DIRECT SURFACE SEEDING STRATEGIES FOR ESTABLISHMENT OF INTERMOUNTAIN WEST NATIVE PLANTS FOR SEED PRODUCTION

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Introduction

Seed of native plants is needed to restore rangelands of the Intermountain West. Reliable commercial seed production is desirable to make seed readily available. Direct seeding of native range plants has been generally problematic, especially for certain species. Fall planting is important for many species, because their seed requires a period of cold to break dormancy (vernalization). Fall planting of native seed has resulted in poor stands in some years at the Malheur Experiment Station. Loss of soil moisture, soil crusting, and bird damage are some detrimental factors hindering emergence of fall planted seed. Previous trials at the Malheur Experiment Station have examined seed pelleting, planting depth, and soil anti-crustants (Shock et al. 2010). Planting at depth with soil anti-crustant improved emergence compared to surface planting. Seed pelleting did not improve emergence. Despite these positive results, emergence was extremely poor for all treatments, due to soil crusting and bird damage.

In established native perennial fields at the Malheur Experiment Station and in rangelands we have observed prolific natural emergence from seed that falls on the soil surface and is covered by thin layers of organic debris. This trial tested the effect of seven factors on surface planted seed (Table 1). Row cover can be a protective barrier against soil desiccation and bird damage. Sawdust can 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. Hydroseeding mulch could be a low cost replacement for row cover. The treatments did not test all possible combinations of factors, but tested the combinations that would theoretically be most likely to result in the best stand establishment.

This trial tested seed cover, row cover, seed treatment, and hydroseed mulch for emergence of six important species that are native to Malheur County and surrounding rangelands.

Materials and Methods

Five species for which stand establishment has been problematic were chosen. A sixth species (*Penstemon acuminatus*) was chosen as a check, because it has reliably produced good stands at Ontario. Seed of *Dalea ornata* was scarified by immersion for 5 min in 98 percent sulfuric acid. Seed weights for all species were determined. A portion of the seed was treated with a liquid

mix of the fungicides Ridomil® MZ58 and Captan (100 g Ridomil, 100 g Captan in 1 liter 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 seven treatments (Table 1). The trial was planted manually on November 3, 2010. The experimental design was a randomized complete block with six replicates. Plots were one 30-inch-wide by 5-ft-long bed. Two seed rows were planted on each bed.

Tetrazolium tests were conducted to determine seed viability of each species (Table 2). The tetrazolium results were used to correct the emergence data to emergence of viable seed.

After planting, the sawdust was applied in a narrow band over the seed row at 0.26 oz/ft of row (558 lb/acre). For the treatments receiving both sawdust and sand, the 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 of the beds were covered with row cover. The row cover (N-sulate, DeWitt Co., Inc., Sikeston, MO) covered four rows (two beds) and was applied with a mechanical plastic mulch layer. For the hydroseeding mulch treatments, hydroseeding mulch (Hydrostraw LLC, Manteno, IL) was applied dry at 7.5 g/ft of row in a 3-cm band over the seed row. The applied dry mulch was sprayed with water using a backpack sprayer to simulate hydroseeding.

On March 23, 2011, the row cover was removed and emergence counts were made in each plot. Emergence counts were again taken on May 13. Seed of *Dalea ornata*, *Penstemon acuminatus*, and *Heliomeris multiflora* was harvested by hand in August. *Heliomeris multiflora* continued to flower and seed was harvested again in November.

Data were analyzed using analysis of variance (General Linear Models Procedure, NCSS, Kaysville, UT). Means separation was determined using Fisher's least significant difference test at the 5 percent probability level, LSD (0.05).

Results and Discussion

By the first emergence count on March 23, 2011, all species were emerging. On March 23 and May 13, the row cover with sawdust and seed treatment resulted in higher emergence than no row cover (bare ground) with sawdust and seed treatment for *Achnatherum thurberianum*, *Penstemon acuminatus*, *P. deustus*, *Heliomeris multiflora*, and *Balsamorhiza sagittata* (Table 3). On March 23, we added sawdust to the row cover and seed treatment but it did not improve emergence of any species; it reduced emergence of *P. deustus.* On May 13, adding sawdust to row cover and seed treatment improved emergence of *Achnatherum thurberianum*, but reduced emergence of *P. deustus.*

On March 23, adding seed treatment to sawdust and row cover improved emergence of *Penstemon acuminatus*. On May 13, adding seed treatment to sawdust and row cover improved emergence of *Achnatherum thurberianum*, *Penstemon acuminatus*, and *P. deustus.* Adding sand to sawdust, seed treatment, and row cover increased emergence for *Balsamorhiza sagittata* and *P. acuminatus* on May 13. There was no difference in emergence between treatments for *Dalea ornata* on either date.

