Seeding Salt-Desert Shrub Ranges in Western Wyoming[1]

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The demands for increased forage, reduced erosion, and control of undesirable plants indicate the need for improvement of salt-desert shrub ranges below their potential production. Most depleted areas can best be improved by better management. Where desirable plants are absent and favorable soil and moisture permit, seeding may speed up revegetation.

To determine the possibilities for revegetation, the Rocky Mountain Forest and Range Experiment Station, U.S. Forest Service, the Bureau of Land Management, and the University of Wyoming initiated 25 studies during 1948 to 1951 to evaluate species and methods of seeding Wyoming rangelands. With the departmental reorganization in 1954, this work was transferred to Agricultural Research Service.

Procedures

Each study area received one to three methods of seedbed preparation which included moldboard plowing, disking, dragging, and grading. The grader blade cut the shrub roots just below the soil surface with as little soil disturbance as possible. Type of seedbed and some characteristics of the study areas are shown in Table 1. On all areas the native plants were sparse and small, typical of deteriorated range. Areas were grouped into vegetation types as follows:

1. Saltbush—almost pure Nuttall saltbush *(Atriplex nuttallii* S. Wats.)

2. Mixed saltbush—Nuttall saltbush with some or all of the following: Schadscale *(A. confertifolia* (Torr. & Frem.) Wats.); winterfat *(Eurotia lanata* (Pursh) Moq.); budsage *(Artemisia spinescens* D. C. Eat.); and birdfoot *(A. pedatifida* Nutt.), low *(A. arbuscula* Nutt.), and big sagebrush *(A. tridentata* Nutt.).

3. Big sagebrush—big sagebrush dominant.

Long-time average precipitation was estimated from the nearest weather stations. Spring has the most rain with 45 to 50 percent of the yearly total falling during April, May, and June. The winter is dry with 10 percent or less of the total falling during December, January, and February. During the years of stand establishment, precipitation was nearly normal.

Species were drilled at right angles to seedbed preparation strips with two replicates per study. Crested wheatgrass *(Agropyron destertorum* (Fisch.) Schult.) was seeded ¾ inch deep at six pounds of seed per acre. Smaller seeded species were seeded ½ inch deep at four to six pounds per acre. Larger seeded species were seeded ¾ to one inch deep at eight pounds per acre. Exceptions were western wheatgrass *(A. smithii* Rydb. and Indian ricegrass *(Oryzopsis hymenoides* (Roem. & Schult.) Ricker), which were seeded at 15 to 18 pounds per acre.

Seedings were rated yearly to 1952 or 1953 and again in 1960 and 1962. Numerical ratings of seeded stands are as follows: zero complete failure, one-two very poor, three-four poor, five-six fair, seven-eight good, and nine-ten excellent. Ratings in Table 2 are from prepared seedbeds.

Eighteen studies were on salt-desert shrub lands. By 1960, two areas, Monument and Dad, had been destroyed. The remaining 16 were rated for success of seeded stands. Two big sagebrush areas with low precipitation were included for comparison.

Results and Discussion

Seedling stands varied from poor to excellent. By 1962 most stands were poor or failures. Poor stands were attributed mainly to reinvasion by native vegetation and to seeded species not being adapted to dry, saline areas. Slow deterioration of 1948 seeded stands of eight species is shown at Kane, one of the older seedings and the one which has been rated most often. From 1949 to 1952 five species had good or excellent stands, one a fair stand, one a very poor stand, and one was a failure (Figure 1). In 1953 native plants commenced to invade the seeded strip. In 1953 and 1954 Russian wildrye *(Ely-*

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Table 1. Location, seedbed preparation, and some site characteristics of 18 seedings areas in Wyoming.

