GLOBEMALLOW SEED PRODUCTION IS UNRESPONSVE TO IRRIGATION IN A SEMI-ARID ENVIRONMENT

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Summary

Sphaeralcea species are important components in the rangelands of the Intermountain West. Relatively little is known about the cultural practices necessary to produce *Sphaeralcea* seed for use in rangeland restorations activities. The seed yield response of three *Sphaeralcea* species to four biweekly irrigations applying either 0, 1, or 2 inches of water (total of 0, 4 inches, or 8 inches/season) was evaluated over multiple years. *Sphaeralcea parvifolia, S. grossulariifolia,* and *S. coccinea* were tested for 5 years. Seed yields were unresponsive to irrigation.

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 stable and consistent seed productivity over years.

In native rangelands, the natural variations in spring rainfall and soil moisture result in highly unpredictable water stress at flowering, seed set, and seed development, which for other seed crops are known to compromise seed yield and quality.

Native wildflower plants are not well adapted to croplands. They often are 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 irrigation 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 seed yield of three globemallow species (Table 1).

Table 1. Globemallow species planted in the drip irrigation trials at the Malheur Experiment Station, Oregon State University, Ontario, OR.

Species	Common names
Sphaeralcea parvifolia	Small-leaf globemallow
Sphaeralcea grossulariifolia	Gooseberryleaf globemallow
Sphaeralcea coccinea	Scarlet globemallow, red globemallow

Materials and Methods

Plant establishment

On April 11, 2006 seed of three globemallow species (*Sphaeralcea parvifolia, S. grossulariifolia, S. coccinea*) was planted at 30 seeds/ft of row. The field was sprinkler irrigated until emergence, which was poor. In late August of 2006 seed of the three globemallow species was harvested by hand. On November 9, 2006 the three species that were planted in 2006 were mechanically flailed and on November 10, they were replanted.

Irrigation for seed production

In April, 2007 each planted strip of each species was divided into plots 30 ft long. 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 applied per irrigation, and 2 inches of water applied per irrigation. Each treatment received four irrigations that were applied approximately every 2 weeks starting with flowering. 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. After each irrigation, the amount of water applied was read on a water meter and recorded to ensure correct water applications. Irrigation dates are found in Table 2.

Cultural practices

Flowering dates for each species were recorded (Table 2). Each year, the middle two rows of each plot were harvested when seed of each species was mature.

In 2007, the three species flowered and set seed for an extended period, making a single mechanical harvest impossible. Seed was harvested manually three times in 2007. Starting in the fall of 2007, all plots were flailed yearly to induce more compact plants and more concentrated flowering. In subsequent years the seed was harvested with a small plot combine. After combining, the seed did not require further cleaning.

Weeds were controlled by hand weeding as necessary.

Table 2. Globemallow flowering, irrigation, and seed harvest dates in 2007-2011, Malheur Experiment Station, Oregon State University, Ontario, OR.

		Flowering			Irrigation		
Species	Year	start	peak	end	start	end	Harvest
Sphaeralcea parvifolia	2007	5-May	25-May		16-May	24-Jun	20-Jun, 10-Jul, 13-Aug
	2008	5-May		15-Jun	15-May	24-Jun	21-Jul
	2009	1-May		10-Jun	22-May	24-Jun	14-Jul
	2010	10-May	4-Jun	25-Jun	28-May	8-Jul	20-Jul
	2011	26-May	15-Jun	14-Jul	20-May	5-Jul	29-Jul
Sphaeralcea grossulariifolia	2007	5-May	25-May		16-May	24-Jun	20-Jun, 10-Jul, 13-Aug
	2008	5-May		15-Jun	15-May	24-Jun	21-Jul
	2009	1-May		10-Jun	22-May	24-Jun	14-Jul
	2010	10-May	4-Jun	25-Jun	28-May	8-Jul	20-Jul
	2011	26-May	15-Jun	14-Jul	20-May	5-Jul	29-Jul
Sphaeralcea coccinea	2007	5-May	25-May		16-May	24-Jun	20-Jun, 10-Jul, 13-Aug
	2008	5-May		15-Jun	15-May	24-Jun	21-Jul
	2009	1-May		10-Jun	22-May	24-Jun	14-Jul
	2010	10-May	4-Jun	25-Jun	28-May	8-Jul	20-Jul
	2011	26-May	15-Jun	14-Jul	20-May	5-Jul	29-Jul

