

# Duration of Seeded Stands on Terraced Mountain Lands, Davis County, Utah

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**Highlight:** *Thirty-seven species were seeded experimentally in northern Utah on 14 areas on depleted and terraced mountainous rangelands from 1936 to 1939. Seventeen species had fair to excellent 3-year-old stands. Most stands decreased; and in 1971 only smooth brome, tall oatgrass, intermediate wheatgrass, and red fescue have fair to excellent stands. Smooth brome spread slowly by rhizomes and usually formed a dense sod. Tall oatgrass spread by seed with a poor to good stand on ten times the original seeded area. Intermediate wheatgrass has spread by rhizomes and forms a good stand on the large plot where it was seeded in 1941. Red fescue did well on favorable sites but was not tested under typical conditions. Native grasses, forbs, shrubs, and trees have reinvaded the seeded areas.*

Davis County, in northern Utah, was much in the news from 1923 to 1930 because of floods which took six lives and caused more than \$1 million damage (Marston, 1958). The 1930 Flood Com-

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Seeding studies were initiated and conducted until 1954 by the Forest Service. At that time, responsibility for seeding research for domestic livestock on rangelands was transferred to Agr. Res. Serv. The author was formerly with the Forest Service and did much of the early work.

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mission concluded that depletion of plant cover by grazing and fire was the primary cause of flooding (Cannon et al., 1931; Bailey et al., 1934.)

From 1933 to 1939, about 1,300 acres of high-elevation flood-source lands in Davis County were contour-trenched and seeded. The earliest seedings were in 1934, when all terraces constructed during 1933 and 1934 were fall-seeded to a mixture of four cultivated grasses and to some native species gathered in the area. Beginning in 1935, terraces constructed each year were seeded to mixtures of perennial grasses and rye<sup>1</sup> in the fall of each year. Seeds were broadcast at 30 lb./acre, and the ground surface was brushed or raked to cover the seed.

All seedings produced good initial

stands, but early records are lacking. Observations in 1936 and 1937 showed poor to fair stands of smooth brome, slender wheatgrass, rye, and horsemint on these early seedings.

To determine species for seeding these depleted and terraced mountain lands, experimental seedings were made from 1936 to 1939. This is a report on the 32- to 35-year-old stands that resulted from these seedings.

## Procedures

Seeded areas were depleted and usually supported only sparse, weedy vegetation such as tarweed (*Madia glomerata*), knotweed (*Polygonum* sp.), and cone-flower (*Rudbeckia occidentalis*). Surrounding vegetation was mainly alpine fir (*Abies lasiocarpa*), aspen (*Populus tremuloides*), big sagebrush (*Artemisia tridentata*), snowberry (*Symphoricarpos oreophilus*), slender wheatgrass, columbia and letterman needlegrasses, geranium (*Geranium viscosissimum*), and other plants of minor importance.

Seeded areas ranged from 7,400 to over 9,000 ft elevation, with most being about 8,000 ft. Most areas sloped south, west, or east with some slopes over 70%. Annual precipitation is about 30 inches at the lowest seeded area and over 45 inches at the highest.

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<sup>1</sup>Scientific names of most species mentioned are listed in Table 1.

We made 14 experimental seedings from 1936 to 1939. Seedings were mostly in the Parrish, Ford, Davis, Steed, and Farmington Creek drainages. Seeded areas had been terraced as described by Bailey and Croft (1937). Plots are irregularly shaped along the contour terraces. They extend up and down the slope from the crest of one terrace to the crest of the next. This width varies from 12 to 50 ft and averages about 25 ft. Along the slope, plots occupy part of or all the length of a single terrace. Plot length varies from 20 to 280 ft and averages about 100 ft. The amount of seed sown was adjusted to the size of the plot.

Thirty-seven species were tested, with 4 to 20 species in each of 14 studies. Seeding rate was at 12 to 20 lb./acre for species such as smooth brome and tall oatgrass. Rates for smaller seeded species

were reduced about 25%. Mountain brome was seeded at 15 to 25 and rye at 20 to 40 lb./acre. There were from one to three replications of each species within each study. Table 1 lists species used with the number of plots of each.