Emergence with hydroseed mulch and seed treatment was lower than with row cover and seed treatment for all species on both dates, except for *B. sagittata* on May 13.

An analysis of the five treatments tested in 2010 and 2011 on the six species, shows that averaged over the 2 years, row cover with seed treatment and sawdust improved emergence compared to no row cover with seed treatment and sawdust for *Achnatherum thurberianum*, *P. deustus*, *Heliomeris multiflora*, and *B. sagittata* (Table 4). For *P. acuminatus*, row cover with seed treatment and sawdust improved emergence compared to no row cover with seed treatment and sawdust only in 2011. Row cover with seed treatment and sawdust had lower emergence than row cover and seed treatment without sawdust for *P. deustus.* The effect of systems with and without seed treatment on emergence differed by year. Adding seed treatment to row cover and sawdust did not improve emergence for any species and reduced emergence for *A. thurberianum*, *P. deustus*, and *H. multiflora* in 2010. In 2011, adding seed treatment to row cover and sawdust improved emergence for *A. thurberianum*, *P. deustus*, and *P. acuminatus*. Precipitation in March, when emergence starts, was higher in 2011 (3 inches) than in 2010 (0.6 inches). Adding sand to row cover, seed treatment, and sawdust did not improve emergence for any species.

Conclusions

The above results describe practices that can be immediately implemented by seed growers.

Averaged over the 2 years:

-Row cover with seed treatment and sawdust improved emergence over no row cover with seed treatment and sawdust for all species except *Penstemon acuminatus*.

-Row cover with sawdust and seed treatment did not improve emergence over row cover without sawdust and with seed treatment and reduced emergence for *P. deustus*.

- The effect of systems with and without seed treatment on emergence differed by year. In a drier year (2010), adding seed treatment to row cover and sawdust did not improve emergence for any species and reduced emergence for three species in 2010. In 2011 (wetter year), adding seed treatment to row cover and sawdust improved emergence for three species.

-Adding sand to row cover, seed treatment, and sawdust did not improve emergence for any species.

References

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and N. Shaw. 2010. Emergence of native plant seeds in response to seed pelleting, planting depth, scarification, and soil anti-crusting treatment. Oregon State University Malheur Experiment Station Annual Report 2009:218-222.

Table 1. Treatments evaluated for emergence of six native plant species. Mouse bait packs were scattered over the trial area. Malheur Experiment Station, Oregon State University, Ontario, OR, 2011.

No.	Row cover	Seed treatment*	Sawdust	Sand	Mulch
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

*mixture of Captan and Ridomil fungicides for prevention of seed decomposition and seedling damping off.

Table 2. Seed weights and tetrazolium test (seed viability) for native plants submitted to emergence treatments in the fall of 2010. Malheur Experiment Station, Oregon State University, Ontario, OR.

Species	Common name	Untreated seed weight	Tetrazolium test
		seeds/g	%
Achnatherum thurberianum	Thurber's needlegrass	352.4	72
Dalea ornata	Blue Mountain prairie clover	276.4	89
Penstemon acuminatus	sharpleaf penstemon	1119.4	73
Penstemon deustus	hotrock or scabland penstemon	6164.4	70
Heliomeris multiflora	showy goldeneye	1821.9	88
Balsamorhiza sagittata	arrowleaf balsamroot	138.6	77

Table 3. Emergence of six native plant species on March 23 and May 13, 2011 in response to seven treatments applied at planting in the fall of 2010. Emergence for each species was corrected to the percent emergence of viable seed. *Dalea ornata* seed was acid scarified. Oregon State University, Malheur Experiment Station, Ontario, OR.

