New methods improve.

SHORTGRASS RANGE

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Summary and Conclusions

Replicated pastures at the Archer Substation near Cheyenne, Wyoming, were treated with a range seeder developed at the University of Wyoming and with a sod drill. Treatments were applied in the spring of 1955 and the pastures were grazed from August 18 to September 22 of the same year.

2.2 pounds of Standard crested wheatgrass, \( \frac{1}{2} \) pound of Ladak alfalfa, and 20 pounds of N in the form of ammonium nitrate was applied at seeding time on pastures treated with the range seeder. On the pastures treated with a sod drill, 6.3 pounds of Standard crested wheatgrass, 2.3 pounds of alfalfa, and 60 pounds of N were used per acre.

Initial stand and survival, as measured by stand counts on permanently marked plots in both 1955 and 1956, were significantly greater on pastures treated with the range seeder than on those treated with the sod drill. Significant differences in stands were found among the designated topographic sites for both treatments. Generally, the poorest stands were obtained on the sloping sites and the best stands on the dry bottomland.

The first complete season of grazing occurred in 1956. Gains per head and per acre for both ewes and lambs were greater from pastures treated with the range seeder than from those treated with the sod drill or from non-treated moderately grazed checks.

Blue grama grass and western wheatgrass measured on the ordinary upland site showed greater leaf height on treated pastures than on non-treated check pastures. This may be due to the added nitrogen or renovation of the treated pastures or to a combination of these two factors.

Small plots treated with these two implements near Laramie, Wyoming, were studied to determine forage yield and stand of introduced species.

Those plots treated with the range seeder yielded more forage and produced a much better stand than non-treated or those treated with a sod drill.

The treatment of certain types of range land with the Wyoming range seeder, which tills two strips of land about 18 inches wide, leaving 22 inches of undisturbed range between strips, and plants and fertilizes in one operation, appears to be a promising method of increasing grazing capacity and pounds of meat. This treatment may be particularly applicable to the shortgrass range of the Great Plains, where the introduction of legumes and cool-season grass species would contribute to the summer grazing and possibly extend the grazing season in both spring and fall.

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New Methods to Improve Shortgrass Range

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Higher productivity from western range land is important to the economic welfare of the western ranchers because many fixed costs in ranching will be nearly the same whether productivity is great or small. Yield of native range in some areas of the West can be increased by the seeding of more productive grasses, such as crested wheatgrass, and legumes wherever feasible. It would help materially if low-cost seeding methods could introduce species into range land without complete seedbed preparation. Lack of such methods has been a serious drawback. Range pitting has resulted in increasing production from the native species, but attempts to introduce species along with pitting have not been successful on the shortgrass plains.

To fulfill such requirements, a till- and seeding machine has been developed at the Wyoming Experiment Station. This machine tills two strips approximately 18 inches wide, leaving

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FIG. 1—Front view of the Wyoming range seeder.

1Contribution from the Wyoming Agricultural Experiment Station and the U. S. Department of Agriculture, Agricultural Research Service.

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22 inches of undisturbed range between strips. It will also apply fertilizer and plant both grass and legumes in range land in one operation. Figures 1 and 2 show a front and rear view of the machine. (Wyoming Agricultural Experiment Station Circular 62, “Wyoming Range Seeder”, describes its mechanical features.)

The machine performed mechanically in a satisfactory manner under a wide variety of conditions such as open shortgrass range land and stands of sagebrush up to 2 ft. high. Mechanical breakage was experienced only when operating on very rocky soils.

**Experimental Procedure**

In the spring of 1955, the Wyoming range seeder was used to treat two 11.25-acre pastures at the Archer Substation east of Cheyenne at approximate right angles to the slope. (Fig. 3). Standard crested wheatgrass and Ladak alfalfa were planted at the rate of 2.2 and ½ pounds per acre respectively. Twenty pounds per acre of N in the form of ammonium nitrate was applied at seeding time. The cost of gasoline, seed, and repairs was estimated to be about $1.50 per acre, and the total cost, exclusive of fertilizer, when the cost of labor and ownership of the tractor and machine was included, was estimated to be just over $3.00.
FIG. 3—A pasture at the Archer, Wyoming, Substation being treated with the range seeder in the spring of 1955. (See Figure 6 for a picture of the area three months later and Figure 7 for a picture of the area in 1957.)

FIG. 4—One of the Archer, Wyoming, Substation pastures in the process of being treated with a sod drill.
At the same time one 11.25-acre pasture and one 15-acre pasture were treated, also at right angles to the slope, with a sod drill (Fig. 4) at the rate of 6.3 pounds of crested wheatgrass, 2.3 pounds of Ladak alfalfa, and 60 pounds of N per acre. Machine costs of this treatment were estimated to be about the same as for the range seeder, but seed costs were higher because of the higher seeding rate.

