the PMC on December 1, 2009. Seed was cleaned by PMC and then sown into plugs trays filled with Sunshine #1 (a sterilized peat-based soil-less media) amended with micronutrients (Micromax) and a balanced slow release fertilizer. Trays of *Nassella lepida* were placed in a cold frame and trays of *Danthonia californica* were placed in a warm greenhouse. Both species germinated in their respective places within two weeks. After two weeks in the cold frame, the *N. lepida* was moved into the warm greenhouse. In early March, the heat in the greenhouse was slowly turned down to match outdoor temperatures and acclimate the grasses to the natural spring conditions. Plants of both species grew rapidly and were ready for outplanting in March.

Table 2. Container plant production for the Marin Headlands project with the Corvallis Plant Materials Center in 2010.

Species	Amt of seed used	# of containers produced	Date sown
Danthonia californica	350 g	16,352	December 3, 2009
Nassella lepida	43g	6500	December 3, 2009
Nassella lepida	150g	7800	September 8, 2010

Seed that was harvested from the *Nassella* seed increase field in 2010 was used to grow more plugs to expand the field in the spring of 2011. These seeds were sown on September 8, 2010 into plug trays filled with our standard mix (mentioned above). Trays were placed in an outdoor shadehouse. Seeds germinated readily and quickly filled the plug container. Plants will remain outside until spring when transplanting conditions are right.

VI. Seed Increase Activities

Plugs were transplanted into prepared fields in mid March using a Holland mechanical transplanter. The fields were fallowed for the winter and sprayed with glyphosate prior to planting. All plugs were planted on one foot spacing. The cool, wet spring helped give the plants a longer period of time to grow roots and get settled in before the summer drought hit. Both fields looked great during the growing season.

The *Nassella* field was surprisingly weedy. It was covered with low-growing, late spring germinating annual weeds. The field also began flowering soon after transplanting, so it was not sprayed with broadleaf herbicide, which can harm fertile tillers. It was decided to leave the field weedy until after harvest, then hand weed or spray if needed. The plants in the field flowered and set seed at highly variable times, so it was harvested multiple times. It was harvested by hand in late May, a flail-vac seed stripper in late June, and then with the seed stripper again in late July The seed stripper worked fairly well, it didn't pull off all the seed that was mature and pulled some of the seed that was still very green. But it could be used multiple times, so that made up for the inconsistencies.

The *Danthonia* field did flower, weakly, and it was not worth harvesting. The field was also covered with late germinating annual bluegrass (*Poa annua*). This annual weed is common in first year fields at the PMC, it is controlled in the fall with a pre-emergent herbicide and should not be a problem in 2011.

Table 3. Seed yields for the Marin Headlands project with the Corvallis Plant Materials Center in 2010.

Species	**Date**	**Method**	**Field size(ac)**	**Yield**
Nassella lepida	May 20, June 30, July28	Hand, seed stripper	0.2	3.3 lbs

V. Delivery of Plant Materials

There were no deliveries made in 2009. All seed not delivered will remain at the Corvallis PMC seed storage facilities until requested.

Table 4. Seed in storage for the Marin Headlands project with the Corvallis Plant Materials Center in 2010.

Species	**Seed lot**	**Amount**
Nassella lepida	SG1-10-GG622	3 lbs

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December 30, 2011

THE 2011 GOLDEN GATE NATIONAL PARK ANNUAL REPORT:
Marin Headlands Revegation Project

Figure 1.California oatgrass (*Danthonia californica*) seed increase field at the Corvallis PMC, June 1, 2010.

I. Brief Background of Project

In 2009, the Corvallis Plant Materials Center (PMC) entered into an agreement with Golden Gate National Park to provide native plant materials for ecological restoration following road construction in the Marin Headlands. The PMC has agreed to produce 250 pounds of two grasses.

Activities in 2011 included containerized production of 3,000 grass plugs, and establishment, maintenance and harvest of two grass seed increase fields.

II. Accessions Involved

Accessions included for the restoration of Marin Headlands are listed in Table 1. This table also displays activities performed by PMC staff in 2011.

Table 1. Accessions involved for the restoration in the Marin Headlands project with the Corvallis Plant Materials Center in 2011.

Species	Common name	Code	Accession	Activity in 2011[1]
Danthonia californica	California oatgrass	DACA3	9079621	Sfp, Dlv
Nassella lepida	foothill needlegrass	NALE2	9079622	Sfp, Pxn, Dlv

1- Dlv=delivered plant materials, pxn= plant production sfp= seed field production,

III. Container Plant Production

Seed that was harvested from the *Nassella* seed increase field in 2010 was used to grow more plugs to expand the field in the spring of 2011. These seeds were sown on September 8, 2010 into plug trays filled with Sunshine #1 (a peat-based soilless media) amended with a slow release fertilizer and micronutrients. Trays were placed in an outdoor shadehouse. Seeds germinated readily and quickly filled the plug containers. They were overwintered in the shadehouse. The PMC experienced some very cold weather in December, and plants did not seem affected by it initially, but about a month later plants began to look dead and rotted. Very few plugs survived the winter.

VI. Seed Increase Activities

Figure 2. Foothill needlegrass (*Nassella lepida*) seed increase field at the Corvallis Plant Materials Center, June 10, 2011.

The few *Nassella* plugs that survived were transplanted into the field in March. The rest of the field had been established in 2010. The field had fewer weeds this year, yet it still had rattail fescue and bentgrass. The field was hand-weeded many times to remove the rattail, but as the *N. lepida* plants grew taller and began to flower it was difficult to find the rattail. The bentgrass was wiped with canes filled with glyphosate. The needlegrass was harvested using a flail-vac seed stripper in early July and again in late July. The second harvest was kept separate from the first because it appeared to have rattail fescue seed in it. Once it was cleaned, it was apparent that the seed lot was badly contaminated with rattail seeds. PMC staff spent a day using different machines to try to remove the rattail fescue seed. The *N. lepida* seed is so similar in size, shape and weight that it was impossible to separate the two. PMC staff described the problem to the Park staff and they decided they did not want the seed lot with the rattail.

The *Danthonia* field was beautiful in 2011. It was covered with flowering stems that were so thick that it was difficult to walk through. PMC staff have many years of experience growing this species and the best way to harvest it is to seed strip the floret seeds when they are mature, then swath the stems that contain a large amount of cleistogamous seed. Once the stems have dried, they can be combined. This method is more laborious, but the yields are worth it.

Table 2. Seed yields for the Marin Headlands project with the Corvallis Plant Materials Center in 2011.

Species	**Date**	**Method**	**Field size(ac)**	**Yield**
Nassella lepida	7/4, 7/26	seed stripper	0.2	9 lbs
Danthonia californica	7/6	Seed stripper, swath/combine	0.5	142 lbs

V. Delivery of Plant Materials

Table 3. Seed delivered for the Marin Headlands project with the Corvallis Plant Materials Center in 2011.

Species	**Seed lot**	**Amount**
Nassella lepida	SG1-11-GG622	9 lbs
Danthonia californica	SG1-11-GG621	80 lbs

A portion of the seed was sent to the Park in the first week of December. All seed not delivered will remain at the Corvallis PMC seed storage facilities until requested.

Table 4. Seed in storage for the Marin Headlands project with the Corvallis Plant Materials Center in 2011.

Species	**Seed lot**	**Amount**
Nassella lepida	SG1-10-GG622	3 lbs
Danthonia californica	SG1-11-GG621	62 lbs

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December 30, 2010

THE 2010 SAN JUAN ISLANDS NATIONAL HISTORICAL PARK ANNUAL REPORT: *American Camp Prairie Restoration Project*

I. Brief Background of Project

Figure 1. Blue wildrye (*Elymus glaucus*) seed increase field for the American Camp Prairie Restoration Project with Corvallis Plant Materials Center, June 15, 2010.

The Corvallis Plant Materials Center (PMC) entered into a new agreement with San Juan Islands National Historical Park in 2009 to provide native plant materials for the restoration of the American Camp Prairie. It was agreed that the PMC would produce a minimum of 900 lbs (PLS) of *Elymus glaucus*, 900 lbs (PLS) of *Bromus sitchensis*, and 440 lbs (PLS) of *Festuca roemerii*. The project is expected to be completed in 2013.

Activities in 2010 included establishment and maintenance of three seed increase fields as well as additional expansion in the fall of 2010 of the fescue and blue wildrye seed increase fields. PMC staff also visited the park and viewed the restoration sites.

II. Accessions Involved

Accessions included for the restoration of American Camp Prairie are listed in Table 1. This table also displays activities performed by PMC staff in 2010.

Table 1. Accessions involved for the restoration of American Camp Prairie project with Corvallis Plant Materials Center in 2010.

Species	Common name	Code	Accession	Activity in 2010[1]
Elymus glaucus	blue wildrye	ELGL	9079607	sfp
Bromus sitchensis	sitka brome	BRSI	9079606	sfp
Festuca roemerii	Roemer's fescue	FERU	9079605	sfp

1- col=wild seed collection, pxn= plant production sfp= seed field production,

III. Seed Increase

The San Juan Island ecotypes seem to be suffering slightly in the wet spring months at the PMC. Plants were reddish and looked sick through most of the spring. It was an unusually wet and cool spring which didn't help these fields. The brome field began to flower in late March and was covered with smut. These plants were not able to make viable seeds due to the wet weather. Another flush of flowering happened in late May and these flowers did produce some seed. Smut was still a problem but did not destroy the harvest.

Figure 2. Sitka brome (*Bromus sitchensis*) seed increase field for the American Camp Prairie Restoration Project with Corvallis Plant Materials Center, June 15, 2010.

The blue wildrye field did not grow much in early spring, but grew fast and flowered moderately as the fields dried out and the temperatures increased. Seeds were highly variable in ripening and shattering upon maturity. A double harvest was attempted by seed stripping the field to remove the seeds that were ripe, then swathing the remaining stems and combining a week later. These methods harvested a large portion of the seed that was produced. Hopefully next year the fields will ripen more evenly.

Table 2. Seed increase field yields in 2010 for the restoration of American Camp Prairie project with the Corvallis Plant Materials Center.

Species	Accession	Field size(ac)	Date	Method	Yield
Elymus glaucus	9079607	0.25	7/14, 7/14,7/26	seed strip swath/combine	53 lbs
Bromus sitchensis	9079606	0.62	6/25,7/2	swath/combine	63 lbs

The fescue field was incredibly weedy. It is filled with aggressive summer annual weeds. The field was mowed in late July to keep the weeds from producing seeds. The field was not sprayed with broadleaf herbicides in the summer due to concerns about spraying the chemicals in the heat of the summer. Sometimes the chemicals can volatilize and effect nearby plants. It was sprayed in early fall. It should be much cleaner next year. A small portion of the fescue field was expected to flower this year. The plants were very small and they did not flower. The seed that was expected from this field was to be used to expand the field to 2.25 acres. Park staff collected more fescue seed in the summer of 2010 and sent it to the PMC for cleaning and fall sowing. The fescue field was expanded to 0.45 acres in early October. Blue wildrye seed from the increase field was used to expand the field up to its contracted size of 0.5 acres.

All fields were fertilized in October 2010 with 25 lbs/ac nitrogen. Weed control within the plots was mainly performed by hand-hoeing, spot applications of glyphosate, and using broadleaf herbicides. Field borders were cultivated periodically throughout the year. In the fall, fields were mowed with a flail chopper and a pre-emergent herbicide was applied.

Table 3. Field establishment in 2010 for the restoration of American Camp Prairie project with the Corvallis Plant Materials Center.

Species	Accession	Date	Seeding rate	Field Size	Total field size (ac)
Elymus glaucus	9079607	1-Oct	7 lbs/ac	0.2	0.5
Festuca roemerii	9079605	1-Oct	5 lbs/ac	0.2	0.52
Bromus carinatus	9079606	-	-	-	0.62

VI. Delivery of Plant Materials

PMC staff was invited to visit the Park and view the restoration sites in August. About 20 lbs of seed was brought to the Park but was later returned to the PMC for storage. All seed will remain in the PMC seed storage facilities until requested.

Figure 3. American Camp Prairie restoration site, San Juan Island National Heritage Park, August 12, 2010.

Table 4. Seed in storage in 2010 for the restoration of American Camp prairie project with the Corvallis Plant Materials Center.

Species	**Seed lot**	**Bulk Wt**	**PLS Wt**	**Purity**	**Germination**
Elymus glaucus	SG1-10-SJ607	53 lbs	44 lbs	99.34%	84%
Bromus sitchensis	SG1-10-SJ606	63 lbs	52 lbs	98.99%	84%

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December 30, 2011

THE 2011 SAN JUAN ISLANDS NATIONAL HISTORICAL PARK ANNUAL REPORT: *American Camp Prairie Restoration Project*

I. Brief Background of Project

Figure 1. Blue wildrye (*Elymus glaucus*) seed increase field (front field) and Sitka brome (Bromus sitchensis) seed increase field (lighter colored field in back) for the American Camp Prairie Restoration Project with Corvallis Plant Materials Center, June 15, 2010.

The Corvallis Plant Materials Center (PMC) entered into a new agreement with San Juan Islands National Historical Park in 2009 to provide native plant materials for the restoration of the American Camp Prairie. It was agreed that the PMC would produce a minimum of 900 lbs (PLS) of *Elymus glaucus*, 900 lbs (PLS) of *Bromus sitchensis*, and 440 lbs (PLS) of *Festuca roemerii*. The project is expected to be completed in 2013.

Activities in 2011 included maintenance and harvest of three seed increase fields.

II. Accessions Involved

Accessions included for the restoration of American Camp Prairie are listed in Table 1. This table also displays activities performed by PMC staff in 2011.

Table 1. Accessions involved for the restoration of American Camp Prairie project with Corvallis Plant Materials Center in 2011.

Species	Common name	Code	Accession	Activity in 2011[1]
Elymus glaucus	blue wildrye	ELGL	9079607	sfp
Bromus sitchensis	sitka brome	BRSI	9079606	sfp
Festuca roemerii	Roemer's fescue	FERU	9079605	sfp

1- sfp= seed field production,

III. Seed Increase

The San Juan Island ecotypes seem to be suffering slightly in the wet spring months at the PMC. Plants were reddish and looked sick through most of the spring. It was an unusually wet and cool spring which didn't help these fields. The Brome field had severe smut issues in 2010. Some smut was seen in the field in 2011, but it wasn't nearly as bad. The fields were fertilized in April. This application seemed well timed, the fields were slow to grow due to the cool temperatures so the late application of fertilizer came at a time when they were starting to grow vigorously. The Brome field flowers very early and blooms for many weeks. Even though the plants bloomed at different times, the seed maturity was relatively even across the field. This made it easier to swath and combine the field. It was swathed in late June, and combined 12 days later.

The blue wildrye field did not grow in early spring, but grew fast and flowered moderately as the fields dried out and the temperatures increased. The field matured more evenly in 2011. The newer section that was planted in the fall of 2010 also flowered. The seed stripper was used again this year and was very effective due to the even seed maturity.

Table 2. Seed increase field yields in 2011 for the restoration of American Camp Prairie project with the Corvallis Plant Materials Center.

Species	Accession	Field size(ac)	Date	Method	Yield
Festuca roemerii	9079605	0.25	7/8	seed stripper	47 lbs
Elymus glaucus	9079607	0.4	7/19	seed stripper	202 lbs
Bromus sitchensis	9079606	0.62	6/29,7/11	swath/combine	143 lbs

The fescue field flowered for the first time in 2011 and was harvested using the seed stripper. The yield in 2011 was fairly high for a Roemer's fescue seed increase field. Hopefully this field will continue to have high yields. The field was much cleaner due to fall applications of pre-emergent herbicides. Fields were also walked many times during the spring and early summer to remove weedy perennial grasses. The fescue field was expanded to 0.45 acres in early October of 2010, the new section did not flower in 2011.

All fields were fertilized in April. Weed control within the plots was mainly performed by hand-hoeing, spot applications of glyphosate, and using broadleaf herbicides. Field borders were cultivated periodically throughout the year. In the fall, fields were mowed with a flail chopper and a pre-emergent herbicide was applied.

VI. Delivery of Plant Materials

There were no deliveries in 2011. All seed will remain in the PMC seed storage facilities until requested.

Table 3. Seed in storage in 2011 for the American Camp Prairie Restoration Project with Corvallis Plant Materials Center .

Species	Seed lot	Bulk Wt	PLS Wt	Purity	Germination
Elymus glaucus	SG1-10-SJ607	53 lbs	44 lbs	99.34%	84%
Elymus glaucus	SG2-11-SJ607	202 lbs	181 lbs	99.90%	90%
Bromus sitchensis	SG1-10-SJ606	63 lbs	52 lbs	98.99%	84%
Bromus sitchensis	SG1-11-SJ606	143 lbs	143 lbs	99.10%	98%
Festuca roemerii	SG1-11-SJ605	47 lbs	41 lbs	97.21%	90%

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January 2, 2011

THE 2010 INSTITUTE FOR APPLIED ECOLOGY ANNUAL REPORT:

Figure 1. Oregon sunshine (Eriophyllum lanatum) seed increase field at the Plant Materials Center, June 20, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with US Fish and Wildlife (USFW) in 2007 to increase seed of Willamette Valley forbs to be used in Wetland Reserve Program (WRP) and Wetland Reserve Enhancement Program (WREP) restoration sites. The Institute for Applied Ecology (IAE) collected seed from remnant wet prairies across the Willamette Valley in 2005, 2006, and 2007 to create composite collections to be released to growers for seed increase. Traditional agronomic seed increase techniques were not successful for some species; these species were brought to the PMC for research and development. Wild collected seed was very limited for a few species; these species were also brought to the PMC. Small common gardens were established at the PMC for many species that were selected for the Willamette Valley Seed Increase Project. Information from these studies will be used to establish seed transfer guidelines. Activities in 2010 included harvest and maintenance of seed increase fields of six forbs and one rush.

II. Accessions Involved
The following table lists the accessions involved in the Willamette Valley Seed Increase Project at the Corvallis Plant Materials Center in 2010.

Table 1. Accessions in the Willamette Valley Seed Increase Project at the Corvallis Plant Materials Center in 2010.

Species	Common name	Code	Accession #	Activity in 2010[1]
Sidalcea virgata	rose checkermallow	SIVI	9079536	sfp
Eriophyllum lanatum	Oregon sunshine	ERLA	9079538	sfp
Ranunculus occidentalis	western buttercup	RAOC	9079564	sfp
Juncus tenuis	poverty rush	JUTE	9079535	sfp
Saxifraga oregana	Oregon saxifrage	SAOR	9079537	sfp
Symphyotricum hallii	Hall's aster	SYHA	9079540	sfp

1- sfp= seed increase,, pxn=plant production, dlv= delivered plant materials

III. Seed Increase


Figure 2. Poverty rush (*Juncus tenuis*) seed increase field at the Corvallis PMC, June 15, 2010.

Juncus tenuis plants were larger in 2010 and the weed fabric had to be cut to allow room for growth. The field was weeded by hand a couple times during the growing season. The plants flowered and the seed matured relatively even across the entire field, so the field was harvested by a self-propelled swather, nick-named the “moon rover”. This machine cuts and sends all material up a conveyor belt where it can be collected into large bags. After being harvested, material was laid on tarps inside in open greenhouse to dry. Last year, the fabric also had to be vaccumed because seed had shattered all over it. This year, the field was cut before the seed had begun to shatter. It is nice to have the fabric as a backup incase the maturity is very uneven. The yield from this field was quite a bit higher than last year and this is mostly likely due to the plants being larger.

The *Saxifraga oregana* field is also covered with weed fabric. It is quite helpful in weed control, but if the holes are not re-cut early in the fall it can impede the saxifrage's growth. This species goes dormant in the summer and emerges again in the fall, usually after a couple of rain storms. The optimal time to enlarge the holes is just before they start growing in the fall. This is also a very busy time at the PMC: seed is still being harvested; all the seed that had to be delivered in the fall is still being cleaned; new fields have to be sown; plants are being delivered; and end of the fiscal year summaries have to be reported. In the fall of 2009, the fabric was cut as the plants were emerging and this worked well. However, the field was incredible weedy this year. It was covered with wild carrot, false dandelion, and other late season weeds. These weeds were really starting to take off during the time that the Saxifrages were trying to flower and set seed. PMC staff tried to weed the plot, but caused damage to the flower stalks, so the field was left weedy. The field was harvested by hand. The cool wet spring created a different environment than usual for this species and many plants attempted a second flowering. This field produced less seed this year than in 2009. The field appeared to have larger plants and more flowering stalks. It is possible that the cool wet weather affected pollination, but it is also possible that the weeds made it harder to harvest the field and more seed was lost. The fabric was not vacuumed this year.

Figure 3. Oregon saxifrage (*Saxifraga oregana*) seed increase field at the Corvallis Plant Materials Center, May 1, 2010.

Eriophyllum lanatum and *Ranunculus occidentalis* fields were hand weeded many times during the growing season. Trefoil became a serious weed in the buttercup field in 2009. Once the buttercup plants went dormant in late summer of 2009, the field was sprayed with a broadleaf herbicide to remove the trefoil. This technique was very effective. The trefoil died in the fall and no new or resprouting plants were observed. A new crop of trefoil germinated in the spring of 2010. They were growing much slower than the buttercup, so they weren't as much of a problem as they were in 2009. The *E. lanatum* field was looking pretty good in the spring but flowering was delayed due to the cool wet summer. Seed yields were dismal on this field last year and as an effort to boost seed production, the field was fertilized in April (after weeding the field). The fertilizer was applied using a belly grinder. This isn't the most effective way to apply fertilizer and it wasn't applied evenly, which left unfertilized strips across the field. This was helpful to be able to see how the fertilizer was affecting the plants. The plants that received the fertilizer were taller and bloomed longer. Seed yields were much higher in this field this year. It is assumed that the fertilizer had the largest affect on the yield, but the plants were larger this year (even without the fertilizer).

Table 2. Seed harvest in 2010 at the Corvallis Plant Materials Center.

