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Wildflower Seed Mixes for Interior Alaska

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INTRODUCTION

Native wildflowers have become an important component of commercial and home landscapes, golf courses, and highway and mine revegetation projects. This is due, in part, to public concerns about the environment and plant and water conservation. Landscape architects have identified water conservation and low maintenance landscapes as the most significant trends in landscape design in the 1990s. These trends have resulted in an increased demand for native plant materials (Garber and Bonderi, 1993). Native wildflowers are "generally more tolerant of the region's climatic irregularities and require less attention, water, and fertilizer. They also, if properly established, will self-sow and persist year after year, obviating the need to repurchase and replant seed each year" (Averett and Northington, 1989). Wildflowers in the landscape have resulted in a 25 to 30% savings in annual mowing or maintenance costs when compared to plantings of turfgrasses (Stroud, 1989).

Since 1987, wildflowers have been specified for use in all federal highway landscape projects (Surface Transportation and Uniform Relocation Assistance Act of 1987). In Alaska, Icelandic poppy (*Papaver nudicaule*) was sown along highways, but this species was eliminated in 1989 because it is not indigenous to Alaska. Since that time, a mixture of native grasses has been used (P. Misterek, Alaska Department of Transportation, pers. comm.).

Home and commercial landscapers interested in wildflower plantings are limited to a small selection of mixes that contain few species indigenous to Alaska. No commercial business presently markets a wildflower mix composed entirely of Alaska species. Development of a true Alaska wildflower seed mix has been hampered by insufficient information on seed germination techniques, species composition, and applicable field management practices.

The objectives of this research were to characterize six native and non-native wildflower seed mixes sold in Alaska in terms of seed germination, flowering dates, winter survival, and public acceptability. In addition, the growth of wildflower seed mixes was evaluated in relation to two management practices: irrigation and seasonal sowing date.

METHODS

Six wildflower seed mixes were sown in field plots at the Agricultural and Forestry Experiment Station's Fairbanks Experiment Farm. Three mixes were purchased from commercial sources: Country Meadow® Mix, Custom Wildflower Mix and Alaska Native Wildflower Mix. In addition, we formulated an Experimental Wildflower Mix composed entirely of Alaska native wildflowers that were hand harvested from wild stands in interior Alaska. Both the Alaska Native Wildflower Mix and the Experimental Native Mix were sown with and without 'Tundra' glaucous bluegrass seed (*Poa glauca cv. Tundra*).[1]

Before begining the field experiments, controlled germination tests were conducted on all species. Seed mixes were separated according to species, and seeds were sown onto moistened filter paper in petri dishes (four replicates of 100 seeds). Seeds were germinated beneath fluorescent lights at a constant 70°F (21°C). Successful germination (radical emergence) was counted daily for 30 days.

Unfertilized Tanana silt-loam soil was tilled to 6–8 inches (15–20 cm). Seventy-two, 4x10 foot (1.2x3m) plots were arranged in a randomized split/split block design with three replicates of three treatments: wildflower mix, irrigated or non-irrigated plots, and fall or spring seeding dates. Spring-planted plots were fumigated with methyl bromide June 8, 1992 to minimize weed competition. Seeds were mixed with sand (1:10 by volume, respectively), broadcast by hand, then lightly raked into the soil June 12, 1992. Seeding rates per plot were Country Meadow® Mix, 9.1g; Custom Wildflower Mix, 5.7g; Alaska Native Wildflower Mix, 1.0g; Experimental Wildflower Mix, 6.0g; and 'Tundra' glaucous bluegrass, 2.3g. Irrigated plots received 0.5 inches (3.4cc) of water daily from the date of sowing until seedling establishment on July 13, 1992.

The experiment was designed to evaluate effects of irrigation and both spring and fall seeding dates on six wildflower mixes. This report presents the results of the first season's spring-seeded mixes on irrigated and non-irrigated plots. Data included species number and frequency in a randomly selected 1.25 ft^2 (1/8 m^2) subsample and flowering dates. This sample plot was further divided into nine equal sections, and species frequency was determined as the percentage of plots in which each species occurred. Data were analyzed by analysis of variance at $P \leq 0.05$.

