TOLERANCE OF NATIVE WILDFLOWER SEEDLINGS TO PREEMERGENCE AND POSTEMERGENCE HERBICIDES

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Introduction

Native wildflower seed is needed to restore rangelands of the Intermountain West. Commercial seed production is necessary to provide the quantity of seed needed for restoration efforts. A major limitation to economically viable commercial production of native wildflower seed is weed competition. Weeds are adapted to growing in disturbed soil, and native wildflowers are not competitive with these weeds. The use of preemergence and postemergence herbicides for wildflower weed control is important, because wildflowers are fall planted. Fall planting results in nearly simultaneous wildflower and weed emergence early in the spring, complicating weed control. There is considerable knowledge about the relative efficacy of different herbicides to control target weeds, but few trials have tested the tolerance of native wildflowers to commercial herbicides. Two trials in 2013 tested the tolerance of 11 wildflower species to preemergence and postemergence herbicides.

This work sought to discover products that could eventually be registered for use for native wildflower seed production. The information in this report is for the purpose of informing cooperators and colleagues in other agencies, universities, and industry of research results. Reference to products and companies in this publication is for the specific information only and does not endorse or recommend that product or company to the exclusion of others that may be suitable. Nor should any information and interpretation thereof be considered as recommendations for the application of any of these herbicides. **Pesticide labels should always be consulted before any pesticide use. Considerable effort may be required to register these herbicides for use in native wildflower seed production.**

Materials and Methods

The trials were conducted on a field of Nyssa silt loam with a pH of 8.3 and 1.1% organic matter where wheat was the previous crop. After the wheat harvest in the fall of 2012, the stubble was flailed and the field was plowed, disked, and groundhogged.

Before planting, drip tape (T-Tape TSX 515-16-340) was buried at 12-inch depth midway between each pair of 30-inch rows. The flow rate for the drip tape was 0.34 gal/min/100 ft at 8 psi with emitters spaced 16 inches apart, resulting in a water application rate of 0.066 inch/hour.

Seed of 11 wildflower species (Table 1) was planted on the soil surface on November 27 at 30 seeds/ft of row. After planting, a thin layer of sawdust was applied over the seed row. The sawdust was applied at approximately 0.18 oz/ft of row (198 lb/acre). Row cover (N-sulate, DeWitt Co., Inc., Sikeston, MO) that covered four rows was applied with a mechanical plastic mulch layer after planting. The field was divided in two. One half of the field was used for a preemergence herbicide trial and the other half was dedicated to a postemergence trial. Each half of the field was divided into plots which consisted of 11 single rows 5 ft long with 1 wildflower species planted per row.

Procedures for Preemergence Trial

The experimental design was a randomized complete block with 12 herbicide treatments (Table 2) replicated 4 times. Each plot consisted of 11 single rows 5 ft long with 1 wildflower species planted per row. For the treatments receiving charcoal, the charcoal was applied on November 28 in a narrow band over the seed row that had been covered with sawdust (Felix and Ishida 2010). The charcoal was applied using a CO_2 sprayer with a 5-ft boom with 8008 nozzles at 10 psi. The sprayer boom was oriented parallel to the seed row. The charcoal was mixed at 23 g (0.81 oz) of charcoal per gal of water and applied at a rate of 189 lb of charcoal per treated acre and 3,675 gal of water per treated acre. The herbicides were broadcast following the charcoal application using the same CO_2 sprayer and boom with 8002 nozzles at 30 psi applying 20 gal/acre. Row cover was applied after the herbicide application. On April 24, 2013, the row cover was removed and stand counts were made in each plot.

Procedures for Postemergence Trial

The experimental design was a randomized complete block with nine herbicide treatments (Table 3) replicated four times. Each plot consisted of 11 single rows 5 ft long with 1 wildflower species planted per row. On April 24, 2013 the row cover was removed and stand counts were made in each plot. On April 26, the treatments were broadcast using a CO_2 sprayer with 8002 nozzles at 30 psi applying 20 gal/acre. On May 14, stand counts and subjective plant damage ratings were taken in each plot.

General Considerations

The focus of these evaluations was wildflower tolerance to the herbicides, not weed control, so weeds were removed as needed.

Treatment differences were compared using ANOVA and protected least significant differences at the 95% confidence LSD (0.05) using NCSS Number Cruncher software (NCSS, Kaysville, UT).

Results and Discussion

The weather during the winter and spring of 2012 was relatively dry and did not favor stand establishment; even weed emergence was erratic.

All observations made on the herbicides tested are strictly preliminary observations. Herbicides that damaged wildflowers as reported here might be helpful if used at a lower rate or in a different environment. The herbicides were relatively safe in this trial but they might be harmful if used at higher rates or in a different environment. Nothing in this report should be construed as a recommendation.

Response to Preemergence Herbicides

Emergence was not uniform between replicates, complicating the interpretation of results. Weed pressure was too poor and not uniform enough to allow any estimates of the relative effectiveness of herbicide weed control. Emergence for *Phacelia linearis*, *Heliomeris multiflora*, *Nicotiana attenuata*, *P. crenulata*, and *Ligusticum porteri* was extremely poor and data are not presented. Emergence for *Thelypodium milleflorum* and *L. canbyi* was too poor to result in statistically significant differences.

