Globemallows

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We initiated research on the ecological and forage characteristics of globemallows *(Sphaeralcea)* in 1986 during a search for beneficial forbs that are well adapted to cold desert and steppe rangelands receiving less than 12 inches of precipitation annually. Globemallows are well adapted to such stressful environments. They also are native species, which may be desired or required in some situations.

Characteristics and Ecology

Globemallows (see cover photos) are in the family Malvaceae, which includes species such as cotton, okra, and hollyhock. *Sphaeralcea* occurs primarily in North and South America (Kearney 1935). There are 25 globemallow species on western U.S. rangelands (Table 1). Arizona, New Mexico, and Texas have the most species. *Sphaeralcea coccinea* is the most widely distributed species.

Generally, globemallow species in the U.S. are perennial, cool-season forbs or half-shrubs (Shaw and Monsen 1983, Pendery and Rumbaugh 1986). Most have showy orange flowers borne on multiple stems that arise from a basal crown. However, *S. coccinea* is more prostrate and spreads by rhizomes. In the western U.S. globemallows grow best in open or disturbed sites (especially roadsides) on sandy- to clay-loam soils, or on gravelly foothills receiving about 8 to 12 inches of precipitation annually (Wasser 1982). *Sphaeralcea grossulariifolia* is found on alkaline soils and tolerates moderate salinity, but it does not tolerate sodic soils.

Recent work has shed light on globemallow life-history strategies, which may improve our management abilities. Under natural conditions globemallows establish during favorable years, or on relatively favorable sites, survive for a few years, and then persist at lower densities or in seed

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Table 1. Globemallow species occurring in the western U.S.[1,2]. An "X" indicates a species has been reported from a particular state. U.S. Postal Service state abbreviations are used to indicate state names.

	States of occurrence																
Species	AZ	CA	CO	ID	KS	MT	NE	NV	NM	ND	OK	OR	SD	TX	UT	WA	WY
S. ambigua	X	X						X							X		
S. angustifolia	X	X	X		X			X	X		X			X			
S. caespitosa								X							X		
S. coccinea[3]	X		X	X	X	X	X	X	X	X	X		X	X	X		X
S. coulteri	X	X															
S. digitata	X								X					X			
S. emoryi	X	X						X	X								
S. fendleri	X		X		X				X					X			
S. grossulariifolia	X	X		X				X	X			X			X	X	
S. hastulata									X					X			
S. incana	X								X					X			
S. janeae															X		
S. laxa	X								X					X			
S. leptophylla	X		X						X					X	X		
S. lindheimeri														X			
S. munroana	X	X		X		X		X				X			X	X	X
S. orcuttii	X	X															
S. parvifolia	X	X	X					X	X						X		
S. pedatifida														X			
S. procera									X								
S. psoraloides															X		
S. rusbyi	X	X													X		
S. subhastata	X								X					X			
S. wrightii	X								X					X			
S. polychroma									X					X			

[1]Forty-three floras and plant atlases were consulted to prepare this list. They are not included in the literature cited, but are available from the authors. Synonyms have not been included.

[2]Species occurring in Canada are *S. coccinea* (British Columbia, Alberta, Saskatchewan, and Manitoba) and *S. munroana* (British Columbia). Species occurring in Mexico are: *S. angustifolia, S. coccinea, S. digitata, S. ambigua, S. axillaris, S. coulteri, S. emoryi, S. endlichii, S. fulva, S. hastulata, S. laxa, S. fendleri, S. hainesii, S. incana, S. leptophylla, S. orcuttii, S. pedatifida, S. wrightii, S. palmeri,* and *S. sulphurea* (Fryxell 1988).

[3]*S. coccinea* also occurs in Iowa and Minnesota.

banks. In the Mojave Desert, *S. ambigua* established in spaces between larger shrubs, where it led a "fugitive" life, avoiding interactions with other plants (Wright and Howe 1987). Henderson et al. (1988) found that globemallow seeds and plants had the patchy distribution common in arid land plant communities where there are few "safe sites." There were no strong associations (positive or negative) with other species, indicating reduced competition in a harsh environment. Ehleringer and Cooper (1988) characterized *S. ambigua* as a short-lived, opportunistic species that probably established during wet years but possibly had higher mortality during dry years due to relatively low water-use efficiency. The photographic record of Sharp et al. (1990) seems to confirm that globemallows establish during wet years, but die back during dry years.