Species	**Accession**	**Field size (ac)**	**Date harvested**	**Method**	**Yield**
Sidalcea virgata	9079536	0.25	July 7	direct combine, seed stripper	9 lbs
Eriophyllum lanatum	9079538	0.3	Aug 20/ Sept 10	swath/combine	75 lbs
Ranunculus occidentalis	9079564	0.15	June 4	seed stripper	8.5 lbs
Juncus tenuis	9079535	0.15	July 6	moon rover	26 lbs
Saxifraga oregana	9079537	0.15	June 8	hand	4 lbs
Symphyotricum hallii	9079540	0.2	Sept 26, Oct 12	seed stripper	4 lbs

The *Symphyotricum hallii* field was established in April of 2008 and the field has had a problem with a weedy annual *Epilobium* sp. The field has to be weeded several times during the growing season. This frequent scraping of the ground keeps the aster plants from getting crowded. The spring and summer of 2010 was very wet and cool. Many species grown on the PMC farm have never had problem with rust or other fungi, but this year the aster was covered with a leaf rust. It was hard to notice until the field was being weeded and it was seen on the pants of staff members. Leaves looked small but not deformed or sick. There are no labeled fungicides that could be applied to the asters, so PMC staff hoped that it would be okay. The rust went away as soon as the weather became hot and dry in July, but the plants never really recovered. They looked thin and didn't flower very much. They also flowered very late. The first harvest wasn't until October and the field was only harvested twice because the bloom time was so short. The field will be fertilized next year to see if that helps.

The *Sidalcea virgata* field flowered in June. The flowering time of this field was much longer than in other years. It was most likely affected by the weather. Very few pollinators were out during the time this field was flowering. The weather was very wet and cool. The plants did appear to make seed and no weevils or weevil damage was noticed. The field was direct combined and PMC staff carried a tarp, acting like a diaper, behind the combine to catch all the chaff that falls out the back. This kept the weed fabric much cleaner. After combining, the weed fabric was seed stripped. This year the seed stripper was attached at an extreme angle to be a better "street sweeper" this worked great on the weed fabric! While cleaning the seed, PMC staff noticed that a majority of the seed was empty. There were many factors that could have attributed to this issue. The field will be fertilized in early spring to see if that helps in 2011.

Figure 4. Rose checkermallow (*Sidalcea virgata*) seed increase field at the Corvallis PMC, May, 17, 2010.

IV. Delivery of Materials

Most of the seed that was produced this year and the aster from last year was delivered to Melanie Gisler on September 13th. The later maturing seed was not available at planting time and remains in the PMC seed storage facilities.

Table 3 . Seed delivery amounts and purity and germination tests results.

Species	Seed lot	Bulk Amount	Purity	TZ	PLS amt
Sidalcea virgata	B40-10-N18SV02	9.5 lbs	98.43%	76%	7 lbs
Ranunculus occidentalis	SG1-10-NS564	8.5lbs	92.87%	91%	7 lbs
Juncus tenuis	SG1-10-NS535	26 lbs	92.07%		
Symphyotricum hallii	B40-9-N18SH02	13 lbs	69.75%	77%	7 lbs
Saxifraga oregana	SG1-10-NS537	4 lbs	94.08%	91%	3.4 lbs

Cleaning *E. lanatum* seed is very difficult. The seeds are small and light. It can be challenging to decide where to set the air to blow out empty, non-viable seeds. The seed lot was cleaned very well and then the air settings were changed to see if more empty seeds could be blown out. Both seed lots were saved and tested. The heavier lot was sent in to the OSU lab to be certified. The lighter seed lot was only TZ tested for viability, since the purity should be about the same as the heavier lot. The test results showed that there wasn't much difference in viability between the two seed lots (58% for the heavy, 57% for the light). PMC staff members remain baffled on how to clean this seed to high levels of viability. A gravity table will be used next year.

Table 4. Seed in storage at the Corvallis Plant Materials Center, December 30, 2010.

Species	Seed lot	Bulk Amount	Purity	TZ	PLS amt
Symphyotricum hallii	B40-10-N18SH02	4 lbs	NA	NA	
Eriophyllum lanatum	B40-10-N17EL03	43lbs	98.31%	58%	24.5 lbs
Eriophyllum lanatum	SG1-10-NS583	32lbs	~ 90%	57%	~16 lbs

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

December 20, 2011

THE 2011 INSTITUTE FOR APPLIED ECOLOGY ANNUAL REPORT:

Figure 4. Rose checkermallow (*Sidalcea virgata*) seed increase field at the Corvallis PMC, May, 17, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement with the US Fish and Wildlife Service (USFWS) in 2007 to increase seed of Willamette Valley forbs to be used on restoration sites. The Institute for Applied Ecology (IAE) collected seed from remnant wet prairies across the Willamette Valley in 2005, 2006, and 2007 to create composite collections to be released to growers for seed increase. Traditional agronomic seed increase techniques were not successful for some species; these species were brought to the PMC for research and development. Wild collected seed was very limited for a few species; these species were also brought to the PMC. Activities in 2011 included harvest and maintenance of seed increase fields of six forbs and one rush.

II. Accessions Involved
The following table lists the accessions involved in the Willamette Valley Seed Increase Project at the Corvallis Plant Materials Center in 2011.

Table 1. Accessions in the Willamette Valley Seed Increase Project at the Corvallis Plant Materials Center in 2011.

Species	Common name	Code	Accession #	Activity in 2011[1]
Sidalcea virgata	rose checkermallow	SIVI3	9079536	Sfp,dlv
Eriophyllum lanatum	Oregon sunshine	ERLA6	9079538	Sfp,dlv
Ranunculus occidentalis	western buttercup	RAOC	9079564	Sfp,dlv
Juncus tenuis	poverty rush	JUTE	9079535	Sfp,dlv
Saxifraga oregana	Oregon saxifrage	SAOR 2	9079537	Sfp, dlv
Iris tenax	Oregon iris	IRTE	9109120	Pxn
Plectritis congesta	rosy plectritis	PLCO4	9109119	Sfp
Symphyotrichum hallii	Hall's aster	SYHA	9079540	Sfp, dlv

1- sfp= seed increase, pxn=plant production, dlv= delivered plant materials

III. Plant Production
Oregon iris (*Iris tenax*) was added to the production list in the fall of 2010. This species can be slow to establish and produce seed, so PMC staff decided to grow greenhouse plugs and transplant them into a seed increase field rather than directly sow the seed in the field. This extra step should provide the plants with the equivalent of another growing season. Normally, it could be year three or four before the plants produce their peak amount of seed.

On September 20, 2010, seeds were sown into 3.5 cubic inch cell trays filled with moistened media (Sunshine #1, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients) and placed in an outdoor shade house. The fall days were sufficiently warm for the plants to receive their "warm stratification". Trays of seeds were left outside until mid November, then were moved to a heated greenhouse set at 65°F days and 50° F nights. Seeds germinated within two weeks. Seedlings grew rapidly in the greenhouse, and the roots quickly began to spiral around the bottom of the short cells. In early January, the heat in the greenhouse was turned down 10°F each week for two weeks, then it was turned off completely. After two more weeks, plants were moved outside. Approximately 9,000 plants were grown. They were transplanted into a field in March.

IV. Seed Increase
Juncus tenuis plants grew tremendously during the spring of 2011 and the weed fabric had to be cut to allow room for growth. The field was weeded by hand a couple times during the growing season. The plants flowered later than usual, most likely due to the wet, cool spring. The plants flowered and the seed matured relatively evenly across the

entire field. Therefore the field was harvested by a self-propelled swather, nick-named the "moon rover". This machine cuts and sends all material up a conveyor belt where it can be collected into large bags. After being harvested, material was laid on tarps inside an open greenhouse to dry. PMC staff didn't realize how large the plants had become until it was time to cut them. There was twice as much material as there was in 2010. All the material had to be fed through the brush machine by hand to remove the seed from the capsules. This threshing method was labor intensive, but it definitely increased the amount of seed that was recovered from the field.

The *Saxifraga oregana* field was removed in the spring of 2011. IAE, USFWS, and other organizations salvaged corms from the field. They were very easy to remove from the field since they are very shallow. They also established well on a variety of sites. Transplanted culms produced flowering plants in the first growing season. Even though the culms were dug in an effort to remove the entire field, the majority of the plants came back. Since this species establishes so well from vegetative pieces, it might be better to establish a production field to harvest culms from, as well as seed.

Figure 1. Oregon sunshine (*Eriophyllum lanatum*) seed increase field at the Plant Materials Center, June 20, 2010.

The *E. lanatum* field was looking vigorous and weed-free in the spring, but flowering was delayed due to the cool, wet summer. The field was fertilized in April, following weeding. The plants were very tall this year (above the knee) and as usual the field was covered in flowers. Pollinators were observed on the flowers during the four weeks that the field was blooming. The most difficult part of increasing seed of this species is harvesting it, especially removing the seeds from the heads. Long spells of hot, dry weather help loosen the seed. There was only one week of hot weather this summer and it fell at the same time as the *E. lanatum* harvest. The field was swathed and combined at the end of the hot week. Seed was cleaned using an air screen machine. Last year's tests showed that lighter seeds are not less viable than heavier seeds. So this year, just the basic chaff and other plant materials were removed as well as very small or very flat seeds. Purity and viability was quite high in this seed lot and it was the highest yield ever seen on this field.

Table 2. Seed harvest in 2011 at the Corvallis Plant Materials Center.

Species	Accession	Field size (ac)	Date harvested	Method	Yield
Sidalcea virgata	9079536	0.25	July 8	direct combine	26 lbs
Eriophyllum lanatum	9079538	0.3	Aug 29	swath/combine	97 lbs
Plectritis congesta	9109119	0.04	June20-30	hand	0.5 lbs
Juncus tenuis	9079535	0.15	July 7	moon rover	95 lbs
Symphyotrichum hallii	9079540	0.2	Sept15- Oct20	seed stripper	13 lbs

The *Symphyotrichum hallii* field was established in April of 2008, and since then the field has had a problem with a weedy annual *Epilobium* sp. The field has to be weeded several times during the growing season. This frequent scraping of the ground also keeps the aster plants from getting crowded. The spring and summers of 2010 and 2011 were very wet and cool. Many species grown on the PMC farm have never had problems with rust or other fungi, but last year the aster was covered with a leaf rust. Leaves looked small but not deformed or sick. There are no labeled fungicides that could be applied to the asters, so PMC staff hoped the plants would survive. The rust went away as soon as the weather became hot and dry in July, but the plants didn't fully recover. They flowered weakly and produced little seed. However, the rust was not a problem in 2011. No rust was observed in late spring and the field was fertilized in April. Plants responded well to the fertilizer; they were more

Figure 3. PMC staff weeding the Hall's aster (*Symphyotrichum hallii)* seed increase field, May 20, 2011.

robust than ever and were covered with flowers. The fall was dry and warm, which greatly extends the harvest period for a late species like aster. The field was seed stripped three times in the fall. A large amount of fluff and seed was harvested, but once it was cleaned it wasn't much more than the first year's harvest of this field. This was surprising because the field looked like it had the potential to produce more seed. It will be fertilized again in spring of 2012 and PMC staff will consider a second summer fertilization near the time of seed set if there is rain to dissolve the fertilizer. If not, irrigation could be used.

The *Sidalcea virgata* field was established in 2007, and since then the yields have not been stellar. The plants are large and usually covered with flowers in the spring. Pollinators have been abundant at times during flowering, yet there is a large amount of empty seed evident during cleaning. This field is comprised of plants from many small isolated populations all over the Willamette Valley. PMC staff began to wonder if there was a breeding problem with the field or an environmental problem. To rule out some possible environmental problems, the weed fabric was removed from the majority of the field. Weed control is no longer an issue in the field, and improvements have been made in harvesting techniques without weed fabric. Staff thought that the weed fabric might be reducing the number of blooms per plant due to the flowering stems growing under the weed fabric. *S. virgata* tends to have a more spreading habit and new stems grow laterally, and consequently, under the fabric. It is a lot of work for PMC staff to crawl over the field, carefully pulling all the stems out from under the fabric. Many stems are broken in this process and most of these stems are flowering stems. Instead of pulling all the stems out from under the fabric this year, the fabric was removed, which left the stems intact. The weed fabric was left on a few rows and the stems were pulled from under the fabric. This left some plants to compare with the non-weed fabric plants. The field was fertilized in April and flowered later than usual due to the cool spring. Once the field flowered, very little difference in flower abundance was noticed between the side with weed fabric and the side without. The field flowered for a very long time this year. The PMC hosts a pollinator field day, usually in early June, and usually the *S. virgata* field is done flowering before this event occurs. However this year, the event was scheduled later than usual and the *S. virgata* field was still flowering. Harvest dates were also almost two weeks later than usual. The field was harvested by direct combining and the side with the weed fabric was also seed stripped. It did not appear that

Figure 3. Rosy plectritis (*Plectritis congesta*) flowers being pollinated at the Corvallis Plant Materials Center, June 10, 2011.

more material was harvested in 2011, but once the seed was cleaned it was apparent that there was much more filled seed in this lot than previous years. Fertilization or the extended bloom time could have been major factors in the boosted yield. The field will be fertilized again in 2012.

A new field of rosy plectritis (*Plectritis congesta*) was established by direct sowing in fall of 2010. Wild-collected seeds were sown on Oct 3, 2010, using a precision cone-seeder. Seeds were observed germinating 5 days after planting. While PMC staff were away on a plant delivery trip, slugs invaded the field and devoured most of the seedlings. Slug bait was applied as soon as staff returned, but most of the seedlings were lost. Slug bait was applied throughout the winter in hopes of thwarting off any more damage that might be caused to new germinants. The field was in very poor shape in the spring of 2011. There were very few plants and an abundance of weeds. PMC staff weeded around the plants and used backpack sprayers to spray out the rest of the weeds. The couple hundred plants that produced seed were carefully tended to and harvested every other day. Next year, plugs will be grown and transplanted into a field covered with weed fabric.

Figure 5. Newly planted Oregon iris (*Iris tenax*) seedlings in a seed increase field at the Corvallis Plant Materials Center, May 15, 2011.

Once transplanted, the *I. tenax* plants grew steadily throughout the summer. It was a nice growing season for transplants. Temperatures were moderate and there was soil moisture until early August, which is very rare. The irises grew quite well and a few even flowered in late summer. They were weeded multiple times during the growing season.

V. Delivery of Materials

Most of the seed that was produced this year and the aster from last year was delivered to Melanie Gisler in multiple shipments in the fall. The later maturing aster seed was not available at planting time and remains in the PMC seed storage facilities.

Table 3 . Seed delivery amounts and purity and germination tests results.

Species	Seed lot	Bulk Amount	Purity %	TZ%	PLS amt
Symphyotrichum hallii	B40-10-N18SH02	4 lbs	64.71	51	1.3 lbs
Eriophyllum lanatum	B40-10-N17EL03	43lbs	98.31	58	24.5 lbs
Eriophyllum lanatum	SG1-10-NS583	32lbs	~ 90	57	~16 lbs
Sidalcea virgata	SG1-11-NS536	26 lbs	97.18	94	24 lbs
Eriophyllum lanatum	SG1-11-NS583	60 lbs	91.84	70	38 lbs
Juncus tenuis	SG1-11-NS535	95 lbs	96.6	85	77.5 lbs

Table 4. Seed in storage at the Corvallis Plant Materials Center, December 30, 2010.

Species	Seed lot	Bulk Amount
Symphyotrichum hallii	SG1-11-NS540	13
Plectritis congesta	SG1-11-NS119	0.5 lbs
Eriophyllum lanatum	SG1-11-NS583	45 lbs

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Amy Bartow

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THE 2010 US FISH AND WILDLIFE SERVICE ANNUAL REPORT:
Oregon Silverspot Butterfly Seed Increase Project

Figure 1. Early blue violet (*Viola adunca*) seed increase field at the Corvallis Plant Materials Center, April 20, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement with the US Fish and Wildlife Service (USFWS) in 2005 to increase seed of early blue violet (*Viola adunca*) for use in recovery efforts for the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). In 2007, the Siuslaw District of the United States Forest Service (USFS) became a new partner in the agreement with USFWS. The butterfly has become threatened due to the degradation and loss of its coastal meadow habitat. The early blue violet is the obligate host to the silverspot caterpillars and has been negatively impacted in its coastal meadow ranges by the encroachment of tall, spreading exotic plants. Coastal red fescue, (recently renamed sand fescue, *Festuca ammobia*) is included in this agreement as a matrix species in the coastal meadows. Most of the forbs included in this project are nectar sources for the adult butterflies.

Activities in 2010 included plug production of three forbs, establishment of two new forb seed increase fields, and maintenance and harvest of one grass and ten forb seed increase plots.

II. Accessions Involved

The following table lists the accessions involved in this project.

Table 1. Accessions in the USFWS Oregon Silverspot seed increase project.

Species	Common name	Symbol	Accession	Activity in 2010[1]
Achillea millefolium	common yarrow	ACMI2	9079448	Sfp, Dlv
Anaphalis margaritacea	pearly everlasting	ANMA	9079451	Sfp
Aster chilensis	pacific aster	ASCH2	9079449	Sfp, Dlv
Soildago canadensis	goldenrod	SOCA6	9079497	Sfp
Festuca amobia	sand fescue	FERU	9079450	Sfp, Dlv
Viola adunca	early blue violet	VIAD	9079406	Sfp, Pxn,Dlv
Solidago simplex spp simplex var spathulata	dune goldenrod	SOSISP	9079561	Sfp
Tanacetum camphoratum	camphor tansy	TACA2	9079559	Sfp
Artemisia suksdorfii	coastal wormwood	ARSU	9079560	Sfp
Trifolium wormskijoldii	sand clover	TRWO	9079619	Sfp
Cirsium edule	edible thistle	CIED	9079620	Sfp

1- sfp= seed increase, col= wild seed collection, pxn=plant production, dlv=delivered plant materials

III. Seed Increase

Figure 2. Early blue violet (*Viola adunca*) seed increase field with wind fence, mouse traps, bird tape and bird netting at the Corvallis Plant Materials Center, June 26, 2010.

A large seed increase plot of *V. adunca* was established in the spring of 2009 using 4200 plants that were produced in 2008. A sheet of weed fabric was stapled down over the field, then holes were cut in the fabric and plants were transplanted into the ground through the holes. As the violet plants grew, they spread out onto the weed fabric. When they flowered and seed pods matured, the pods released the seed onto the weed fabric. The plants were covered with seed pods this year! In late May, just as the first round of pods were maturing, mice invaded the plot, caching pods in piles on the side of the field. Mouse traps were set all over the plot and many mice were caught within the first two days and predation on the pods ceased. Without the damage from the mice, the pods were shattering and seeds were piling up on the fabric. A "wind fence" was put up around the plot using fence posts and weed fabric to keep seeds from blowing off the fabric. A flock of doves eating seeds off the fabric became a regular site inside the windfence. Flashy bird tape was put up all over the plot as a deterrent, but the flock just grew larger. Finally, the PMC purchased bird netting and enclosed the entire plot. This was effective, but if a hole opened up in the net, the birds quickly entered the enclosure. Once all the pests were excluded, the amount of seed piling up on the fabric was very impressive. Battery-powered vacuums were used to collect the seed from the fabric. Staff would take turns and spend about and hour and a half twice per week vacuuming the plot throughout July, August, and mid September. The plants stopped producing pods in early September. Even though this harvest method was time consuming, the amount of seed collected was amazing. The dirt, leaves, dove scat, seeds, ect that were vacuumed from the fabric filled a small child's plastic pool. Once cleaned, the seed weighed 40 lbs! If this amount of seed can be produced every year, direct sowing will be a viable option for establishing more violets on restoration sites.

Figure 3. PMC staff weeding Canada goldenrod seed increase field and the PMC farm, April 20, 2010.

Seed increase plots of *Aster chilensis, Anaphalis margaritacea*, and *Solidago canadensis* were established using plugs in the spring and fall of 2009. Early in the spring, the plants were growing very slowing and the fields were covered with weeds. Over 150 hours were spent weeding these fields. After weeding in April, the goldenrod, pearly everlasting, yarrow, and violet fields were fertilized. All the fields were weeded by hand numerous times during the growing season. As the temperatures warmed up, the goldenrod and pearly plants grew very fast. The asters grew steadily throughout the year. The Canada goldenrod plants began to bloom in early July and were harvested by hand for the first time on August 12. PMC staff had never tried seed stripping the goldenrod so a conservative approach was taken towards the field this year. All the early maturing flower heads were hand harvested multiple times. Once the field had reached peak maturity, it was seed stripped. The seed stripper appeared to damage flowers, but left the plants intact, and removed all the seed that was ripe. The seed stripper should not be used to harvest goldenrod when many flowers are present. It is a great method once

Figure 4. Canada goldenrod (*Solidago canadensis*) seed increase field, July 28, 2010.

the plants are mostly done flowering but are forming seeds. The machine did not seem to damage or remove immature or “green” seed. The field was seed stripped three times during the summer and fall. PMC staff took this same idea and applied it to the pearly everlasting field. The field was harvested by hand until the majority of the plants were finished flowering and there was a lot of ripe seed present in the field. This field was seed stripped twice, once at peak maturity and once late in the season. PMC staff has experience with seed stripping the asters and has seen that aster flowers are not damaged by the machine. The field was seed stripped multiple times. The tractor tires damage the plants by running over the same plants multiple times. When starting a field, it should be built with “lanes” for the tractor tires. PMC staff tried to avoid harvesting the field when it was really warm and there were lots of pollinators on the plants. Bees and other insects do not move

Figure 5. Pearly everlasting (*Anaphalis margaritacea*) seed increase field at the Corvallis PMC, July 28, 2010.

out of the way of the seed stripper and will be sucked up and severely wounded. If the field had to be harvested when lots of pollinators were out, a person would walk in front of the seed stripper (at a safe distance) and try to herd the bees out of the field.

Figure 6. Sand clover (*Trifolium wormskijoldi*) seed increase field at the Corvallis PMC, June 30, 2010.

Two new fields were established in 2010. Seeds of sand clover (*Trifolium wormskijoldii*) and edible thistle (*Cirsium edule*) were provided to the PMC in the fall of 2009 and were grown out in the fall/winter of 2009/2010. When soil conditions were favorable in March, plugs were transplanted into seed increase fields using a mechanical transplanter (pulled behind a tractor). The plugs of both species grew moderately in early summer. A few thistles bloomed this year, but most of them didn't flower, which is typical of biennial plants. All of the clover plants flowered and they were covered with blooms for most of the summer. They were harvested twice by hand during the summer. The seed heads are so low to the ground that they cannot be harvested with machinery. Growing them densely might force the plants to grow up instead of out, and then they could be harvested mechanically.

Figure 7. Edible thistle (*Cirsium edule*) seed increase field at the PMC farm, June 20, 2010.

The dune goldenrod and tansy fields were established using plugs in the spring of 2008. Both fields reached their peak seed production last year and need to be fertilized every other year in order to maintain this level of production. They were not fertilized in 2010 and need to be in 2011. Both fields were harvested by hand. The tansy was harvested once in September and the dune goldenrod was harvested multiple times very late in the summer and in early fall. This plant blooms so late on the PMC farm that pollination can easily be interrupted by cool tempatures and rain.

Figure 8. Coastal wormwood (*Artemisia suksdorfii*) seed increase field at the Corvallis Plant Materials Center, July 28, 2010.

