IRRIGATION REQUIREMENTS OF ANNUAL NATIVE WILDFLOWER SPECIES FOR SEED PRODUCTION, FALL 2012 PLANTING

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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 (forb) seed is stable and consistent seed productivity over multiple years.

In native rangelands, the natural variations in rainfall modify the emergence and establishment of annual wildflowers. Spring rainfall and soil moisture result in highly unpredictable water stress at flowering, seed set, and seed development, factors which for other seed crops are known to compromise seed yield and quality.

Native wildflower plants may not be well adapted to croplands. Native plants are often not competitive with crop weeds in cultivated fields, and this can limit wildflower seed production. Both sprinkler and furrow irrigation could provide supplemental water for seed production, but these systems risk further encouraging weeds. Also, sprinkler and furrow irrigation can lead to the loss of plant stand and seed production due to fungal pathogens. By burying drip tapes at 12-inch depth and avoiding wetting the soil surface, we hoped to assure flowering and seed set without undue encouragement of weeds or opportunistic diseases. The trials reported here tested the effects of three low rates of irrigation on the 2013 seed yield of 11 native wildflower species (Table 1) planted in the fall of 2012.

Materials and Methods

Plant Establishment

Each wildflower species was planted in 4 rows 30 inches apart (a 10-ft-wide strip) about 450 ft long on Nyssa silt loam at the Malheur Experiment Station, Ontario, Oregon. The soil had a pH of 8.3 and 1.1% organic matter. In October 2012, 2 drip tapes 5 ft apart (T-Tape TSX 515-16-340) were buried at 12-inch depth to irrigate the 4 rows in the plot. Each drip tape irrigated two rows of plants. 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.

On October 30, 2012 seed of 11 species (Table 1) was planted in 30-inch rows using a custom-made plot grain drill with disk openers. All seed was planted on the soil surface at 20-30 seeds/ft of row. After planting, sawdust was applied in a narrow band over the seed row at 0.26 oz/ft of row (558 lb/acre). Following planting and sawdust application, 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.

Cultural Practices in 2013

Starting on March 29, the row cover was removed. Immediately following the removal of the row cover, bird netting was placed over the seedlings to prevent bird feeding on young seedlings and new shoots. The bird netting was placed over No. 9 galvanized wire hoops. During seedling emergence, wild bird seed was placed several hundred feet from the trial to attract quail away from the trials. On July 26, all plots of *Machaeranthera canescens* were sprayed with Capture® at 19 oz/acre (0.3 lb ai/acre) for aphid control.

Table 1. Wildflower species planted in the fall of 2012 at 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
Enceliopsis nudicaulis	nakedstem sunray
Heliomeris multiflora	showy goldeneye
Ipomopsis aggregata	scarlet gilia
Nicotiana attenuata	coyote tobacco
Thelypodium milleflorum	manyflower thelypody
Ligusticum porteri	Porter's licorice-root
Ligusticum canbyi	Canby's licorice-root

Irrigation for Seed Production

In March, 2013 the strip of each wildflower species was divided into 12 30-ft-long plots. Each plot contained four rows of each species. The experimental design for each species was a randomized complete block with four replicates. The three treatments were a nonirrigated check, 1 inch of water per irrigation, and 2 inches of water per irrigation. Each treatment received four irrigations that were applied approximately every 2 weeks starting with flowering of the wildflowers. The amount of water applied to each treatment was calculated by the length of time necessary to deliver 1 or 2 inches through the drip system. Irrigations were regulated with a controller and solenoid valves.

The drip-irrigation system was designed to allow separate irrigation of each species due to different timings of flowering and seed formation. All species were irrigated separately except the two *Phacelia* spp. and the two *Ligusticum* spp. Flowering, irrigation, and harvest dates were recorded (Table 2) with the exception of *Nicotiana attenuate*, which did not germinate and the *Ligusticum* spp., which did not flower.

Table 2. Native wildflower flowering, irrigation, and seed harvest dates in 2013 by species. Malheur Experiment Station, Oregon State University, Ontario, OR.

	Flowering			Irrigation		
Species	start	peak	end	start	end	Harvest
Chaenactis douglasii	23-May	30-Jun	15-Jul	22-May	3-Jul	2-Jul, 22-Jul
Machaeranthera canescens	13-Aug		1-Oct	17-Jul	28-Aug	2-Oct
Phacelia hastata	17-May		30-Jul	22-May	3-Jul	30-Jul (0 in), 7-Aug, 19-Aug (8 in)
Phacelia linearis	3-May	16-May	15-Jun	2-May	12-Jun	2-Jul
Enceliopsis nudicaulis	30-Jun		15-Sep	3-Jul	14-Aug	8-Aug to 30-Aug
Heliomeris multiflora	15-Jul		30-Aug	5-Jun	17-Jun	8-Aug, 15-Aug, 28-Aug
Ipomopsis aggregata	31-Jul	very little flowering		31-Jul	11-Sep	
Thelypodium milleflorum		No flowering				

Results and Discussion

Precipitation from January through July in 2013 was 2.6 inches, below the 66-year average of 6.1 inches (Fig. 1). The accumulation of growing degree-days (50-86°F) was higher than average in 2013 (Fig. 2).

Stands of *Chaenactis douglasii, Nicotiana attenuata, Ligusticum porteri,* and *L. canbyi* were poor and uneven and did not permit evaluation of irrigation responses. *Thelypodium milleflorum* is a biennial and *Ipomopsis aggregata* had very little flowering in 2013, perhaps also a biennial in this trial.