The role of nonstructural carbohydrates in the grazing tolerance of globemallows has been the subject of several studies (Trlica et al. 1977, Menke and Trlica 1981, Menke and Trlica 1983). With few exceptions, root and crown nonstructural carbohydrate concentrations in defoliated *S. coccinea* did not differ from unclipped plants; however, *S. coccinea* could be sensitive to fall grazing because of its carbohydrate accumulation patterns.

Pendery et al. (submitted) found that a single springtime defoliation did not affect *S. munroana* total nonstructural carbohydrate amounts (pools). They also found that carbohydrates in roots and crowns accounted for only 7% of the total biomass in *S. munroana* regrowth following defoliation. Meristematic characteristics and flexibility in the allocation of carbohydrates are more important than the total amount of carbohydrates for the regrowth of defoliation bunchgrasses (Richards and Caldwell 1985), and the same may be true of globemallows.

Genetics and Reproduction

Sphaeralcea is a morphologically variable and complex genus. Its genetics and taxonomy have been extensively revised (Kearney 1935, Fryxell 1988). Diploid, tetraploid, hexaploid, and decaploid forms of globemallows occur (Table 2). This variability may be due to active evolution; the species are apparently poorly genetically delimited. Intergradation among species is common, probably as a result of interspecific hybridization. Globemallows are strongly outcrossing and are pollinated by insects. Several types of bees are important pollinators, especially *Diadasia* (Hymenoptera: Anthophoridae).

Nutritional Value and Utilization

Globemallows are utilized by wildlife and livestock, but *S. coccinea* is the only species that has been shown to be heavily utilized in a variety of environments (Hyder et al. 1975, Howard et al. 1990, Rumbaugh et al. 1993a). *Sphaeralcea coccinea* is a prominent component of native plant communities on the Great Plains, but it is less common in the Intermountain area.

Rumbaugh et al. (1993a) conducted a 4-year grazing trial with sheep in southern Idaho and found that the relative utilization of globemallows (*S. coccinea, S. munroana, S. grossulariifolia,* and *S. parvifolia*), alfalfa, and crested wheatgrass was as follows:

1988 (fall)	alfalfa > grass > globemallow
1989 (fall)	grass > alfalfa > globemallow
1990 (spring)	alfalfa > globemallow > grass
1991 (spring)	alfalfa > globemallow > grass.

They concluded that globemallows were acceptable, but not highly preferred, forbs which can be seeded in environments where alfalfa or other more desirable species are not adapted.

Rumbaugh et al. (1993b) concluded that forage from pastures containing 'Hycrest' crested wheatgrass and globemallows would meet dietary elemental requirements for beef cattle and sheep in the spring and fall. They also found that globemallows were similar to 'Spredor 2' alfalfa in elemental constituent values in the spring and fall.

Table 2. 2N chromosome numbers reported for several globemallow species in the western U.S. An "X" indicates that a particular 2N chromosome number has been reported for a species.

Species	2N chromosome number[1]				Source[2]
	10	20	30	50	
S. ambigua	X	X	X		1,2
S. angustifolia	X	X	X		3
S. caespitosa			X		4
S. coccinea	X	X	X		1,2
S. coulteri	X				1
S. digitata	X				1
S. emoryi		X	X	X	1
S. fendleri	X	X	X		1,3
S. grossulariifolia	X	X			2
S. incana	X	X			1,3
S. laxa	X				1
S. lindheimeri	X				1
S. munroana	X	X			2
S. orcuttii	X				1
S. parvifolia	X	X			1,2
S. pedatifida	X				1
S. rusbyi	X	X			1
S. subhastata	X	X			1
S. wrightii		X			3
S. polychroma		X			3

[1]Webber (1936) reported haploid (N) chromosome numbers.
[2]1 = Webber (1936), 2 = Rumbaugh et al. (1989), 3 = LaDuke (1986), and 4 = R. R-C. Wang (personal communication).