The coastal wormwood (*Artemisia suksdorfii)* field was established from plugs in the fall of 2009. It did not flower this year. The plants grew vigorously in the summer and will most likely bloom successfully next year. It is suspected that the plugs were not large enough last winter to be completely vernalized. This species usually will not flower on its first year.

Table 2. Yields in 2010 for the USFWS Oregon Silverspot seed increase project.

Species	Code	method	Harvest Date	Area	Yield (bulk lbs)
Achillea millefolium	ACMI2	seed stripper	Aug 17, Aug 24	0.15	6
Viola adunca	VIAD	vac weed fabric	May 30- Sept 15	0.2	40
Tanacetum camphoratum	TACA2	hand	Sept 6	0.08	17
Anaphalis margaritacea	ANMA	vac, seed stripper	Aug 22- Sept 25	0.2	2.3
Aster chiliensis	ASCH	seed stripper	Aug 26- Oct 30	0.3	25
Soildago canadensis	SOCA	hand, seed stripper	Aug 15- Oct 15	0.2	36
Trifolium wormskijoldii	TRWO	hand	July 20- Aug 30	0.2	6.5
Festuca ammobia	FEAM	seed stripper	July10, 17	0.51	110
Solidago simplex var spathulata	SOSP	Hand, sicklebar-mower	Sept 29- Nov 3	0.08	2

The *Achillea millefolium* field was spot-sprayed with glyphosate in spring and hand weeded twice in the summer of 2010. This field was established in 2007 by direct seeding. It is becoming overtaken by exotic grasses that are hard to remove. The plot needs to be re-established in a new site in the spring of 2011. This year, the seed stripper was used to harvest the field. This method brushes the seed from the plant and collects it in a hopper. Very little plant material is collected this way. Seed and chaff were dumped onto a tarp and placed in a shed to dry. Once dry, the seed was cleaned using an air-screen machine.

F. ammobia field was infested with non-native bentgrass and ryegrass. The field was hand weeded many times and spot applications of glyphosate were used to control weeds. The field was very vigorous and flowered well. The older stand that bloomed last year (fall sown 2007) did not bloom as well this year. It is not known for sure what caused the lowered production on this section of the field. Plants are becoming crowded as they grow. The section that did not bloom last year (spring sown in 2008) bloomed much more than the other section. Both sections of field were sprayed with fungicides to control rust. The field was seed stripped this year rather than swathed and combined like last year. This is a good method for harvest and can be done multiple times. Each section of field was harvested twice.



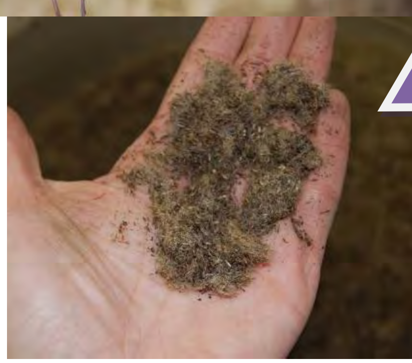

Figure 9. After harvest, aster seed is placed in the brush machine to break the pappas away from the seeds.

Handling and cleaning seed of the species that have a large amount of pappas can be difficult and time consuming. Piles of fluff that come out of the hopper on the seed stripper are laid on tarps and placed in enclosed sheds or an open greenhouse to dry. Most of these species are being harvested later in the season which means that they are damp when harvested and the humidity is high. This makes the fluff very hard to dry. It has to be turned frequently and fans can be set up around the fluff to help move air, but the fans cannot be directed onto the fluff or it will blow away. As the fluff is dried, it can be run through a large brush machine to break everything up. The result is a mass of fine fluff that takes up much less space. Once it is brushed, it can be stored in 30-gallon garbage barresl. This protects the seed from humidity and mice. For the largest field, the aster, these piles of fluff filled 12 30-gallon barrels. It was then put into a large air-screen machine. The “Crippen” is a two-screen machine that uses rubber balls inside of trays under the screens to help the material flow down the screens. The number of balls in the tray can be adjusted depending on what type of seed is being cleaned: very few or no balls to clean easy flowing seeds like lupine, and many balls for hard to sift seed lots. Using many balls helps break up the fuzzballs and sift the seeds out of the fluff. After one run through the Crippen, the 12 30-gallon barrels of fluff and aster seed was reduced to about two 30-gallon barrels of fine sticks, seed, and chaff. A small air-screen machine and an air density separator were used for fine cleaning.

Table 3. 2010 seed increase field sizes at the Corvallis Plant Materials Center for the USFWS Oregon Silverspot seed increase project.

Species	Common name	Symbol	Accession #	Field size (ac) at the end of 2010
Achillea millefolium	common yarrow	ACMI2	9079448	0.15
Anaphalis margaritacea	pearly everlasting	ANMA	9079451	0.2
Aster chilensis	pacific aster	ASCH2	9079449	0.3
Soildago canadensis	goldenrod	SOCA6	9079497	0.2
Festuca ammobia	sand fescue	FERU	9079450	0.51
Viola adunca	early blue violet	VIAD	9079406	0.15
Tanacetum camphoratum	camphor tansy	TACA2	9079559	0.08
Artemisia suksdorfii	coastal wormwood	ARSU	9079560	0.1
Trifolium wormskijoldii	sand clover	TRWO	9079619	0.2
Cirsium edule	edible thistle	CIED	9079620	0.2
Solidago simplex spp simplex var spathulata	dune goldenrod	SOSISP	9079561	0.1

IV. Container Plant Production.

Figure 10. Edible thistle (Cirsium edule) plugs waiting to be transplanted at the Corvallis PMC, February 10, 2010.

Seeds of sand clover and edible thistle were sown into 1020 plug trays in the fall of 2009. The flats were placed in a warm greenhouse and seeds readily germinated. Some flats were placed outside in fall conditions. These flats showed some germination but at a much slower rate. It is best to germinate both of these species under warm conditions. Plants remained in the warm greenhouse until late December, and then they were moved to a cooler greenhouse. Temperatures were slowly lowered until the temperature in the greenhouse matched outdoor temperatures. In February, plants were moved outside to a shadehouse to acclimate before transplanting them into a seed increase field.

On January 12, 2010 24g of *V. adunca* seed were sown into 4410 Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix) and lightly covered with fine vermiculite. Seeded flats of violets were placed in polyethylene bags and moved into a walk-in cooler (36-38^{o} F) for four months. After stratification, they were moved to a warm greenhouse. Flats were moved to an outdoor shadehouse in late June.

V. Delivery of Materials

4000 Violet plants were picked up by USFWS staff on September 30, 2010. Fescue and violet seed was also given to USFWS and USFS staff to use in replanting areas that had been covered with weed fabric for two years (to remove existing vegetation). Seed was also provided to The Nature Conservancy to plant Safe Harbor sites.

Table 4. Seed delivered in 2010 for the Oregon Silverspot seed increase project.

Species	Code	Seed lot	Amount delivered	Recipient
Viola adunca	VIAD	SG1-09/10-OS406	5.6 lbs	Debbie Pickering TNC
Festuca ammobia	FEAM	SG1-09-OS450	3 lbs	Debbie Pickering TNC
Achillea millefolium	ACMI2	SG1-08-OS448	0.5 lbs	Debbie Pickering TNC
Aster chilensis	ASCH	SG1-09-OS449	0.5lbs	Debbie Pickering TNC
Viola adunca	VIAD	SG1-07-OS406	200g	Beaver Lake Nursery
Viola adunca	VIAD	SG1-07-OS406	100 g	Oregon Zoo
Viola adunca	VIAD	SG1-10-OS406	1.5 lb	USFS
Festuca ammobia	FEAM	SG1-09-OS450	38 lbs	USFS

All seed that has been produced for this project and has not been delivered will remain in the PMC seed storage facilities until requested. Samples of seed produced from the PMC fields were sent to the Oregon State University Seed Lab for purity and germination testing. This information is important for calculating pure live seed amounts (pls) for each seed lot. OSU seed lab usually performs the germination tests by first exposing the seed to 7 days of cool moist conditions before being placed in warm temperatures. This pre chill was omitted this year and germination results were much lower than in previous years when the pre chill was implemented. PMC staff performed germination tests in using both pre chill and no pre chill with the same seed lots and found germination rates to be significantly lower in the tests that did not of the prechill. PMC germination tests found the seed lots to have about 60% germination. This difference needs to be considered when calculating PLS amounts for these seed lots.

Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle number of a seed lot indicates which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (OS is for the Oregon Silverspot butterfly) and includes the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 6. Seed in storage at the Corvallis Plant Materials Center for the Oregon Silverspot seed increase project.

Species	Code	Seed lot	Yield (bulk lbs)	Purity	Germ	PLS weight
Achillea millefolium	ACMI2	SG1-10-OS448	6	87.60	92	4.83 lbs
Achillea millefolium	ACMI2	SG1-09-OS448	8	76.12	93	7 lbs
Achillea millefolium	ACMI2	SG1-08-OS448	6.5	87.72	94	5.77 lbs
Achillea millefolium	ACMI2	SG1-07-OS448	6	57.55	91	3.14 lbs
Achillea millefolium	ACMI2	SWC-07-OS448	0.5	-	-	-
Viola adunca	VIAD	SG1-10-OS406	35	97.08	91	31.80 lbs
T. camphoratum	TACA2	SG1-10-OS559	17	74.41	37	4.68 lbs
T. camphoratum	TACA2	SG1-09-OS559	23	58.39	37	5 lbs
Anaphalis margaritacea	ANMA	SG1-10-OS451	2.3	-	-	-
Anaphalis margaritacea	ANMA	SG1-09-OS451	0.5	-	-	-
Aster chilensis	ASCH	SG1-10-OS449	25	64.38	41*	6.6 lbs*
Aster chilensis	ASCH	SG1-09-OS449	7.5	61.99	58	2.87 lbs
Soildago canadensis	SOCA	SG1-10-OS497	36	91.86	27*	8.93 lbs*
Soildago canadensis	SOCA	SG1-09-OS497	1.4	65.75	53	0.48 lbs
Festuca ammobia	FEAM	SG1-09-OS450	57	98.88	94	53 lbs
Festuca ammobia	FEAM	SG1-10-OS450	110	90.85	75	74 lbs
S. simplex var spathulata	SOSP	SG1-09-OS561	2	65.75	53	0.69 lbs
S. simplex var spathulata	SOSP	SG1-10-OS561	2	57.29	19*	0.22 lbs*
Trifolium wormskijoldii	TRWO	SG1-10-OS619	6.5	-	-	-

*OSU seed lab germination tests were performed without a 7 day pre-chill, these tests appear to have a lower germination rates than ones performed at the PMC using a 7 day pre-chill.

CORVALLIS PLANT MATERIALS CENTER
USDA NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

December 28, 2011

THE 2011 US FISH AND WILDLIFE SERVICE ANNUAL REPORT:
Oregon Silverspot Butterfly Seed Increase Project

Figure 1. An array of pollinators was found on the edible thistle (Cirsium edule) seed increase field at the Corvallis Plant Materials Center, May 30, 2011.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement with the US Fish and Wildlife Service (USFWS) in 2005 to increase seed of early blue violet (*Viola adunca*) for use in recovery efforts for the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). In 2007, the Siuslaw District of the United States Forest Service (USFS) became a new partner in the agreement with USFWS. The butterfly has become threatened due to the degradation and loss of its coastal meadow habitat. The early blue violet is the obligate host for the silverspot caterpillars, and has been negatively impacted in its coastal meadow ranges by the encroachment of tall, spreading, exotic plants. Coastal red fescue, recently renamed sand fescue (*Festuca ammobia)*, is included in this agreement as a matrix species in the coastal meadows. Most of the forbs included in this project are nectar sources for the adult butterflies.

Activities in 2011 included maintenance and harvest of one grass and ten forb seed increase plots, as well as development and application of seed mixes on three sites in the Critical Habitat Area.

II. Accessions Involved

The following table lists the accessions involved in this project.

Table 1. Accessions in the USFWS Oregon Silverspot seed increase project.

Species	Common name	Symbol	Accession	Activity in 2011[1]
Achillea millefolium	common yarrow	ACMI2	9079448	Dlv
Anaphalis margaritacea	pearly everlasting	ANMA	9079451	Dlv
Aster chiliensis	Pacific aster	ASCH2	9079449	Sfp, Dlv
Solidago canadensis	Canada goldenrod	SOCA6	9079497	Sfp
Festuca ammobia	sand fescue	FEAM5	9079450	Sfp, Dlv
Viola adunca	early blue violet	VIAD	9079406	Sfp, Dlv
Solidago spathulata	dune goldenrod	SOSISP	9079561	Sfp
Tanacetum camphoratum	camphor tansy	TACA2	9079559	Sfp
Artemisia suksdorfii	coastal wormwood	ARSU4	9079560	Sfp
Trifolium wormskioldii	sand clover	TRWO	9079619	Sfp
Cirsium edule	edible thistle	CIED	9079620	Sfp

1- sfp= seed increase, col= wild seed collection, pxn=plant production, dlv=delivered plant materials

III. Seed Increase

A large seed increase plot of *V. adunca* was established in the spring of 2009 using 4,200 plants that were produced in 2008. A sheet of weed fabric was stapled down over the field, then holes were cut in the fabric and plants were transplanted into the ground through the holes. As the violet plants grew, they spread out onto the weed fabric. When they flowered and seed pods matured, the pods released the seed onto the weed fabric. Over the past two years, the plants have gotten larger. Growing these plants is very easy, but keeping pests from stealing all the seeds is difficult. As soon as seed pods appeared on the plants, mouse traps were set all over the plot and many mice were caught within the first two days. A “wind fence” was put up around the plot using fence posts and weed fabric to keep seeds from blowing off the fabric. Bird netting had to be installed over the plot to keep birds from eating seed off the fabric. If pests can be excluded, seeds pile up on the fabric and can be vacuumed up as the plants are done flowering. The plants bloom and set seed over a long period in the summer. Usually, most of the plants are done flowering by July and vacuuming begins in late July. PMC staff used a gas-powered generator and two shop-vacs to harvest the seed from the fabric. Using two vacuums at once cut down on the amount of time it took to harvest the field. The plants stopped producing pods in early September, and the entire plot was vacuumed again. Even though this harvest method was time consuming, the amount of seed collected was amazing. The dirt, leaves, dove scat, seeds, etc. that were vacuumed from the fabric filled a small, child’s plastic pool. Seed was then cleaned using an air-screen machine. Yields in 2011 were very close to the yields from 2010. Plants appear to be long-lived and can hopefully maintain this amount of seed production for a couple more years.

Seed increase plots of *Aster chilensis, Anaphalis margaritacea*, and *Solidago canadensis* were established using plugs in the spring and fall of 2009. The fields were very weedy in 2010 and PMC staff weeded the fields by hand numerous times during the growing season. In 2011, the fields were less weedy and only needed to be weeded twice. After weeding in April, the goldenrod, aster, and violet fields were fertilized.

The Canada goldenrod plants began to bloom in early July and were harvested by hand for the first time on August 10th. The seed stripper appears to damage goldenrod flowers, so the field is not seed stripped until the plants have finished flowering. All the early maturing flower heads were hand harvested twice a week for two weeks. Once the field had reached peak maturity, it was seed stripped. This is a great method once the plants are mostly done flowering and are forming seeds. The machine did not seem to damage or remove immature or "green" seed. The field was seed stripped two times during the summer and fall.
The aster field matures later and it is also seed stripped. PMC staff have experience with seed stripping the asters and have seen that aster flowers are not damaged by the machine. The field was seed stripped multiple times over two months. The tractor tires damage the plants by running over the same plants multiple times. When starting a field, it should be built with "lanes" for the tractor tires. PMC staff tried to avoid harvesting the field when it was really warm and a large amount of pollinators were present. Bees and other insects do not move out of the way of the seed stripper and will be sucked up and severely wounded or killed.

Figure 2. Sand clover (*Trifolium wormskioldii*) and many other seed increase fields awash with color at the Corvallis Plant Materials Center, May 30, 2011.

Two new fields were established in 2010. Seeds of sand clover (*Trifolium wormskioldii*) and edible thistle (*Cirsium edule*) were provided to the PMC in the fall of 2009 and were grown out in the fall/winter of 2009-2010. The thistle plot did not flower in 2010, which was expected because this plant is thought to be a biennial. In late spring 2011, the thistle plants grew rapidly and were covered with buds. The PMC farm has a moderate amount of wildlife. It borders natural areas and has resident populations of many raptors, and some songbirds.

Goldfinches have never been a problem and haven't even really been noticed on the farm until the thistle plot was in bud stage. A large flock of goldfinches took up residence in the thistles even before the plants were flowering. PMC staff attempted to drive the birds out of the field, but they would just fly to one side or the other.

Figure 3. Goldfinches eating seed of edible thistle (*Cirsium edule*) as they ripened in a seed increase field at the Corvallis Plant Materials Center, May 25, 2011.

Aside from the birds, the plot also attracted an array of pollinators. The finches began to eat the seed as it was ripening, so when about 20% of the heads were ripe, the mature heads were harvested by hand. Walking though the plot was more painful than grabbing the flowerheads. PMC staff did not enjoy harvesting the seed this way and a mechanized technique needed to be developed. While harvesting, a large number of damaged seed heads were observed. Upon closer inspection, the heads appeared to be infested with weevils. Also, some plants were stunted and wilting. These plants were pulled up and examined. Most of these plants had stem damage that is consistent with a stem borer. The number and diversity of insects present in this field was amazing. There were many pollinators and beneficial insects, but there were also a lot of pests. Early in the season, some plants were damaged by severe infestations of cucumber beetles. Once spring arrived and plants were growing rapidly, they were able to outgrow the damage. The most extensive damage was from the seed weevils. After most the seed was mature, the moon rover was used to harvest the entire remaining plants. This worked well because staff did not have to handle the plants. Material was laid on tarps to dry and was later fed through a combine to remove the seed. Only ten pounds of seed was recovered from the field. Most of the seed came from the first harvest that was made by hand. The weevils destroyed the second harvest. If this species is to be grown again at the PMC, a small, highly-managed plot is preferred. A small plot could be protected from the birds and could be sprayed at the appropriate time to prevent weevil and stem borer damage.

Figure 5. Harvesting the edible thistle (*Cirsium edule*) field using the moon rover. Rakes were used to move material from the conveyor belt to the tarp, to reduce handling by PMC staff.

Compared to the thistles, the seed production of sand clover was much simpler and was problem free. All of the clover plants flowered and they were covered with blooms for most of the summer. In 2011, they had spread to create a closed canopy and the centers of the plants were tall enough to harvest with the seed stripper. The seed stripper did not remove all of the seed, but it did recover a large amount of seed. If the plants were taller, it would be more effective. The field will receive multiple applications of fertilizer in 2012 to see if plants can grow taller.

The dune goldenrod and tansy fields were established using plugs in the spring of 2008. Both fields reached their peak seed production year in 2010, and need to be fertilized every other year in order to maintain this level of production. The tansy was harvested in September by swathing and combining, and the dune goldenrod was harvested by hand multiple times very late in the summer and in early fall. The dune goldenrod blooms so late on the PMC farm that pollination can easily be interrupted by cool temperatures and rain in the fall.

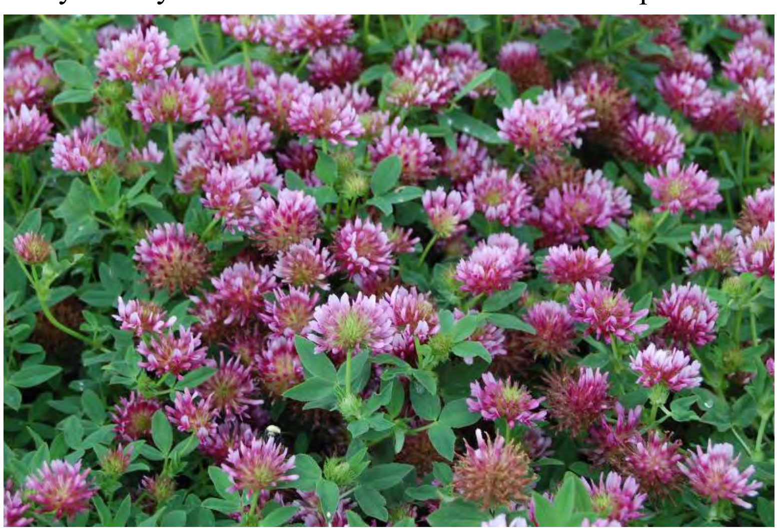

Figure 6. Sand clover (*Trifolium wormskioldii*) seed increase field at the Corvallis Plant Materials Center, June 12, 2011.

The coastal wormwood (*Artemisia suksdorfii)* field was established from plugs in the fall of 2009. It did not flower in 2010, but it did in 2011. The plants were quite tall and had many seedheads. The field was harvested using the moon rover. Material was laid on tarps to dry. Once it was dry it was fed through a combine to thresh the seed from the plant material.

Table 2. Yields in 2011 for the USFWS Oregon Silverspot seed increase project.

Species	Code	Method	Harvest Date	Area (ac)	Yield (bulk lbs)
Viola adunca	VIAD	vac weed fabric	8/2-8/12	0.2	37
Tanacetum camphoratum	TACA2	swath/combine	8/30	0.08	39
Aster chiliensis	ASCH	seed stripper	9/10-10/20	0.3	41
Artemisia suksdorfii	ARSU4	moon rover	8/25	0.11	23
Solidago canadensis	SOCA6	hand, seed stripper	9/2-9/15	0.2	77
Trifolium wormskioldii	TRWO	seed stripper	7/28/-8/18	0.2	110
Festuca ammobia	FEAM	seed stripper	7/14	0.51	167
Cirsium edule	CIED	hand, moon rover	7/1-7/15	0.15	10
Solidago spathulata	SOSIS4	hand	10/12-11/13	0.08	1

The *F. ammobia* field is infested with non-native bentgrass and ryegrass. Multiple times per year the field is walked and weedy grasses are wiped with a glyphosate mixture. The field has become much cleaner in the last two years. As the plants mature, the crowns are growing together. It is not known how this will affect seed production. Yields were higher this year than they were last year. Post harvest management also seems to affect seed yields with this species. Studies on other fescues at the PMC have shown that seed yields can decrease in the growing season after a low mowing in the fall. Since there is an abundance of seed in storage of this species and the field at the PMC is large, an experiment was overlaid on the production field. A large portion was burned in the fall, and the other portion was mowed at various heights or not mowed at all. In 2012, plots will be evaluated for seed yields.

Figure 7. Coastal wormwood (*Artemisia suksdorfii*) seed increase field at the Corvallis Plant Materials Center, July 28, 2010.

