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Cultural Methods and Their Relation to Establishment of Native and Exotic Grasses in Range Seedings[1]

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Others have developed criteria for determining the need and the suitability for reseeding range lands based upon range condition, land capability factors, and economics. This paper treats with methods for re-establishment of range forage species by seeding. It has particular application to the lands of the Snake River plains, specifically on Sierozem soils. The work was done at Aberdeen, Idaho where average rainfall is 8.8 inches but varies widely among years as shown in Table 1. A gradual decline in annual precipitation was encountered during the time that most of the data discussed in this paper were taken. Elevation is approximately 4,500 feet.

Table 1. September-August precipitation, Aberdeen, Idaho

Year	Inches
1947-48	9.24
1948-49	8.69
1949-50	7.69
1950-51	7.25
1951-52	6.50
1952-53	5.90
1953-54	6.54
1954-55	6.19
1913-1950 average	8.79

The soil was mapped as Portneuf fine sandy loam. It was farmed during World War I, abandoned shortly thereafter, and then grazed as spring-fall sheep range. The land had been severely eroded by wind and water during the period of cultivation. It is typical of large areas in the Snake River plains.

The principal vegetation at the beginning of these trials was cheatgrass *(Bromus tectorum)*, with invasions of big sage brush *(Artemisia tridentata)*, squirreltail *(Sitanion hystrix)*, and rabbitbrush *(Chrysothamnus nauseosus)* from the unplowed roadsides. Some residual patches of streambank wheatgrass *(Agropyron riparium)* survived the period of cultivation.

Procedures

Based upon results and experiences gained in earlier work reported by Stark, *et al.*[2] these trials were designed with the following objectives: (1) to determine the effect of five land preparation methods, (2) to compare methods of planting, (3) to compare times of seeding, and (4) to determine the effect of the age of the stand on yield. These factors affect establishment, development, and production of grass stands. Plantings were made in each of five successive years to sample the effect of climate, one of the principal limiting factors. Comparisons were made among several species and varieties of grass with standard cultural methods.

Two basic mixtures were used in all trials except in those comparing species and varieties. One, which will be referred to as the "crested mixture," contained standard crested wheatgrass *(Agropyron desertorum)*, streambank wheatgrass *(A. riparium)*, and Sandberg bluegrass *(Poa secunda)*. The other, referred to as the "Whitmar mixture," contained Whitmar wheatgrass *(A. inerme)*, streambank wheatgrass, and Sandberg bluegrass. Standard field equipment was used in all cases. All plots were one-seventh acre in size.

Plantings were made in the fall and the following spring of each year. Harvests were made annually beginning with the third season following planting. Basal density data by species were recorded from ten quadrats within each plot. Each quadrat was marked and later harvested by hand and the vegetation was separated into component parts.

Land Preparation Methods

The principal purposes of land preparation for making seedings

[1] *Based on a presentation at the annual meeting of the American Society of Range Management in Phoenix, Arizona, January 1958.*

[2] *R. H. Stark, J. L. Toevs, and A. L. Hafenrichter. 1946. Grasses and cultural methods for reseeding abandoned farm lands in southern Idaho. Idaho Agric. Expt. Sta. Bull. 267. pp. 36.*

were to remove the weedy grasses and brush, create a favorable medium for the establishment of plants, and facilitate the use of seeding equipment. Methods of land preparation varied from simple to intensive. The more intensive land preparation methods gave several advantages: (1) greater reduction of competing weedy plants and the quicker establishment of planted grasses, (2) lengthening of the safe seeding season, (3) reducing the time required by the planted forage species to reach grazing readiness, (4) postponement of reinvasion by undesirable weeds, and (5) greater choice of grasses for reseeding.

Several methods, "summer fallow," "early burn," "late burn," "cultivated," and "no treatment" were used for preparing the land. The principal objective of the "summer fallow" operation was to eliminate competing plants. The tillage operations, whether with plow, sweeps, or oneway, were timed to kill the cheatgrass at late-boot or early heading stage, about the third week in May. This was early enough to prevent seed formation by the cheatgrass but late enough that most of the soil moisture had been removed to prevent the growth of summer weeds. No further weed killing operations were necessary in this winter-wet and summer-dry climate.

For the "early burn" treatment cheatgrass was permitted to come to the "red" stage and then burned, usually about mid-June. Some regrowth occurred on rabbitbrush and perennial grasses following the burn. In some instances the fire was not hot enough to kill the green and growing big sagebrush. The "late burn" was made in September after cheatgrass seed had dropped.