We seeded some study areas in the spring and some in early or late fall. Spring seedings were made in May or June, just as snow melted from the area. This often necessitated using horses to get to areas when roads were still covered with snowdrifts. Early fall seedings were made in late August or early September; late fall seedings occurred in October. In three areas we seeded in early fall, late fall, and in the spring; in one area we seeded in early fall and in the spring. As stands for each season of seeding were similar, they are averaged for each of the four studies.

Seeds were broadcast by hand on the loose soil of the newly-constructed terraces or, in the case of spring seeding, on terraces constructed the previous summer. Seed was covered by raking with garden rakes. On hard soil or on undisturbed soil between the terraces, rake-like hand diggers were used to loosen the soil and cover the seeds.

For 3 to 5 years following seeding, notes were made on seeding success, and the stands were rated. Ratings were again made in 1966 and 1971. Ratings range from 10 to 0, with 10 being a full stand of seeded grass. In 1938 we obtained yields by clipping the grass mixture on 36 1-ft<sup>2</sup> samples per area. In 1971 we clipped ten 4.8-ft<sup>2</sup> samples of each seeded or native grass sampled on each area. In both years the samples were from areas judged to have a good stand of grass.

Table 1. Species seeded, number of areas and plots, and ratings of 37 species about 3 years after seeding and in 1971. Davis County. Ratings are 10 to 0 with 10 being a full stand of grass.

Species	Areas seeded	Number of plots	Average ratings	
			1938-43	1971
GRASSES				
Bluegrass, Canada ( <i>Poa compressa</i> )	4	10	1.2	.2
Bluegrass, bulbous ( <i>Poa bulbosa</i> )	4	10	.3	0
Bluegrass, Kentucky ( <i>Poa pratensis</i> )	4	10	3.2	.3
Brome, mountain ( <i>Bromus carinatus</i> )	11	31	4.7	.1 <sup>a</sup>
Brome, smooth ( <i>Bromus inermis</i> )	13	37	5.0	5.2
Canarygrass, reed ( <i>Phalaris arundinacea</i> )	7	16	4.1	.6
Fescue, meadow ( <i>Festuca elatior</i> )	7	16	4.0	0
Fescue, red ( <i>Festuca rubra</i> )	2	3	3.7	8.3
Fescue, sheep ( <i>Festuca ovina</i> )	8	19	4.0	.2
Fescue, spike ( <i>Hesperochloa kingii</i> )	2	4	4.3	1.3
Needlegrass, Columbia ( <i>Stipa columbiana</i> )	3	10	5.3	1.0 <sup>a</sup>
Needlegrass, letterman ( <i>Stipa lettermanni</i> )	2	4	6.5	1.0 <sup>a</sup>
Oatgrass, tall ( <i>Arrhenatherum elatius</i> )	12	32	4.2	4.4
Orchardgrass ( <i>Dactylis glomerata</i> )	5	15	3.1	.7
Redtop ( <i>Agrostis alba</i> )	4	10	6.7	.2
Rye ( <i>Secale cereale</i> )	6	14	4.0	0
Ryegrass, perennial ( <i>Lolium perenne</i> )	7	16	2.3	0
Timothy ( <i>Phleum pratense</i> )	5	13	5.2	.5
Wheatgrass, bearded ( <i>Agropyron subsecundum</i> )	3	10	2.4	0
Wheatgrass, bluebunch and beardless ( <i>Agropyron spicatum</i> and <i>A. inerme</i> )	2	8	1.4	.1
Wheatgrass, crested ( <i>Agropyron desertorum</i> )	8	24	3.6	.7
Wheatgrass, slender ( <i>Agropyron trachycaulum</i> )	12	34	5.6	1.0 <sup>a</sup>
Wheatgrass, western ( <i>Agropyron smithii</i> )	7	17	2.6	.1
Wildrye, blue ( <i>Elymus glaucus</i> )	3	10	5.0	0
Wildrye, Canada ( <i>Elymus canadensis</i> )	2	8	3.9	0
LEGUMES				
Alfalfa ( <i>Medicago sativa</i> )	6	14	1.7	0
Clover, white ( <i>Trifolium repens</i> )	3	9	0	0
Lupine, ornate ( <i>Lupinus ornatus</i> )	1	2	.5	0
Lupine, tailcup ( <i>L. caudatus</i> )	1	2	2.5	0
Sweetclover, white ( <i>Melilotus alba</i> )	1	2	0	0
Sweetclover, yellow ( <i>M. officinalis</i> )	3	10	3.3	.3
FORBS				
Goldeneye, showy ( <i>Viguiera multiflora</i> )	2	4	3.8	0
Groundsel, butterweed ( <i>Senecio serra</i> )	1	2	0	0
Horsemint ( <i>Agastache urticifolia</i> )	2	4	6.8	.1
Ligusticum, Porter ( <i>Ligusticum porteri</i> )	1	2	4.0	0
Sunflower, little ( <i>Helianthella uniflora</i> )	1	2	2.5	0
Yarrow, western ( <i>Achillea, lanulosa</i> )	2	4	7.0	.8

<sup>a</sup>Probably native.

