Renovation and Fertilization of Crested Wheatgrass Stands in the Northern Great Plains

WALTER R. HOUSTON

Range Conservationist (Research), Field Crops Research Branch, Agricultural Research Service, U. S. Dept. of Agriculture, Miles City, Montana

The problem of renovating or increasing the yield of sodbound or low-producing older stands of Standard crested wheatgrass (Agropyron desertorum) has recently received increasing attention in the Northern Great Plains Region. This grass has become widely recognized as being well adapted for range reseeding in this area and over much of the western United States.

Crested wheatgrass has several attributes which have led to its wide acceptance and use. It greens up in the spring from two to four weeks earlier than native range, is drought resistant, produces well for hay and pasture, and is palatable to livestock.

Other characteristics limit its acceptability and use. It is unpalatable after maturity, summer dormant, and tends to become sodbound and low-producing in older stands.

Observations in eastern Montana have indicated a tendency for pure stands to increase in both density and production with favorable weather. Then in periods of less favorable weather, production drops rapidly—more rapidly than density—often to a point below that of newer plantings of a like density. From this it seems that possibly the drop in production with age of stand is not due to fewer plants, but to reduced vigor and size of individual plants. This phenomenon seems to be related to a large degree to depletion of nutrients available to the plants as well as to soil compaction, aeration, etc.

Because of the high value and wide use of crested wheatgrass for pasture and hay in the Northern Great Plains Region, studies have been conducted over the past decade at the U. S. Range Livestock Experiment Station, Miles City, Montana, on methods and practices that might help to overcome the decreased production in old stands.

Review of Literature

Renovation studies in Wyoming have indicated that certain mechanical treatments of native grasslands succeeded in increasing forage production from 10 to 36 percent (Barnes, et al., 1945).

A preliminary report on later renovation studies of reseeded grasslands in Wyoming (Barnes, et al., 1952) indicated that land treatments which severely disturb cover show promise of increasing forage production, but may be uneconomical for the small increase in yield obtained. Application of nitrogen fertilizer to stands of crested wheatgrass, western wheatgrass (Agropyron smithii), and Russian wildrye (Elymus junceus) increased production markedly, the greatest increase coming in those years of more favorable precipitation. In this study application of manure gave similar increases in production but had greater carryover effect into the second year. Spring applications of nitrogen or manure greatly stimulated seed production of Russian wildrye the year following application.

A twenty-year study by Heady (1952) in Montana of the effects of manuring, light renovation (disking), and heavy renovation (disking plus spring tooth harrowing) on native range indicated that all practices increased the yield of grasses, but manuring more than renovation. These treatment differences were generally apparent 12 years after the treatments had ceased. A residual effect of manuring upon plant height 12 years after treatment was evident.

Recent studies in Canada (Lodge, 1954) have indicated that mechanical disturbance of old stands of crested wheatgrass can double yield even in dry years. Here the greatest increase in yield accompanied the greatest disturbance or thinning of the stand. Burning old stands in spring or fall or fall mowing may increase yields from one-third to one half over untreated seedings.

Experimental Procedure

Preliminary renovation studies were conducted in 1944 at the U. S. Range Livestock Station on crested wheatgrass pastures that had been seeded in 1937 and grazed since 1939.

Between 1950 and 1952, a second, more comprehensive study was carried out in the same crested wheatgrass stand to determine the effect on production of various renovation methods and nitrogen fertilization.

This study was initiated in April, 1950 on an area of uniform soil, slope and stand density. Six treatments were involved, consisting of two nitrogen levels on each of three cultural or tillage treatments. Nitrogen levels were: (1) 50 pounds of N per acre applied in the spring of 1950 and (2) no nitrogen. Cultural treatments included: (1) harrowing with springtooth harrow, (2) plowing and reseeding with crested wheatgrass at a rate of five pounds per acre, and (3) an untreated control. A randomized split-plot design with two replications were used. Cultural treatments were in whole plots...
and nitrogen fertilizer levels in sub-plots. The study included a total of 12 plots each 35 x 50 feet in size.

Data on stand density were taken in early April, 1950, prior to treatment of the plots, and again in early April of 1952. Production determinations were made in early August of 1950 and 1952 following completion of the current season's growth. Production was determined by clipping to a 1/2-inch stubble height, ten 4.356-square-foot (1/10 mil-acre) circular plots located at random in each treatment. Density was determined by the point plot method, using three transects per plot with 100 points per transect.

**Weather**

Spring and early summer precipitation—April through July—was 5 to 10 percent below the normal of 7.21 inches in all three years of the second study. Only during the months of April and June of 1950 did monthly precipitation reach the long-term average.

Total annual precipitation for the three years was 5 to 15 percent below the long-time average of 13.00 inches. The first and third years (1950 and 1952) may be considered as dry years with 1951 as almost normal. Especially dry weather prevailed in 1949, the year before this study started, when precipitation was 40 to 60 percent below normal.

**Experimental Results**

Results of the 1944 studies indicated that, in the first year, both harrowing and double-disking the stand resulted in a decrease in forage production, number of plants per unit of area, and proportion of plants bearing seed. Further, these renovation measures lowered total forage production and encouraged invasion by low-value weeds and other plants. Figure 1 shows the disked areas, both grazed and protected, in contrast to adjacent untreated areas. The thinner stands of crested wheatgrass on the treated portion, both grazed and protected, may be seen as well as the noticeable greater quantity of sweet clover.

