DIRECT SURFACE SEEDING SYSTEMS FOR THE ESTABLISHMENT OF NATIVE PLANTS IN 2015

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Introduction

Seed of native plants is needed to restore rangelands of the Intermountain West. Reliable commercial seed production is needed to make seed readily available. Direct seeding of native range plants has been problematic for many species evaluated at the Malheur Experiment Station. Fall planting is important for many species to overcome physiological dormancy through cold stratification, yet this technique still has resulted in poor stands some years at the Malheur Experiment Station. Inadequate soil moisture, crusting, and seed predation by birds are identified hindrances to adequate stand establishment for fall-planted seed. Previous trials to address these issues examined seed pelleting, planting depth, and soil anticrustant with four species planted in the fall (Shock et al. 2010). Planting at depth with soil anticrustant improved emergence compared to surface planting whereas seed pelleting did not improve emergence. Planting at ⅛-inch depth resulted in higher emergence than either surface planting or planting at ¼-inch depth for three of the four species. Emergence for one species was too poor for any conclusions to be made. Despite these positive results, emergence was extremely poor for all species tested. Soil crusting, loss of soil moisture, and bird damage could have contributed to the poor emergence.

In established native perennial fields at the Malheur Experiment Station and in rangelands we observed prolific emergence from seed naturally falling on the soil surface and subsequently covered by thin layers of normally occurring organic debris. Building on this observation, we developed and tested planting systems, focusing on surface-planted seed (Table 1, Shock et al. 2012-2014). Treatments include row cover, sawdust, sand, and seed treatments. Row cover acts as a protective barrier against soil desiccation and bird damage. Sawdust was intended to mimic the protective effect of organic debris. Sand can help hold the seed in place. Seed treatment can protect the emerging seed from fungal pathogens that might cause seed decomposition or seedling damping off. Trials did not test all possible combinations of treatments, but focused on combinations likely to result in adequate stand establishment based on previous observations.

Materials and Methods

In 2015, 10 species for which stand establishment has been problematic were included and an additional species (*Penstemon speciosus*) was chosen as a check, because it has reliably produced good stands at Ontario. Seed weights for all species were determined. In November, 2015, a portion of the seed was treated with a liquid mix of the fungicides Thiram and Captan (10 g Thiram, 10 g Captan in 0.5 L of water). Seed weights of the treated seeds were determined after treatment. The seed weights of untreated and treated seed were used to make seed packets containing approximately 300 seeds each. The seed packets were assigned to one of six treatments (Table 1). The planned planting time of November was postponed to January due to unusually high precipitation and cold weather in November and December. The trial was planted manually on January 7-9, 2015. The experimental design was a randomized complete block with six replicates. Plots were one 30-inch-wide by 5-ft-long bed. The seed was placed on the soil surface in two rows on each bed.

After planting, sawdust was applied in a narrow band over the seeded row at 0.26 oz/ft of row (558 lb/acre). For the treatments receiving both sawdust and sand, sand was applied at 0.65 oz/ft of row (1,404 lb/acre) as a narrow band over the sawdust. Following planting and sawdust and sand applications, some beds were covered with row cover. The row cover (N-sulate, DeWitt Co., Inc., Sikeston, MO) covered four rows (two beds). Since the soil was frozen, preventing the use of the mechanical plastic mulch applicator, the row cover was applied manually. Clamps were used to fasten the row cover. Mouse bait packs were scattered under the row cover. The hydroseed mulch was tested in one planting system in 2014, but due to the low air temperatures the hydroseed mulch treatment was not applied in 2015. On April 15, 2015, the row cover was removed and emergence counts were recorded in all plots.

Tetrazolium tests were conducted to determine seed viability of each species (Table 2) and the results were used to correct the emergence data to emergence as a percentage of planted viable seed. Data were analyzed using analysis of variance (General Linear Models Procedure, NCSS, Kaysville, UT). Means separation was determined using a protected Fisher's least significant difference test at the 5% probability level, LSD (0.05). To evaluate factors, the following treatment comparisons were used: row cover, treatments 1 and 4; seed treatment, treatments 1 and 3; sawdust, treatments 1 and 2; sand, treatments 1 and 5; mulch, treatments 2 and 6.

Results and Discussion

Emergence was poor for most species and treatments (Table 3). The January planting date may have resulted in inadequate cold stratification for physiologically dormant species and the dry spring probably contributed to poor emergence. The precipitation for January through April in 2015 was 2.8 inches compared to the 72-year-average precipitation for January through April of 3.9 inches.

Stand of *Phacelia hastata, Ligusticum porteri, L. canbyi, Nicotiana attenuata, Thelypodium milleflorum, and Ipomopsis aggregata* across all treatments was 7.5% or less (Table 3). There was no significant difference in stand between planting systems for *Phacelia hastata, Ligusticum porteri, L. canbyi, Thelypodium milleflorum,* and *Ipomopsis aggregata.*

There were statistically significant differences in stand between planting systems for five species. The row cover with sawdust plus seed treatment resulted in higher stands than no row cover (bare ground) with sawdust and seed treatment for *Machaeranthera canescens* and *Heliomeris multiflora* (Table 3). Sawdust added to the row cover plus seed treatment did not improve stands of any species.

Adding seed treatment to sawdust plus row cover did not improve stand for any species, and reduced stands of *Chaenactis douglasii, Phacelia linearis,* and *Heliomeris multiflora*. Adding sand to sawdust, seed treatment, plus row cover combination increased stand for *Penstemon speciosus,* but reduced stand for *Machaeranthera canescens.*

Averaged over species, row cover with sawdust plus seed treatment resulted in higher stands than no row cover (bare ground) with sawdust and seed treatment. Averaged over species, when seed treatment was added to the row cover and sawdust combination, stands were reduced. Adding sand to sawdust, seed treatment, plus row cover combination increased stand.