A second experiment evaluated seeding rates of the Alaska Native Wildflower Mix. This mix was sown at one, two, and three times the recommended seeding rate (1 g per 3.6 m^2 or 0.03 oz per 40 ft^2). Three replicates of each seeding rate were sown in 4 x 10

[1]Seed sources: Country Meadow® Mix, Denali Seed Co, Anchorage; Custom Wildflower Mix, Alaska Feed Co., Fairbanks; Alaska Native Wildflower Mix, Nauriaq Gardens, Fairbanks, Experimental Wildflower Mix, Big Dipper Gardens and Nauriaq Gardens, Fairbanks; and glaucous bluegrass, Alaska Plant Materials Center, Palmer.

foot plots arranged in a randomized block design and irrigated as outlined above.

A public opinion survey was conducted to determine preference for different seed mixes on irrigated and non-irrigated plots. Respondents ranked the six mixes in order of preference from one (most preferred) to six (least preferred). A similar survey was conducted with the seeding rate study in which plots were ranked from one (most preferred) to nine (least preferred). Data were analyzed by Duncan's HSD at P≤0.05.

RESULTS AND DISCUSSION

Evaluation of the wildflower mixes. The Custom Wildflower and Country Meadow® mixes had significantly higher percentage of species establishment (seed germination and survival throughout the growing season) than the other mixes on both irrigated and non-irrigated plots (Table 1). This higher establishment may be related to a higher germination percentage of field-cultivated as opposed to wild-collected seeds (Tables 2 through 4). The results of the controlled environment germination tests showed an average germination percentage for all species in the field-cultivated Country Meadow® and Custom Wildflower mixes of 64% (n=20) and 66% (n=14), respectively. In contrast, the Alaska native species in the Alaska Wildflower and Experimental mixes averaged 23% germination (n=20).

Some of the species have complex germination requirements that delayed or prevented germination during the first season (Table 2). For instance, wild iris (*Iris setosa*) seeds are physiologically dormant, and require a period of cold stratification for germination (Holloway, 1987). We did not expect wild iris seeds to germinate the first year. Arctic lupine (*Lupinus arcticus*), seeds require scarification for optimum germination (Baldwin Seed Co., 1987). Only 8% of the seeds germinated in the controlled environment tests, and no seeds germinated on either irrigated or non-irrigated plots.

Table 1. Species emergence in six spring-sown wildflower mixes on all plots regardless of irrigation treatment.

Wildflower Mix[z]	Species emergence (%)
Custom Wildflower Mix	68a[y]
Country Meadow® Mix	67a
Experimental Wildflower Mix	46b
Experimental Wildflower Mix + grass	43b
Alaska Native Wildflower Mix + grass	30bc
Alaska Native Wildflower	23c

[y]mean separation by Tukey's HSD at P = .05.
[z]3 replicates of non-irrigated and irrigated plots, n = 6

The public opinion survey showed Country Meadow® Mix to be the most preferred of the six mixes (Fig 1). The most important aspects of these mixes were the long bloom season and the multi-colored flowers. The Alaska Native Wildflower Mix and the Custom Wildflower mixes were dominated by a single flower color: the yellow-orange of California poppy and the blue of globe gilia, respectively. The Experimental Mix had some mixed-color flowers but not nearly the intensity and showiness of the Country Meadow® Mix. Some respondents chose the Experimental Mix specifically because they identified all the components as Alaska wildflowers. However, the majority of respondents preferred the showy, colorful display of the non-native mix.

Table 2. Establishment and bloom dates for Alaska native wildflower and grass species on non-irrigated and irrigated plots.