The "cultivated" land treatment was once-over with a tandem disk. The "no treatment" land was seeded directly without any tillage or burning. A deep-furrow press drill was used to make all seedings where land preparation methods were compared.

The intensity of land preparation influenced the date the stand reached sufficient production to permit grazing. Table 3 illustrates this rate of development for the "crested mixture" when fall planted with the deep-furrow press drill.

Table 2. The effect of method of land preparation on the basal density of squirreltail (*Sitanion hystrix*) and of planted perennial grasses.

Method of land preparation	Basal Density in Percent			
	Crested Mixture		Whitmar Mixture	
	Planted grass	Squirrel-tail	Planted grass	Squirrel-tail
None	.85	1.63	.36	2.13
Early burn	1.35	1.50	.31	1.51
Late burn	2.16	1.24	.62	1.44
Disked	3.07	.18	1.65	.86
Fallow	3.58	.44	1.99	.76

The data given in Table 2 are typical of the results obtained with land preparation methods in this study. They show how the basal densities of planted grasses and of common competitive weedy grasses were influenced by land preparation. The dominant planted grasses were crested wheatgrass and Whitmar wheatgrass. The stands had reached full production at the time of basal density readings. The more intensive land preparation methods, plowing and fallowing or disking in the fall, reduced the competing squirreltail and allowed full development of the planted grass. Burning reduced the squirreltail slightly.

Basal density of the squirreltail as influenced by method of land preparation was also negatively correlated with the yield of planted grass. The value for "r" was -.648(n=8). The basal density of all annual weeds taken together was not correlated with either the density or the yield of planted grass.

These assumptions were made: (1) a seeding is ready for grazing use during the growing season when production of the planted perennials exceeds 300 pounds per acre, and (2) under grazing use, at least 300 pounds of stubble per acre are required for erosion control and to maintain plant vigor. Using these criteria, the plantings made on fallow were ready for light use by the end of the second growing season. Those planted with no land preparation were not ready for use until the fifth growing season.

Several factors must be taken into account when choosing a method for preparing an area for seeding. The more common ones are those inherent with the land and the soil, such as susceptibility to erosion by water or wind, slope, salinity, stoniness, texture, depth, and profile. The kinds of vegetation that predominate on

Table 3. Herbage production of the "crested mixture" by method of land preparation and age of stand.

Method of land preparation	Age of stand—years from planting				
	3	4	5	6	7
	(Pounds per acre)				
Fallow	572	891	938	873	788
Disked	224	418	580	658	1190
Burned	194	328	465	682	913
No cultivation	81	235	326	443	708

the areas to be seeded are as important as the land factors. The presence of perennial fire-tolerant vegetation requires the more intensive types of land preparation. The plants in this group that have given the greatest competition to seeded grass are rabbitbrush, squirreltail, streambank wheatgrass, and Sandberg bluegrass. Wherever these plants occurred, singly or in combination, seedings were successful only to the degree that they were eliminated by land preparation. Rabbitbrush was not a serious problem in this study.

Methods of Planting

The effects of five methods of planting on production are shown in Table 4. All plantings were made in the fall on land that was prepared by the fallow method. Fall plantings were made as soon after September 15 as soil moisture conditions justified. In three of five years, plantings were made in early October. In two years, plantings were delayed until late October and finally made in dry soil. The first three methods of planting used were: broadcasting, double-disk drilling, and deep-furrow press drilling. Broadcasting was done with a hand-operated broadcast seeder followed by harrowing with a spike-tooth harrow. The double-disk drill was a standard grain drill with 6-inch spacing. The deep-furrow press drill was a single-disk type with 14-inch spacing and standard press wheels.

Two additional methods of planting were used which are adaptable to arable land. These were (1) drilling the grass in alternate rows with wheat, and (2) planting the grass into wheat stubble without land preparation. For planting in alternate rows, a fallow such as would be suitable for the production of winter wheat was prepared. A standard 6-inch double-disk drill was used with a divider in the drill box so that wheat and grass were planted through alternate feeds. Spring pressure was released from the openers planting grass and the grain was seeded at one-half the normal rate.