IV. Container Plant Production

In the summer of 2011, seeds of violets from Mt. Hebo and *Danthonia californica* from Cascade Head were sown into stubby cone-tainers filled with Sunshine #1 soil-less media amended with a slow-release fertilizer and micro-nutrients. Flats of cones were placed in plastic bags and then in a walk-in cooler for cold-moist stratification to break seed dormancy. *D. californica* seeds were removed from the cooler after 90 days are were placed in a lath house in early September. Seeds germinated within two weeks. Germination was low and many weeds were present in the cones, which must have been in the seed collection. Violet seeds remained in the cooler for 120 days and then were moved to a greenhouse in early October. *D. californica* plants will spend the winter outside and be transplanted into a seed increase field in March of 2012. The violets will be hardened off and moved outside in January 2012, and transplanted into a seed increase field in March of 2012.

V. Delivery of Materials

In 2010, about an acre of salal was mowed and chipped in Area 7 (south of Yachats, near Big Creek). Chips were left on site and were too thick for seedlings to get established, so chips were removed in the fall of 2011 leaving bare ground. This site was sown with three different mixes: a mix that can tolerate mowing and also has a high amount of violets, a higher growing mix of mostly nectar species that is less tolerant of mowing and does not include violet, and a heavy mix of fescue and sand clover as a border to help slow weed invasion. Two large sections of this site were also heavily planted with violet plugs.

Table 4. Seed mixes sown in October 2011, for the recovery of the Oregon silverspot butterfly.

Mix	Species	Bulk lbs/ac	seeds per Sq ft
Area 7	*Solidago spathula*	1	50
mow	*Trifolium wormskioldii*	1	15
	Festuca ammobia	2	40
	Viola adunca	2	50
	Tanacetum camphoratum	1	30
Area 7	*Festuca ammobia*	2	40
no mow	*Solidago canadensis*	2	200
	Aster chilensis	1	50
	Achillea millefolium	1	60
	Cirsium edule	1	
Big	*Viola adunca*	10	250
Creek	*Festuca ammobia*	4	80
	Solidago canadensis	4	400

	Aster chilensis	4	150
	Achillea millefolium	1	60
	Cirsium edule	3	2

Seed mixes were developed for two other sites. In the Big Creek Preserve, small plots needed to be seeded following tree removal. The mix contained a very high rate of violets, but was also quite diverse. The other site was about an acre and needed to be sown following blackberry removal. PMC staff were not quite convinced that this site would be successful due to the persistence of blackberry. A mix without violets was developed. The mix included a high rate of fescue and also more aggressive nectar species like aster and yarrow. Violet plugs were also planted on this site, and as blackberry plants are removed, more violets can be added in the future using plugs or seed.

PMC staff assisted with the planting of the sites after the seed mixes were prepared. Sites were sown using a hand-crank fertilizer spreader in mid-October. Sites will be evaluated in the spring.

Table 5. Seed delivered in 2011 for the Oregon Silverspot seed increase project.

Species	Seed lot	Amount delivered	Recipient
Viola adunca	SG1-10-OS406	10 lbs	Debbie Pickering TNC
Festuca ammobia	SG1-09-OS450	4 lbs	Debbie Pickering TNC
Solidago canadensis	SG1-10-OS497	4 lbs	Debbie Pickering TNC
Aster chilensis	SG1-09-OS449	4 lbs	Debbie Pickering TNC
Achillea millefolium	SG1-07-OS448	1 lb	Debbie Pickering TNC
Cirsium edule	SG1-10-OS620	3 lbs	Debbie Pickering TNC
Solidago spathulata	SG1-09-OS561	1 lb	USFWS Anne Walker
Trifolium wormskioldii	SG1-11-OS619	4 lbs	USFWS Anne Walker
Festuca ammobia	SG1-09-OS450	6 lbs	USFWS Anne Walker
Viola adunca	SG1-10-OS406	2 lbs	USFWS Anne Walker
Tanacetum camphoratum	SG1-09-OS559	1 lbs	USFWS Anne Walker
Solidago canadensis	SG1-10-OS497	2 lbs	USFWS Anne Walker
Aster chilensis	SG1-09-OS449	1 lb	USFWS Anne Walker
Achillea millefolium	SG1-07-OS448	1 lb	USFWS Anne Walker
Cirsium edule	SG1-11-OS620	1 lb	USFWS Anne Walker
Anaphalis margaritacea	SG1-09-OS451	3.5g	Oregon Zoo
Aster chilensis	SG1-09-OS449	2 g	Oregon Zoo
Viola adunca	SG1-10-OS406	50 g	Oregon Zoo
Solidago canadensis	SG1-10-OS497	3 g	Oregon Zoo
Tanacetum camphoratum	SG1-09-OS559	2 g	Oregon Zoo
Cirsium edule	SG1-10-OS620	7 g	Oregon Zoo
Artemisia suksdorfii	SWC-07-OS560	7 g	Horning Nursery

Solidago canadensis	SG1-10-OS497	40 g	Horning Nursery
Festuca ammobia	SG1-09-OS450	4 lbs	USFS Marty Bray
Achillea millefolium	SG1-07-OS448	1 lb	USFS Marty Bray
Solidago canadensis	SG1-10-OS497	1 lb	USFS Marty Bray
Aster chilensis	SG1-10-OS449	1 lb	USFS Marty Bray

All seed that has been produced for this project and has not been delivered will remain in the PMC seed storage facilities until requested. Samples of seed produced from the PMC fields were sent to the Oregon State University Seed Lab for purity and germination testing. This information is important for calculating pure live seed amounts (PLS) for each seed lot.

Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle number of a seed lot indicates which year the seed was produced. The last portion of the seed lot describes which project the seed is for (OS is for the Oregon Silverspot butterfly) and includes the last three digits of the accession number that has been assigned to this species specifically for this project. Aside from individual bags of seed, there are also two seed mixes that were prepared but not delivered. They remain in the seed storage facilities and will hopefully be sown on sites in the fall of 2012. There are two bags which each contain 10 lbs of violet, 4 lbs of fescue, 1 lb of yarrow, 4 lbs of Canada goldenrod, 4 lbs of aster, 3 lbs of thistle, and 0.3 lbs of pearly everlasting. Each bag was prepared to sow an acre.

Table 6. Seed in storage at the Corvallis Plant Materials Center for the Oregon Silverspot seed increase project.

Species	**Code**	**Seed lot**	**Weight (lbs)**
Achillea millefolium	ACMI2	SG1-10-OS448	13.8
Achillea millefolium	ACMI2	SG1-09-OS448	10
Achillea millefolium	ACMI2	SG1-08-OS448	12.5
Achillea millefolium	ACMI2	SG1-07-OS448	0.5
Achillea millefolium	ACMI2	SWC-07-OS448	0.5
Viola adunca	VIAD	SG1-10-OS406	5.2
Viola adunca	VIAD	SG1-11-OS406	37
Tanacetum camphoratum	TACA2	SG1-10-OS559	17
Tanacetum camphoratum	TACA2	SG1-09-OS559	21
Tanacetum camphoratum	TACA2	SG1-11-OS559	39
Anaphalis margaritacea	ANMA	SG1-10-OS451	2.3
Aster chiliensis	ASCH	SG1-11-OS449	41
Solidago canadensis	SOCA6	SG1-10-OS497	36
Solidago canadensis	SOCA6	SG1-09-OS497	1.4
Solidago canadensis	SOCA6	SG1-11-OS497	77
Festuca ammobia	FEAM5	SG1-09-OS450	28

Festuca ammobia	FEAM5	SG1-10-OS450	104
Festuca ammobia	FEAM5	SG1-11-OS450	148
Solidago spathulata	SOSIS4	SG1-09-OS561	630g
Solidago spathulata	SOSIS4	SG1-11-OS561	1
Cirsium edule	CIED	SWC-10-OS620	375g
Artemisia suksdorfii	ARSU4	SG1-11-OS560	23
Trifolium wormskioldii	TRWO	SG1-10-OS619	6.5
Trifolium wormskioldii	TRWO	SG1-11-OS619	94.5

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow
January 10, 2011

THE 2010 USFWS ANNUAL REPORT:
North Coast Oregon Silverspot Butterfly Seed Increase Project

Figure 1.Coastal red fescue (*Festuca rubra*) seed increase field at the Corvallis Plant Materials Center, June 25, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the US Army in 2007 to increase seed of early blue violet (*Viola adunca*) for use in recovery efforts for the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). The butterfly is thought to be extirpated from its northern range due to the loss of disturbance in its coastal meadow habitat. The early blue violet is the obligate host to the silverspot caterpillars and has also been negatively impacted in its coastal meadow ranges by the encroachment of tall, spreading exotic plants. Seed increase on the violets will provide a source for future seedling grow-outs which can then be transplanted back into areas of Oregon silverspot butterfly habitat enhancement and restoration. Production of nectar plants or other matrix species will be added to this agreement if seeds and funds become available. The United States Fish and Wildlife Service (USFWS) in Washington also became a partner in this agreement in 2009, and in 2010 became the main agency contracting with the PMC.

II. Accessions Involved

The table below lists the accessions involved in this project. Activities in 2010 included seed collection, seed cleaning of wild collected seed, plant production of three forbs, and harvest and maintenance of two seed increase fields (one grass and one sedge).

Table 1. Accessions in the North Coast Oregon Silverspot Butterfly Seed Increase Project in 2010.

Speices	Common name	Code	Accession number	Activity in 2010[1]
Viola adunca	*early blue violet*	VIAD	9079558	Pxn, dlv
Viola adunca	*early blue violet(white)*	VIAD	9079616	Dlv
Carex pansa	*dune sedge*	CAPA16	9079563	Sfp, dlv
Solidago spathulata	*dune goldenrod*	SOSIS4	9079532	Pxn, col
Soildago canadensis	*Canada goldenrod*	SOCA	9109116	Col
Achillea millefolium	*yarrow*	ACMI	9079609	Col
Aster chilensis	*Pacific aster*	ASCH	9109117	Pxn, col
Fesctuca rubra	*Coastal red fescue*	FERU	9079617	Sfp
Angelica hendersoni	*Henderson's angelica*	ANHE	9109074	Trl, col
Brodiea hyacinthinia	*white brodiea*	BRHY	9109115	Col
Cirsium edule	*edible thistle*	CIED	9079612	Trl, col
Sisryinchium idahoense	*blue-eyed grass*	SIID	9079608	Trl, col
Cirsium brevistylum	*short-styled thistle*	CIBR	9109073	Trl, col
Ameria maritima	*sea thrift*	AMMA	9109069	Trl, col
Sanicula arctopoides	*footsteps of spring*	SAAR	9109070	Trl, col
Lupinus littoralis	*seashore lupine*	LILU2	9109071	Trl, col
Sidalcea hendersonii	*Henderson's checkermallow*	SIHE	9109072	Trl, col
Angelica lucida	*seacoast angelica*	ANLU	9109076	Trl, col
Sisrynchium calfornicum	*yellow-eyed grass*	SICA8	9109075	Trl, col
Trifolium wormskijoldii	*sand clover*	TRWO	9109077	Trl, col
Conioselinum pacifica	*pacific hemlock*	COPA	9109068	Trl, col
Tanacetum camphoratum	*camphore tansy*	TACA	9079613	Trl, col
Anaphalis margaritacea	*pearly everlasting*	ANMA	9010118	Trl, col
Luzula multiflora	*common woodrush*	LUMU2	9079611	
Ranunculus occidentalis	*western buttercup*	RAOC	9079610	

1- col= wild seed collection, pxn=plant production, sfp= seed production, dlv= delivered plant materials, trl= conducted plant trials

III. Seed Collections

Throughout the summer of 2010, a private seed collector was hired to collect seed of many species that were candidates for seed or plant production. Collections were made all over the North Coast area from Seaside, Oregon up to Ledbetter Point in Washington.

These collections were brought to the PMC, bulked, cleaned and stored in the PMC seed storage facilities.

Table 2. Cleaned amount of wild seed collected in 2010 for the North Coast Oregon Silverspot Butterfly Seed Increase Project.

Species	lot number	Amount (g)
Viola adunca	SWC-10-NC558	2
Carex pansa	SWC-10-NC563	51
Solidago spathulata	SWC-10-NC532	84
Soildago canadensis	SWC-10-NC116	33
Achillea millefolium	SWC-10-NC609	102
Aster chilensis	SWC-10-NC117	60
Fesctuca rubra	SWC-10-NC617	100
Angelica hendersoni	SWC-10-NC074	33
Brodiea hyacinthinia	SWC-10-NC115	1
Cirsium edule	SWC-10-NC612	31
Sisryinchium idahoense	SWC-10-NC608	24
Cirsium brevistylum	SWC-10-NC073	9
America maritima	SWC-10-NC069	22
Sanicula arctopoides	SWC-10-NC070	3
Lupinus littoralis	SWC-10-NC071	58
Sidalcea hendersonii	SWC-10-NC072	3
Angelica lucida	SWC-10-NC076	671
Sisrynchium calfornicum	SWC-10-NC075	2
Trifolium wormskijoldii	SWC-10-NC077	64
Conioselinum pacifica	SWC-10-NC068	30
Tansy camphoratum	SWC-10-NC613	412
Anaphalis margaritacea	SWC-10-NC118	79

V. Experimental Propagation

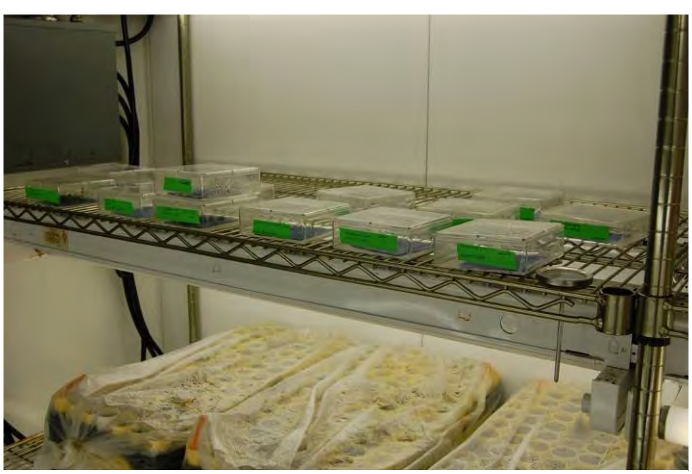
Figure 2. Germination trials in the warm growth chamber at the PMC.

Many of the species that were targeted for seed collection were species that the PMC has never worked with. After cleaning the seed, germination trails were set up for these species. Sets of 50 seeds were counted and placed in plastic germination boxes on moistened germination paper. The boxes were placed in either a warm growth chamber set at 70°(F) days and 50° (F) nights with 12 hours of daylight or in a walk-in cooler set at a constant 35° (F) with no light. All boxes are monitored weekly for germination. Not all trials were finished at the writing of this report and will be included in next year's report.

Table. 3. Germination trials using various temperatures.

Species	Treatment	Germination	Remarks
Soildago canadensis	Warm (75°)	84	
Soildago canadensis	Cooler (35°)	0	
Achillea millefolium	Warm (75°)	94	
Achillea millefolium	Cooler (35°)	0	
Cirsium edule	Warm (75°)	60	
Cirsium edule	Cooler (35°)	60	Germinated after three weeks
Cirsium brevistylum	Warm (75°)	70	
Cirsium brevistylum	Cooler (35°)	70	Germinated after three weeks
Ameria maritima	Warm (75°)	54	Sporadic germination
Ameria maritima	Cooler (35°)	86	Uniform germination, high vigor
Lupinus littoralis	Warm (75°)	37	Showed signs of rot
Lupinus littoralis	Cooler (35°)	40	Seedlings were more vigorous
Sidalcea hendersonii	Warm (75°)	22	Showed signs of rot
Sidalcea hendersonii	Cooler (35°)	60	Seedlings were more vigorous
Trifolium wormskijoldii	Warm (75°)	42	
Trifolium wormskijoldii	Cooler (35°)	10	
Tansy camphoratum	Warm (75°)	16	
Tansy camphoratum	Cooler (35°)	0	
Solidago spathula	Warm (75°)	71	
Solidago spathula	Cooler (35°)	3	
Anaphalis margaritacea	Warm (75°)	83	
Anaphalis margaritacea	Cooler (35°)	0	

IV. Seed Production

In March of 2009, the PMC received, from the Judy Landor with the USFWS, approximately 600 plugs of red fescue to be used to establish a seed increase field. The plants were transplanted out into a field in late March and grew moderately well, but only two of the plants flowered. In 2010, all the plants flowered. However, the plants were flowering during an unusually wet and cool June and that may have affected pollination.

The PMC agreed to establish a seed increase field of *Carex pansa*. Transplants were grown over the fall and winter of 2008/2009. On March 12, 2009 plants were placed on two feet apart and rows were planted three feet apart. This species is very rhizomatous but has not spread out and filled in the spaces between the plants. The ground at the PMC is very hard in the summer which is the active growing time for the heat-loving sedges. The field was hand weeded twice during the summer to remove grasses from the plot.

Only a small percent of plants flowered in 2010. The plants are large and appear very healthy. It is not known why these plants are still not flowering. Sedges can take many years to reach maturity, usually producing a lot of seed on the third growing season. This was the third growing season for these plants, but the first season was spent in containers. Maybe 2011 will yield better results. PMC staff contacted another grower who has seed increase fields of *C. pansa*. His results were similar to the ones at the PMC: this plant doesn't produce a lot of seed in a cultivated setting.

Figure 2. PMC staff member, Tyler Ross, standing in the Carex pansa seed increase field during the Conservation of Imperiled Butterflies workshop.

Using the seed that was collected from the wild in the summer of 2009, a seed increase field of red fescue was established in the fall of 2009. The seed had been collected from four different populations and the populations were planted in separate rows in the same field, so the populations have the opportunity to interbreed. They were planted separately in the event that non-native fescues were collected in some populations, it will be easier to weed out non-native plants in some rows rather than all of them. Also, identification of the fescues is very difficult. If some populations are later identified as the wrong species, it is easier to take out a block within the field, rather than the entire field. Approximately 0.15 acres were sown in the fall. In 2010 the field looked great. Very few plants flowered which is typical for red fescue in the first growing season. Some differences in vegetative growth could be seen among the populations, but no conclusions can be drawn at this time. As the field blooms in 2011, the field can be examined for the presence of non-native fescues.

Table 2. Seed Produced at the Corvallis Plant Material Center for the North Coast Oregon Silverspot Butterfly Seed Increase Project in 2010.

Species	**Accession**	**Method**	**Harvest area**	**Date**	**Yield**
Carex pansa	9079563	hand	0.56	7/13/2010	26 g
Festuca rubra	9079617	seed stripper	0.1	9/15/2010	4.5 lbs

V1. Container Plant Production

Seeds of the aster and dune goldenrod were sown into plastic trays with 3.5 cubic inch round cells. Trays were placed inside a warm greenhouse and seedlings emerged within four weeks. They will remain in the greenhouse until the roots have filled the cells, then the plants will be slowly acclimated to outdoor temperatures in order to be transplanted out into fields in March.

Table 3. Plants produced for the North Coast Oregon Silverspot Butterfly Seed Increase Project in 2010.

Speices	Code	Accession number	Number produced	Treatment	Start date
Viola adunca	VIAD	9079558	4500	120 days cold strat	16-Aug
Solidago spathulata	SOSIS4	9079532	9500	warm greenhouse	1-Dec
Aster chillensis	ASCH	9019117	2570	warm greenhouse	1-Dec

On August 16, 2010, 20 and 15 grams of the seed produced from plants in 2008 and 2009, respectively, were used to grow violets for spring establishment of a seed increase field. Seeds were sown in 4500 cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix) amended with a balanced slow-release fertilizer and micronutrients. Flats of cone-tainers were placed in polyethylene bags and left in a walk-in cooler for 120 days. After being removed from the cooler, flats were placed in a warm greenhouse. They will remain in the greenhouse until the roots have filled the cones, then the plants will be slowly acclimated to outdoor temperatures in order to be transplanted out into fields in March. There was a noticeable difference in germination and vigor among the two different seed lots that were used to grow the plugs. The seed that was produced in 2008 had much lower germination and seedlings looked less healthy than the ones that were grown from the seed that was produced in 2009. It is unusual that this big of a difference would be noticed in seed that was only two years old. In previous work with

Figure 4. Comparison of early blue violet seedlings grown from seed that was produced in 2008 (left) and 2009 (right).

violets from the Central Coast of Oregon, a decline in germination and vigor wasn't noticed until the seeds were five years old.

VII. Delivery of Materials

Table 4. Seed delivered to partners in the North Coast Oregon Silverspot Butterfly Seed Increase Project.

Species	**Seed lot**	**Amount**	**Recipient**	Date
Viola adunca	SG1-09-NC558	250g	Bill Ritchie (USFWS)	10/14/2010
Viola adunca (w)	SG1-09-NC616	130g	Bill Ritchie (USFWS)	10/14/2010
Carex pansa	SWC-07-NC563	118g	Dave Hays (WDFW)	1/7/2010

Our seed lot numbers describe the generation of the field (SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot indicates which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (or an abbreviation for the seed source) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 4. Seeds in storage for the North Coast Oregon Silverspot Butterfly Seed Increase Project.