The 1950 production data from the second study disclose some significant differences between renovation treatments during the season of treatment (Table 1). Both the harrowed and control plots produced about 90 percent more crested wheatgrass forage than the plowed and reseeded treatment. The average amounts of crested wheatgrass produced were 564, 1076 and 1096 pounds per acre, respectively, for the plowed and reseeded, harrowed and control treatments.

Nitrogen applied at the rate of 50 pounds per acre increased production on all land treatments in the first year. The increases in yield were not large, but they amounted to 22 percent on the harrowed treatment, 48 percent on the plowed and reseeded treatment, and 13 percent on the control.

The only weeds found in 1950 were on the plowed and reseeded treatment. Here the fertilized plots produced 1,196 pounds of weeds per acre in addition to the 673 pounds of crested wheatgrass, while the unfertilized plots produced 950 pounds of weeds with 454 pounds of crested wheatgrass forage.

By 1952 production had declined on all plots except the unfertilized plot of the plowed and reseeded treatment.

<table>
<thead>
<tr>
<th>LAND TREATMENT</th>
<th>Harrowed</th>
<th>Plowed &amp; Reseeded</th>
<th>No Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crested Wheatgrass</td>
<td>Crested Wheatgrass</td>
<td>Crested Wheatgrass</td>
</tr>
<tr>
<td></td>
<td>lbs/acre</td>
<td>lbs/acre</td>
<td>lbs/acre</td>
</tr>
<tr>
<td>August 1950</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilized (N)</td>
<td>1181</td>
<td>673</td>
<td>1163</td>
</tr>
<tr>
<td>Not fertilized</td>
<td>972</td>
<td>454</td>
<td>1028</td>
</tr>
<tr>
<td>August 1952</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilized (N)</td>
<td>454</td>
<td>548</td>
<td>470</td>
</tr>
<tr>
<td>Not fertilized</td>
<td>402</td>
<td>508</td>
<td>488</td>
</tr>
<tr>
<td>L. S. D. (.05)</td>
<td>1950</td>
<td>1952</td>
<td></td>
</tr>
<tr>
<td>Cultivation</td>
<td>236</td>
<td>166</td>
<td></td>
</tr>
<tr>
<td>Fertilizer</td>
<td>270</td>
<td>220</td>
<td></td>
</tr>
</tbody>
</table>
treatment. The decline in production averaged approximately 60 percent on both fertility levels of the harrowed and control treatments, and 19 percent on the fertilized plot of the plowed and reseeded treatment. Production in this period increased 12 percent on the unfertilized plot of the latter treatment.

In 1952 production on the plowed and reseeded treatment was above that on the other two treatments, although the differences were not significant. Also in this year there was no significant difference in production between the harrowed and no treatment, or between the two levels of fertilization on these treatments. For both harrowed and plowed and reseeded treatments there was about 10 percent higher production on the fertilized plot, but the yield was about the same on both fertility levels of the plots which received no tillage.

Crested wheatgrass density was remarkably similar in 1950 and 1952 in all treatments and between all treatments in both years. Density averaged between 20.5 and 26.0 percent on all treatments in both years, with no significant differences present.

Discussion

Under the conditions of these studies, conducted during a comparatively dry period, nitrogen fertilizer tended to increase production of old stands of crested wheatgrass at least during the year of application. Yields were not taken the second year after application, but by the third growing season such response had largely disappeared. This could have been due to failure of the nitrogen effect to carry over into the second year after application or to the dry weather, or both factors could have been operating. These results indicate possibilities for range fertilization in this area, but the practicality and economies of such a practice will need to be determined by future studies of a more comprehensive nature.

These studies also indicate that considerable disturbance of the old stand by double-disking or plowing and reseeding not only decreases production, height of growth, and seed production in the first year, but also allows considerable invasion by low value annual weeds. However, two years after plowing and reseeding the stand regains optimum density, weeds largely disappear, and there is a slight tendency for increased production. Moderate disturbance of the stand by harrowing may or may not decrease production, probably depending in part on amount of rainfall during the growing season.

In this study differences in crested wheatgrass density resulting from renovation or fertilization (at 50 pounds per acre of nitrogen) also were non-existent.

It is possible that the fertilization and renovation treatments would be more effective in periods of more nearly normal precipitation.

Summary

The effects of renovating or fertilizing old crested wheatgrass stands were studied at the U. S. Range Livestock Experiment Station, near Miles City, Montana, in 1944 and in 1950-1952.

Treatments consisted of spring-tooth harrowing, double diskin, plowing and reseeding, and nitrogen fertilization. Dry weather prevailed over much of the period during which these studies were conducted. The following results were obtained:

1. Nitrogen fertilization at the rate of 50 pounds of N per acre increased forage production to some extent in the year of application, but two years after application this response had largely disappeared.
2. Considerable disturbance of the stand by double diskin or plowing and reseeding caused decreased forage and seed production and increased weed growth in the first year.
3. After two years the efforts of plowing and reseeding upon production and weed density largely disappeared.
4. Moderate disturbance of the stand by harrowing had little effect upon production or plant density, although it did result in decreased seed production in the first year.

LITERATURE CITED


LATE BULLETIN

W. T. (Terry) White, Executive Secretary of the American Society of Range Management since January, 1952, died at Providence Hospital, Portland, Oregon, on the morning of December 10, 1956. Terry had been seriously ill for over a month before his death. Terry's devotion to the objectives of the Society, his friendly, active personality, and his spirit of cooperation in the conduct of Society business won him the friendship of all with whom he came in contact. The Society and his many personal friends will miss him.

John G. Clouston, Box 4137, Portland 8, Oregon, has been named by the Directors to succeed Terry as Executive Secretary.