Effects of Burning, Cultivating, and Mowing on the Yield and Consumption of Crested Wheatgrass

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Crested wheatgrass *(Agropyron cristatum)* has been used for three decades as a forage crop in the Northern Great Plains. As a conservation measure, extensive acreages of abandoned farm lands have been sown to this grass. These acreages have been used for hay and pasture, though they have seldom been managed carefully. When crested wheatgrass pasture fields are not grazed in early spring at an optimum rate of stocking, they produce an abundance of seed. As a result, additional plants become established between the rows and the stands then contain many small, unthrifty plants. Such stands are low producing, and dead stemmy material makes the forage unpalatable to livestock. It has been suggested that the usefulness of these fields might be increased by mechanical renovation. Heinrichs (1950) found that although renovation nearly doubled the hay yield of sod-bound crested wheatgrass for a two-year period, the effect did not last. Consequently, he recommends intensive cultivation followed by seeding to a grass-alfalfa mixture. This solution may not be practical or economically feasible for large acreages of crested wheatgrass administered by public agencies. The test reported herein was initiated to examine the merits of burning and to compare burning with mowing, to remove dead plant material, and cultivation, to reduce the density of the stand. The primary objectives were to determine if the treatments increased the early season use of crested wheatgrass, and the effects of the treatments on the cover and floristic composition of the vegetation.

Studies concerned with the renovation of crested wheatgrass are in the main limited to cultivation and fertilization (Barnes and Nelson, 1945), (Heady, 1952), (Houston, 1957). The burning of grass stands to remove old growth and encourage early spring utilization has been used for centuries. A review of the work concerning the use of fire as a management tool in the range area of North America (Sampson, 1952) summarizes the effects of burning grasslands. Paramount among these effects are possible increases in soil fertility, particularly nitrate nitrogen, higher soil temperatures, lowered moisture content, and stimulation of early spring growth of plants. Indiscriminate burning of grasslands is condemned, particularly if done too frequently or unseasonably. As a result there have been few studies of burning as a management tool.

Procedure

In the fall of 1952, a crested wheatgrass pasture at the Experimental Farm, Swift Current, was selected as the site for this trial. The area was seeded to crested wheatgrass in 1942; prior to that it had been used for cereal crops. From 1942 to 1952 the pasture had been grazed lightly by the Experimental Farm sheep flock. The stand had deteriorated by 1952 and was unthrifty and low-yielding. When examined as a possible site for this trial, the individual plants were small, and the stand a mass of dead leaves and culms from previous years.

For the trial, a level area of two acres was subdivided, by single furrow ploughed strips, into 20 plots each 44 by 100 feet. The area was fenced and five treatments, each replicated four times, were applied. Treatments were: (1) plots mowed in fall to sever old plant material, this material left on plots; (2) me-

FIG. 1. FORAGE YIELD OF CRESTED WHEATGRASS AFTER MOWING, CULTIVATING & BURNING.

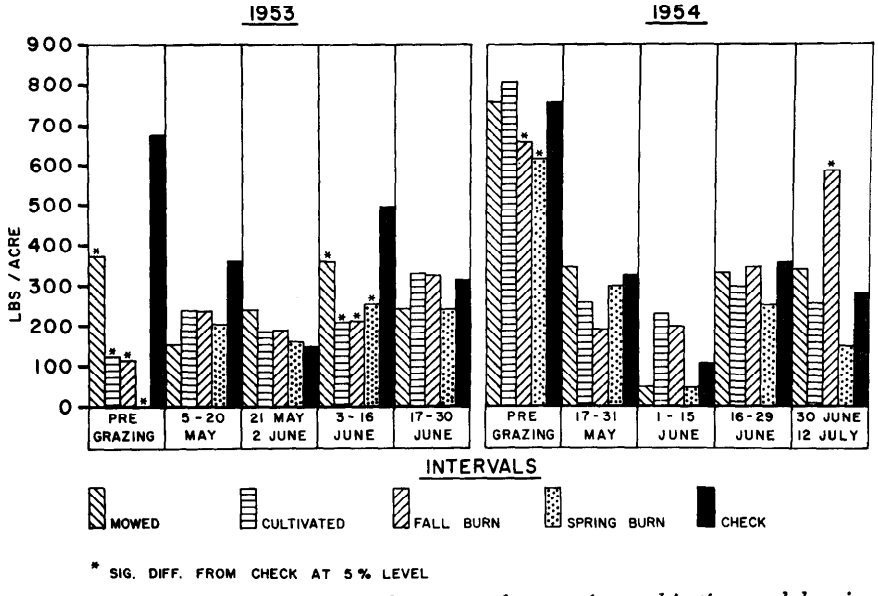

FIGURE 1. Forage yield of crested wheatgrass after mowing, cultivating, and burning.