In 2013 (Shock et al. 2014), the same establishment systems were tested with 15 species, including all of the species in the 2015 trial. In 2013, systems including row cover improved stand of 6 of the species including *Chaenactis douglasii*, *Machaeranthera canescens*, *Thelypodium milleflorum,* and *Penstemon speciosus*. The combined planting system that included seed treatment improved the stand of *P. speciosus* and reduced the stand of *Phacelia hastata* and *Ipomopsis aggregata.* The treatment combination that included covering seed with sand improved stand of *Chaenactis douglasii* and *Heliomeris multiflora*.

In 2014, the same establishment systems were tested with eight of the species in the 2015 trial (Shock et al. 2015). Overall, emergence in 2014 was poor. December of 2013 and January of 2014 precipitation was about 50% lower than normal and could have contributed to the poor emergence. There was no significant difference in stand between treatments for *Phacelia linearis, P. hastata, Heliomeris multiflora,* or *Ligusticum canbyi.*

In 2014, systems including row cover improved stand of *Machaeranthera canescens* and *Ligusticum porteri*. Sawdust added to the row cover plus seed treatment only improved stands of *L. porteri.* Adding seed treatment to sawdust plus row cover did not improve stands of any species. Adding sand to sawdust, seed treatment, plus row cover combination increased the stand of *Penstemon speciosus.*

Conclusions

Planting systems that include row cover have most consistently improved stand establishment over the years of trials at the Malheur Experiment Station (Shock et al. 2012-2014). Sawdust and sand are factors that for some species in some years have shown value in improving stand, but their performance has not been consistent. Seed treatments with the fungicides Thiram and Captan have generally had no effect or a negative effect on stand establishment. In three years of testing, seed treatment improved stand of only one species in one year, but reduced stand of two species in 2013 and three species in 2015.

References

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Table 1. Planting systems evaluated for emergence of 11 native plant species. Malheur Experiment Station, Oregon State University, Ontario, OR, 2015.

No.	Row cover	Seed treatment[a]	Sawdust	Sand	Mulch[b]
1	yes	yes	yes	no	no
2	yes	yes	no	no	no
3	yes	no	yes	no	no
4	no	yes	yes	no	no
5	yes	yes	yes	yes	no
6	no	yes	no	no	yes
7	no	no	no	no	no

[a]Mixture of Captan and Thiram fungicides for prevention of seed decomposition and seedling damping off.
[b] Treatment 6 (hydroseed mulch) was not tested in 2015 due to January planting.

Table 2. Seed weights and tetrazolium test (seed viability) results for seed used for the planting system treatments in the fall of 2014 and evaluated in the spring of 2015, Malheur Experiment Station, Oregon State University, Ontario, OR.

Species	Common name	Preplant untreated seed weight	Tetrazolium test
		seeds/g	%
Chaenactis douglasii	Douglas' dustymaiden	600	69
Machaeranthera canescens	hoary tansyaster	1,020	78
Phacelia hastata	silverleaf phacelia	996	96
Phacelia linearis	threadleaf phacelia	3,213	98
Heliomeris multiflora	showy goldeneye	1,600	94
Ligusticum porteri	Porter's licorice-root	206	28
Ligusticum canbyi	Canby's licorice-root	256	17
Nicotiana attenuata	coyote tobacco	7,823	81
Thelypodium milleflorum	manyflower thelypody	5,482	93
Ipomopsis aggregata	scarlet gilia	693	40
Penstemon speciosus	showy penstemon	608	86

Table 3. Plant stands of 11 native plant species on April 15, 2015 in response to 7 planting systems used in January 2015. Stand for each species was corrected to the percent of viable seed based on the tetrazolium test. To evaluate factors, the following treatment comparisons were used: Row cover, treatments 1 and 4; Seed treatment, treatments 1 and 3; Sawdust, treatments 1 and 2; Sand, treatments 1 and 5. Oregon State University, Malheur Experiment Station, Ontario, OR.

Treatment no.	1	2	3	4	5	7
Species	Row cover, seed treatment, sawdust	Row cover, seed treatment	Row cover, sawdust	Seed treatment, sawdust	Row cover, seed treatment, sawdust, sand	Untreated check
	------ % stand ------					
Chaenactis douglasii	3.9	2.9	14.8	2.6	4.3	7.3
Machaeranthera canescens	35.4	30.7	30.5	17.7	27.4	17.4
Phacelia hastata	0.9	2.5	1.8	2.2	2.4	1.3
Phacelia linearis	9.0	4.0	3.1	5.0	11.6	1.8
Heliomeris multiflora	27.5	27.1	44.4	9.1	31.6	9.9
Ligusticum porteri	3.4	1.8	2.4	3.6	3.6	0.6
Ligusticum canbyi	0.3	0.7	1.6	5.6	7.5	0.7
Nicotiana attenuata	1.2	0.8	1.8	0.2	1.3	0.3
Thelypodium milleflorum	1.4	2.1	2.1	1.2	2.2	1.6
Ipomopsis aggregata	0.3	1.7	2.5	0.7	2.2	0.3
Penstemon speciosus	4.7	1.6	2.1	1.3	10.2	1.6
Average	7.7	7.0	9.8	4.5	9.5	3.8
LSD (0.05)						
Treatment	1.4					
Species	2.1					
Treatment X species	5.4					