Influence of Spring, Fall, and Spring-Fall Grazing on Crested Wheatgrass Range[1]

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Highlight

Grazing crested wheatgrass during spring only, fall only, and spring and fall to a 1-inch stubble height for 10 years had little effect on vegetative characteristics of the seeded stands. Invasion of the stands by other species was greater with spring or spring–fall use than with fall use. Litter decreased with all seasonal treatments, but decreased most under spring–fall use. Drought and growing-season moisture were the critical factors in determining forage yields. The spring–fall pastures produced more forage, provided more days of grazing, and gave the highest average beef production, 177 lb/season. Spring grazing was next and fall grazing the least productive for animal weight gains.

Crested wheatgrass (*Agropyron desertorum* (Fisch.) Schult.) is undoubtedly the most common and widely used introduced grass for range seedings in the western United States and parts of southern Canada. Its earliest record of introduction into the United States dates back to 1898. In 1915 it was found to be particularly adapted in the northern Great Plains (Westover and Rogler, 1934; Weintraub, 1953, p. 3). Since that time, crested wheatgrass has been used extensively for seedings both west and south of the Plains area. Large areas are commonly seeded and it was estimated as early as 1951 that, of the 8 million acres seeded in the western United States since the mid-thirties, a majority was planted to crested wheatgrass (Woolfolk, 1951).

With this long history, literature is extensive pertaining to adaptability, response to fertilization, clipping, morphological attributes, and economics of seeding crested wheatgrass. Also, its grazing value has been widely investigated throughout the entire western region. Most of the grazing reports, however, have dealt with livestock gains and/or changes in vegetative cover as a result of grazing intensities during one particular season of use: spring grazing, season-long grazing, or a combination of spring grazing plus later use of the regrowth forage. Essentially no research has been done on how long-term grazing influences crested wheatgrass when comparing specific grazing seasons. Therefore, it was the purpose of the research reported here to find out what happens to crested wheatgrass when it is grazed only in the spring, the fall, or both spring and fall over an extended period of years.

Study Area and Methods

The research was conducted at the Manitou Experimental Forest, 28 miles northwest of Colorado Springs, Colorado. The study site is situated at an elevation of approximately 7,800 ft. Annual precipitation has averaged 15.7 inches during the past 25 years. For the 10-year period of study 1957–1966, annual moisture averaged 16.1 inches, with approximately two-thirds of this amount or 10.7 inches being received during the growing season from April through August.

Because of the elevation and weather patterns along the Front Range, winters are open but cold, with temperatures occasionally as low as –40 F. The growing season is short, and only during July and August do overnight temperatures usually stay above freezing. Daytime temperatures during this period seldom exceed 90 F.

Soils on the site are alluvial, derived primarily from outwash materials of Pikes Peak granite. They are generally of low to moderate fertility, have a moderate amount of organic matter, and are quite porous. Classification is a sandy loam.

The study pastures were located on a large alluvial fan within a natural grassland opening of the ponderosa pine type. Years back, many of these open areas were cultivated; this particular one was last cultivated in 1934. Both during and after cultivation, considerable sheet and gully erosion occurred on its westerly facing, 6 to 10% slopes. At the time of seeding in 1946, the area was occupied by a dense cover of low-value forbs typical of abandoned fields in the pine-bunchgrass type.

In preparation for seeding, the area was moldboard plowed, disked, and cultipacked in the fall of 1945. It was then planted in the spring of 1946 at the rate of 5 lb/acre of crested wheatgrass seed, using a single-disc grain drill with a 7-inch row spacing. An excellent stand developed in the next 2 years, and

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it was mowed for hay in 1948 and 1949. From that time until the study began in 1957, the area was grazed only occasionally in winter by horses.

Grazing treatments.—Six pastures, each 3.3 acres in size, were fenced within a large block to obtain two pastures for each seasonal treatment: spring, fall, and both spring and fall use on the same pasture, hereafter referred to as spring-fall use. Spring grazing began when maximum leaf length of the crested wheatgrass plants in the spring-only treatment averaged 3 inches. Fall grazing started about September 1 each year. Spring-fall pastures were stocked in conjunction with the starting dates for the respective single season treatments. All pastures were grazed to a 1-inch stubble height, an intensity of grazing that was considered heavy enough to show in time any differences in the effects of grazing during the different seasons.