Area, number of species seeded, and location	Elevation	Precipitation	Type of seedbed	Dominant shrubs in order of abundance[a]
	(Feet)	(Inches)		
Saltbush				
Bolton Creek - 10 (22 mi. SW Casper)	5,200	9	Grubbed	Atnu
Fifteen-mile Creek - 7 (14 mi. W. Worland)	4,500	8	No treatment	Atnu
Greybull - 3 (8 mi. SE Greybull)	4,200	6	Graded	Atnu
Manderson 1[b] - 10 (10 mi. NE Manderson)	4,000	6	½ graded	Atnu
Manderson 2 - 12 (5 mi. N Manderson)	4,000	6	½ disked and graded	Atnu
Manderson 3 - 12 (4 mi. NNE Manderson)	4,000	6	½ graded	Atnu
Manderson 4A - 7 (2 mi. NE Manderson)	3,800	6	graded	Atnu
Mixed Saltbush				
Manderson 4B - 7 (2 mi. NE Manderson)	3,800	6	graded	Atnu, Arsp
Manderson 4C - 7 (2 mi. NE Manderson)	3,800	6	graded	Atco, Arsp, Atnu
Arminto - 7 (1 mi. NE Arminto)	6,000	7	No treatment	Arpe, Atnu
Kane - 8 (5 mi. SE Kane)	4,000	7	½ graded	Atnu, Arsp, Atco
Carter Draw - 7 (20 mi. SE Riverton)	5,600	8	½ graded	Arpe, Atnu, Artr[d]
Bates Hole 1 - 7 (22 mi. SW Casper)	5,200	9	[c]	Arpe, Atnu, Arsp, Artr[d]
Bates Hole 2 - 7 (22 mi. SW Casper)	5,200	9	[c]	Atco, Eula, Arsp
Muskrat Creek - 7 (20 mi. S. Moneta)	5,400	8	½ graded	Arpe, Atnu
Fraser Draw[b] - 9 (21 mi. S Moneta)	5,400	8	⅓ plowed ⅓ dragged	Arpe, Atnu
Big sagebrush				
Worland Airport - 12	4,100	8	Plowed	Artr
Fuller Draw - 1 (20 mi. NE Riverton)	5,500	8	Plowed	Artr, Arpe, Atnu

[a] Atnu - *Atriplex nuttallii,* Atco - *A. confertifolia,* Arsp *Artemisia spinescens,* Arpe - *A. pedatifida,* Artr - *A. tridentata,* Eula - *Eurotia lanata*

[b] Sometimes flooded during heavy run off

[c] ⅓ plowed, ⅓ graded, straw and manure mulches

[d] Swales only

mus junceus Fisch.) still had a good stand; intermediate (*Agropyron intermedium* (Host) Beauv.) and crested wheatgrasses had poor stands, four species had very poor stands, and one was a failure. By 1956 Russian wildrye had only a fair stand, crested wheatgrass a poor stand, four species very poor stands, and two were failures. In 1960 and 1962 Russian wildrye and crested wheatgrass had poor stands, western and pubescent (*Agropyron trichophorum* (Link) Richt.) wheatgrasses and Indian ricegrass had very poor stands and three species were failures.

Other areas such as Manderson 3 were similar to Kane. On most areas, however, stands deteriorated more rapidly than at Kane. For example, seedings on prepared seedbeds at Bolton Creek and Carter Draw produced good seedling stands which were poor to failure by 1951. Factors which affected stands are discussed below.

FIGURE 1. Intermediate wheatgrass was drilled in 1948 on the unprepared foreground and on the graded background at Kane. Seedlings emerged equally well with good stands on both areas in 1949. By 1950 all plants had died on the unprepared area while the graded area still had a good stand. Plants commenced to die in 1953 and all were dead by 1960. U. S. Forest Service photograph taken June 29, 1950.

an almost pure saltbush area with eight inches of precipitation at Church Butte. Russian wildrye showed best with scattered plants. Even fewer plants of crested wheatgrass and Indian ricegrass were present. The Intermountain Forest and Range Experiment Station seeded 13 species each year, 1936 to 1940, on a sagebrush and saltbush area east of Kemmerer, where rainfall was approximately nine inches annually. Only crested wheatgrass survived. It produced fair to good stands and is now spreading. Russian wildrye was not available when these seedings were made.