Table 1. Total season yield of crested wheatgrass and consumption by sheep after mowing, cultivating and burning

	1953		1954	
	Yield	Consumption	Yield	Consumption (Pounds per Acre)
Mowed	1374*	995*	1755	1076
Cultivated	1068*	861	1778	1049*
Fall Burn	954*	760	1962	1280*
Spring Burn	823*	637*	1413*	855*
Check	1850	799	1826	1150

*Sig. diff. from check at 5 percent level.

chanical renovation, plots one-way disked twice; (3) plots burned in late fall (November, 1952); (4) Plots burned in spring (April, 1953); (5) check. Both fall and spring burns were conducted on the fifth day of a warm, dry period. At each burn the ground was moist. Hot, fast burns were obtained and there was little afterburning.

The area was grazed in 1953 and 1954 by ten yearling Rambouillet ewes. In 1953 the ewes grazed the area for 53 days between May 5 and June 30, except during three days of inclement weather. In 1954, snow and rain in early May delayed the start of the 55-day grazing season until May 17.

Forage yield and consumption were obtained by the difference method described by Brown (1954) on page 117. In this method paired series quadrats are used. The quadrats of one series are grazed while those of the other series are protected by cages from grazing during successive intervals. Consumption is the difference in the amount of forage between paired open and caged quadrats clipped on the same day. Yield is found by subtracting the weight of forage on the open quadrat from the weight of forage on the adjacent caged quadrat at the end of the next interval. Quadrats were 40 by 18 inches and one paired series was used on each plot. The forage from the quadrats was hand-clipped with sheep shears, bagged, oven-dried, and weighed. Oven-dry weights were recorded on a pounds per acre basis. Five clippings were made each year, one prior to grazing and four at 13- to 15-day intervals during the grazing period (Figure 1). The sheep had access to all plots for the entire grazing season. The vertical-point method of Clarke et al. (1942) was used to obtain basal area cover and floristic composition data. Sampling was done before the treatments were carried out (October, 1952), after the renovation treatments were completed (May, 1953), before the grazing began in 1954 (May, 1954) and upon completion of the test (June, 1955). Three hundred points per plot were required to obtain reliable estimates of the basal area cover and floristic composition.

Results and Discussion

The total season yields of forage and consumption data for the different treatments are given in Table 1. All treatments reduced the forage yield in 1953, but the only treatment which had an over-all adverse effect on total forage yield was spring burning. Differences in forage consumption by sheep from the various treatments occurred in both years, but again only spring burning reduced total consumption.

Figure 1 compares the forage yield, at intervals through the grazing season, of the treatments with that of the check. The lower total yields in 1953 from the renovation treatments are shown to be, in part, a reflection of a high yield of forage on the check prior to grazing. This yield, largely residue from previous years, was undoubtedly unpalatable and low in nutrients, and consequently of little value as forage. In 1953 forage yield from the check was also higher in the third grazing interval than that of all other treatments. This was partly a result of the greater production of fertile culms by the plants in the check treatment. The increased yield of the third clipping from the mowed treatment was also partly fertile culm production. Differences in yield in the first year following burning and cultivation are, therefore, not wholly a result of lower yields of foliage. In addition, as Pig-

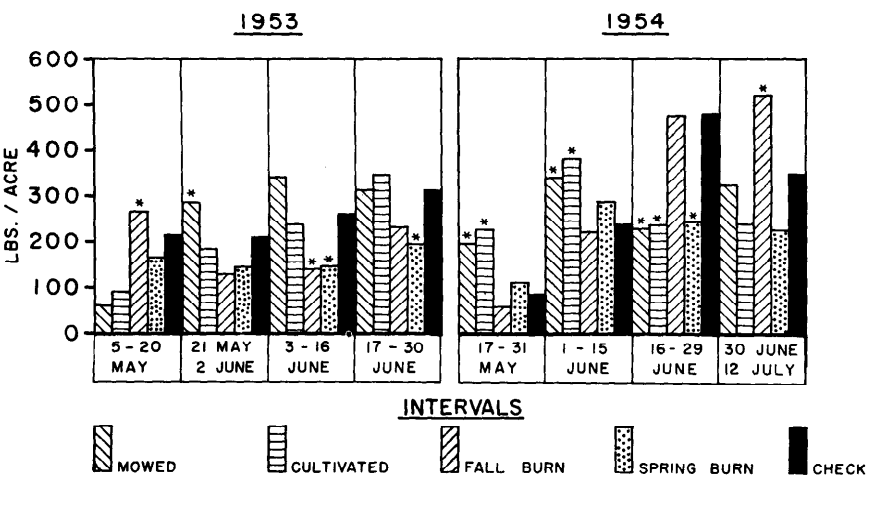

FIGURE 2. Consumption by sheep of crested wheatgrass after mowing, cultivating and burning.