Yearling Hereford heifers were used to graze the pastures, but animal numbers were not constant each year. Instead, definite grazing season limitations were established. For the spring treatments, a date of June 10 was set as the latest date to reach the desired level of use; in the fall, October 31 was the established date. Additional animals were added if necessary to reach the stubble height objectives in the specified time. In years with low forage production, at least two heifers were put in each pasture, and the goal for the minimum length of grazing treatment was 3 weeks. Dates were kept on stocking, and the heifers were weighed "in" and "out" following an overnight shrink. Seasonal and daily weight gains were computed for each treatment.

Vegetation measurements.—Leaf lengths were measured along random pace transects to determine range readiness, vigor, and termination of grazing. When maximum leaf length of 60 plants, 20 along each of three transects, averaged approximately 3 inches in the spring-grazed pastures, then plants in the spring-fall and fall-grazed pastures were also measured to compare relative vigor. Pastures of the spring and spring-fall treatments were then stocked with the appropriate number of animals. Plant stubble heights were measured in a comparable manner at the end of grazing in each pasture at each season. Animals were removed when stubble heights for 60 plants averaged approximately 1 inch.

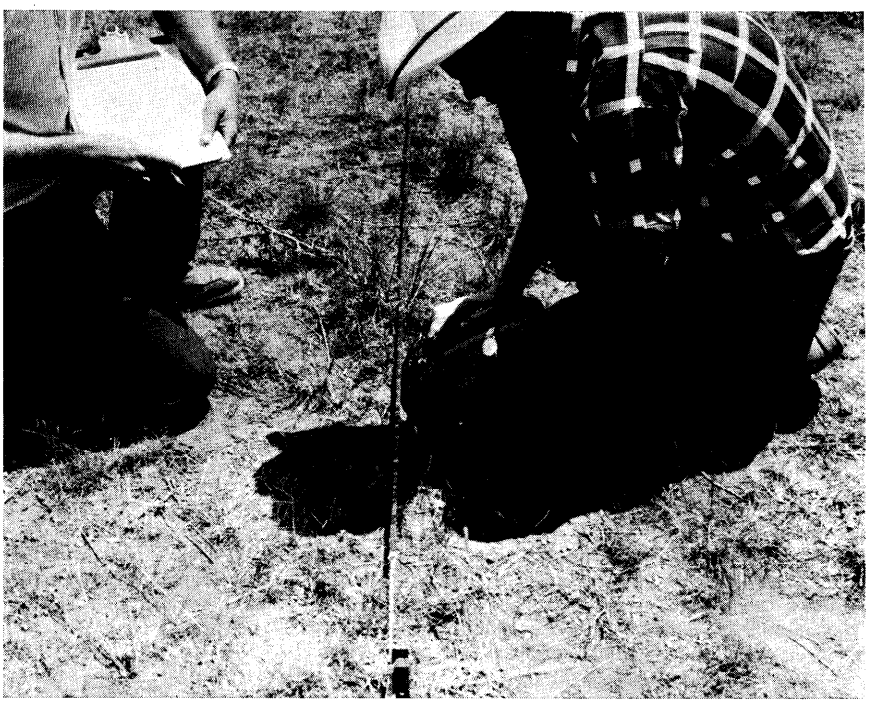

FIG. 1. Intercepted crown distances of individual crested wheatgrass plants were measured and recorded on graph paper to .01-ft. Plants along the same transects were measured four times during the study to evaluate crown intercept changes.

Production and utilization were estimated by the paired plot-differences method, with twelve 9.6 ft^2 plot pairs in each pasture. The 12 herbage production plots were protected from grazing by steel agronomy cages, while their paired counterparts were open to use. In years with high forage production during the spring, and to more accurately estimate regrowth forage, plots were clipped and cages moved one to several times during the grazing season. In years of low production and in the fall, plots were harvested once immediately after grazing ended.

Ground cover and aggregration and dispersal characteristics of crested wheatgrass were measured on 10 permanent 20-ft transects placed at right angles to the drill rows. Plants along the transects were measured in 1959, 1961, 1964, and 1966, but different methods were used for evaluating stand characteristics.

Basal ground cover was evaluated by the vertical point quadrat method (Clark et al., 1942). Measurements were based on 100 hits at ground level along each transect to evaluate changes in crested wheatgrass, invading species, litter, and total cover. The aggregation and dispersal characteristics of the crested wheatgrass pastures were evaluated by a modification of the line interception method (Canfield, 1941). For these measurements, a 20-ft tree diameter tape, graduated in feet, 0.1-ft and .01-ft increments, was stretched between the metal transect stakes. The plants intercepted by the tape were then recorded on graph paper to the nearest .01 ft (Fig. 1). An arbitrary

decision that the space between plant portions or crowns at ground level had to exceed 0.5 inch was used to determine individual plants. Species other than crested wheatgrass were not measured.