Five sites, delineated on the basis of topography, were involved in each pasture. Site 1 was upland with a very slight slope to the north; it occupied about 16 percent of the pasture area. Site 2 was an abrupt north-facing slope occupying approximately 20 percent; Site 3, a dry bottomland covering about 13 percent. Site 4 was a south-facing slope accounting for nearly 14 percent, and Site 5, the largest in the pastures, occupying about 37 percent of the total area, was characterized as upland with a slight slope to the south (see Fig. 5).

A soil survey of the pastures showed that the soils of sites 1, 3, and 5 were similar—a grayish-brown to dark grayish-brown friable, very fine sandy loam of medium to fine-crumb structure containing up to 5 percent gravel with a pH of about 6.5. Likewise, the soils of sites 2 and 4 were similar and...
described as brown to pale-brown fine sandy loam with weak crumb structure and a tendency to prismatic breakage. A few streaks of weakly calcareous material were present in this soil.

Composition of the native vegetation on sites 1 and 5 was predominantly blue grama grass (*Bouteloua gracilis*). There was some western wheatgrass (*Agropyron smithii*) present at both locations, but this species was much more abundant on site 5 than on site 1. Many other species such as Sandberg bluegrass (*Poa secunda*), false mallow (*Sphaeralcea coccinea*), and fringed sagebrush (*Artemisia tridentata*) were present in small amounts on all sites in the pastures.

Western wheatgrass was very abundant on site 2 but did not equal blue grama grass. On site 3, however, western wheatgrass was the dominant species in abundance, and blue grama grass contributed only a minor part of the total vegetational composition.

Needleandthreadgrass (*Stipa comata*) was the dominant grass species encountered on site 4, the south-facing slope. Western wheatgrass was present as was blue grama grass, but neither made up a large proportion of the total vegetation.

Buffalograss (*Buchloë dactyloides*)

FIG. 6—Pasture treated with the range seeder at the Archer Substation, showing rows of crested wheatgrass and alfalfa. Photographed in June 1955.
was present in small quantities on all sites except the south-facing slope.

Shortly after pasture treatment, five plots 80 x 80 in. in size were randomly located on each topographic site within each pasture, to study seedling emergence and establishment. These plots were permanently marked so that stand counts could be made of identical areas in succeeding years. Stand counts of crested wheatgrass and alfalfa were made in early August of 1955 and in the spring of 1956 just before the animals were admitted to graze (Fig. 6).

By August 18, 1955, the seedling of alfalfa and the crested wheatgrass were judged to be well enough established to permit grazing. Ewes and heavy lambs grazed all treated pastures until September 22.

In 1956 the experimental pastures were grazed from May 18 to September 19 for a total of 124 days. The experimental animals were weighed individually at beginning and close of the grazing season; gains were calculated from these weight data.

In addition to these pasture trials, small plot studies were conducted on range land near Laramie. Plots were treated both in the fall of 1954 and spring of 1955 with both the range seeder and the sod drill, both with and without nitrogen at seeding time. Stand counts of introduced species and yield data were collected from clipped plots in both of 1955 and 1956 (Fig. 7).
FIG. 8—Average number of crested wheatgrass and alfalfa plants per 100 square feet on pastures treated with the range seeder, and those treated with a sod drill.

FIG. 9—Average number of alfalfa plants per 100 square feet on five topographic sites within pastures treated with the range seeder and pastures treated with a sod drill.
Results from Pasture Trial

The first year of grazing data was obtained in 1956. The pastures treated with the range seeder and sod drill were stocked with about one-third more sheep than were the non-treated check pastures. The highest animal gains per day and per acre were from pastures treated with the range seeder. Gains per head were similar from the pastures treated with the sod drill and the non-treated, moderately grazed checks (see Table 1).

**TABLE 1—Grazing Capacity and Animal Gains from Treated and Check Pastures in 1956**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Sheep days per acre</th>
<th>Pounds of gain per head</th>
<th>Pounds of gain per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ewes</td>
<td>Lambs</td>
</tr>
<tr>
<td>Range seeder</td>
<td>66.1</td>
<td>31.2</td>
<td>62.9</td>
</tr>
<tr>
<td>Sod drill</td>
<td>66.1</td>
<td>25.5</td>
<td>55.3</td>
</tr>
<tr>
<td>Moderately grazed non-treated check</td>
<td>47.7</td>
<td>21.0</td>
<td>55.3</td>
</tr>
</tbody>
</table>

Initial stands of both crested wheatgrass and alfalfa were greater on pastures treated with the range seeder than those treated with the sod drill; height of individual plants was also greater. Random measurements taken on August 15, 1955, showed alfalfa plants measuring 8 to 10 in. in height and crested wheatgrass with flowering stalks 8 in. high on pastures treated with the range seeder as compared with 3 in. and 1 1/2 to 2 in. respectively on pastures treated with the sod drill.