Cultural Considerations

Seed Production, Harvesting, and Cleaning

Sphaeralcea grossulariifolia seed is usually collected by hand or machine from wild land stands during July or August (Wasser 1982). To maximize yield, plants should be harvested when the lowest globes start to split and the majority are just ready to open. Globes at this time will be light green-brown. At the time of maximal seed yield, an estimated 15% of the globes of *S. coccinea* and about 25% of *S. munroana, S. grossulariifolia,* and *S. parvifolia* globes were ripe (Pendery and Rumbaugh 1990). This emphasizes the indeterminate seed ripening of globemallows, which is a problem for commercial seed production.

Dry seed can be cleaned with a seed cleaner in combination with a debearder to remove seed from capsules, and then recleaned on a clipper or fanning mill if necessary. The limited supply of commercially available seed ranges from about $35 to $65 per pound.

Seeding Procedures

Globemallow seed can be aerially broadcast and covered, drilled in a seed mixture, or cultipacked separately or in mixtures (Shaw and Monsen 1983). It should be seeded in fall or winter. Experience has shown that globemallows cannot successfully establish if planted at more than 1/4-inch depth, which creates difficulties in seeding mixtures where the other species should be planted deeper. Seeding rate recommendations have ranged from 1/4- to 2-pounds per acre (Plummer et al. 1968, Wasser 1982, Horton 1989). This emphasizes that there are no absolute prescriptions for globemallow seeding; experience is probably the best guide.

Seed Germination

Sabo et al. (1979) found that *S. incana* had 100% germination after 12 days when daily temperatures were alternated at 75° F for 8 hours and 65° F for 16 hours. The seed had been scarified for 3 minutes with medium grit sandpaper. Roth et al. (1987) achieved maximum germination in most of their treatments when seed was scarified with dioxane; however, due to the potential dangers of this chemical, they recommended a 10-minute soak in sulfuric acid as a preferable scarification procedure. Other studies have also clearly shown that scarification is required to improve globemallow seed germination.

Forage Yields

Sphaeralcea coccinea standing crop averaged 150 pounds per acre in blue grama grasslands in Colorado (Stanton et al. 1984). Pendery and Rumbaugh (1990) reported forage yields of *S. grossulariifolia* and *S. munroana* grown with 'Hycrest' crested wheatgrass on a favorable site in northern Utah (Table 3). The 2 globemallow species did not differ significantly in forage yield. However, the mean forage yield of globemallow was significantly less than the mean yield of alfalfa. The mean yield of crested wheatgrass did not differ whether grown with alfalfa or with globemallow.

Table 3. Forage yield of globemallows grown with crested wheatgrass, and of alfalfa grown with crested wheatgrass, at a northern Utah study site (adapted from Pendery and Rumbaugh 1990).

	Forb component		
Year	Globemallow yield	Alfalfa yield	Grass yield
	lb./ac.		
1985	1115	636	100
1986	195	3617	956
1987	314	3810	1757
1988	478	5106	795
Mean	526	3292	902

These results (Table 3) indicate that globemallows are not highly competitive but that they may prevent soil erosion while other species in a seeding establish. Globemallows do not produce as much forage as other selected forage species when seeded on sites with fertile soils and which receive more than 12 inches precipitation annually. However, they will be advantageous in seeding mixtures for sites where high heat and drought stress restrict the choice of species to be planted.

Improved Varieties

Our work with globemallows (Pendery and Rumbaugh 1990; Rumbaugh et al. 1993a, b) has resulted in the registration and release of two globemallow germplasms. ARS-2936 scarlet globemallow *(S. coccinea)* was selected for excellent spread by rhizomes, the number of shoots arising from rhizomes, and palatability for sheep (Rumbaugh et al. 1993). ARS-2892 Munroe globemallow *(S. munroana)* was selected for amount of shoot biomass, leafiness, and seed yield (Rumbaugh and Pendery 1993). Small amounts (1/3-ounce) of seed of these germplasms are available upon written request to the authors, and with the stipulation that appropriate recognition of the original source will be given when they contribute to research or development of new cultivars.

Conclusion

Globemallows are an alternative native forb component for rangeland seedings. They are best suited to areas receiving 12 inches or less of precipitation annually. While globemallows are suited to—and may be easier to establish on—wetter areas, there may be more desirable species for those sites. Globemallows are acceptable, but not highly preferred, forbs that meet the dietary elemental requirements of beef cattle and sheep when sown with grasses.

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