Manderson 3 seemed to be near the lower limit of adaptability for Russian wildrye and crested wheatgrass. Seeded in 1948, stands of these species started out good to excellent and then deteriorated. Russian wildrye reached a low about 1960, when there were only 98 plants on two plots. Since then it has commenced to spread from seed. In 1962 crested wheatgrass plants were still dying. On two plots of each species only two plants of

Species

Of 14 species, none was uniformly successful on saltbush or mixed saltbush areas. Russian wildrye was best adapted with stands rating from failure to good. Crested wheatgrass was next with stands varying from failure to fair. Other species ranged from poor to failure. The four most widely used or successful species are shown in Table 2. The other 10 species follow:

Some of these species were seeded on similar areas in Wyoming. At Fuller Draw a large area was plowed and drilled to crested wheatgrass in 1948. The grass was grazed for 11 years. In 1962 a good stand produced 1,277 pounds of air-dry grass per acre. The University of Wyoming seeded several species on

Species seeded	No. of areas where seeded	Results[a]
Tall wheatgrass (*Agropyron elongatum* (Host) Beauv.)	13	Failure
Pubescent wheatgrass	11	Five plants at Kane. Poor stands at Bates Hole 1 & 2 and Fraser.
Western wheatgrass	7	Ten plants at Kane, 1 at Arminto
Intermediate wheatgrass (Amur strain)	7	Few plants at Fraser
Stiffleaf wheatgrass (*A. pungens* (Pers.) Roem. & Schult.)	6	Failure
Siberian wheatgrass (*A. sibiricum* (Willd.) Beauv.)	3	Two plants at Carter Draw
Beardless wheatgrass (*A. inerme* (Scribn. & Smith) Rydb.)	3	Failure
Indian ricegrass	10	Very poor stands[b]
Sand dropseed (*Sporobolus cryptandrus* (Torr.) A. Gray)	4	Failure
Yellow sweetclover (*Melilotus officinalis* (L.) Lam.)	5	Failure

[a]In 1962 seeded plants were at only locations noted.
[b]Hard to distinguish from native plants.