Species	Lot number	Amount (g)
Viola adunca	SG1-09-NC558	180
Carex pansa	SWC-07-NC563	470
Carex pansa	SWC-10-NC563	51
Solidago spathulata	SWC-10-NC532	84
Solidago spathulata	SWC-07-NC532	104
Soildago canadensis	SWC-10-NC116	33
Achillea millefolium	SWC-10-NC609	102
Fesctuca rubra	SWC-10-NC617	100
Fesctuca rubra	SG1-10-NC617	4.5 lbs
Angelica hendersoni	SWC-10-NC074	33
Brodiea hyacinthinia	SWC-10-NC115	1
Cirsium edule	SWC-10-NC612	31
Cirsium edule	SWC-08-NC612	2
Sisryinchium idahoense	SWC-10-NC608	24
Cirsium brevistylum	SWC-10-NC073	9
America maritima	SWC-10-NC069	22
Sanicula arctopoides	SWC-10-NC070	3
Lupinus littoralis	SWC-10-NC071	58
Sidalcea hendersonii	SWC-10-NC072	3
Angelica lucida	SWC-10-NC076	671

Sisrynchium calfornicum	SWC-10-NC075	2
Trifolium wormskijoldii	SWC-10-NC077	64
Conioselinum pacifica	SWC-10-NC068	30
Tansy camphoratum	SWC-10-NC613	412
Tansy camphoratum	SWC-08-NC613	4
Anaphalis margaritacea	SWC-10-NC118	79
Luzula multiflora	SWC-08-NC611	7
Ranunculus occidentalis	SWC-08-NC610	33

CORVALLIS PLANT MATERIALS CENTER
USDA NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow
January 10, 2012

THE 2011 USFWS ANNUAL REPORT:
North Coast Oregon Silverspot Butterfly Seed Increase Project

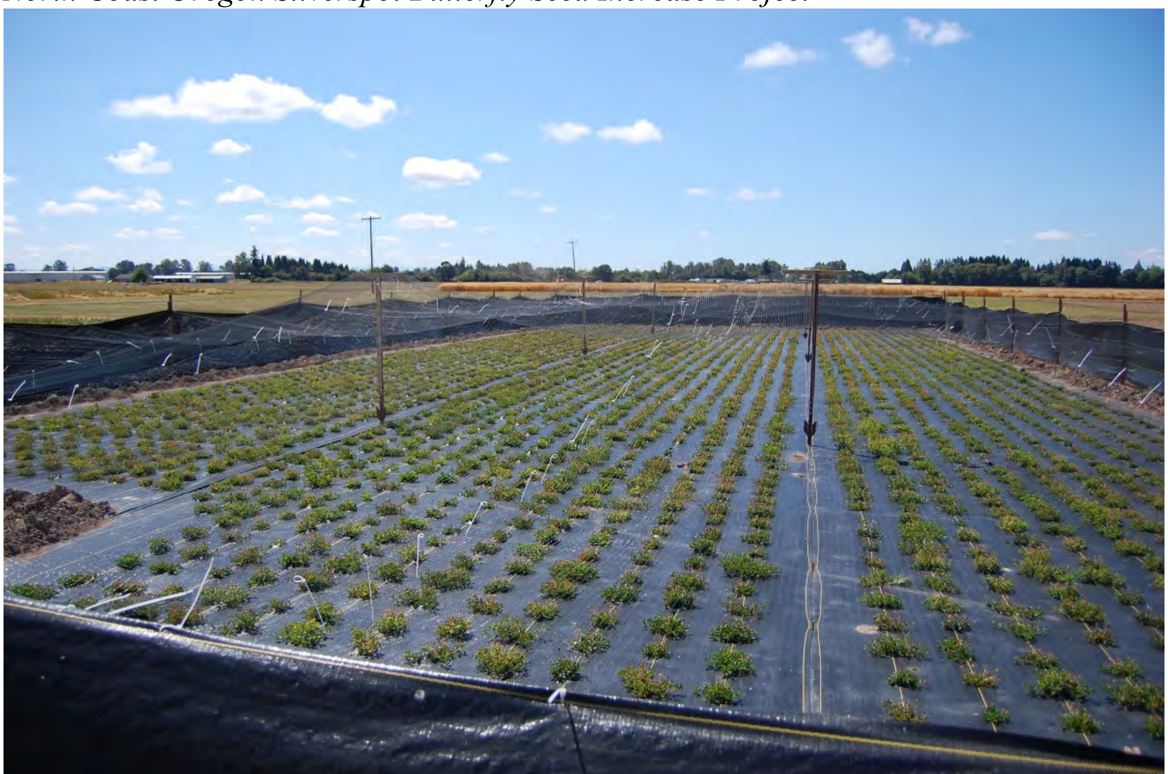

Figure 1. Early blue violet (Viola adunca) seed increase field at the Corvallis Plant Materials Center, June 25, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement in 2010? with the United States Fish and Wildlife Service (USFWS) in Washington to increase seed of early blue violet (*Viola adunca*) for use in recovery efforts for the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). The butterfly is thought to be extirpated from its northern range due to the loss of disturbance in its coastal meadow habitat. The early blue violet is the obligate host for the silverspot caterpillars, and has also been negatively impacted in its coastal meadow ranges by the encroachment of tall, spreading, exotic plants. Seed increase of the violets will provide a source for future seedling grow-outs which can then be transplanted back into areas of Oregon silverspot butterfly habitat enhancement and restoration. Production of nectar plants or other matrix species were added to this agreement in 2011.

II. Accessions Involved

The table below lists the accessions involved in this project. Activities in 2011 included seed collection, seed cleaning of wild collected seed, plant production of three forbs, and establishment, harvest and maintenance of five seed increase fields (one grass, one sedge, and three forbs).

Table 1. Accessions in the North Coast Oregon Silverspot Butterfly Seed Increase Project in 2011.

Speices	Common name	Code	Accession number	Activity in 20111
Achillea millefolium	yarrow	ACMI2	9079609	sfp
Armeria maritima	thrift seapink	ARMA6	9109069	Trl
Anaphalis margaritacea	pearly everlasting	ANMA	9010118	Trl
Angelica hendersonii	Henderson's angelica	ANHE	9109074	Trl
Angelica lucida	seacoast angelica	ANLU	9109076	Trl
Aster chiliensis	Pacific aster	ASCH	9109117	Pxn, sfp
Brodiaea hyacinthina	white brodiaea	BRHY	9109115	
Carex pansa	sanddune sedge	CAPA16	9079563	Sfp
Cirsium brevistylum	clustered thistle	CIBR2	9109073	Trl
Cirsium edule	edible thistle	CIED	9079612	Trl
Conioselinum pacifica	pacific hemlockparsley	COPA	9109068	Trl
Danthonia californica	California oatgrass (Camp Rilea)	DACA3	9109142	
Danthonia californica	California oatgrass (Mt. Hebo)	DACA3	9109144	
Festuca rubra	Coastal red fescue	FERU2	9079617	Sfp
Lupinus sp.	lupine	LUPIN	9109143	
Lupinus littoralis	seashore lupine	LULI2	9109071	Trl
Luzula multiflora	common woodrush	LUMU2	9079611	
Ranunculus occidentalis	western buttercup	RAOC	9079610	
Sanicula arctopoides	footsteps of spring	SAAR9	9109070	Trl
Sidalcea hendersonii	Henderson's checkermallow	SIHE4	9109072	Trl
Sisyrinchium idahoense	Idaho blue-eyed grass	SIID	9079608	Trl
Sisyrinchium californicum	yellow-eyed grass	SICA8	9109075	Trl
Solidago canadensis	Canada goldenrod	SOCA6	9109116	
Solidago spathulata	dune goldenrod	SOSIS4	9079532	Pxn, sfp
Tanacetum camphoratum	camphor tansy	TACA2	9079613	Trl
Trifolium wormskioldii	sand clover	TRWO	9109077	Trl
Viola adunca	early blue violet	VIAD	9079558	Pxn, sfp

1- col= wild seed collection, pxn=plant production, sfp= seed production, dlv= delivered plant materials, trl= conducted plant trials

III. Seed Collections

Throughout the summer of 2011, Mike Patterson, a private seed collector, was hired to collect seed of many species that were candidates for seed or plant production. Collections were made all over the North Coast area from Seaside, Oregon, up to Ledbetter Point in Washington. These collections were brought to the PMC, bulked, cleaned and stored in the PMC seed storage facilities.

Table 2. Cleaned amount of wild seed collected in 2011 for the North Coast Oregon Silverspot Butterfly Seed Increase Project.

Species	Common name	Amount
Aster chiliense	Pacific aster	128 g
Armeria maritima	sea thrift	130g
Brodiea hyacinthina	white brodiea	1 g
Cirsium brevistylum	short-styled thistle	48g
Cirsium edule	edible thistle	56 g
Danthonia californica-Camp Rilea	California oatgrass	22g
Danthonia californica-Mt Hebo	California oatgrass	31g
Festuca rubra-Camp Rilea	red fescue	18g
Festuca rubra-Delaura	red fescue	33g
Festuca rubra-Gearhart	red fescue	95g
Festuca rubra-Sunset #1	red fescue	14 g
Festuca rubra-Sunset #4	red fescue	74 g
Lupinus sp.	Lupine species	44 g
Lupinus littoralis	seashore lupine	40g
Sanicula arctopoides	footsteps of spring	42 g
Sisyrinchium californicum	yellow-eyed grass	5g
Sisyrinchium idahoense	Idaho blue-eyed grass	140g
Solidago canadensis	Canada goldenrod	90g
Trifolium wormskioldii	sand clover	55 g

IV. Experimental Propagation

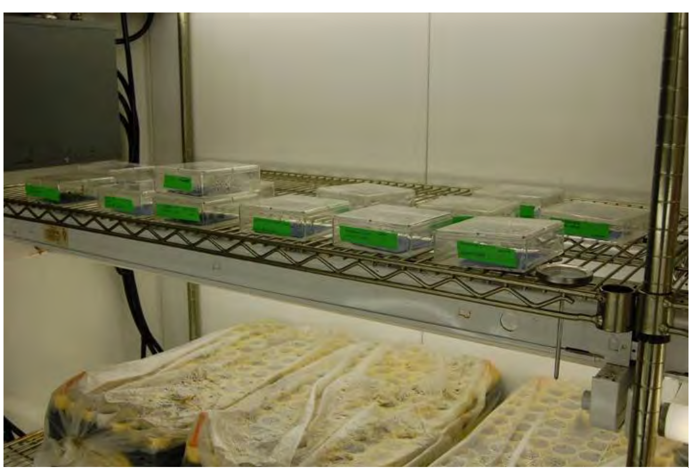

Figure 2. Germination trials in the warm growth chamber at the PMC.

Many of the species that were targeted for seed collection were species that the PMC has never worked with. After cleaning the seed, germination trials were set up for these species. Sets of 50 seeds were counted and placed in plastic germination boxes on moistened germination paper. Each treatment had two replications. The boxes were placed in either a warm growth chamber set at 70°F days and 50°F nights with 12 hours of daylight or in a walk-in cooler set at a constant 35°F with no light. All boxes were monitored weekly for germination.

After reviewing all the data, it seems that most species fell into one of three categories for germination requirements:
1) Seeds are not dormant and germinate readily in warm temperatures: *Solidago canadensis, Achillea millefolium*, *Trifolium wormskioldii, Solidago spathulata,* and *Tanacetum camphoratum.*
2) Seeds are not dormant and readily germinate in warm or cool temperatures: *Cirsium edule, Cirsium brevistylum, Lupinus littoralis*
3) Seeds germinate only after a warm treatment followed by a cold treatment to break dormancy: *Angelica hendersonii, Sisyrinchium idahoense, Sanicula arctopoides,* and *Angelica lucida.*

Conioselinum pacifica seeds did not germinate at a higher percent from receiving a warm treatment prior to the cold treatment, so we conclude that this species will germinate after 90 days of cold-moist stratification. *Sidalcea hendersonii* and *Armeria maritima* seeds germinated at higher percentages when they received cold treatments, but seeds also germinated in the warm treatment. Seedlings in the warm treatments were moldy and seemed less vigorous. A short cold treatment followed by 50-60°F temperatures would probably be the best germination strategy for these two species.

Table. 3. Germination trials using various temperature regimes.

Species	Treatment (temp °F)	Percent Germination	Remarks
Solidago canadensis	Warm (75)	84	
Solidago canadensis	Cooler (35)	92	
Achillea millefolium	Warm (75)	95	
Achillea millefolium	Cooler (35)	95	
Angelica hendersonii	Warm (75)	0	?
Angelica hendersonii	Cooler (35)	6	
Cirsium edule	Warm (75)	60	
Cirsium edule	Cooler (35)	66	germinated in the cooler after 4 weeks
Sisyrinchium idahoense	Warm (75)	0	54 % germination was seen after warm treatments were placed in cold for 90 days, then returned to warm
Sisyrinchium idahoense	Cooler (35)	1	
Cirsium brevistylum	Warm (75)	71	
Cirsium brevistylum	Cooler (35)	65	Germinated in the cooler after 4 weeks
Armeria maritima	Warm (75)	66	
Armeria maritima	Cooler (35)	86	
Sanicula arctopoides	Warm (75)	0	85% germination was seen after warm treatments were placed in cold for 90 days, then returned to warm
Sanicula arctopoides	Cooler (35)	45	
Lupinus littoralis	Warm (75)	49	

Table. 3. Germination trials using various temperature regimes. Con't.

Lupinus littoralis	Cooler (35)	40	germinated in the cooler after 4 weeks
Sidalcea hendersonii	Warm (75)	25	
Sidalcea hendersonii	Cooler (35)	60	
Angelica lucida	Warm (75)	0	65% germination was seen after warm treatments were placed in cold for 90 days, then returned to warm
Angelica lucida	Cooler (35)	9	
Trifolium wormskioldii	Warm (75)	42	
Trifolium wormskioldii	Cooler (35)	32	
Conioselinum pacifica	Warm (75)	0	44% germination was seen after warm treatments were placed in cold for 90 days, then returned to warm
Conioselinum pacifica	Cooler (35)	47	
Tanacetum camphoratum	Warm (75)	24	
Tanacetum camphoratum	Cooler (35)	14	
Solidago spathulata	Warm (75)	71	
Solidago spathulata	Cooler (35)	85	

V. Container Plant Production

In the fall of 2010, seeds of the Pacific aster and dune goldenrod were sown into plastic trays with 3.5 cubic inch round cells. Trays were placed inside a warm greenhouse and seedlings emerged within four weeks. They remained in the greenhouse until the roots had filled the cells, and then the plants were slowly acclimated to outdoor temperatures and were transplanted out into fields in March of 2011. On August 16, 2010, 20 and 15 grams of the seed produced from plants in 2008 and 2009, respectively, were used to grow violets for spring establishment of a seed increase field. Seeds were sown in 4,500 cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix) amended with a balanced slow-release fertilizer and micronutrients. Flats of cone-tainers were placed in polyethylene bags and put in a walk-in cooler for 120 days. After being removed from the cooler, flats were placed in a warm greenhouse. Once the roots had filled the cone-tainers, they were slowly acclimated to outdoor temperatures. In March 2011, the violets were transplanted into a field that had been covered with weed fabric.

Table 3. Plants produced for the North Coast Oregon Silverspot Butterfly Seed Increase Project in winter 2010-2011.

Species	Code	Accession number	Number produced	Treatment	Start date
Viola adunca	VIAD	9079558	4500	120 days cold strat	16-Aug
Solidago spathulata	SOSIS4	9079532	9500	warm greenhouse	1-Dec
Aster chilense	ASCH	9019117	2570	warm greenhouse	1-Dec

VI. Seed Production

In March of 2009, Judy Landor with the USFWS sent the PMC approximately 600 plugs of red fescue to be used to establish a seed increase field. The plants were transplanted out into a field in late March of 2009 and grew moderately well, but only two of the plants flowered that summer. In 2010, all the plants flowered. However, the plants were flowering during an unusually wet and cool June and that may have affected pollination because seed yields were very low. The summer of 2011 was similarly wet and cool, and once again, seed yields were incredibly low.

Figure 3. Coastal red fescue (*Festuca rubra*) is a short-statured fescue. In full flower, the plants are only knee-high.

An additional 0.15 acre of red fescue was sown in the fall of 2009 using seed that was collected from the wild in the summer of 2009. The seed had been collected from four different populations and the populations were planted in separate rows in the same field, so the populations have the opportunity to interbreed. They were planted separately in the event that non-native fescues were collected in some populations, it will be easier to weed out non-native plants in some rows rather than all of them. Also, identification of the fescues is very difficult. If some populations are later identified as the wrong species, it is easier to take out a block within the field, rather than the entire field. In 2010, the field looked great. Very few plants flowered which is typical for red fescue in the first growing season. The field was expected to flower and produce at least 20 pounds of seed in 2011. The field flowered and heads were so thick that they fell over during mid summer rain storms; this "lodging" is normal in grass seed production fields, but can interfere with harvesting. Seed was harvested using a seed stripper. This machine can also pick up the seeds heads that have fallen over. After the seed was harvested, it was spread out on tarps to dry, and then it was fed

Figure 4. Seed stripping the coastal red fescue (*Festuca rubra*) seed increase field, July 14, 2011.

through a brush machine to remove the small awns. It was cleaned using an air screen machine. While brushing the seed, PMC staff noticed that the seed was very light and was not brushing well. Upon further inspection, it appeared that most seeds were not filled. Once the seed lot was cleaned in the air screen machine, it was clear that the field had produced very little viable seed. The air blew out barrels and barrels of empty seed, leaving only 7 lbs of viable seed. The PMC staff has worked with many native fescues over the years and currently has fields of seven other fescues on the farm. In previous work with Roemer's fescue, it was found that seed increase fields that were created using wild collected seed had incredibly low yields. But if Generation 2 seed was used to create a seed increase field, the plants looked more vigorous and seed production was much higher. It is theorized that these native fescues now only exist in small isolated patches and do not have adequate gene flow to keep them from becoming inbred. Using Generation 2 seed in a production field helps restore some of this gene flow. After seeing the low yields from this wild-collected North Coast fescue field, we recommend using second generation seed to enlarge the field and compare production to the Generation 1 field.

Figure 5. Dune sedge (*Carex pansa*) seed increase field with various tillage and mowing treatments.

A seed increase field of *Carex pansa* was created using transplants in March of 2009. The plants were expected to flower in 2010, but did not. A portion of the field was removed and salvaged plants were delivered to various restoration projects in the North Coast restoration area. In early spring 2011, treatments were applied to sections of the remaining field to encourage flowering. Most of the field was fertilized before treatments were performed. A portion of the field was left unfertilized as a treatment. The treatments were:
Low mow: plants were cut off at soil level.
High mow: plants were cut off 2-3" above soil level.
Side till: areas along both sides of the plants were tilled.

Over till: plants were completely tilled over (this did not actually till up the plant as intended, the soil all around the plant was disturbed but the plant was intact).
Burn: plants were burned back to the crown using a portable propane weed torch.
No fertilizer: plants were not fertilized.
Control: no treatment was applied.
Side till + no fertilizer: plants were not fertilized and areas along both sides of the plants were tilled.

All plants began flowering a month after treatments were applied. Visually, treatments did not appear to have an effect on the abundance of seed, except for the high mow. These plants appeared to have more seed heads, but since the old foliage was cut back, it may have just been easier to see them. The plants in this field are highly variable. A large enough sample needed to be taken from each treatment to capture the diversity of the plants in the field, as well as any treatment effects. For each treatment, three consecutive plants were harvested and placed in a paper bag. This was replicated 10 times for each treatment, at regularly spaced intervals across the field. Seed from each bag was cleaned and weighed separately.

Table 4. Weight (g) of *Carex pansa* seed harvested per treatment.

Rep	Control	Overtill	No fertilizer	High mow	Side-till + no fert	Low mow	Burn	Side till
1	2.3476	1.2174	3.748	0.2551	0.7791	2.8071	0.7535	2.3907
2	2.8076	0.177	3.8019	0	0.1369	4.2283	0.012	0.5412
3	2.4435	3.0409	1.9429	0.17	0.3477	3.8807	0.243	2.1267
4	2.2699	1.998	0.7955	0.8335	1.4681	4.8386	4.4406	0.5097
5	0.6145	0.6628	2.7903	0.7489	0.9637	2.5599	0.9478	0.5778
6	1.1298	1.0786	8.0759	0.5578	0.9514	1.7171	2.9769	5.8588
7	5.3525	2.3992	1.358	4.2262	0.3039	1.8932	3.6828	3.3885
8	1.7255	13.7453	0.3789	1.6666	4.3454	2.3345	6.4985	1.4783
9	2.2935	0.7902	4.2011	0.3693	3.3487	4.119	2.3578	3.7136
10	3.204	2.6826	1.7344	4.787	0.8356	5.7529	4.654	2.8728
Average	2.4188	2.7792	2.8826	1.3614	1.3480	3.4131	2.6566	2.3458

A single factor ANOVA test was performed on the data. It showed no significant relationship between treatment and seed yield ($P = 0.35$). The high mow treatment did appear to have the highest average yield, which is good because harvesting with the moon rover cuts all the plants 2-3" above soil level and this is the standard harvest method employed by the PMC for this species.

After seed from the treatments was harvested, the entire field was harvested using the moon rover. Seed heads and foliage were too sparse for the moon rover to cut and move the material up the conveyor belt, so it had to be modified. Brushes were mounted on the reel to help sweep the heads and foliage up onto the belt. Plant material was dried on tarps and then fed into a stationary thresher. The thresher barely removed the seeds from the heads. PMC staff then tried using the combine to break up the seed heads. The combine worked better, but it wasn't removing all of the seed. Material was fed through the combine twice to remove as many seeds as possible. Seed was then cleaned using an air screen machine.

Table 5. Seed produced at the Corvallis Plant Materials Center for the North Coast Oregon Silverspot Butterfly Seed Increase Project in 2011.

Species	Accession	Method	Harvest area	Date	Yield
Aster chilense	9079532	seed stripper	0.25 ac	Sept 15- Oct 20	9 lbs
Carex pansa	9079563	moon rover	0.56 ac	Aug 5	4.5 lbs
Festuca rubra	9079617	seed stripper	0.2 ac	July 14	8 lbs
Solidago spathulata	9109117	hand	0.25 ac	Nov 5Dec 1	4.8 lbs
Viola adunca	9079558	vacuum	0.15 ac	Sept 13-20	9 lbs

The plugs of dune goldenrod, Pacific aster, and violet were transplanted into fields in March. Since it was the plants' first growing season they were not expected to flower abundantly. Plants grew well in the wet cool spring. The soil moisture remained higher than usual into July and August, which helped the new transplants get established. All three fields flowered this year.

Figure 6. A flail-vac seed stripper is the most efficient harvest method for aster. It was used many times on the Pacific aster (*Aster chilense*) field in 2011.

The violets began to flower by June. The plants were not full-sized this year, but they did produce a fair amount of seed. All the seed was vacuumed up once at the end of the growing season. A "wind fence" was erected around the plot to keep the seeds from blowing off the weed fabric and bird netting was placed over the entire plot to keep birds from eating the seeds. Mouse traps were set periodically when seeds began to pile up on the fabric.

Figure 3. The new dune goldenrod (*Solidago spathulata*) transplants grew all summer and bloomed in late fall.

The asters were very tall compared to the Central Coast ecotype. The plants produced seed over a couple months in late summer and fall. At first, seed was collected by hand, and then the seed stripper was used for later harvests when all plants were covered with seed.

The goldenrod did not begin to bloom until very late in the fall. By the time it flowered, most other plants were done, so it attracted many pollinators on warm days. One harvest was performed in early November, then all remaining heads were harvested on December 1. Plants were still flowering on Dec 1, but PMC staff assumed that these plants would not be capable of making seed in the middle of winter.

On October 5, 2011 a new yarrow field was sown using the PMC's precision cone-seeder. The red fescue field was also expanded using G2 seed and wild collected seed.

VII. Delivery of Materials

Table 6. Seed delivered to partners in the North Coast Oregon Silverspot Butterfly Seed Increase Project in 2011.