## Results

The loose soil provided seed covering, and good seedling stands followed most seedings. Seventeen of the 37 species had stands which rated 4 (fair) or better 3 years after seeding (Table 1). Stands of most species deteriorated over the 32 to 35-year period, and by 1971 only three species (smooth brome, tall oatgrass, and red fescue) had stands which exceeded 4. From 1939 to 1971, stands of smooth brome on 37 plots increased on 16, decreased on 12, and remained the same on nine plots. On 32 plots, tall oatgrass increased on 11, decreased on 15, and remained the same on six. Red fescue increased on all three plots. However, fescue plots were on partially-shaded, moist, favorable sites and were not typical of the seeded areas.

Intermediate wheatgrass (*Agropyron intermedium*) was seeded in 1941 in a larger planting adjacent to experimental seedings in Farmington Canyon. This species has spread rapidly by rhizomes and has a good stand of vigorous plants over the seeded area. Seedings in other areas show that this grass is well adapted to many mountainous ranges. Reed canarygrass failed on dry sites, but it produced dense stands and spread in gullies and moist places wherever it was seeded. This species should be considered for seeding such sites.

The growth habits and spread of smooth brome and tall oatgrass are different. Smooth brome has spread slowly, mainly by rhizomes, and has formed a good sod to the exclusion of most other species. On harsh sites, the sod is often interrupted. Seldom has brome spread to double the original seeded area. The low

brome ratings resulted when brome occupied only part of the plot but was averaged over the entire plot.

Tall oatgrass has spread widely by seed. Adjacent plots often have heavier stands than the seeded plots. In two studies on the Davis Creek watershed, tall oatgrass was seeded on six of 120 plots. It now occupies 60 plots with an average rating of 5.6. It also occurs in smaller amounts on 30 additional plots. Its spread is most rapid on disturbed areas; however, it is growing well on some areas with good stands of big sagebrush and other native vegetation.

In general, the best seedling stands were in the bottom of the terrace trenches. Next best were stands on the loose soil of the fill, followed by stands on the cut. If melting snows or spring rains filled the trenches for extended periods, the young seedlings in the bottom of the furrow were killed, and spotty stands resulted. As plants matured, they were able to withstand flooding. After 32 years the best seeded and naturally revegetated stands are in the furrow, the fill, and the cut in the order named. However, species have spread and there are often good stands on the undisturbed area between terraces.

In 1938 the 1-, 2-, 3-, and 4-year-old stands of seeded grass mixtures yielded 77, 294, 840, and 2,644 lb./acre, air-dry, respectively. Yields of the three most successful seeded species and the two most abundant native grasses in 1971 are shown in Table 2.

Based on these studies, smooth brome, tall oatgrass, and intermediate wheatgrass are the best species for long-time stands and have out-yielded native species. These three grasses are recommended for high elevations in Utah and Idaho by Plummer et al. (1955), Hull et al. (1962), and Hull and Holmgren (1964). The tests were not fair for slender wheatgrass because the plains strain was used. This is shortlived and does not reseed itself on these areas. Other possible adapted species, such as meadow foxtail (*Alopecurus pratensis*), were not readily available for testing when these seedings were made.

Native species have increased on all areas. Where terraces were close to aspen, the formerly closely-cropped aspen sprouts were released and aspen trees up to five inches in diameter are growing in the trenches. Dense stands of big sagebrush account for 70% of the vegetation on some areas (Fig. 1). Sagebrush does especially well on the outer terrace bank. Two needlegrasses, columbia and letter-

Table 2. Production (lb./acre air-dry) of seeded and native grasses at 4 locations on the Davis County watershed, 1971.