March 23

#	Row cover	Seed treatment	Sawdust	Sand	Mulch	*Balsamorhiza sagittata*	*Achnatherum thurberianum*	*Dalea ornata*	*Penstemon acuminatus*	*Penstemon deustus*	*Heliomeris multiflora*	Average
						---------- % emergence ----------						
1	yes	yes	yes	no	no	80.3	45.7	4.9	46.9	30.5	35.4	40.6
2	yes	yes	no	no	no	78.9	47.8	10.7	47.5	55.3	34.0	45.7
3	yes	no	yes	no	no	84.1	56.6	1.5	29.2	18.1	37.6	37.8
4	no	yes	yes	no	no	46.8	5.9	0.0	21.4	0.0	12.5	14.4
5	yes	yes	yes	yes	no	94.0	44.1	3.0	58.7	37.9	49.0	47.8
6	no	yes	no	no	yes	44.2	0.0	0.0	10.9	0.0	6.9	10.3
7	no	no	no	no	no	44.7	5.4	0.0	14.6	11.7	8.6	14.2
Average						67.6	29.4	2.9	32.7	21.9	26.3	30.1
LSD (0.05) Treatment												5.3
LSD (0.05) Species												6.2
LSD (0.05) Treatment X Species												16.5

May 13

#	Row cover	Seed treatment	Sawdust	Sand	Mulch	*Balsamorhiza sagittata*	*Achnatherum thurberianum*	*Dalea ornata*	*Penstemon acuminatus*	*Penstemon deustus*	*Heliomeris multiflora*	Average
						---------- % emergence ----------						
1	yes	yes	yes	no	no	57.5	48.2	1.6	38.3	32.1	35.5	35.5
2	yes	yes	no	no	no	57.7	36.6	0.7	38.8	46.5	30.5	35.1
3	yes	no	yes	no	no	63.9	36.0	0.0	24.1	15.3	31.6	28.5
4	no	yes	yes	no	no	37.9	26.0	0.8	26.4	14.7	17.6	20.6
5	yes	yes	yes	yes	no	69.6	42.1	0.1	48.8	31.3	43.6	39.3
6	no	yes	no	no	yes	48.6	27.9	1.1	19.5	20.0	22.3	23.2
7	no	no	no	no	no	33.7	24.1	1.6	17.7	5.7	9.6	15.4
Average						52.7	34.4	0.9	30.5	23.7	27.2	28.2
LSD (0.05) Treatment												3.8
LSD (0.05) Species												3.6
LSD (0.05) Treatment X Species												9.6

Table 4. Plant stands of six native plant species on April 9, 2010 and May 13, 2011 in response to five treatments applied at planting in the fall of 2009 and 2010. Plant stands for each species was corrected to the percent of viable seed. *Dalea ornata* seed was acid scarified. Oregon State University, Malheur Experiment Station, Ontario, OR.

#	Row cover	Seed treatment	Sawdust	Sand	*Balsamorhiza sagittata*	*Achnatherum thurberianum*	*Dalea ornata*	*Penstemon acuminatus*	*Penstemon deustus*	*Heliomeris multiflora*	Average
					---------- % emergence ----------						
					2010						
1	yes	yes	yes	no	60.0	44.3	9.6	19.6	32.3	26.0	35.5
2	yes	yes	no	no	49.6	41.9	9.8	18.8	49.1	23.4	34.8
3	yes	no	yes	no	66.7	54.3	3.2	26.4	43.8	39.2	44.4
4	no	yes	yes	no	25.5	41.2	5.0	18.1	17.1	10.9	20.7
5	yes	yes	yes	yes	59.3	47.2	13.9	22.5	29.8	22.3	37.4
Average					52.2	45.8	8.3	21.1	34.4	24.4	34.6
					2011						
1	yes	yes	yes	no	57.5	48.2	1.6	38.3	32.1	35.5	35.5
2	yes	yes	no	no	57.7	36.6	0.7	38.8	46.5	30.5	35.1
3	yes	no	yes	no	63.9	36.0	0.0	24.1	15.3	31.6	28.5
4	no	yes	yes	no	37.9	26.0	0.8	26.4	14.7	17.6	20.6
5	yes	yes	yes	yes	69.6	42.1	0.1	48.8	31.3	43.6	39.3
Average					52.7	34.4	0.9	30.5	23.7	27.2	31.8
					Average						
1	yes	yes	yes	no	58.8	46.3	5.6	29.0	32.2	30.7	35.5
2	yes	yes	no	no	53.7	39.2	5.2	28.8	47.8	26.9	34.9
3	yes	no	yes	no	65.3	45.1	1.6	25.3	29.6	35.4	37.1
4	no	yes	yes	no	31.7	33.6	2.9	22.3	15.9	14.2	20.6
5	yes	yes	yes	yes	64.4	44.7	7.0	35.6	30.6	33.0	38.2
Average					52.5	39.1	4.0	26.6	28.2	26.0	33.3
LSD (0.05)											
Treatment				4.1							
Species				3.2							
Treatment X Species				7.2							
Treatment X Year				3.5							
Treatment X Species X Year				8.5							