Species	Seed lot	Amount	Recipient
Viola adunca	SG1-11-NC558	2 lbs	Bill Ritchie (USFWS)
Viola adunca	SG1-11-NC558	200 g	Oregon zoo

Our seed lot numbers describe the generation of the field (SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot indicate which year the seed was produced. The last portion of the seed lot describes which project the seed is for (or an abbreviation for the seed source) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 7. Seeds in storage for the North Coast Oregon Silverspot Butterfly Seed Increase Project.

Species	Seed lot	Weight
Achillea millefolium	SWC-10-NC609	85 g
Anaphalis margaritacea	SWC-10-NC118	79 g
Angelica hendersonii	SWC-10-NC074	33 g
Angelica lucida	SWC-10-NC076	671 g
Armeria maritima	SWC-10/11-NC069	152 g
Aster chilense	SWC-11-NC117	128 g
Aster chilense	SG1-11-NC117	4.5 lbs
Brodiea hyacinthina	SWC-11-NC115	1 g
Carex pansa	SWC-08-NC563	453 g
Carex pansa	SG1-11-NC563	3 lbs
Cirsium brevistylum	SWC-10/11-NC073	57 g
Cirsium edule	SWC-10/11-NC071	87 g
Conioselinum pacifica	SWC-10-NC068	30 g
Danthonia californica-Camp Rilea	SWC-11-NC144	22 g

Table 7. Seeds in storage for the North Coast Oregon Silverspot Butterfly Seed Increase Project. Con't.

Danthonia californica-Mt. Hebo	SWC-11-NC142	31 g
Festuca rubra-Camp Rilea	SWC-11-NC617	18 g
Festuca rubra-Delaura	SWC-11-NC617	33 g
Festuca rubra-Gearhart	SWC-11-NC617	95 g
Festuca rubra-Sunset #1	SWC-11-NC617	14 g
Festuca rubra-Sunset #4	SWC-11-NC617	74 g
Lupinus sp.	SWC-11-NC143	44 g
Lupinus littoralis	SWC-10/11-NC071	98 g
Luzula multiflora	SWC-08-NC611	7 g
Ranunculus occidentalis	SWC-08-NC610	33 g
Sanicula arctopoides	SWC-10/11-NC070	45 g
Sidalcea hendersonii	SWC-10-NC072	3 g
Sisyrinchium idahoense	SWC-10/11-NC608	182 g
Sisyrinchium californicum	SWC-10/11-NC075	7 g
Solidago canadensis	SWC-10/11-NC116	123 g
Solidago spathulata	SG1-11-NC532	4.8 lbs
Solidago spathulata	SWC-09/10-NC532	208 g
Tanacetum camphoratum	SWC-10-NC613	421 g
Trifolium wormskioldii	SWC-10/11-NC077	119 g
Viola adunca	SWC-09/10-NC558	182 g
Viola adunca	SG2-11-NC558	4 lbs

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Tyler C. Ross
March 14, 2011

THE 2010 UNITED STATES DEPARTMENT OF FISH AND WILDLIFE SERVICE ANNUAL REPORT:*Western Lily (Lilium occidentale) Bulb Production Project*

I. Brief Background of Project

In 2009 the Corvallis Plant Materials Center (PMC) entered into an agreement with the United States Fish and Wildlife Service (USFWS) to produce 1,000 bulbs of Western lily (*Lilium occidentale*) to be planted out onto restoration sites. The bulbs are to be provided within 5 years from the start of the agreement. The Western lily has been a federally listed endangered species since 1994. It is only found in a narrow band, about 200 miles in length, along the southern Oregon and northern California coast. This long lived lily species has become endangered primarily due to loss of habitat. There are several factors contributing to the loss of Western lily habitat. Western lily habitat is in high demand to be used for the creation of cranberry bogs. The recent growth in the cranberry industry caused more land to be cleared and turned into bogs. Fire suppression has enabled forests to slowly encroach on the sparse shrublands and grasslands where the Western lily thrives. The roots of large trees puncture the "hard pan" that provides these plants with the perched water table that they need to thrive. A reduction in grazing by cattle, elk, and deer has also helped to speed the loss of habitat. Managing land for grazing involves removing small trees and dense shrubs before they are able to out-compete the lilies. Grazing in itself also helps to slow the encroachment of trees and shrubs by keeping them "pruned back."

II. Bulb Production Activities

In the fall of 2009, pods of Western lily were collected from 8 different wild populations. Collections were performed by the Oregon Department of Agriculture. In all, 66 pods were collected from 50 different mothers. The Corvallis PMC received the pods on November 5th 2009. Seeds were manually removed from pods, cleaned by hand, and then counted. There were 7,575 seeds that looked viable upon visual inspection. No air cleaning was performed on the seeds because there would have been the possibility of losing some potentially good seeds in the process. It is likely that a high percentage of the seeds that appeared to be good upon visual inspection were not viable. Many of the pods showed signs of predation. Some seeds were obviously non-viable while others looked fine but broke open as they were being counted. It is possible that many seeds looked viable but were actually unfilled seed.

Three pods were randomly selected from each population to be used in germination trials since little information was available on the specifics of propagating Western lily from seed. These seeds were set aside for later use. Information provided by the USFWS indicated that seeds would need a period of warm, moist stratification followed by a period of cool moist stratification to germinate. The USFWS asked that the plants be tracked by maternal lines, so the decision was made to place the seeds from each mother into their own 14" by 14" tray filled with Sunshine mix #4 (a soil-less peat based potting mix) along with a balanced controlled release fertilizer and micronutrient mix. Seeds from the remaining pods were scattered into their own tray and placed into a warm greenhouse (70 degrees Fahrenheit) In mid November. After 30 days (mid December), the trays were moved into a cold frame for outdoor cold stratification until some plants began to emerge. After 90 days in the cold frame (mid-March), the trays were moved into an unheated greenhouse where the night temperatures dropped to near freezing but the day temperatures warmed to around 70 degrees. During this time a thick layer of moss grew and eventually covered all of the trays. Fungus gnats and shore flies were also a problem and the plants were sprayed several times with a mixture of dish soap and neem oil. This treatment seemed to help the problem and no damage to the seedlings was observed. Seedlings continued to emerge until late spring. At this point, a rough count was done and there were approximately 1,200 seedlings visible. The trays were moved to an outdoor shade

Figure 1.Trays of Lilies in the PMC lath house preparing to go dormant.

Figure 2. Seedling with 8 leaves after one growing season.

house where they remained throughout the summer. In late summer the trays were moved to a lath house and watering was reduced so the soil would dry out considerably between watering. This was done to signal the plants to begin to go dormant for the winter but they continued to grow. At this point some of the plants had 8 leaves and looked very healthy. The plants continued to send up new leaves even after the first killing frost of the fall. The trays were moved into a walk-in cooler for the rest of the winter to protect the bulbs from freezing solid while still providing adequate chilling that is likely required before the bulbs can resume growing in the spring.

III. Germination Study Activities

Since official protocol for Western lily was lacking, it was necessary to do a germination study with the seeds. Three pods from each population were randomly selected. The seeds from the pods were manually removed and cleaned by hand. Seeds were then counted then divided into two equal groups. The groups were placed on moist germination paper in germination boxes. Group 1 was labeled warm and group 2 was labeled cold. Group 1 (warm) was placed in a growth chamber with daytime temperatures of 20 degrees Celsius and nighttime temperatures of 15 degrees Celsius for 30 days. Group 2 (cold) was placed directly into a cooler at a temperature of 2 degrees Celsius for 90 days. After 30 days, the seeds in the group 1 (warm) had no germination so they were moved to the cooler, joining the group 2 (cold) at 2 degrees Celsius. All seeds in the boxes appeared to be in good condition with

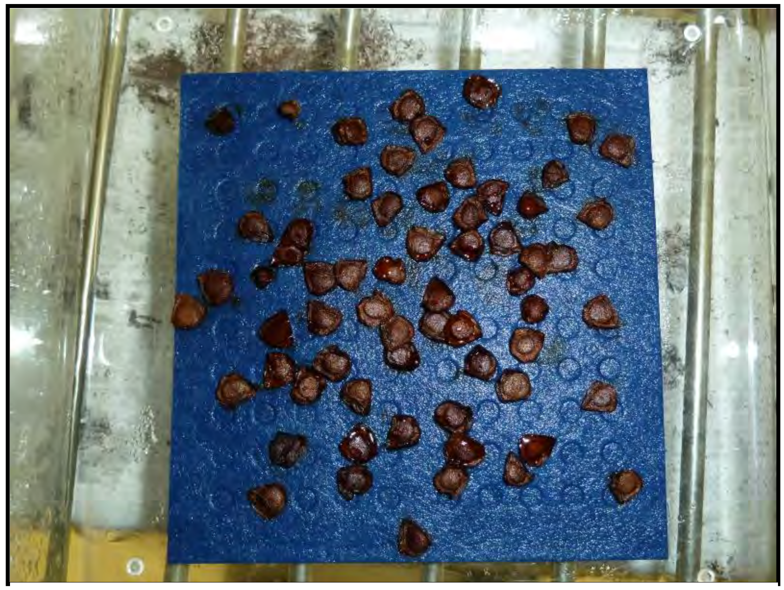

Figure 13. Clean seeds of Western Lily in germination box on moist germination paper.

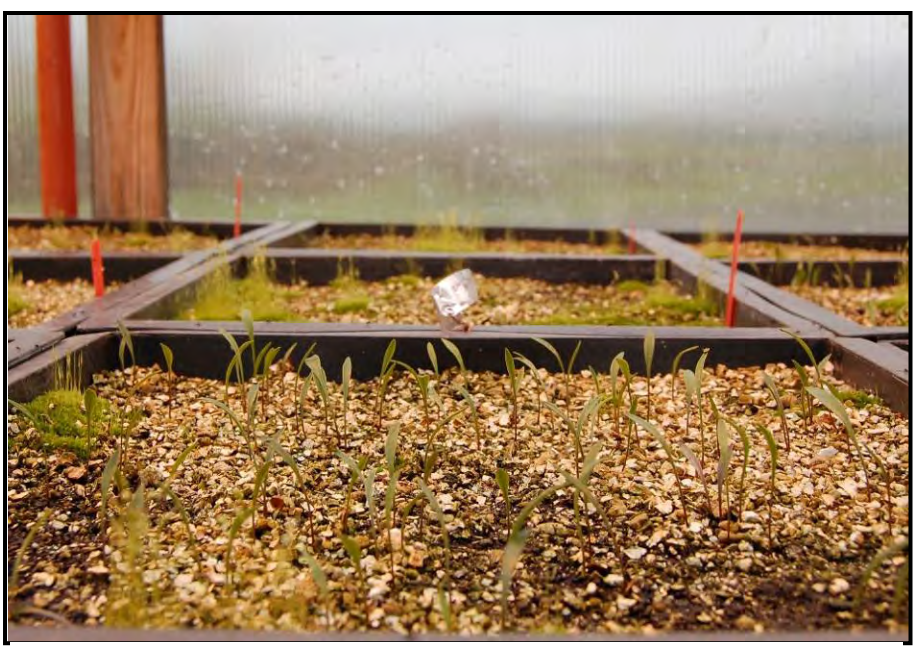

Figure 4. Box filled with western lily seedlings, April 20, 2010.

very little mold. After about 40 days in the cooler some seeds from group 1 (warm) began to germinate. As the seeds germinated they were removed and planted into the same type of trays that were described under Bulb Production Activities. After being in the cold for 127 days germination had slowed. There was some germination from group 2 (cold) but numbers were much lower than in group 1 (warm). All of the results can be viewed in Table1.

Table 6: Western lily germination trial

Group 1: 30 days warm then cold				Group 2: Cold			
Box	**Seeds in Box**	**Seeds Germinated**	**Percent Germination**	**Box**	**Seeds in Box**	**Seeds Germinated**	**Percent Germination**
AR 2-A	42	25	59.52	AR 2-A	41	2	4.88
AR 3-A	50	50	100.00	AR 3-A	50	12	24
AR 3-B	53	51	96.23	AR 3-B	53	4	7.55
BB 1-A	75	32	42.67	BB 1-A	75	0	0
BB 2-A	76	56	73.68	BB 2-A	76	2	2.63
BB 4-A	77	56	72.73	BB 4-A	77	0	0
CB 8-A	42	0	0.00	CB 8-A	42	0	0
CB 9-A	86	86	100.00	CB 9-A	85	0	0
CB 12-B	42	42	100.00	CB 12-B	42	16	38.1
FL 2-A	37	34	91.89	FL 2-A	37	6	16.22
FL 2-B	44	36	81.82	FL 2-B	44	4	9.09
FL 3-A	63	57	90.48	FL 3-A	63	3	4.76
HAU 1-A	102	11	10.78	HAU 1-A	102	12	11.76
HAU 6-B	81	36	44.44	HAU 6-B	82	0	0
HAU 11-A	89	17	19.10	HAU 11-A	89	0	0
HBSMA 3-B	69	59	85.51	HBSMA 3-B	69	8	11.59
HBSMA 5-A	66	60	90.91	HBSMA 5-A	66	0	0
HBSMA 5-B	67	58	86.57	HBSMA 5-B	66	0	0
HBSP 1-A	63	40	63.49	HBSP 1-A	62	0	0
HBSP 3-A	47	29	61.70	HBSP 3-A	47	1	2.13
HBSP 6-3	110	57	51.82	HBSP 6-3	110	0	0
SA 3-A	31	27	87.10	SA 3-A	32	4	12.5
SA 4-A	32	24	75.00	SA 4-A	31	0	0
SA 4-B	58	56	96.55	SA 4-B	57	0	0
Average Germination Rate			**70.08**	Average Germination Rate			**6.05**

The results of the germination study show that it is highly beneficial to do warm, moist stratification for at least 30 days followed by cold stratification until germination takes place. If seeds are only placed in cold stratification the germination percentages will be disappointing (about 6 percent).

Seeds from the cold treatment were moved back into warm conditions at the end of the study. After 30 days of being in the warmer no more had germinated so they were moved back to the cold condition. This warm/cold cycle triggered a new flush of germination.

The PMC had run out of 14” square trays so the remaining germinates were planted in 4410 Ray Leach “stubby” cone-tainers. One seedling was planted in each cone.
The Corvallis PMC successfully produced over 1,000 bulbs of Western lily from seed in 2010. If the bulbs continue to grow well, the agreement will be fulfilled by the end of year 5 if not sooner.

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCE CONSERVATION SERVICE
CORVALLIS, OREGON
Tyler C. Ross

January 16, 2012

THE 2011 UNITED STATES DEPARTMENT OF FISH AND WILDLIFE SERVICE ANNUAL REPORT: Western Lily (*Lilium occidentale*) Bulb Production Project

Figure 1. Two-year old Western lily (*Lilium occidentale*) bulbs flowering in the Corvallis PMC shadehouse.

I. Brief Background of Project

In 2009 the Corvallis Plant Materials Center (PMC) entered into an agreement with the United States Fish and Wildlife Service to produce 1,000 Western lily (*Lilium occidentale*) bulbs to be planted out onto restoration sites. In 2010, the Corvallis PMC agreed to produce an additional 1,000 bulbs. The bulbs are to be provided for out-planting within 5 years from the start of each agreement. Supplemental work includes development of propagation protocols for this species.

The Western lily has been a federally listed endangered species since 1994. It is only found in a narrow band, about 200 miles in length, along the coast of southern Oregon and northern California. This potentially long-lived lily species has become endangered primarily due to loss of habitat. The Western lily seems to only thrive in coastal grasslands scattered with small shrubs. The sites it occupies typically have a perched water table caused by a naturally occurring hardpan which functions to keep the soil moisture high for most of the growing season. When settlers of the Pacific Northwest coast started suppressing fires in the area, large shrubs and trees began to encroach on Western lily habitat. These larger plants were able to shade out the Western lily over time but, more importantly, their vast roots grew deep and punctured the hardpan which drained the perched water table in the area making it difficult for the Western lily to thrive. Furthermore, a reduction in grazing by elk, deer, and livestock has helped to speed the encroachment of the forest. More recently, the spike in demand for cranberries has triggered farmers to convert critical habitat into cranberry bogs. Western lily sites also prove to be excellent cranberry habitat. The man-made bogs displace the Western lily as well as drain the perched water table.

II. Germination Study Activities

Table 7. Western Lily Germination Study: 90 days warm treatment followed by cold stratification.

Box	Seeds	Number of Germ.	Percent Germ.
Cape blanco 21	45	41	91.11
Cape blanco 22	32	30	93.75
Cape blanco 23	65	59	90.77
Airport 21	70	59	84.29
Airport 22	148	144	97.30
Bastendorf bog 21	128	92	71.88
Bastendorf bog 22	55	0	0.00
Bastendorf bog 23	75	38	50.67
Hauser bog 21	21	4	19.05
Hauser bog 22	16	12	75.00
Hauser bog 23	79	47	59.49
HBSMA 23	134	0	0.00
HBSMA 26	68	0	0.00
HBSMA 28-B	114	0	0.00
Shore Acres 21	108	95	87.96
Shore Acres 22	153	139	90.85
Shore Acres 23	107	93	86.92

In the fall of 2010, 48 seed pods were collected from 6 different populations. Staff at the Corvallis PMC removed the seeds from the pods by hand and randomly selected 3 pods from each population to include in a germination study. The germination study performed the previous year suggested that most Western lily seeds need a warm, moist stratification period followed by a period of cold stratification to condition the seeds to germinate. The 2009 study only used a 30 day warm treatment followed by a cold treatment until germination took place. After approximately 40 days in cold stratification some seeds began to germinate; three months later, seeds were still sporadically germinating even when seeds were removed from stratification and placed in outdoor spring temperatures. This year, a 90 day warm treatment was used to observe whether or not a longer warm stratification will improve germination percentages or make germination more simultaneous. The results of the 2011 germination study appear in table 1.


Figure 14. Western lily (*Lilium occidentale*) two months old seedlings.

The average germination percentage per population was not significantly different using a 30 day warm treatment (with 2009 seed) compared to a 90 day warm treatment (with 2010 seed). Germination still took place over a 3 month period as it did in 2010. There seems to be no advantage of using a warm stratification period of longer than 30 days. The average germination percentage of all the populations was lower from 2010 seed, this is likely due to a lesser quality of seed. The 2011 seed had more signs of predation and mold than the 2010 seed.

All germinants were planted into racks of 7 inch “stubby” cone-tainers labeled by population. The racks were kept in a warm greenhouse until May, and then were moved to a shadehouse. While in the greenhouse the PMC experienced an outbreak of fungus gnats and shore flies that may have contributed to the spread an unidentified crown rot pathogen to most of the lily seedlings from the germination study. This caused an unusually high rate of mortality. The seedlings that survived seemed to be unaffected and began to grow normally as soon as temperatures were warm enough to move them outside.


Figure 15. Western lily flowers in the PMC shadehouse.

I. Bulb Production Activities.

Seed from 2010-In the fall of 2010, the USFWS requested an additional 1,000 bulbs to the contract. At the end of October 2010, wild collected seed that was not used in the germination study was planted into 14”X14”trays that were filled with 4” of Sunshine mix #4 (a peat based, soil-less media) with added controlled release fertilizer and micronutrient mix. Seeds were lightly covered with perlite, watered in, and placed in a warm greenhouse for 65 days, then moved to outdoor cold stratification in a lath house. In mid-April they were moved to a shadehouse where they spent the rest of the growing season. These seedlings never grew past the one leaf stage because of aphid problems throughout the growing season. Plants were sprayed with neem oil , insecticidal soap and spinosad on several occasions to control the aphids but success was very limited and short lived. Pyrethrum was used in late summer after the arsenal of natural products failed. This seemed to knock the aphid population down to an acceptable level but they could still be found up to the first killing frost. As winter approached, the flats were moved to a walk-in cooler set at 35°(F) to spend the winter where they would be safe from rodent predation and potentially harmful low temperatures.

Seed from 2009 (1 year old bulbs in 2011)- The older crop of lilies spent the winter of 2010/2011 inside a walk-in cooler set at 35 degrees F. They were moved outside to a shadehouse in early March where they quickly started growing. Some of the flats became very crowded and suffered from a possible stem rot (*botrytis)* infection. A drench of copper fungicide was used and it appear to help. They continued to grow and many went on to flower. Out of the bulbs that flowered, a small percentage was *Lilium columbiana* and a few appeared to be a hybrid between *Lilium Columbiana* and *Lilium occidentale*. This could only be observed while the flower was open and could not be marked because bulb were quite crowded in the trays making it impossible to identify which bulb the flower actually originated from. After they entered winter dormancy, the decision was made to dig the bulbs to make an accurate count and observe the range of their size. The flats were dumped and all of the soil was sifted through to find all of the bulbs. Bulbs were lightly rinsed and placed in gallon plastic bags with moistened vermiculite and transferred to a walk-in cooler for storage. A total of 1,704 bulbs were found in the 46 flats. They ranged in size from ¼" to 2" in diameter with the most common size being between ½" and 1". The bulbs will be planted back into the same type of trays but will be spaced evenly with 25 bulbs per tray. This will hopefully allow for the bulb sizes to even out and help to increase air flow which will keep disease at bay. A product called Actinovate® will be added to the Sunshine mix #4 along with the controlled release fertilizer and micronutrient blend. Actinovate® is a biological fungicide. It is a beneficial bacterium that colonizes the soil which makes it more difficult for plant diseases to become established because they must first

Figure 16. Two-year old Western lily bulbs were lifted from the trays for inventory. Some bulbs were over 2 inches in diameter.

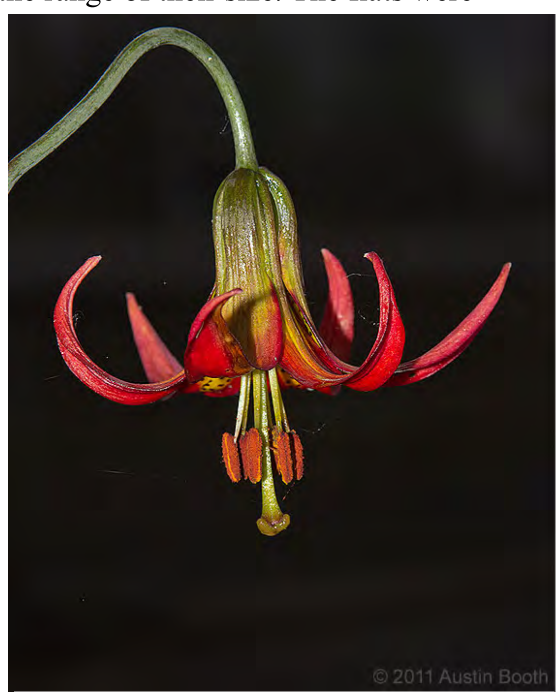

Figure 5. Western lilies are threatened by bulb collectors who remove this rare plant from the wild and into private gardens.

out-compete the beneficial bacteria. Beneficial nematodes will also be added to keep any insects that may produce a bulb eating larval stage under control.
Late germinants from the 2010 germination study were planted in 7 inch“stubby” cone-tainers™ throughout the summer of 2011. They spent the growing season in a shadehouse. Most of the bulbs were nearly the diameter of the cone-tainers but none flowered. This may have been attributed to inadequate chilling since they spent part of the previous winter in a warm greenhouse. In October, the racks of cone-tainers were moved into a lathhouse to overwinter. They will not be protected in any way from freezing temperatures t can be noted whether or not it is necessary to protect the bulbs from freezing solid by observing winter survival.