Table 2. Percent protein of crested wheatgrass after mowing, cultivating, and burning, 1953.

Treatment	Pre-grazing	May 20	June 2	June 16	June 30
Fall Burn	23.1	17.0	18.7	17.5	14.4
Spring Burn	.....	21.1	18.3	17.9	17.1
Mowed	10.5	11.0	12.1	11.0	12.2
One-Wayed	9.9	10.6	13.8	13.1	12.0
Check	7.7	9.2	10.3	10.4	11.2

den (1953) has pointed out, the crested wheatgrass forage containing a greater proportion of heavily lignified stems would be less digestible than would that of leafier material. Few significant interval yield differences occurred in 1954. Forage yields from the burn treatments were lower prior to grazing, but the yield of forage on the plots burned in the fall was sufficiently high in the fourth clipping to balance their low pre-grazing yield. This high yield was noticeable at the time on the plots. It was also noticeable that the sheep were especially attracted to the fall burn plots, and an increased amount of dung and urine was deposited on these plots. This increased yield may have been partly due to increased fertility as a result of sheep congregating on the burned plots. In practice, where an entire field had been burned, the yield increase response to this treatment might be less.

The consumption by sheep during the intervals between clippings is shown in Figure 2. In 1953 individual treatments were grazed more or less heavily than the check in several intervals, but there was no clear-cut proof of any treatment influencing consumption either early or late in the grazing period. In 1954 the mowed and cultivated treatments were favoured early in the season, while forage consumption from the fall burn treatment equalled or exceeded consumption from the check in late June and early July.

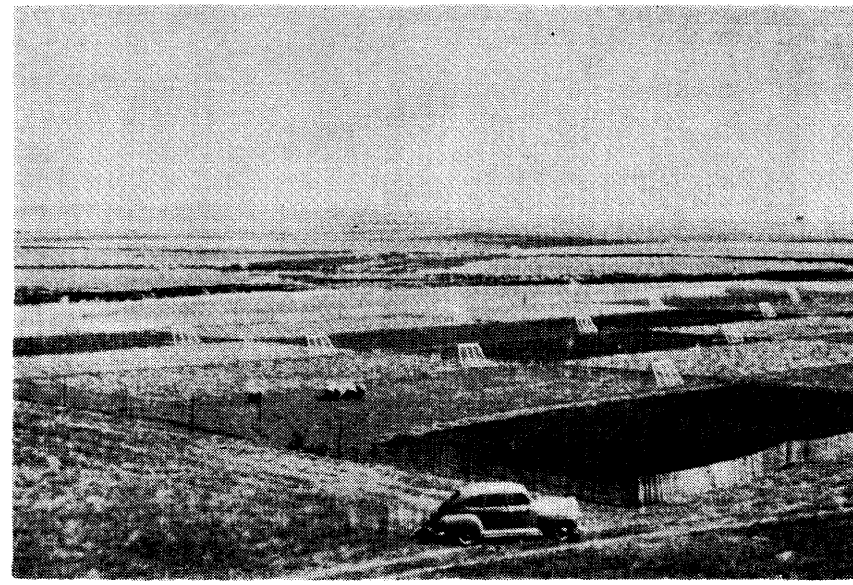

FIGURE 3. General view of experiment area, May 1953. Spring burn plot in foreground.

The results of the crude protein analyses of the 1953 treatments are given in Table 2. Differences in protein content as a result of the treatments are indicated. As might be expected, the burn treatments, by removing dead plant material, increased the protein content. The other treatments also increased the protein content but to a lesser degree. With a higher protein content the feeding value of the forage from the treated plots would be greater than that of the forage from the check.