The data in Table 4 show that drilling was superior to broadcasting, both in the rate of development of stands and in total annual production. Deep-furrow drilling was slightly superior to seeding with a double-disk drill. Drilling produced more uniform stands each year and better stands among years than did broadcasting. Planting grass in alternate rows with winter wheat gave yields slightly, but not significantly, superior to the best method of drilling without a companion crop. The wheat apparently provided less competition to the grass during the establishment year than did volunteer annual grasses where no companion crop was used. Volunteer grasses and weeds were never prominent in the alternate-row seedings. When rye was used for making alternate-row seedings, poor results were obtained. Drilling into wheat stubble gave good stands, but the rate of development of the plants was greatly retarded. Both seeding in alternate rows with wheat and into stubble provided protection against wind erosion.

Table 4. Herbage production of the "crested mixture" by planting method, fall planted on fallow.

Method of Planting	Age of stand—years from planting				
	3	4	5	6	7
	(Pounds per acre)				
Broadcast	284	564	745	767	758
Double-disk	524	730	818	835	765
Deep-furrow	572	891	938	873	788
Alt. row with grain	581	810	836	1081	849
Seeded in stubble	168	299	464	647	576

Table 5. Average yield of two mixtures planted fall and spring with a deep-furrow press drill by methods of land preparation.

Time of planting	Land Preparation				
	Fallow	Early burn	Late burn	Cultivated	Non-cultivated
	(Pounds per acre)				
Fall planted	543	446	424	552	320
Spring planted	432	200	193	406	138

Time of Seeding

Fall planting was more dependable for establishing stands than spring planting. The detailed data showed no complete failures with the "crested mixture," but one year the "Whitmar mixture" failed to establish from fall seeding. Spring plantings have been erratic, ranging from high density, vigor, and production to a relatively high proportion of failures. Planting on fallow reduced the incidence of failure from spring planting, while failures were frequent with other methods of land preparation. Table 5 summarizes the comparative production from fall and spring plantings.

Species Comparisons

Detailed comparisons were made between standard crested wheatgrass and Whitmar wheatgrass. Both are adapted to this low-rainfall area but differ in ease and rate of establishment. As indicated in Table 6, crested wheatgrass attained sufficient growth to permit grazing one to three years earlier than Whitmar. As stands became older, Whitmar and bluebunch wheatgrasses equalled or exceeded

crested wheatgrass in production. In this table the older stands were on an adjacent and similar piece of land and were maintained from plantings begun in 1939. They were used for comparison with the detailed data reported from the present study that was begun in 1947.

Whitmar and bluebunch wheatgrasses were similar, particularly in rate of establishment and production potential on this site. Differences in the table between these two grasses were in age, not species.

More important than yield are the differences in use and management of the two grasses. Crested is adapted to early spring and late fall grazing. Whitmar and bluebunch are adapted to late spring, summer, fall, and winter use and stay green about 2 weeks longer into the summer than does crested wheatgrass. On the individual ranch, forage needs by season will influence the choice of grass for reseeding, as well as will soil and climatic factors.

Another interesting comparison, although not in such detail, can be made between the plantings for which the data are shown in Table 7. These were planted in each of five successive years. Siberian wheatgrass *(Agropyron sibiricum)* was similar to standard crested wheatgrass in adaptation and season of use but differed in several important respects. It was more drought resistant, had better seedling vigor, and was more productive than crested on the lighter soils and on the lower rainfall sites. Siberian showed superior forage characteristics: awnless heads, finer stems, more leaves, and it stayed green 10 to 14 days longer into the season than crested wheatgrass. Siberian wheatgrass has maintained this production advantage over crested wheatgrass in a 15-year-old stand. Fairway crested wheatgrass *(A. cristatum)* consistently produced less forage than the other two but made a more uniform ground cover and reseeded more readily. Ladak alfalfa was satisfactorily established in three of the five years from fall planting. Grasshoppers and rodents grazed it closely in the early years. The data suggest that alfalfa in a range seeding may have stimulated the vigor and production of the grass.

Table 7. Herbage production of three wheatgrasses and an alfalfa-grass mixture, fall planted on fallow with double-disk drill, 1947-1951.

Species	Age of stand—years from planting					
	3	4	5	6	7	Average
	(Pounds per acre)					
Fairway crested	656	671	730	994	756	761
Standard crested	443	779	859	1142	969	838
Siberian wheatgrass	808	1012	902	909	1114	949
Standard crested & alfalfa	531	947	1030	1333	1266	1021

Other Species Comparisons

A number of other species were tested, but none is as well adapted to the conditions of this trial as those already discussed. Sherman big bluegrass *(Poa ampla)* was earlier in season of use than crested, Siberian, or Whitmar wheatgrass and just as productive, but in these trials it was more difficult to establish. Livestock men have shown a definite interest in this member of the vernal dominant grass group, and under less rigorous climatic conditions Sherman makes a valuable contribution as very early feed. Russian wildrye *(Elymus junceus)* established as readily as crested wheatgrass, but under this low rainfall production per acre was low. This grass is recognized for its high quality feed at any season of the year, and this factor must be considered when making comparisons. Other field plantings have indicated that at higher elevations with summer rainfall, Russian wildrye is a definite adjunct to planned summer-long grazing. It is singular among the grasses west of the Continental Divide in this respect.