Results and Discussion

Precipitation from January through June in 2007 and 2008 was lower than the average of 5.8 inches (Table 3). Precipitation from January through June in 2006, 2010, and 2011 was higher than the average of 5.8 inches. The accumulated growing degree-days (50-86°F) from January through June in 2006 and 2007 were higher than average (Table 3).

Subsurface drip-irrigation systems were tested for native seed production because they have two potential strategic advantages: a) low water use, and b) the buried drip tape provides water to the plants at depth, precluding most irrigation-induced stimulation of weed seed germination on the soil surface and keeping water away from native plant tissues that are not adapted to a wet environment.

Flowering and seed set

The three *Sphaeralcea* spp. flowered over a long period (early May through September) in 2007. Multiple manual harvests were necessary because seeds fall out of the capsules once they are mature. The flailing of the three *Sphaeralcea* spp. starting in the fall of 2007 was done annually to induce a more concentrated flowering, allowing a single mechanical harvest. Precipitation in June of 2009 (2.27 inches) and 2010 (1.95 inches) was substantially higher than average (0.76 inches). Rust (*Puccinia sherardiana*) infected all three *Sphaeralcea* spp. in June of 2009 and 2010, causing substantial leaf loss and reduced vegetative growth. Stand of all three *Sphaeralcea* spp. deteriorated in 2011 and the plots were disked out in 2012.

Seed yields

In 2007-2011 there were no significant differences in seed yield among irrigation treatments for the three *Sphaeralcea* spp. (Table 4). The higher seed yield in 2007 was due to multiple hand harvests that were not repeated in subsequent years. Stand of the three *Sphaeralcea* species was poor in 2012 and the plantings were eliminated. Possible contributions to the lack of seed yield response were rust some years and excellent weed control all years. The weed control allowed the limited water resources to be allocated to plant growth and seed production.

Conclusions

Due to the arid environment, supplemental irrigation may often be required for successful flowering and seed set because soil water reserves may be exhausted before seed formation. The *Sphaeralcea* spp. did not respond to irrigation in these trials. Natural rainfall was sufficient to maximize seed production in the absence of weed competition.

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Table 3. Early season precipitation and growing degree-days at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2006-2011.

	Precipitation (inches)		Growing degree-days (50-86°F)
Year	Jan-Jun	Apr-Jun	Jan-Jun
2006	9.0	3.1	1120
2007	3.1	1.9	1208
2008	2.9	1.2	936
2009	5.8	3.9	1028
2010	8.3	4.3	779
2011	8.3	3.9	671
70-year average	5.8	2.7	1010[a]

[a]24-year average.

Table 4. Globemallow seed yield response to irrigation rate (inches/season) in 2007-2011. Malheur Experiment Station, Oregon State University, Ontario, OR.

Species	Year	Irrigation rate			
		0 inches	4 inches	8 inches	LSD (0.05)
		lb/acre			
Sphaeralcea parvifolia	2007	1062.6	850.7	957.9	NS
	2008	436.2	569.1	544.7	NS
	2009	285.9	406.1	433.3	NS
	2010	245.3	327.3	257.3	NS
	2011	81.6	142.5	141.2	NS
Sphaeralcea grossulariifolia	2007	442.6	324.8	351.9	NS
	2008	275.3	183.3	178.7	NS
	2009	270.7	298.9	327	NS
	2010	310.5	351	346.6	NS
	2011	224	261.9	148.1	NS
Sphaeralcea coccinea	2007	279.8	262.1	310.3	NS
	2008	298.7	304.1	205.2	NS
	2009	332.2	172.1	263.3	NS
	2010	385.7	282.6	372.5	NS
	2011	89.6	199.6	60.5	NS