Seed yields of *Machaeranthera canescens, Phacelia hastata,* and *P. linearis* showed a quadratic response to irrigation rate (Tables 3 and 4). Seed yields were estimated to be maximized by a seasonal total of 2.4, 5.4, and 6.2 inches of applied water for *M. canescens, P. hastata,* and *P. linearis*, respectively. Seed yield of *Enceliopsis nudicaulis* was very low and was not responsive to irrigation. Seed yield of *Heliomeris multiflora* increased with increasing irrigation rate up to the highest tested of 8 inches (Tables 3 and 4).

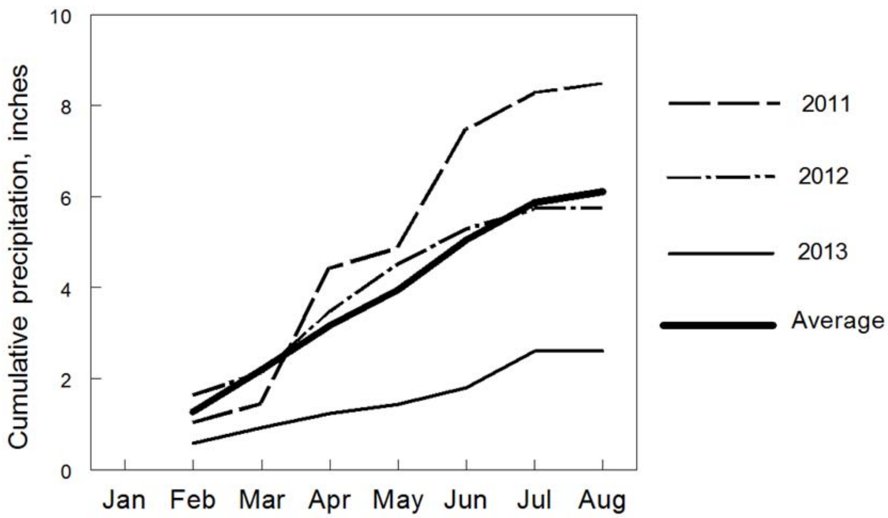

Figure 1. Cumulative annual and 66-year-average precipitation from January through July at Malheur Experiment Station, Oregon State University, Ontario, OR.

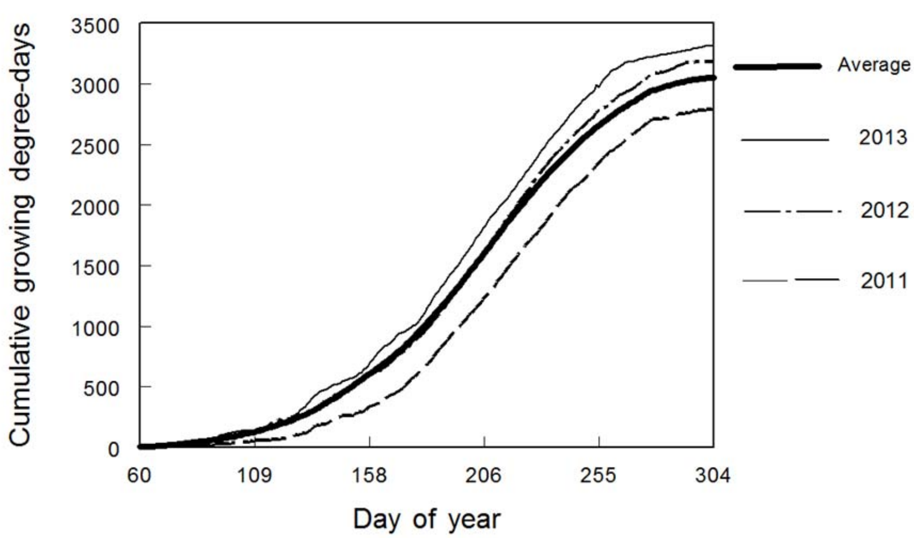

Figure 2. Cumulative growing degree-days (50-86°F) for selected years and 23-year average at Malheur Experiment Station, Oregon State University, Ontario, OR.

Table 3. Native wildflower seed yield response to season-long irrigation rate (inches). Malheur Experiment Station, Oregon State University, Ontario, OR, 2013.

	------- Irrigation -------			
Species	0 in	4 in	8 in	LSD (0.05)
	--------- lb/acre ---------			
Machaeranthera canescens	206.1	215.0	124.3	73.6
Phacelia hastata	35.3	102.7	91.2	35.7
Phacelia linearis	121.4	306.2	314.2	96.0
Enceliopsis nudicaulis	2.3	6.8	5.9	NS
Heliomeris multiflora	28.7	57.6	96.9	NS

Table 4. Regression parameters for native wildflower seed yield response to irrigation rate (inches/season). For the quadratic equations, the amount of irrigation that resulted in maximum yield was calculated using the formula: -b/2c, where b is the linear parameter and c is the quadratic parameter. Malheur Experiment Station, Oregon State University, Ontario, OR, 2013.

Species	Intercept	Linear	Quadratic	R^2	*P*	Estimated maximum yield	Water applied for estimated maximum yield
						lb/acre	inches/season
Machaeranthera canescens	206.1	14.7	-3.1	0.54	0.05	223.4	2.4
Phacelia hastata	35.3	26.7	-2.5	0.66	0.01	107.7	5.4
Phacelia linearis	121.4	68.3	-5.5	0.69	0.01	332.5	6.2
Enceliopsis nudicaulis	3.1	0.4		0.16	NS[a]		
Heliomeris multiflora	27.0	8.5		0.38	0.05	95.1	8.0

[a]not significant. There was no statistically significant difference in yield between the nonirrigated plots and the plots receiving 4 or 8 inches of water.