2011 Conclusion
The Corvallis PMC is ahead of schedule on fulfilling the agreement with the United States Fish and Wildlife Service. Close to 2,000 bulbs were produced from the 2009 seed crop, these bulbs will be three years old at the end of 2012 when they will hopefully be transplanted into restoration sites. At the end of 2012, the 2010 seed crop will be two years old and will probably add 700 bulbs to the total number of bulbs that will be available for outplanting. The exact number is difficult to observe without lifting all of the bulbs and counting them at the end of each growing season.

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

February 20, 2010

THE 2010 UNITED STATES FOREST SERVICE ANNUAL REPORT:
Forest Service seed increase projects

Figure 1. Tall managrass (Glyceria elata) at the Corvallis Plant Materials Center, June 28, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the United States Forest Service (USFS) in 2007 to provide native plant materials for ecological restoration. This agreement is mainly for research and development of species for which germination and or seed production protocols are unknown. Multiple forest districts can use this "umbrella" agreement. In 2010, the PMC worked with three districts to develop germination and seed increase protocols for three forbs, one grass, one sedge, and one rush.

II. Accessions Involved

Accessions included for the USFS in 2010 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for the USFS cooperative agreement with Corvallis Plant Materials Center in 2010.

Scientific Name	Common name	Code	Forest	Accession #	Activity in 2010[1]
Penstemon procerus	littleflower penstemon	PEPR2	UMA	9079526	Dlv
Hellianthella uniflora	oneflower hellianthella	HEUN	UMA	9079527	Sfp
Trifolium ericephalum	woollyhead clover	TRER	UMA	9079522	Trl
Glyceria elata	tall managrass	GLEL	MAL	9079618	Sfp, pxn
Carex obnupta	slough sedge	CAOB	OLY	9079623	Trl, pxn
Spariganium emersum	burr reed	SPER	OLY	9079624	Trl, pxn

1- sfp= seed increase, trl=germination trials, dlv= delivered plant materials, pxn= plant production

III. Field Seed Increase Activities

Most of the seed increase plots that the PMC had been growing for the Umatilla district were plowed under in 2009 due to thistle infestation. Only the *Hellianthella uniflora* plot was maintained in 2010. The plants in this plot were three years old but still were small and not too vigorous. This species may not be well adapted to living on the west side of the Cascades. Some of the plants flowered this year, but the cool wet spring prevented many pollinators from being out during the time that the plants were flowering. Only a couple grams of seed were produced. Plants did not appear to have any signs of disease or pests.

In the fall of 2009, a new field of *Glyceria elata* was sown. The seedlings did not emerge until the spring of 2010. The rows were full and plants grew slowly in the spring. Spring rain continued into June in 2010, so the field was not irrigated until late July and was irrigated every two weeks through August and mid September. This species can be successfully grown in an upland setting even though it is a wetland plant. However, it does require irrigation in the summer months. As a comparison, the PMC also grew plugs of the mannagrass and transplanted them into a constructed wetland pond in May of 2010. This plot is smaller than the upland field planting, but these two plantings will be compared to see how much more seed is produced in the "pond" planting versus the upland planting.

IV. Plant Production

Plugs of *G. elata* were produced in the spring of 2010. Seeds were sown into racks of Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients). Flats were placed in a heated greenhouse. Seedlings emerged within two weeks and their roots had filled the cone in two months. Plants were moved to an outdoor shadehouse to acclimate to spring temperatures, and were transplanted into a constructed wetland pond in May of 2010.

Seeds of *Carex obnupta* and *Spariganium emersum* were mailed to the PMC in the fall of 2009. The PMC had no previous experience working with either of these species, so germination trials were performed.

Sets of 100 seeds were counted and placed on moistened germination paper in plastic germination boxes. Boxes were placed in a walk-in cooler (5° C) or a warm growth chamber (23° C) depending on treatment. Boxes remained in the cooler for 45 or 90 days and then were moved to the warm growth chamber. No germination was observed in the cooler. Seedlings only germinated in warm temperatures. Flats of cone-tainers were also sown with seeds of each species and were left out over the winter for “natural stratification”. Approximately 40% germination was recorded for the *C. obnupta* seeds, and no germinants were observed in the *S. emersum* flats. More trials will be conducted using the S. emersum seed. Hot water treatments and 30° c germination temperatures will be tried in 2011.

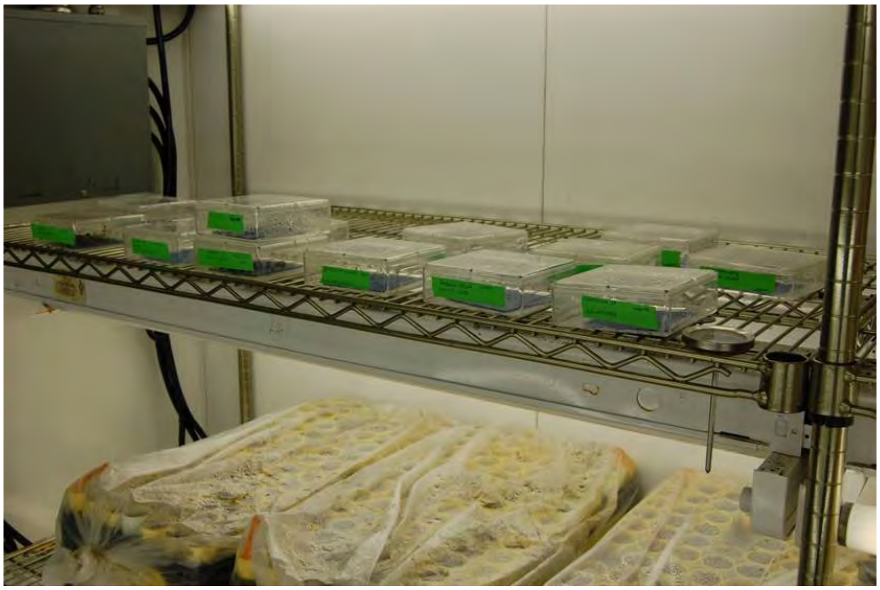

Figure 2. Germination trials in the warm growth chamber at the PMC.

Table 2. Germination trials using various lengths of cold moist stratification.

Species	**Treatment**	**Germination**
Carex obnupta	warm	1%
Carex obnupta	45 days c/m strat	6%
Carex obnupta	90 days c/m strat	2%
Spariganium emersum	warm	1%
Spariganium emersum	45 days c/m strat	22%
Spariganium emersum	90 days c/m strat	2%

The plants that were produced during the germination trials will be transplanted into a constructed wetland in the spring of 2011.

V. Delivery of Plant Materials

The entire five pound bag of *Penstemon procerus* was mailed to Karen Prudhomme on Sept 23, 2010. No other seed was delivered in 2010. Seed that has been produced for this project will remain in the PMC's seed storage facilities until requested by the USFS.

Table 3. Seeds in storage at the Corvallis Plant Material Center for the USFS in 2010.

Species	Seed lot	Amount
Eriogonum heracleoides	SG0-06-UA523	130 g
Eriogonum heracleoides	SG1-09-UA523	194 g
Monardella odoratissima	SG0-06-UA525	65 g
Monardella odoratissima	SG1-08-UA525	34 g
Penstemon fruticosus	SG0-07-UA524	260 g
Penstemon fruticosus	SG1-09-UA524	88 g
Penstemon procerus	SG0-07-UA526	230 g
Trifolium eriocephalum	SG0-04-UA522	80 g
Glyceria elata	SG0-06-MA618	300g
Carex obnupta	SG0-09-OF628	7 g
Spariganium emersum	SG0-09-OF624	39g

Our seed lot numbers describe the generation of the field (SG0 is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle number of a seed lot notes which year the seed was produced in. The last portion of the seed lot describes which project the seed is for and the last three digits of the accession number that has been assigned to this species specifically for this project.

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

February 20, 2012

THE 2011 UNITED STATES FOREST SERVICE ANNUAL REPORT:
Forest Service seed increase projects

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the United States Forest Service (USFS) in 2007 to provide native plant materials for ecological restoration. This agreement is mainly for research and development of species for which germination and or seed production protocols are unknown. Multiple forest districts can use this "umbrella" agreement. In 2010, the PMC worked with four districts to develop germination and seed increase protocols for three forbs, three legumes, four grass, one sedge, and one rush.

II. Accessions Involved

Accessions included for the USFS in 2011 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for the USFS cooperative agreement with Corvallis Plant Materials Center in 2011.

Scientific Name	Common name	Code	Forest	Accession #	Activity in 2011[1]
Glyceria elata	tall managrass	GLEL	MAL	9079618	Sfp
Carex obnupta	slough sedge	CAOB	OLY	9079623	Trl, pxn
Spariganium emersum	burr reed	SPER	OLY	9079624	Trl, pxn
Aristida longiseta	three awn	ARLO	WA-WH	9109139	Trl
Hesperostipa comata	needle and thread	HECO	WA-WH	9109137	Trl
Festuca viridula	Green fescue	FEVI	WA-WH	9109140	Trl
Trifolium longipes	long stalk clover	TRLO	WILL	9109138	Trl
Lotus crassifolius	big deervetch	LOCR	WILL	9109129	Pxn
Lotus purshianus	spanish clover	LOPU	WILL	9109146	Pxn
Penstemon cardwellii	Cardwell's beardtongue	PECA	WILL	9109128	Pxn
Iris tenax	toughleaf iris	IRTE	WILL	9109120	Pxn
Eriophyllum lanatum	Oregon sunshine	ERLA	WILL	9109126	Pxn

1- sfp= seed increase, trl=germination trials, dlv= delivered plant materials, pxn= plant production

III. Field Seed Increase Activities

In the fall of 2009, a new field of *Glyceria elata* was sown. The seedlings did not emerge until the spring of 2010. As a comparison, the PMC also grew plugs of the mannagrass and transplanted them into a constructed wetland pond in May of 2010. This plot is smaller than the upland field planting, but these two plantings will be compared to see how much more seed is produced in the "pond" planting versus the upland planting. Usually this species requires irrigation when grown in upland situations, but the spring and early summer of 2011 was very wet in the Willamette Valley, therefore the field was not irrigated. The pond planting was spring flooded with approximately 2-3" of water throughout the spring and early summer. The field planting showed very little flowering and the pond planting had zero flowering. It is unclear at this time why more flowering and seed set did not occur. Seeds were collected from the few plants that produced seed.

Horning Seed Orchard grew out plugs of three forbs and two legumes which were delivered to the PMC on June 9, 2011. These plugs were used to establish seed increase fields. The *Lotus crassifolius* and *Penstemon cardwellii* were put into fields in the fall of 2011 using a mechanical transplanter. The other species were transplanted by hand in March of 2012. Seed of *Lotus purshianus* was directly sown (after scarifying) into a field that was covered with weed fabric. Holes were cut on 1ft by 1 ft spacing. Seed was sprinkled into holes and covered with fine vermiculite. Field sizes are noted in Table 2.

Table 2. Field Establishment for USFS agreements in 2011.

Species	Field size	Transplant Date
Glyceria elata	0.22	n/a
Lotus crassifolius	0.02	October 5, 2011
Lotus purshianus	0.04	March 7, 2012
Penstemon cardwellii	0.03	October 5, 2011
Iris tenax	0.03	April 8, 2012
Eriophyllum lanatum	0.04	April 10, 2012

IV. Plant Production/ Germination Trials

Seeds of *Carex obnupta* and *Spariganium emersum* were mailed to the PMC in the fall of 2009. The PMC had no previous experience working with either of these species, so germination trials were performed in 2010. Very little germination was noted in all treatments for *C. obnupta*. *S. emersum* had the highest germination (22%) after 45-days cold moist stratification followed by warm/wet conditions. More germination trials were conducted in 2011. Scarification and light/dark treatments were added for *C. obnupta and S. emersum.* No germination was noted in any trial in 2011 for *S. emersum*, even the most successful treatment from the 2010 trials. An internet search suggested that *Spariganium* seed germinates best when fresh and should not completely dried. Completely drying the seed may reduce viability. Germination was noted, however, in flats that were sown in 2010, but overwintered outside in natural conditions. Only about 50 plants were produced. While scarifying the *Carex* seed, it became obvious that the seed was of poor quality, many seeds had holes in them and crushed easily. This may explain the very low germination in the trials. However, the total amount of seed collected was enough to produce approximately 600 plugs. These plugs and the *S. emersum* were transplanted into tubs filled with Sunshine #1 (a peat-based soil-less media) amended with a slow-release fertilizer.

Seeds of *Aristida longiseta, Hesperostipa comata, Festuca viridula*, and *Trifolium longipes* were mailed to the PMC in the fall of 2011. The PMC had no previous experience working with either of these species, so germination trials were performed Sets of 100 seeds were counted (some were scarified using a two blocks of wood covered with sandpaper) and placed on moistened germination paper in plastic germination boxes. Boxes were placed in a walk-in cooler (5° C) or a warm growth chamber (23° C) depending on treatment. Boxes remained in the cooler for 45 or 90 days and then were moved to the warm growth chamber. No germination was observed in the cooler. Seedlings only germinated in warm temperatures.

Table 3. Germination trials using various lengths of cold moist stratification and scarification.

Species	**Treatment**	**Average Germination**
ARLO (SR)	Warm	84
ARLO (SR)	45 day cold	84
ARLO (SR)	90 day cold	78
ARLO (Pitts)	Warm	77
ARLO (Pitts)	45 day cold	70
ARLO (Pitts)	90 day cold	50
FEVI	Warm	5
FEVI	45 day cold	18
FEVI	90 day cold	23
HECO	Warm	8
HECO	45 day cold	6
TRLO	Warm (scarified)	18
TRLO	Warm	4
TRLO	45 day cold (scarified)	57
TRLO	45 day cold	7
TRLO	90 day cold	6
CAOB	Scarified	34
CAOB	Non-scarified	7
SPEM	Scarified (45-day cold)	0
SPEM	Non-scarified (45-day cold)	0
SPEM	Scarified (warm)	0
SPEM	Non-scarified (warm)	0

V. Delivery of Plant Materials

There were no plant material deliveries made in 2011.

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

February 20, 2010

THE 2010 SEED INCREASE OF THREATENED AND ENDANGERED SPECIES ANNUAL REPORT

Figure1. Golden paintbrush (*Castellija levisecta*) seed increase field at the Corvallis Plant Materials Center, June 17, 2010.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) has entered into agreements with the United States Fish and Wildlife Service (USFWS) to produce seed and plants of threatened and endangered species. The PMC also works in a close partnership with the Institute for Applied Ecology (IAE) to establish the PMC-grown plants and seeds at restoration sites. Two seed increase fields of Nelson's checkermallow began in 2009. This project will help reach recovery goals by producing seeds, plants, and rhizome pieces to be planted out in various restoration projects on protected sites. New in 2010, is an agreement to produce seeds and plants of golden paintbrush. This plant is thought to have been extirpated from Oregon and the products of this project will be used to establish new populations in Oregon according to recovery goals. The PMC is also researching seed increase techniques for Kincaid's lupine and Willamette Valley daisy.

II. Accessions Involved

Table 1. Accessions involved in the Threatened and Endangered Species Seed Increase project at the Corvallis Plant Materials Center in 2010.

Species	Common name	Population Source	Accession #	Activity in 2010[1]
Erigeron decumbens var. *decumbens*	Willamette valley daisy	Allan & Allan Farm	9079508	sfp
Erigeron decumbens var. *decumbens*	Willamette valley daisy	Baskett Butte	9079509	sfp
Lupinus oreganus var. *kincaidii*	Kincaid's lupine	Lupine meadows	9079514	sfp, dlv
Lupinus oreganus var. *kincaidii*	Kincaid's lupine	Piercy farm	9079515	sfp,dlv
Sidalcea nelsoniana	Nelson's checkermallow	Salem West	9079600	sfp, pxn, dlv
Sidalcea nelsoniana	Nelson's checkermallow	Corvallis West	9079597	sfp, pxn,dlv
Castilleja levisecta	golden paintbrush	Nass, Ft. Casey, Ebey's landing, Rocky Prairie	9079625	pxn,sfp, dlv

1- sfp= seed increase, pxn= plant production, dlv= delivery of plant materials

III. Plant Production

The Corvallis PMC was contracted to produce a minimum of 8000 plugs of Nelson's checkermallow (4000 plugs for the Salem West zone and 4000 for the Corvallis West zone) for delivery in the fall of 2010. Using the field produced seed from each recovery zone, plugs were started on March 9, 2010. Seeds were scarified by rubbing them between two pieces of sandpaper and then sown into Ray Leach stubby "cone-tainers" filled with Sunshine #1 (a sterile soil-less, peat-based media) amended with micronutrients and a balanced slow release fertilizer. Racks of cones were wrapped in plastic bags and placed in a walk-in cooler for four months of stratification. After coming out of the cooler, racks were placed outside in a shadehouse. Seedlings emerged within two weeks after being removed from the cooler (some seedlings had germinated in the cooler). Cones that had more than two seedlings were thinned and extra seedlings were transplanted into empty cones. The seedlings grew very rapidly and attempted to flower in August. The plants were very large and becoming difficult to water. Usually PMC staff use battery-powered hand trimmers to cut back excessive growth of container plants, but this method wasn't efficient for the amount of plants in the shadehouse. Creative summer employees built a raised track for the push mower to drive on and the racks of cone-tainers were placed beneath it. Many racks of plugs could be cut at once and all the plants in both shadehouses (approximately 25,000 plants) could be cut in a day.

Figure 2. Raised track built for trimming plants in racks of conetainers.

The PMC had agreed to produce 1500 plugs of *Castilleja levisecta* for delivery in spring of 2010, and another 1500 plugs to be used to establish a seed increase plot. Seed collections were made over the summer of 2009 by various groups in Washington and was provided to the PMC by IAE in the fall of 2009. Germination tests were performed on each of the populations. Sets of 50 seeds were counted and placed on moistened germination paper in plastic germination boxes. They were placed in a walk-in cooler (35° F) for six weeks, and then placed in a growth chamber (70° days /55° nights). A quick flush of germination occurred within five days and then ceased in the growth chamber.

Table 2. Germination results for formal trial on *Castilleja levisecta* populations

Source	**Treatment**	**Total Percent Germination**
Ebey's Landing	6 weeks cold	72
Naas	6 weeks cold	44
Rocky Prairie	6 weeks cold	4
Fort Casey	6 weeks cold	55

On November 19, 2009, the remaining seed was sprinkled on moistened germination paper in plastic germination boxes placed in a walk-in cooler. Instead of taking the boxes out of the cooler after six weeks, they were left in the cooler. Seeds began to germinate at seven weeks and continued to germinate for three more weeks in the cooler. The boxes that were left to germinate in the cooler appeared to have a much higher germination rate than the boxes that were placed in the warm growth chamber after six weeks. Exact percentages could not be recorded however, because the seeds were placed in large germination boxes in bulk amounts that were not counted. When the seeds first began to germinate, they were carefully removed by hand using tweezers and transplanted into Ray Leach stubby "cone-tainers" filled with Sunshine #1 (a sterile soil-less, peat-based media) amended with micronutrients and a balanced slow release fertilizer. Racks of cones were placed in a greenhouse set at moderate temperatures. Populations were kept

Figure 3. Golden paintbrush (*Castellija levisecta*) growing with fescue host in the PMC greenhouse, April 2, 2010.

separate. The plants grew slowly and there was a significant amount of death and damping off. This species is known to be hemi-parasitic and will thrive if planted with a host. Seeds of sand fescue (*Festuca ammobia*) were sown in the cone-tainers of paintbrush which were used for the seed increase plot. Golden paintbrush does not appear to be host specific, therefore sand fescue was chosen mostly for convenience in PMC field planning. Plugs that were slated to be delivered to IAE were not sown with a host. In March, the Rocky Prairie population was contaminated with a small number of plants from the Naas and Fort Casey populations. Two seed increase plots had been planned, one being an isolation of the Rocky Prairie population, the other a mixed plot of all four populations. Due to the mixing and low numbers of Rocky Prairie from low germination and damping off, the second seed increase plot of Rocky Prairie plants was not established.

In April of 2010, 1098 plugs were picked up by IAE for outplanting, and the remaining 1850 plugs were used to establish a seed increase plot at the PMC.

Table 2. Plant Production in 2010 for the Threatened and Endangered Species Seed Increase project at the Corvallis Plant Materials Center.

Species	Source	Treatment	Start date	# of Plants
Castilleja levisecta	Ebey's Landing	7 weeks cold	Nov 19,2009	839
Castilleja levisecta	Fort Casey	7 weeks cold	Nov 19,2009	725
Castilleja levisecta	Naas	7 weeks cold	Nov 19,2009	950
Castilleja levisecta	Rocky Prairie	7 weeks cold	Nov 19,2009	435
Sidalcea nelsoniana	Salem West	Scarify, 4 mos cold	Mar 1, 2010	4000
Sidalcea nelsoniana	Corvallis West	Scarify, 4 mos cold	Mar 1, 2010	4000
Castilleja levisecta	Mixed	6 weeks cold	Oct 1 2010	5000
				15949

IV. Field Seed Increase Activities

Castilleja levisecta- On April 6, 2010, 1851 plugs with a host were transplanted into a field on the PMC farm. Each row consisted of one population and the rows were alternated throughout the field This makes it possible to make visual qualitative assessments of the growout and production of the different populations,. A field map was made and labels were kept at the head of each row.

Table 3. *Castilleja levisecta* plugs transplanted out on the PMC farm

Source	Number of Plants
Ebey's Landing	600
Fort Casey	507
Naas	528
Rocky Prairie	216

The plants grew well in the field and flowered. Seeds matured unevenly across the field; one stalk would contain mature seed pods and still be flowering at the tip of the stalk. Seed pods were held tightly closed on the plant, so the PMC workers were able to harvest the field in two intervals. By a visual assessment of the field, the populations performed similarly, the only exception being the Ebey's Landing population, which tended to produce more flowering branches. Seed pods were dried in an open-air greenhouse. The pods were fed through a Wintersteiger stationary thresher to break them open, and debris was separated from seeds in a small air-screen machine.

Figure 4. Golden paintbrush (Castellija levisecta) seed increase field at the Corvallis Plant Materials Center, June 17, 2010.