For *Chaenactis douglasii*, *Eriophyllum lanatum*, *Thelypodium milleflorum* and *Ligusticum canbyi* none of the herbicides significantly reduced emergence compared to the check (Table 4). For *Chaenactis douglasii*, the plant stands following treatment with Eptam® plus charcoal were statistically greater than for the untreated check treatment. For *Machaeranthera canescens*, only Prowl® without charcoal, Outlook® without charcoal, and Treflan® significantly reduced stands compared to the untreated check treatment. For *Phacelia hastata*, many products tested significantly reduced emergence compared to the untreated check. For *Chaenactis douglasii*, Eptam with charcoal resulted in higher emergence than Eptam without charcoal, but charcoal provided no benefits for the Prowl or Dual Magnum® treatments. For *Machaeranthera canescens*, Prowl with charcoal resulted in higher emergence than Prowl without charcoal, but charcoal provided no benefits for the Eptam or Dual Magnum treatments. Charcoal application did not significantly improve emergence for any other species plus herbicide combinations tested.

Response to Postemergence Herbicides

Postemergence herbicides were evaluated on April 26 (Table 5). Buctril® resulted in significantly higher injury than the untreated check for all species tested, except the *Ligusticum* spp., for which poor stand did not allow for injury evaluation. Aim® resulted in significantly higher injury than the check for all species tested, except for the *Ligusticum* spp., for which poor stand did not allow for injury evaluation. Buctril resulted in significantly higher stand loss than the check for *Phacelia hastata, Heliomeris multiflora*, *Thelypodium milleflorum, Ligusticum canbyi,* and *L. porteri.* Aim resulted in significantly higher stand loss than the check for *Phacelia hastata, Heliomeris multiflora,* and *Thelypodium milleflorum.* Raptor® and Chateau® resulted in significantly higher stand loss than the check for *T. milleflorum.* GoalTender®, Select Max®, Prowl® H_2O, and Outlook did not result in higher injury or stand loss than the check for any species.

Conclusions

These results, while preliminary, suggest that some of the herbicides tested in these trials could be used for weed control in wildflower seed production. Charcoal was an effective safening agent for certain species-herbicide combinations.

References

Felix, J. and J. Ishida. 2010. Use of activated charcoal to detoxify Dual Magnum and Outlook applied pre-emergence on direct-seeded onions. Malheur Experiment Station Annual Report 2009:115-118.

Table 1. Wildflower species planted in the fall of 2012 in herbicide trials. Malheur Experiment Station, Oregon State University, Ontario, OR.

Species	Common name
Chaenactis douglasii	Douglas' dustymaiden
Machaeranthera canescens	hoary tansyaster
Phacelia hastata	silverleaf phacelia
Phacelia linearis	threadleaf phacelia
Eriophyllum lanatum	common woolly sunflower, Oregon sunshine
Heliomeris multiflora var. *nevadensis*	showy goldeneye
Nicotiana attenuata	coyote tobacco
Phacelia crenulata var. *corrugata*	cleftleaf wildheliotrope
Thelypodium milleflorum	manyflower thelypody
Ligusticum porteri	Porter's licorice-root
Ligusticum canbyi	Canby's licorice-root

Table 2. Preemergence herbicide treatments applied in the fall of 2012 following fall planting of native wildflowers. Malheur Experiment Station, Oregon State University, Ontario, OR.

Treatment	Herbicide	Charcoal	Rate
			(lb ai/acre)
1	Check	no	none
2	Prowl	no	0.95
3	Outlook	no	0.84
4	Eptam	no	2.6
5	Dual Magnum	no	0.95
6	Prowl	yes	0.95
7	Outlook	yes	0.85
8	Eptam	yes	2.6
9	Dual Magnum	yes	0.95
10	Treflan	no	0.38
11	Balan	no	1.2
12	Prefar	no	5.0

Table 3. Postemergence herbicide treatments applied in the spring of 2013 following fall planting of native wildflowers. Malheur Experiment Station, Oregon State University, Ontario, OR.

		Rate	
Treatment	Activity	oz/acre	lb ai/acre
Untreated			
Buctril	foliar	8	0.12
GoalTender	soil/foliar	2	0.06
Select Max	foliar	6	0.05
Prowl H_2O	soil	32	0.95
Outlook	soil	18	0.85
Aim	foliar	1	0.02
Chateau	soil/foliar	1.5	0.05
Raptor	soil/foliar	4	0.03

Table 4. Plant stand of native wildflowers on April 24, 2013 in response to preemergence herbicide treatments with and without charcoal applied in the fall of 2012 to fall-planted seed. Malheur Experiment Station, Oregon State University, Ontario, OR.