Species	Germination[z] (%)	Irrigated Plots		Non-irrigated Plots	
		Established	Bloom Date	Established	Bloom Date
Sneezewort *(Achillea ptarmica)*	35	*[y]			
Alpine arnica *(Arnica alpina)*	30	*		*	
Siberian Aster *(Aster sibiricus)*	28	*		*	
Thoroughwax *(Bupleurium triradiatum)*	12				
Strawberry spinach *(Chenopodium capitatum)*	12	*	Jul 16	*	Jul 27
Rock-harlequin *(Corydalis sempervirens)*	21	*		*	
Fireweed *(Epilobium angustifolium)*	48				
Fleabane *(Erigeron glabellus)*	20	*		*	
Bedstraw *(Galium boreale)*	31				
Wild sweetpea *(Hedysarum Mackenzii)*	25	*		*	
Hawkweed *(Hieracium scabriusculum)*	2	*		*	
Wild iris *(Iris setosa)*	0				
Butter and eggs *(Linaria vulgaris)*	5	*	Aug 29		
Blue flax *(Linum perenne)*	53	*		*	
Arctic lupine *(Lupinus arcticus)*	8				
Oxytropis campestris	6				
Star of parnassus *(Parnassia palustris)*	0				
Tundra Glaucous bluegrass *(Poa glauca 'Tundra')*	*		Aug 12	*	
Jacob's ladder *(Polemonium acutiflorum)*	4	*	Aug 29	*	Aug 12
Great Burnet *(Sanguisorba officinalis)*	60				
Goldenrod *(Solidago multiradiata)*	4				
Wild Chamomile *(Tripleurospermum inodoratum)*	3	*	Jul 30	*	Jul 30

[z]Average germination percentage of 4 replicates of 100 seeds in a controlled environment seed germination test.
[y]A* indicates species germinated, and seedlings survived throughout the first growing season

Table 3. Species establishment and bloom dates for wildflower species in the Custom Wildflower Mix sown on non-irrigated and irrigated plots.

Species	Germination[z] (%)	Irrigated Plots		Non-irrigated Plots	
		Established	Bloom Date	Established	Bloom Date
Common yarrow *(Achillea millefolium)*	37	*[y]			
Basket -of-gold *(Alyssum saxatile)*	88				
Cornflower *(Centaurea cyaneus)*	99	*	Jul 27	*	Jul 27
Wallflower *(Cheiranthus allionii)*	92	*	Aug 12	*	Aug 12
Shasta daisy *(Chrysanthemum maximum)*	95	*		*	
Globe gilia *(Gilia capitata)*	35	*	Aug 3	*	Aug 3
Dame's rocket *(Hesperis matronalis)*	44	*		*	
Blue flax *(Linum lewisii)*	53	*	Jul 30	*	Jul 30
Scarlet flax *(Linum rubrum)*	86	*	Aug 3	*	Aug 3
Baby-blue-eyes *(Nemophila menziesii)*	30	*	Aug 12	*	Aug 12
Evening primrose *(Oenothera lamarkiana)*	71				
Icelandic poppy *(Papaver nudicaule)*	89				
Rocky Mountain Penstemon *(Penstemon strictus)*	9	*			
Black-eyed susan *(Rudbeckia hirta)*	92				

[z]Average germination percentage of 4 replicates of 100 seeds in a controlled environment seed germination test.
[y]A* indicates species germinated, and seedlings survived throughout the first growing season

Effects of Irrigation. The percent species establishment was significantly greater (P≤0.05) on irrigated (81%) versus non-irrigated (67%) plots. This study parallels wildflower research from many geographic locations where irrigation is commonly recommended for greater seedling establishment and improved flower color displays (i.e. Salac and Traeger, 1982; Rose-Fricker, 1991; Sanford, 1991; and Airhart et al., 1983).

Eleven Alaska wildflower species became established on the non-irrigated plots (Table 2). Two species, sneezewort and butter-and-eggs, germinated only on irrigated plots. Soil moisture may be more critical to establishment of these plants than the other wildflower species. Also, seeds of butter-and-eggs germinated poorly (6%) even under controlled environment conditions. Drier soil conditions may have exacerbated this poor germinability during the first year.

Two Alaska wildflowers, butter-and-eggs and Jacob's ladder, bloomed the first year only under irrigated conditions. Three Alaska wildflowers became established and bloomed on non-irrigated plots: strawberry spinach, wild chamomile and blue flax (Tables 2, 3 and 4). The latter wildflowers will be essential for the establishment of first-year color in Alaska wildflower mixes.

Twenty-three non-native wildflowers in the Custom Wildflower and Country Meadow® mixes became established and bloomed during the first season on both non-irrigated and irrigated plots (Tables 3 and 4). Three species became established only on the irrigated plots: baby-blue-eyes, common yarrow, and Rocky Mountain penstemon; and only the common yarrow did not flower. Six of the remaining species did not become established on any plot despite germination percentages under controlled conditions of greater than 70%. This response is probably related to inappropriate field germination conditions. For instance, Basket-of-gold and Icelandic poppy require light for germination (Hartman et al. 1990). The process of raking the seeds into the surface at planting may have excluded light and prevented germination.