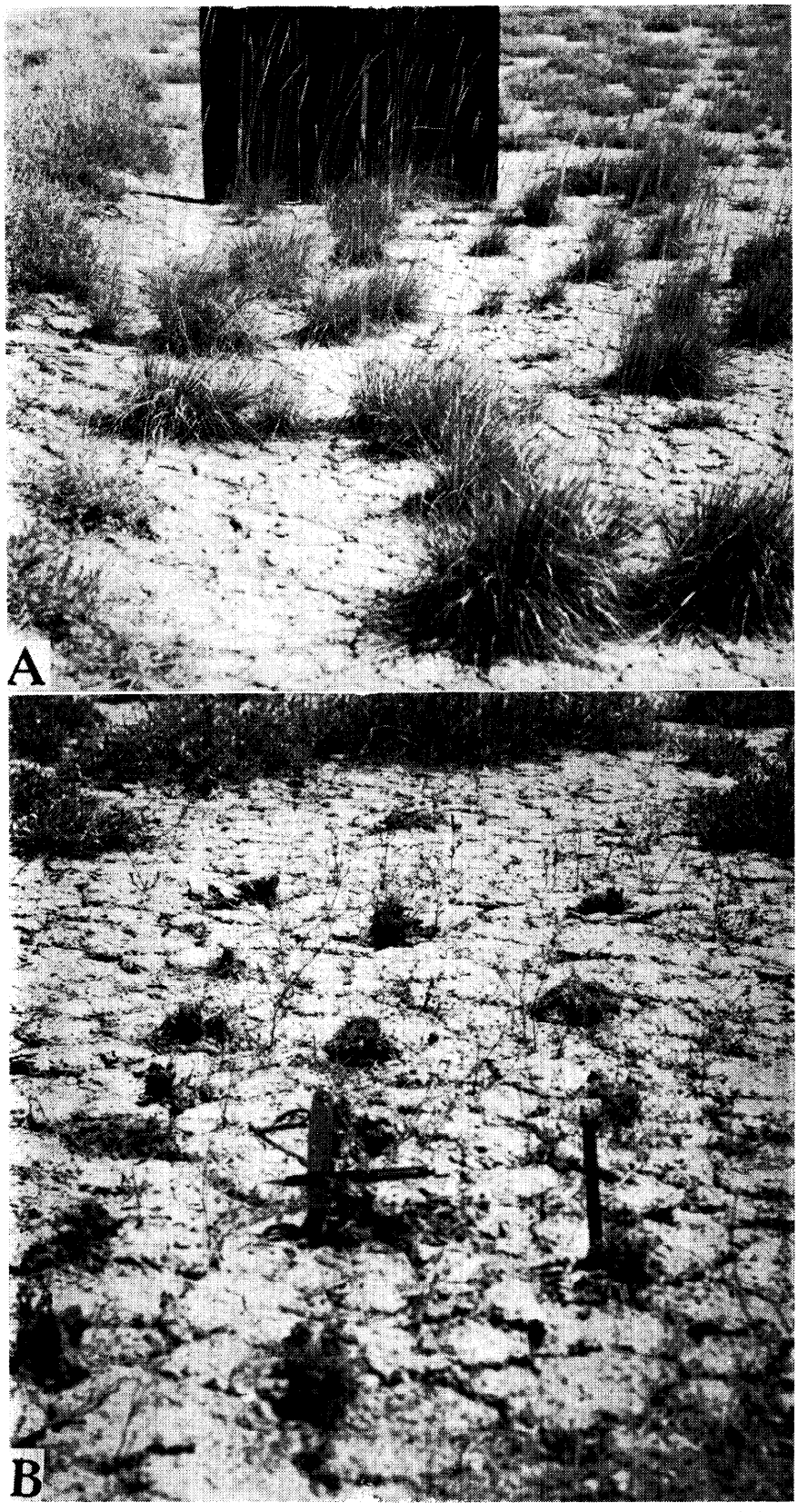

FIGURE 2. Manderson 3 supported a pure stand of saltbush before grading and drilling in 1948. A. Russian wildrye plants died out at first but became vigorous and new plants came from seed. Non-graded on left. B. Crested wheatgrass plants still dying. These dead clumps were alive in 1960. Photographed July 1962.

the standard and 25 plants of the rhizomatous form remained (Figure 2).

Dewey (1960 and 1962) showed that wheatgrass species and strains varied considerably in their tolerance to salt. Future seeding might evaluate salt-tolerant forms of Russian wildrye, crested wheatgrass, and other introduced and native grasses, forbs, and shrubs.

Seedbed preparation

Unprepared seedbeds did not produce satisfactory stands. Seedlings emerged equally well on both prepared and unprepared seedbeds (Figure 1). Death was mainly from competition with native plants. Straw and manure mulches at Bates Hole made no difference in seedling numbers but increased seedling vigor. By 1962 straw and manure mulches had no effect upon plant vigor but they supported slightly more plants than the unmulched strip.

Soils

Soil samples were taken at depths of 0-12 and 12-24 inches on all areas in 1960 or 1962. Except for a shallow soil at Bolton Creek, soils were deeper than rainfall normally penetrates. Except at Kane, Fuller Draw, Worland, and Manderson 4C, soils were of fine texture. Observation indicated that the fine-textured soils had low infiltration rates. The percent moisture-holding capacity at saturation ranged from 23 at Worland and Manderson 4C through 27 at Fuller Draw and 33 at Kane to 60 at Bates Hole and 63 at Bolton Creek. Organic matter was below one percent. The pH ranged from 8.0 to 9.7. Soluble salts and exchangeable sodium varied widely. Except for low salt (.07 percent) and low sodium (5 percent), at Manderson 2, sodium and salt were generally high with saltbush vegetation and decreased with the mixed saltbush and sagebrush. Seeding success

Table 2. Success rating of four species at 18 areas, the first year following seeding (1), mostly 1952 (2), and 1962 (3).