The basal area and floristic composition of the cover, prior to and after renovation and grazing, are given in Table 3. No change in basal area took place after the treatments except after one-way disking. This cultivation treatment reduced the total area of the cover from 6.60 percent to 2.70 percent, but the

Table 3. Comparison of basal area cover and floristic composition of crested wheatgrass swards after mowing, cultivating, and burning

	October 16, 1952 Before Treatment			May 4, 1953 After Treatment	May 10, 1954 Grazed One Year			June 10, 1955 Grazed Two Years		
Treatment	Crested Wheatgrass	Sweet Clover	Other* Species	Total	Crested Wheatgrass	Sweet Clover	Other Species	Crested Wheatgrass	Sweet Clover	Other Species
				(Percent)						
Fall Burn				6.60	5.40	0.05	0.05	5.78	0.76	0.08
Spring Burn				6.00	5.50	0.25	0.42	5.78	0.74	0.41
Mowed in Fall				6.60	5.40	T	T	5.65	1.25	0.08
One-Wayed (2x) in Fall				2.70	4.50	0.50	0.50	5.40	1.75	0.08
Check	6.40	0.06	0.14	6.60	5.70	T	0.28	6.10	1.16	0.08

*Principally—Goldenrod (*Solidago* sp.), Aster (*Aster* sp.)

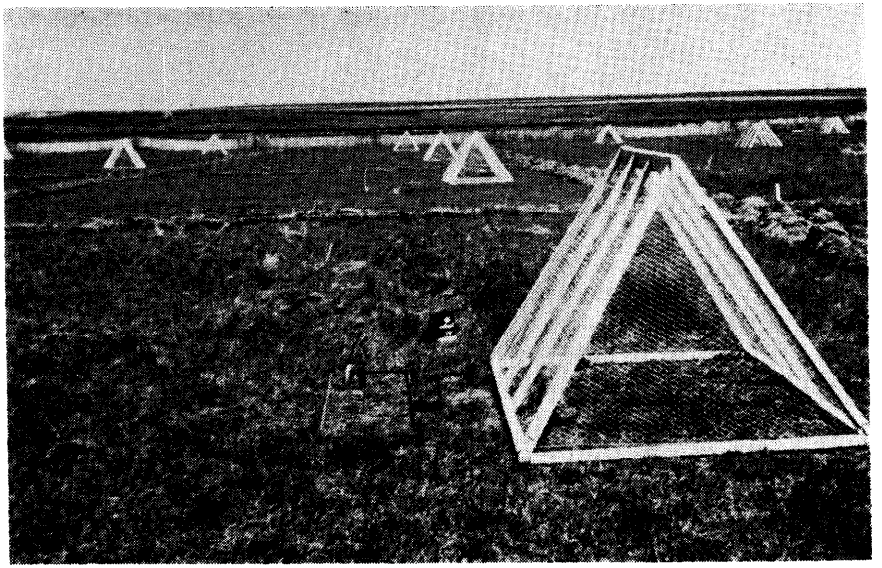

FIGURE 4. View showing type of cage used in experiment. Note clipped frame in plot in foreground.

measurements of the vegetation in May 1954, and June 1955, show that this reduction in basal area was not permanent. The basal area and floristic composition of this crested wheatgrass field were not, in the long run, changed by any of the treatments. There was a slight change in floristic composition, crested wheatgrass decreasing, other species increasing, as a result of grazing. The increase in sweet clover in itself is of no particular significance, but rather reflects an abundance of sweet clover in adjacent areas. However, the increase in species other than crested wheatgrass indicates that the competitive ability of the crested wheatgrass has been reduced. Had there been seed sources of less desirable species available, they might have become as abundant as sweet clover. It is worth noting that the increase of species other than crested wheatgrass was lowest on the burn treatments.

In terms of early spring use, no clear-cut advantage is shown by any of the treatments. Spring burning reduced early use, and total consumption. Mowing and fall burning appear to be useful treatments as they did not adversely affect yield or consumption. However, mowing as a management tool would have to be considered in relation to cost, and its practicability on hilly or stony areas of seeded range pastures. Fall burning, in view of the fact that it did not change the density or composition of the vegetation, appears to be a treatment worthy of further consideration as a management tool in renovating underutilized crested wheatgrass stands in the Northern Great Plains.

Summary

The effects of renovation treatments, cultivating, mowing, and fall and spring burning on the forage yield and consumption by sheep of crested wheatgrass were examined during and after two spring grazing seasons. The basal area of the cover and its floristic composition were not, in the long run, affected by any of the treatments. All treatments reduced forage yield in the first year. Consumption by sheep in the two-year period after fall burning and mowing was not reduced. Spring burning reduced both forage yield and consumption by sheep.

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