Wildflower and grass seed mixes. The addition of 'Tundra' glaucous bluegrass to the Experimental and Alaska Native wildflower mixes had no significant effect on wildflower species establishment on irrigated and non-irrigated plots. Wildflower species establishment was 31 to 55% for the Experimental Wildflower Mix and 19 to 36% for the Alaska Native Mix. In addition, the frequency of each plot did not differ significantly between plots with and without grass. The plot frequency of the glaucous bluegrass reached an average 83% by July 20 in both mixes but declined to 77% by September 5. The decline in frequency probably resulted from grasshopper damage.

Native grasses included in a seed mixture may be less costly than a mix composed entirely of wildflower seed. Grasses also add bulk to the mix for easier application, aid in soil stabilization, and tend to decrease annual weed competition (Cotter et al., 1989; Martin, 1990; Pompei, 1986; Rose-Fricker, 1991).

Seeding rate of Alaska Native Wildflower Mix. Species emergence in the Alaska Native Wildflower Mix did not differ significantly among plots sown at one, two and three times the recommended sowing rate. By September 5, average emergence ranged from eight to 12 species per ⅛ m^2 plot. The public was capable of distinguishing between the recommended rate and the higher rates but not between the two and three times seeding rates. Most respondents had difficulty ranking the nine plots at the end of the season because nearly every plot was covered with California poppy and other annuals.

Conclusions. The non-native Country Meadow® wildflower mixes performed the best of six wildflower seed mixes when evaluated for species emergence, appearance of first-year bloom, and public opinion. All mixes had greater species emergence on irrigated as opposed to non-irrigated plots. These results emphasize the importance of establishing first-year color and choosing species that provide a multi-colored mix of blooms. Three Alaska wildflowers—strawberry spinach, wild chamomile and blue flax, bloomed even under non-irrigated conditions and will be important for establishing first-year color. The glaucous bluegrass added to the Experimental and Alaska Native mixes had no effect on wildflower species establishment during the first year. Seeding the Alaska Native Wildflower mix at one, two or three times the recommended rate had no effect on the number of species that became established.

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Table 4. Establishment and bloom dates for wildflower species in Country Meadow® Mix sown on non-irrigated,irrigated plots.

Species	Germination[z] (%)	Irrigated Plots		Non-irrigated Plots	
		Established	Bloom Date	Established	Bloom Date
Alyssum *(Alyssum sp.)*	85	*[y]	Jul 23	*	Jul 23
Columbine *(Aquilegia sp.)*	0				
Calendula *(Calendula officinalis)*	21	*	Aug 12	*	
Cornflower *(Centaurea cyaneus)*	87	*	Jul 27	*	Jul 27
Wallflower *(Cheiranthus allionii)*	72	*	Aug 12	*	Aug 12
Garland chrysanthemum *(Chrysanthemum coronarium)*	69	*	Aug 6	*	Aug 6
Oxeye daisy *(Chrysanthemum leucanthemum)*	87	*		*	
Chinese forget-me-not *(Cynoglossum amabile)*	71	*	Sept 5	*	
California poppy *(Eschscholzia californica)*	54	*	Jul 27	*	Jul 27
Clarkia *(Godetia sp.)*	95	*		*	
Baby's breath *(Gypsophila muralis)*	90	*	Jul 30	*	Jul 30
Dame's rocket *(Hesperis matronalis)*	32	*		*	
Toadflax *(Linaria maroccana)*	72	*	Jul 23	*	Jul 23
Blue flax *(Linum lewisii)*	65	*	Jul 30	*	Jul 23
Scarlet flax *(Linum rubrum)*	93				
Maltese cross *(Lychnis chalcedonica)*	89				
Baby-blue-eyes *(Nemophila menziesii)*	30	*	Aug 12		
Icelandic poppy *(Papaver nudicaule)*	30				
Corn poppy *(Papaver rhoeas)*	57	*	Jul 30	*	Jul 30
Fiddleneck *(Phacelia tanacetifolia)*	24	*	Jul 30	*	Jul 30

[z]Average germination percentage of 4 replicates of 100 seeds in a controlled environment seed germination test.
[y] A* indicates species germinated, and seedlings survived throughout the first growing season

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