Stand counts made in 1955 and on the same plots in 1956 showed an average of 107.16 crested wheatgrass plants and 160.59 alfalfa plants per 100 sq. ft. in 1955 on pastures treated with the range seeder. This count had dropped to 86.89 crested wheatgrass plants and 127.93 alfalfa plants per 100 sq. ft. in 1956. This may be compared with the pastures treated with the sod drill, which had an average of 17.75 and 21.17 crested wheatgrass plants and 119.59 and 49.32 alfalfa plants per 100 sq. ft. in 1955 and 1956, respectively. These data are presented graphically in Figure 8; the differences were statistically significant at the 1 percent level.

The stands of both crested wheatgrass and alfalfa varied with the topographic sites in both treatments. It may be noted from Figures 9 and 10 that the best stands of both seeded species were on site 3, the dry bottomland. Sites 2 and 4, the slopes, had generally the poorest initial stands.

When these data were analyzed by the analysis of variance, the differences between sites were significant at the 1 percent level. The interaction of treatments and sites was non-significant for alfalfa and barely significant at the 5 percent level for crested wheatgrass. The interaction of sites and years was non-significant for crested wheatgrass and barely significant at the 5 percent level for alfalfa.

Random leaf-height measurements were made for two native species, (blue grama and western wheatgrass) on site 1, and for one native species (needleandthreadgrass) on site 4. These measurements were taken on
plants about midway between the tilled rows on the pastures treated with the range seeder and sod drill, and strictly at random within a site on the check pastures.

There was very little difference in leaf height within a species between pastures treated with the range seeder and those treated with a sod drill. However, when the treated pastures were compared with the check, considerable difference was noted for those species measured on site 1. The leaf height of blue grama grass averaged 2.51 and the western wheatgrass averaged 8.40 in. on treated pastures compared with 1.86 and 7.68 in. on the check pastures. Leaf height of needleandthreadgrass was similar on both the treated and the check pastures.

FIG. 10—Average number of crested wheatgrass plants per 100 square feet on five topographic sites within pastures treated with the range seeder and pastures treated with a sod drill.
Results from Small Plot Trials

Results from plot plantings made during the fall of 1954 and the spring of 1955 showed a slight but statistically non-significant yield increase in 1955 for both the range seeder and the sod-drill-treated plots. 1956 yields from the plots treated with a range seeder were higher than yield from the non-treated and the sod-drill-treated plots except where 40 pounds of nitrogen was used with the sod drill (see Table 2).

The yield of seeded species represented 41 percent of the total yield for plots treated with the range seeder with 20 pounds of nitrogen, and 22 percent without fertilizer. The yield of introduced species for plots treated with the sod drill was negligible. In the range-seeder plots, stand counts of crested wheatgrass and alfalfa showed that 100 crested wheatgrass and 4 alfalfa plants per 100 sq. ft. survived. (see Table 3).

**TABLE 2—Pounds of Forage* Produced per Acre from Small Plot Trials near Laramie, Wyoming**

<table>
<thead>
<tr>
<th>Year</th>
<th>Check</th>
<th>Mechanical treatment only</th>
<th>Seed only</th>
<th>20 lb. N and seed</th>
<th>Mechanical treatment only</th>
<th>Seed only</th>
<th>40 lb. N and seed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1955</strong></td>
<td>195.0</td>
<td>285.0</td>
<td>247.5</td>
<td>277.5</td>
<td>302.5</td>
<td>245.0</td>
<td>362.5</td>
</tr>
<tr>
<td><strong>1956</strong></td>
<td>100.0</td>
<td>220.0</td>
<td>202.5</td>
<td>230.0</td>
<td>113.8</td>
<td>100.6</td>
<td>206.9</td>
</tr>
</tbody>
</table>

*Calculated as hay at 12% moisture.
**Includes some residual vegetation from the previous year.

**TABLE 3—Number of Plants of Alfalfa and Crested Wheatgrass per 100 Square Feet on Small Plots at Laramie, Wyoming**

<table>
<thead>
<tr>
<th>Year</th>
<th>20 lb. N</th>
<th>No fertilizer</th>
<th>40 lb. N</th>
<th>No fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alfalfa</td>
<td>Crested wheatgrass</td>
<td>Alfalfa</td>
<td>Crested wheatgrass</td>
</tr>
<tr>
<td>1955</td>
<td>43</td>
<td>115</td>
<td>64</td>
<td>146</td>
</tr>
<tr>
<td>1956</td>
<td>5</td>
<td>67</td>
<td>3</td>
<td>130</td>
</tr>
</tbody>
</table>