Herbicide	Rate	Charcoal	*Chaenactis douglasii*	*Machaeranthera canescens*	*Phacelia hastata*	*Eriophyllum lanatum*	*Thelypodium milleflorum*	*Ligusticum canbyi*	Average
	(lbs ai / ac)								
Check	none	no	27.5	46.3	30.0	24.5	21.0	8.8	26.3
Prowl	0.95	no	30.8	23.0	10.5	24.0	5.0	13.3	17.8
Outlook	0.84	no	6.8	8.5	5.8	5.8	5.5	3.3	5.9
Eptam	2.6	no	22.3	62.8	25.0	15.0	9.8	4.8	23.3
Dual Magnum	0.95	no	32.5	55.5	0.3	14.0	5.5	8.0	19.3
Prowl	0.95	yes	14.5	65.3	18.3	13.8	11.8	15.3	23.1
Outlook	0.85	yes	20.5	22.5	9.3	14.3	12.0	7.3	14.3
Eptam	2.6	yes	47.0	45.0	8.5	15.8	11.0	6.3	22.3
Dual Magnum	0.95	yes	31.0	49.3	15.3	28.8	16.3	3.8	24.0
Treflan	0.38	no	33.3	22.0	7.5	34.0	5.5	12.0	19.0
Balan	1.2	no	30.5	42.8	6.8	21.0	8.5	5.8	19.2
Prefar	5.0	no	29.0	43.5	14.5	15.5	8.5	13.0	20.7
		Average	27.1	40.5	12.6	18.9	10.0	8.4	19.6
LSD (0.05) Treatment									13.8
LSD (0.05) Species									5.9
LSD (0.05)Trt. X Species									20.4

Table 5. Native wildflower stand loss and subjective evaluation of injury (0 = no injury, 10 = highest injury) in response to postemergence herbicide treatments applied on April 26 to fall-planted seed. Malheur Experiment Station, Oregon State University, Ontario, OR. Continued on the next page.

	Chaenactis douglasii		*Machaeranthera canescens*		*Phacelia hastata*		*Eriophyllum lanatum*		Average	
Treatment	Injury	Stand loss	Injury	Stand loss	Injury	Stand loss	Injury	Stand loss	Injury	Stand loss
	0-10	%	0-10	%	0-10	%	0-10	%	0-10	%
Untreated	0.0	4.8	0.0	4.3	0.0	3.4	0.0	3.8	0.7	6.6
Buctril	2.0	7.8	2.3	0.0	3.7	43.3	4.0	22.3	3.9	31.7
GoalTender	0.0	1.3	0.0	4.6	0.5	13.5	1.0	3.8	1.1	9.1
Select Max	0.0	2.5	0.0	8.6	0.0	5.0	0.0	22.8	0.8	10.0
Prowl H_2O	0.0	9.0	0.0	10.7	0.0	21.5	0.0	0.0	0.4	10.8
Outlook	0.0	5.6	0.0	1.6	0.0	0.0	0.0	13.2	0.6	11.5
Aim	2.4	5.4	3.2	4.1	7.0	52.8	7.5	16.7	4.5	22.1
Chateau	0.0	2.3	0.0	2.7	1.7	4.2	1.3	14.0	1.2	14.7
Raptor	0.0	13.3	0.3	8.2	5.0	6.7	0.0	5.6	2.6	12.9
Average	0.5	5.8	0.6	5.0	2.0	16.2	1.5	11.4	1.8	14.4
LSD (0.05) Treatment									NS	8.0
LSD (0.05) Species									0.5	7.6
LSD (0.05) Trt. X Species									1.4	22.9

Table 5. Continued. Native wildflower stand loss and subjective evaluation of injury (0 = no injury, 10 = highest injury) in response to postemergence herbicide treatments applied on April 26 to fall-planted seed. Malheur Experiment Station, Oregon State University, Ontario, OR.

	Heliomeris multiflora		*Thelypodium milleflorum*		*Ligusticum porteri*		*Ligusticum canbyi*		Average	
Treatment	Injury	Stand loss	Injury	Stand loss	Injury	Stand loss	Injury	Stand loss	Injury	Stand loss
	0-10	%	0-10	%	0-10	%	0-10	%	0-10	%
Untreated	0.0	4.0	2.5	12.2	1.0	12.5	4.0	8.5	0.7	6.6
Buctril	4.0	33.3	6.5	59.3	0.0	51.7	0.0	41.7	3.9	31.7
GoalTender	0.0	0.0	3.7	27.7	1.0	19.6	5.0	0.0	1.1	9.1
Select Max	0.0	7.1	2.8	26.0	2.0	0.0	4.0	6.3	0.8	10.0
Prowl H_2O	0.0	12.5	2.3	11.0	0.0	17.8	2.0	8.3	0.4	10.8
Outlook	0.0	12.5	3.0	27.9	1.0	16.7	1.5	15.5	0.6	11.5
Aim	4.5	40.5	4.2	39.6	0.0	8.3	0.0	21.4	4.5	22.1
Chateau	0.0	0.0	3.0	43.8	3.0	21.3	0.0	25.0	1.2	14.7
Raptor	0.0	0.0	7.7	37.5	5.0	22.2	5.0	5.1	2.6	12.9
Average	0.9	12.2	4.0	31.7	1.4	18.9	2.4	14.6	1.8	14.4
LSD (0.05) Treatment									NS	8.0
LSD (0.05) Species									0.5	7.6
LSD (0.05) Trt. X Species									1.4	22.9