Area	Year seeded	Russian wildrye (1)	(2)	(3)	Crested wheatgrass (1)	(2)	(3)	Crested wheatgrass (rhizomatous) (1)	(2)	(3)	Intermediate wheatgrass (1)	(2)	(3)
Saltbush													
Bolton Creek	1948	9	.5	0	6	.1	0	9	0	0	4	.1	0
Fifteen-mile	1948	10	3	.5	9	1	0	-	-	-	8	0	0
Greybull	1950	9	6	.1	6	1	0	-	-	-	4	0	0
Manderson 1[a]	1949	8	4	.5	1	1	0	1	0	0	5	0	0
Manderson 2	1949	2	1	0	2	0	0	2	1	0	2	0	0
Manderson 3	1948	8	8	2	7	5	.1	8	7	1	4	0	0
Manderson 4A	1950	2	1	0	1	1	0	1	0	0	1	0	0
Mixed saltbush													
Manderson 4B	1950	2	1	2	1	1	.5	1	0	0	1	0	0
Manderson 4C	1950	1	2	3	2	1	1	1	0	0	1	0	0
Arminto	1948	6	1	2	9	2	2	-	-	-	7	.5	0
Kane	1948	9	9	4	7	7	3	-	-	-	8	7	0
Carter Draw	1948	4	2	3	7	3	4	-	-	-	8	2	.1
Bates Hole 1	1949	7	6	6	1	2	2	1	2	3	9	5	0
Bates Hole 2	1949	5	2	5	2	2	2	1	2	3	8	2	0
Muskrat Creek	1948	10	5	7	9	4	6	10	5	5	7	1	0
Fraser Draw[a]	1949	5	6	6	1	1	5	2	1	3	6	2	1
Big sagebrush													
Worland Airport	1948	10	9	[b]	9	9	9	10	9	[b]	8	2	[b]
Fuller Draw	1948	-	-	-	9	9	9	-	-	-	-	-	-

[a] Flooded during heavy run-off.

[b] Most stands destroyed in 1954 by the airport enlargement.

usually decreased as salt and sodium in the soil increased.

Soluble salts, 1.72 percent at Bolton Creek and exchangeable sodium percentages, 24 at Greybull, 28 at Bolton Creek, 29 at Manderson 1, 35 at Kane, and 40 at Fifteen-Mile, were sufficient to prevent growth of the seeded grasses.

It is difficult to correlate specific soil characteristics with seeding success on these areas. Undoubtedly soil is one of many factors which limit growth of seeded species on salt-desert shrub areas. Plummer *et al.* (1955) stated that seeding failures were common on salt-desert shrub lands. Hull (1962) found that grasses and shrubs did not grow in the greenhouse in shadscale subsoil which had 1.4 to 2.2 percent soluble salts and 38 to 72 percent exchangeable sodium. For the present, areas with high salt or sodium should be avoided in seeding.

Season of seeding

Most of the seedings were made in September with good seedling emergence but poor survival. Two studies to determine the best season of seeding gave inconclusive results. Because fall has a longer and more favorable working season, it would appear to be the best time for large-scale seedings.

Precipitation

A small difference in annual or seasonal precipitation often makes for success or failure of seeded stands. The high spring precipitation on the seeded areas was favorable for grass growth, even though annual rainfall was low. Factors other than annual precipitation are important in this area. For example, Fuller Draw is between Muskrat Creek and Carter Draw with similar elevation, precipitation, and seedbed preparation. Crested wheatgrass in 1962 yielded 1,277 pounds of herbage at Fuller Draw, 511 pounds at Muskrat Creek and 355 pounds at Carter Draw, from good initial stands on all areas.

Summary

Experimental seedings with 14 species were made on 18 salt-desert shrub areas in Wyoming during 1948-50. Seeded stands were poor; but considering the aridity, salinity, and alkalinity of the soils, even a few surviving plants gave encouragement.

Russian wildrye was the best species with some stands ranging to good. Crested wheatgrass was slightly inferior to Russian wildrye. Other species either failed or were reduced to very poor stands. Seedling emergence was poor to excellent on all seedbeds but all plants died on unprepared seedbeds.

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