Considering the late-maturing grasses, tall wheatgrass *(Agropyron elongatum)* established satisfactorily but developed more slowly than crested. It was especially valuable in the sequence of species, producing green and usable forage in midsummer. However, under the conditions of soil and climate in this trial, tall wheatgrass was short-lived. In the older plantings, established stands died from the center of the crown and disappeared in 10 to 15 years.

Establishment of intermediate wheatgrass *(A. intermedium)* and pubescent wheatgrass *(A. trichophorum)* was erratic and production was low. The land capability conditions where these

Table 6. Herbage production by two mixtures, crested wheatgrass, and bluebunch wheatgrass fall planted on fallow with a deep-furrow press drill as influenced by age of stand.

Species	Age of stand—years from planting								
	3	4	5	6	7	10	11	12	13
	(Pounds per acre)								
Crested mix	572	891	938	873	788				
Whitmar mix	76	176	339	466	631				
Crested wheatgrass						400	626	891	923
Bluebunch wheatgrass						479	814	1009	1277

trials were conducted were too stringent for these species.

Mixtures

The use of two mixtures in the cultural phases of these trials was an attempt to reconstitute the grass phase of the prairie association. Each mixture contained a dominant bunch wheatgrass, sod-forming streambank wheatgrass, and vernal dominant Sandberg bluegrass. In these trials excellent ground cover and species balance was maintained in the absence of grazing. However, observations made on field plantings under grazing indicated that exceptionally good management would be needed to maintain a balance, otherwise streambank wheatgrass would tend to become dominant. The bunchgrass-vernal dominant association maintains ground cover and balance under good grazing management. Other grasses tested for understory use were not suitable for one reason or another.

Summary

In summary, the choice of land preparation methods for reseeding range lands depended, to a considerable degree, upon the kind and amount of vegetation on the land. Summer fallow was the best method, especially if weedy, fire-tolerant perennials were abundant. Burning was effective if big sagebrush and cheatgrass were the only plants present, but disking just before planting was more effective than burning. Planting directly into unprepared land gave the poorest stands and slowest development.

Five methods of planting were compared on summer fallow. The deep-furrow drill gave best results, broadcasting was poorest, and seeding with a double-disk drill gave intermediate results. Planting the grass in alternate rows with winter wheat resulted in good establishment. When this method was used erosion and weeds were never serious. Seedings made in grain stubble with a deep-furrow drill consistently made good stands, but they developed slowly.

Fall plantings produced better stands and higher yields than spring plantings. Spring plantings were variable but presented possibilities on higher capability land and with the more intensive land preparation methods.

Crested wheatgrass established easier and faster than Whitmar wheatgrass or bluebunch wheatgrass and reached grazing readiness one or two years earlier. As the stands reached maturity, Whitmar and bluebunch wheatgrass first equalled, then exceeded production of crested. Crested provided spring-fall use and Whitmar and bluebunch late-spring, summer, fall, or winter grazing. Thus they supplement each other.

Siberian wheatgrass established more rapidly and outproduced standard and Fairway crested wheatgrasses. Siberian had more desirable forage characteristics and stayed green about 10 days later into the season. Ladak alfalfa planted with grass was established in good years and had recognized value in the mixture.

Sherman big bluegrass was even earlier than crested for seasonal grazing readiness but more difficult to establish. Russian wildrye was established easily and contributed to lengthening the grazing season with high quality feed, but the production of dry matter was low. Tall wheatgrass established well but was short-lived under the low rainfall conditions of these studies. Pubescent and intermediate wheatgrasses were erratic in establishment and production. They were below their range of adaptation.

Mixtures containing understory grasses have recognized advantage for soil and water conservation on range lands, but exceptional management is needed to maintain the balance of species.

The choice of a species depends upon the seasonal feed requirements of the ranch operation, the soil and climatic resources, and the grazing management plan for the ranch.

Summer Meeting In South Dakota

Make your plans now to attend the Society's summer meeting at Custer, South Dakota, July 21, 22, and 23. Directors meet on the 21st. Full program and meeting details later.