Species	Davis Creek	Ford Creek	Parrish Creek	Farmington Creek
Seeded				
Smooth brome	1625	2436	2170	3780
Tall oatgrass	1267	1380	1625	2132
Intermediate wheatgrass <sup>a</sup>	—	—	—	3720
Native				
Slender wheatgrass	1524	1484	1628	2179
Columbia and letterman needlegrasses	1204	924	921	1297

<sup>a</sup>Seeded in 1941 adjacent to experimental studies.



Fig. 1. General view of experimental seeding on the Davis Creek watershed. When terraced and seeded in the fall of 1936 and the spring of 1937, this area supported a sparse stand of perennial and annual weeds. Big sagebrush is now the dominant species. Smooth brome has an average rating of 8.7 and tall oatgrass 8.3 on three plots of each. Tall oatgrass has spread to 37 of the 60 plots on this site. The town of Bountiful is left center.



Fig. 2. This site had only scattered annual weeds when it was terraced and seeded in the fall of 1936. Native and seeded species, especially columbia needlegrass, are growing so well that it is difficult to see the terrace trench in the center of the photo.

man, are present on all areas and sometimes comprise 50% of the vegetation (Fig. 2). Native slender wheatgrass and a great variety of perennial forbs are abundant on most areas. The estimated average percent cover of all native species on seeded areas follows:

Species	% Cover
Forbes, including sedges and rushes	30
Sagebrush	22
Other shrubs, mainly snowberry	4
Needlegrasses	21
Other grasses, mainly slender wheatgrass	20
Trees, aspen, and chokecherry	3

Where seedings failed and native species did not reinvade terraced areas, there is considerable tarweed, knotweed, and other annuals. In such areas the terraces are partially filled and the outer banks are reduced in height by soil sloughing. Good stands of seeded and native vegetation have helped hold the soil and prevent filling of trenches or breakdown of the outer banks. With good stands, the gullies are healing, and there has been no disastrous runoff from these areas since they were terraced and seeded over 30 year ago (Fig 3). Some larger gullies which could not be treated now have good stands of reed canarygrass and smooth brome. These two rhizomatous seeded species along with native species are helping to stabilize these gullies.

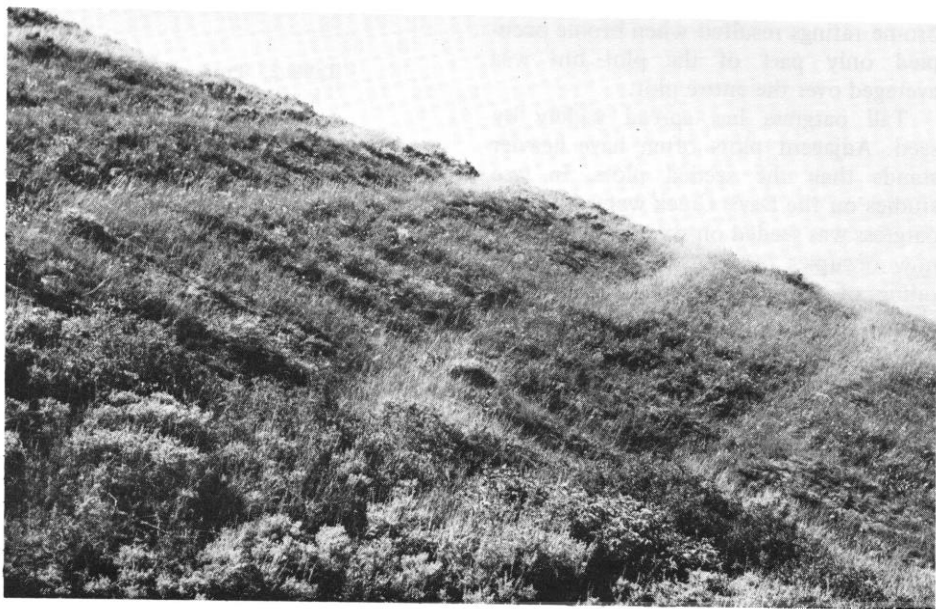


Fig. 3. Gullies from the 1923-30 floods may still be seen in this experimental seeding on the Davis Creek drainage. This site was raw and bare with no vegetation when it was terraced and seeded in fall, 1936, and spring, 1937. A good stand of smooth brome and tall oatgrass with some native species are holding the soil, and there has been no appreciable soil erosion since 1936. Photographed in 1971.

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