Kincaid's lupine- this was the fourth growing season for both lupine plots. In early March the plants emerged from dormancy and began to grow vigorously. Many plants in the Lupine meadows plot did not emerge in the spring. This plot is on heavier soils than the Piercy plot, which has had 100% survival over the three growing seasons. Both plots were weeded by hand and field borders were tilled. Seed production of both plots was down significantly from past years. Weather was one factor in this decline. June was very cool and wet in 2010. Bee activity was minimal, and seed maturity was two weeks later

Figure 5. Kincaid's lupine (Lupinus oreganus var kincaidii) at the Corvallis Plant Material Center April 15, 2010.

from the average maturity date for this field. When seed pods turned light tan they were collected by hand and placed inside a tarp "taco" in an open greenhouse.

Willamette Valley Daisy- This was the fourth growing season for both of the daisy plots. In late January the plants emerged from dormancy and began to grow vigorously. Both plots were weeded by hand and field borders were tilled. Seeds were harvested using a portable battery-powered vacuum. The plots were harvested three times a week for three weeks during July and August. The excessively wet June helped these plants grow quite large before they flowered in July. This may have been why yields were higher this year than in previous years.

Figure 6. Willamette valley daisy seed increase plot at the Corvallis Plant Materials Center, June 25, 2010.

Salem West (SW) and Corvallis West (CW) Nelson's checkermallows- These fields were established in mid March of 2009 using plugs that were grown over the winter. Plants from each of the metapopulations were distributed across the fields to reduce the chances of an entire metapopulation being lost due to damage to the fields (flood, pest attack, gophers, mowing or spraying accident, ect). This arrangement also increases the opportunity for cross-pollination between the metapopulations. The two seed increase fields were isolated from each other by three miles.

Weed fabric was installed on the SW field but not on the CW field. Originally, it was planned that both fields would have weed fabric, but the CW field had a large amount of glass, sharp rocks, and other debris that could make crawling on weed fabric dangerous for PMC employees. Also, having a checkermallow field without weed fabric gives the PMC an opportunity to compare the seed increase fields. The CW field was weeded by hand twice during the growing season and also spot sprayed with glyphosate to remove weedy clover plants. Field borders were tilled. The SW field was weeded once by hand and the borders of the field were sprayed with glyphosate.

Figure 7. Corvallis West Nelson's checkermallow (*Sidalcea nelsoniana*) seed increase field at the Corvallis Plant Materials Center, June 22, 2009.

Spring and early summer of 2010 was unusually wet and cool. The SW field appeared to start growing earlier than the CW field and plants were larger in the early spring-summer. This is most likely due to the increased soil temperatures under the black weed fabric. The SW field also showed signs of a leaf rust. Some plants were severely affected (stunting, withered seed heads, lack of seed production), but most plants did not appear damaged. The rust was observed on a few plants in the CW field but no plants were severely affected. The fabric may have played in role in promoting the leaf rust by creating a wetter, warmer environment. Both the SW and CW seed increase fields matured at approximately the same time. The CW field was combined a week sooner because it did not have weed fabric. The weed fabric catches all the early maturing seed as it shatters, which means that the field can be combined when the latest maturing seeds are ripe. Without the weed fabric, the field has to be carefully assessed to figure out when the largest percent of seed is mature but hasn't shattered (because it will fall to the ground).

Table 4. Harvest Information for the Threatened and Endangered Species Seed Increase project at the Corvallis Plant Materials Center in 2010.

Species	**Accession**	**Field size (ac)**	**Date harvested**	**Method**	**Yield**
Erigeron decumbens var. *decumbens*	Allan & Allan Farm	0.006	July 12- July20	vacuum	106 g
Erigeron decumbens var. *decumbens*	Baskett Butte	0.006	July 12- July20	vacuum	165 g
Lupinus oreganus var. *kincaidii*	Lupine meadows	0.01	July 1-19	hand	176 g
Lupinus oreganus var. *kincaidii*	Piercy farm	0.01	June27-July 17	hand	635 g
Sidalcea nelsoniana	Salem West	0.3	July 27	combine	89 lbs
Sidalcea nelsoniana	Corvallis West	0.3	July 22	combine	87 lbs

V. Delivery of Plant Materials

Seed was delivered in the fall to IAE and USFWS staff. The remaining seed will be kept in the PMC seed storage facilities until requested.

Table 5. Seed delivered for the Seed Increase of Threatened and Endangered Species project in 2010.

Species	**Source**	**Seed lot**	**Amt**	**Viability**	**Purity**
Erigeron decumbens var. *decumbens*	Allan & Allan Farm	SG1-10-AA508	106 g	N/A	N/A
Lupinus oreganus var. *kincaidii*	Lupine meadows	SG1-10-LM514	176 g	N/A	N/A
Lupinus oreganus var. *kincaidii*	Piercy farm	SG1-10-PE516	623 g	N/A	N/A
Sidalcea nelsoniana	Salem West	SG1-09-SW600	51 lbs	41*	99.57
Sidalcea nelsoniana	Salem West	SG1-10-SW600	89 lbs	88	97.67
Sidalcea nelsoniana	Corvallis West	SG1-09-CW597	34 lbs	59*	99.9
Sidalcea nelsoniana	Corvallis West	SG1-10-CW597	87 lbs	91	98.98
Castilleja levisecta	Mixed	SG1-10-NS625	603 g	N/A	N/A

*seeds were not nicked prior to soaking in Tetrazolium at the seed lab, therefore this TZ viability test does not include "hard" but viable seed. Tests in 2010 were nicked and viability percents were much higher due to the inclusion of hard seed.

Our seed lot numbers describe the generation of the field (SG0 is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot indicates which year the seed was produced in. The letters in the last portion of the seed lot describes which project the seed is for (or an abbreviation for the seed source) and the numbers are the last three digits of the accession number that has been assigned to this species specifically for this population source.

Table 6. Plant delivery for the Seed Increase of Threatened and Endangered Species project in 2010.

Species	Source	Number	Delivery Date
Sidalcea nelsoniana	Salem West	4000	22-Nov
Sidalcea nelsoniana	Corvallis West	4000	22-Nov
Castilleja levisecta	Ebey's Landing	239	10-Apr
Castilleja levisecta	Fort Casey	218	10-Apr
Castilleja levisecta	Naas	422	10-Apr
Castilleja levisecta	Rocky Prairie	219	10-Apr

Table 7. Seed in storage for Seed Increase of Threatened and Endangered Species project in 2010.

Species	Source	Seed lot	Weight
Erigeron decumbens var. *decumbens*	Allan & Allan Farm	SG1-09-AA508	48 g
Erigeron decumbens var. *decumbens*	Baskett Butte	SG1-09-BB509	64 g
Erigeron decumbens var. *decumbens*	Baskett Butte	SG1-10-BB509	165 g
Castilleja levisecta	Mixed	SG1-10-NS625	20 g

CORVALLIS PLANT MATERIALS CENTER
USDA NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

January 20, 2012

THE 2011 SEED INCREASE OF THREATENED AND ENDANGERED SPECIES ANNUAL REPORT


Figure 1. Golden paintbrush *(Castilleja levisecta)* seed increase field at the Corvallis Plant Materials Center, May 17, 2011.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) has entered into agreements with the United States Fish and Wildlife Service (USFWS) to produce seed and plants of threatened and endangered species. The PMC also works in a close partnership with the Institute for Applied Ecology (IAE) to establish the PMC-grown plants and seeds at restoration sites. Two seed increase fields of Nelson's checkermallow began in 2009. This project will help reach recovery goals by producing seeds, plants, and rhizome pieces to be planted out in various restoration projects on protected sites. In 2010, an agreement to produce seeds and plants of golden paintbrush was added. This plant is thought to have been extirpated from Oregon, and the products of this project will be used to establish new populations in Oregon according to recovery goals. The PMC has also been researching seed increase techniques for Kincaid's lupine and Willamette Valley daisy for the past four years. Kincaid's lupine fields and one of the Willamette Valley daisy fields were removed in the fall of 2010in order to make room for other plantings.

II. Accessions Involved

Table 1. Accessions involved in the Threatened and Endangered Species Seed Increase project at the Corvallis Plant Materials Center in 2011.

Species	Common name	Population Source	Accession #	Activity in 2011[1]
Erigeron decumbens var. *decumbens*	Willamette Valley daisy	Baskett Butte	9079509	sfp
Sidalcea nelsoniana	Nelson's checkermallow	Salem West	9079600	sfp, dlv
Sidalcea nelsoniana	Nelson's checkermallow	Corvallis West	9079597	sfp, dlv
Castilleja levisecta	golden paintbrush	Western Washington	9079625	pxn,sfp, dlv

1- sfp= seed increase, pxn= plant production, dlv= delivery of plant materials

III. Plant Production

The PMC agreed to produce 5,000 plugs of *Castilleja levisecta* for delivery in spring of 2011. Using the seed that was produced by the seed increase field in 2010, plugs were started in late October 2010. Seeds were sown into Ray Leach stubby "cone-tainers" filled with Sunshine #1 (a sterile soil-less, peat-based media) amended with micronutrients and a balanced slow release fertilizer. Racks of cones were wrapped in plastic bags and placed in a walk-in cooler for six weeks of cold-moist stratification. After coming out of the cooler, racks were placed inside a cool greenhouse (set at about 60°F). Seedlings emerged within two weeks after being removed from the cooler. Previous work with this species has suggested that seeds germinate at higher percentages if seeds are in moderate temperatures rather than warm temperatures (65-75°F). Seedlings were thinned down to two seedlings per cone-tainer and greenhouse temperatures were increased to 75°F to speed up the growth of the seedlings. Most seedlings appeared healthy for the first two months, but then more and more disease issues were noticed among the plants. Healthy plants were green, tall, and usually had multiple stems. Sick plants were pale, some almost white, others having a reddish tint to their leaves, and usually they were very stunted and had little root development. Many cone-tainers had infestations of fungus gnats, so predatory nematodes were applied to all plants in the greenhouse. This reduced the fungus gnat population, but did not appear to improve the health of diseased plants. Plant samples were sent to the OSU plant pathology lab. The diagnosis was root rot disease, most likely caused by *Pythium*. In January, seeds of host plants were added to the *Castilleja* containers. Hosts grew at various rates depending on the species. *Prunella vulgaris* ssp. *lanceolata* hosts grew faster than the paintbrushes and had to be pruned. Seeds of *Danthonia californica* and *Eriophyllum lanatum* were pre-stratified. This worked well for the *D. californica*, but resulted in uneven germination for the *E. lanatum*. *Achillea millefolium* appeared to be a favored host. Paintbrush plants that had yarrow as their hosts were larger, exhibited more flowering, and looked more vigorous. These seedlings may have been larger when they received their host, so we could not conclude that yarrow is a preferred host. Survival data after outplanting will be collected by IAE to assess differences among hosts.

Table 2. Plant production in 2011 for the Threatened and Endangered Species Seed Increase project at the Corvallis Plant Materials Center.

Species	Host	Treatment	Number
Castilleja levisecta	*Festuca roemeri*	6 weeks cold	1,200
Castilleja levisecta	*Koeleria macrantha*	6 weeks cold	450
Castilleja levisecta	*Deschampsia cespitosa*	6 weeks cold	350
Castilleja levisecta	*Sidalcea virgata*	6 weeks cold	500
Castilleja levisecta	*Achillea millefolium*	6 weeks cold	450
Castilleja levisecta	*Danthonia californica*	6 weeks cold	350
Castilleja levisecta	*Prunella vulgaris* ssp. *lanceolata*	6 weeks cold	450
Castilleja levisecta	*Eriophyllum lanatum*	6 weeks cold	360
Castilleja levisecta	No host	6 weeks cold	400

IV. Field Seed Increase Activities

Golden paintbrush- In April 2010, 1851 plugs with a fescue host were transplanted into a field on the PMC farm. Each row consisted of one population and the rows were alternated throughout the field. This makes it possible to make visual qualitative assessments of the growout and production of the different populations. A field map was made and labels were kept at the head of each row.

The plants grew well in the field and flowered early in 2011. The plants were much larger than in 2010, and were covered with many flowering stems. The fescue also bloomed this year. The fescue heads were cut off before the seeds were ripe so they would not shatter all over the field. The fescue seedheads were tall enough to cut them off without hitting the *C. levisecta* seed heads. The seed pods of *C. levisecta* will not split open for many weeks after seeds are mature which leaves a large harvest window. Pods were harvested early anyway (after seeds were mature, but pods were not splitting) due to lagging harvest times on other fields. Seed pods were dried in an open-air greenhouse. The pods were fed through a Wintersteiger stationary thresher to break them open, and debris was separated from seeds in a small air-screen machine. The thresher did de-hull many seeds, but this doesn't seem to harm them. The seed lot was tested after cleaning and was found to be 67% viable. This was expected since PMC staff were conservative with blowing out empty or small seed.

Willamette Valley daisy- This was the fifth growing season for the remaining daisy plot. In late January, the plants emerged from dormancy and began to grow vigorously. The plot was weeded by hand and field borders were tilled. A large piece of remay (spun polyester) was stapled down over the field to exclude pollinators to see how it affected seed yields Seeds were harvested directly from the plants once at the end of the season using a portable battery-powered vacuum. The seeds were smaller, lighter, and less developed than in previous years. Germination trials were initiated in fall of 2011. Results will be available in the spring of 2012.

Figure 2. Golden paintbrush (*Castelleja levisecta*) seed increase field at the Corvallis Plant Materials Center, May 17, 2011.

Salem West (SW) and Corvallis West (CW) Nelson's checkermallows- These fields were established in mid-March of 2009 using plugs that were grown from wild collected seed. The two seed increase fields were isolated from each other by three miles.

Weed fabric was installed on the SW field, but not on the CW field. Originally, it was planned that both fields would have weed fabric, but the CW field had a large amount of glass, sharp rocks, and other debris that could make crawling on weed fabric dangerous for PMC employees. Also, having a checkermallow field without weed fabric gives the PMC an opportunity to compare the seed increase fields.

In the winter of 2010-2011, rhizomes were harvested from both fields. This activity was performed by IAE staff and contracted labor. A portion of each field was dug up and mother plants were divided. Small pieces of the mother plants still remained in the field, and in the spring many new leaves were seen emerging from the edges of the holes where the plants had been dug out. Plugs leftover from the fall delivery were also transplanted into the holes in the fields.

The CW field was very weedy in 2011. The entire field was weeded twice by hand during the growing season and also spot sprayed with glyphosate to remove weedy clover plants. Field borders were tilled. The SW field was weeded once by hand and the borders of the

the Corvallis Plant Materials Center, June 25, 2011.

field were sprayed with glyphosate. The previous two years have been wet and cool in the spring and early summer. The weather created a more favorable environment for rusts and other fungi. Some leaf spots were noticed last year on both fields, but the SW field (the one with weed fabric) had many more affected leaves. The rust did not seem to damage the plants or reduce vigor. In 2011, both fields were covered with the same leaf rust, but the CW field was severely damaged by the rust. No labeled fungicides exist for this crop, so it was not sprayed. Some plants may have died from the fungus, but most were stunted with curled seed heads. A few *Sidalcea campestris* plants are in the field and they were totally unaffected by the rust. The portion of the field where rhizomes were harvested was more impacted by the rust. The CW field produced very little seed. The SW field had many affected leaves, and although the seed heads looked intact, the seed yields from this field were half of what they were last year, so the rust may have impacted this field also. Both fields were harvested by direct combining.

Table 4. Harvest information for the Threatened and Endangered Species Seed Increase Project at the Corvallis Plant Materials Center in 2011.

Species	**Accession**	**Field size (ac)**	**Date harvested**	**Method**	**Yield**
Erigeron decumbens var. *decumbens*	Baskett Butte	0.006	Aug 1	vacuum	144 g
Castilleja levisecta	Mixed	0.04	July 13	hand	4 lbs
Sidalcea nelsoniana	Salem West	0.3	July 27	combine	42 lbs
Sidalcea nelsoniana	Corvallis West	0.3	July 27	combine	13 lbs

V. Delivery of Plant Materials

Seed was delivered in the fall to IAE staff. The remaining seed will be kept in the PMC seed storage facilities until requested.

Table 5. Seed delivered for the Seed Increase of Threatened and Endangered Species Project in 2011.

Species	Source	Seed lot	Weight
Castilleja levisecta	Mixed	SG1-11-NS625	1.5 lbs
Sidalcea nelsoniana	Salem West	SG1-11-SW600	42 lbs
Sidalcea nelsoniana	Corvallis West	SG1-11-CW597	13 lbs

Our seed lot numbers describe the generation of the field (SG0 is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot indicate which year the seed was produced. The letters in the last portion of the seed lot describe which project the seed is for (or an abbreviation for the seed source) and the numbers are the last three digits of the accession number that has been assigned to this species specifically for this population source.

Table 6. Seed in storage for Seed Increase of Threatened and Endangered Species Project in 2011.

Species	Source	Seed lot	Amt
Erigeron decumbens var. *decumbens*	Allan & Allan Farm	SG1-09-AA508	48 g
Erigeron decumbens var. *decumbens*	Baskett Butte	SG1-08/11-BB509	0.5 lb
Castilleja levisecta	Mixed	SG1-11-NS625	2 lb
Castilleja levisecta	Mixed	SG1-10-NS625	90 g

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

January 20, 2010

THE 2010 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
Willamette Valley Daisy *(Erigeron decumbens* var. *decumbens)* Breeding System Study.

Figure 1.Willamette Valley daisy (*Erigeron decumbens* var. *decumbens)* flowers with native pollinator at the Corvallis Plant Materials Center, July 7, 2010.

Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement with the Bureau of Land Management in 2007 to study the breeding system of the endangered Willamette Valley daisy. The breeding system of this species is not well understood. Information about the breeding system is needed for future management and planning. The purpose of this study is to determine which treatment will produce the highest amount of quality seed. Treatments will also be compared between one large population(Oxbow West) and one small population (Balboa).

Methods

Seeds were collected from wild stands in the summer of 2008 and delivered to the PMC during the fall. PMC staff removed large debris from the envelopes and then placed all the seeds into germination boxes filled with moistened germination paper. The germination boxes were placed in a walk-in cooler set at a constant temp of 3° for 120 days. After this cold period, boxes were placed on a counter at room temperature. Germination occurred within two weeks. Seedlings were transplanted into Ray Leach "stubby" conetainers filled with moistened media (Sunshine #1, a peat-based sterile media amended with micro nutrients and a slow-release fertilizer). In April of 2009, the plants were transplanted into a prepared field covered with bark mulch. Plants grew very slowly and did not flower (delaying the treatments for a year). Unusually cold temperatures in the winter of 2009 killed some of the plants. This left the study with an uneven number of plants. When the plants began to flower in the summer of 2010, heads were bagged on each plant. Flowers were bagged with a tightly woven nylon bag before the flower had opened. Treatments began as flowers became fertile (female flowers becoming pollen receptive) and were treated twice a week (sometimes three times a week in warmer weather). Treatments were as follows:

Selfing: while in pollen-receptive (female) stage, pollen from male-stage flowers from the same plant was rubbed across the styles of the study plant.

Within population: while in pollen-receptive (female) stage, pollen from male-stage flowers from all the other plants from the same population was rubbed across the styles of the study plant. Pollen was collected by using a pipe cleaner, then brushed across the study flower.

Population cross: while in pollen-receptive (female) stage, pollen from male-stage flowers from all the other plants in the study (both populations) was rubbed across the styles of the study plant. Pollen was collected by using a pipe cleaner, then brushed across the study flower.

When seed was ripe on the study plants, the stem was cut (carefully so as not to spill the seed in the mesh bag) and placed in a paper envelope to dry.

After drying, the seeds in each envelope were counted. Previous work at the PMC has shown that the human eye cannot determine a good seed from bad seed for this species. Seed cleaning machines that use air are much more accurate than a visual assessment. Seeds were counted, but not assessed for viability, weighed, and placed in germination boxes filled with moistened germination paper. The germination boxes were placed in a walk-in cooler set at a constant temp of 3° for 120 days. After this cold period, boxes were placed on a counter at room temperature. Germination occurred within two weeks. Germinants were counted twice a week for four weeks.

Results

Table 1. Results of Controlled Crosses Using Field Grown *Erigeron decumbens var. decumbens.*

Population	Plant	Treatment	# of seeds	Weight of seeds (g)	Germ	
Balboa	1	Self	187	0.0045	0	
Balboa	1	Within pop	111	0.0032	0	
Balboa	1	pop cross	360	0.0143	7	
Balboa	5	Self	195	0.0041	0	
Balboa	5	Within pop	211	0.0047	0	
Balboa	5	pop cross	192	0.0065	8	
Balboa	6	Self	114	0.005	0	
Balboa	6	Within pop	98	0.0037	1	
Balboa	6	pop cross	134	0.0285	2	
Balboa	8	Self	166	0.0057	10	
Balboa	8	Within pop	188	0.0074	15	
Balboa	8	pop cross	169	0.0126	63	
Balboa	14	Self	236	0.0089	2	
Balboa	14	Within pop	287	0.008	0	
Balboa	14	pop cross	202	0.0108	13	
Oxbow	2	Self	213	0.0045	4	
Oxbow	2	Within pop	174	0.0128	57	
Oxbow	2	pop cross	276	0.0147	50	
Oxbow	3	Self	195	0.0052	0	
Oxbow	3	Within pop	113	0.0064	17	
Oxbow	3	pop cross	193	0.0124	46	
Oxbow	6	Self	127	0.0068	1	
Oxbow	6	Within pop	119	0.0035	1	
Oxbow	6	pop cross	221	0.0094	0	
Oxbow	12	Self	293	0.0141	0	
Oxbow	12	Within pop	295	0.0235	99	** bag fell off
Oxbow	12	pop cross	283	0.0152	23	
Oxbow	13	Self	147	0.0429	0	
Oxbow	13	Within pop	350	0.0309	1	* 2 flwrs
Oxbow	13	pop cross	167	0.0031	0	

Conclusions

Figure 2. Willamette Valley daisy (*Erigeron decumbens* var. *decumbens)* study plant with pollinator exclusion bags, August 14, 2010.

From glancing at the data it appears that there is a correlation between the seed weight and germination rate. The data suggests trends in the amount of germinants among each treatment. Selfing tended to produce the least amount of germinable seeds among both populations. The heads the received pollen from their respective populations showed an increase in seed production over the selfing treatments, which could suggest that pollinators are very important to this species. The population cross treatments consistently produced the highest amount of germinants in the Balboa plants. This treatment also produced high numbers for the Oxbow plants but it wasn’t as consistent. This data suggests that it might be beneficial to the long-term survival of these populations that there is some gene flow between existing populations. This may be more important for a small populations rather than large populations.