Treatment Effects

Utilization.—Average percent utilization (by weight) of crested wheatgrass from 1957 to 1966 in the respective treatments was as follows:

Treatment	Utilization
Spring	77
Fall	82
Spring-Fall	
Spring-	75
Fall	68
Average	72

This use was uniformly heavy when plants were grazed to a 1-inch stubble height, but there were definite appearances to the pastures which should be mentioned for practical purposes. For example, the spring-fall grazed pastures appeared to receive much heavier use than the others because the crested wheatgrass was kept grazed to a shorter height. Also, plants invading the pastures were much more apparent within this treatment, and gave the stands an appearance of being more severely depleted than the other treatments. Except for a reduction in initial leaf height, however, this visual appearance was misleading and did not represent true deterioration.

Leaf heights.—April 26 was the average date for crested wheatgrass leaves to reach a 3-inch height and for livestock to be put on the pastures in the spring. The earliest date was April 19 and the latest was May 2. Neither the spring nor the fall grazing treatment influenced plant height. As shown below, average leaf lengths were quite similar in these two treatments, and this similarity was consistent each year.

Grazing Treatment	Leaf Lengths (inches)
Spring	2.76
Fall	2.70
Spring-Fall	2.23

Table 1. Forage production (lb/acre) from crested wheatgrass ranges grazed at different seasons in relation to April-through-August precipitation (inches), Manitou Experimental Forest.

	Precipitation						Forage production		
Year	April	May	June	July	Aug.	Total	Spring	Fall	Spring–Fall
1957	2.80	3.63	1.10	6.20	1.89	15.62	1734	1894	2457
1958	1.59	3.75	0.57	1.99	2.28	10.18	1090	1362	1046
1959	1.50	1.43	1.44	1.22	2.24	7.83	1026	824	878
1960	0.72	1.96	0.60	2.69	0.72	6.69	708	926	956
1961	1.41	2.09	2.22	5.73	4.80	16.25	838	1525	1736
1962	1.19	0.65	1.23	1.60	1.69	6.36	783	501	668
1963	0.00	0.23	2.37	1.81	8.79	13.20	(703)*	741	(896)*
1964	0.52	1.68	1.61	2.09	1.67	7.57	769	758	934
1965	1.22	1.44	3.87	4.44	4.07	15.04	958	1277	1128
1966	1.25	0.86	1.47	5.57	1.00	10.15	486	640	823
Average	1.22	1.77	1.65	3.33	2.92	10.89	910	1045	1152

* Fall or regrowth forage. No measurable forage was produced for spring grazing.

On pastures receiving spring-fall use, leaf lengths for the 10-year period averaged 0.5 inch shorter than on the other pastures. Height growth tended to become progressively less each year in this treatment and by the end of the study in 1966, leaves on the spring-fall grazed pastures averaged 2.1 inches compared with 3.1 for spring grazing.

This effect on plant height in the spring-fall treatment did not influence total forage production. Yields were larger initially from these spring-fall grazed pastures and remained larger at the end of the study (Table 1).

Forage yields.—Variations in forage yields of crested wheatgrass were largely not attributable to seasonal treatment, but were primarily due to the amount of moisture received during the growing season (Currie and Peterson, 1966). It was found from regression analysis that 88 to 97% of the differences in yield were explained by the rainfall received in specific months. For example, yields on spring-grazed pastures ranged from 1,734 lb/acre in 1957 to essentially 0 in 1963, and the variation was due primarily to variation in April precipitation. Production of fall-grazed pastures varied in response to May–July moisture. In pastures grazed both spring-fall, the April and May moisture influenced spring forage yields, while June and July rainfall controlled the fall regrowth. In all pastures yields varied considerably from year to year. In 1966 they were considerably below the long-term average, but in 1965, when moisture was good, their production was near or above average. These fluctuations in production, although common, tended to be less extreme on the pastures grazed only in the spring.

Cover.—Ground cover characteristics of the stands also showed only minor and nonsignificant differences between the different seasonal grazing treatments (Table 2). Average total ground cover ranged from a low of 44.9% on spring-fall grazed pastures to 49.0% on pastures grazed in the spring, or a difference of less than 5%. Crested wheatgrass, invading species, and litter cover differed by only 2, 3.2, and 3.9%, respectively, among the three treatments.

Cover differences between years were significant, and showed that the changes in ground cover varied from year to year within the treatments. In 1959, pastures grazed only in the fall had more litter, crested wheatgrass, and total cover than pastures grazed in spring or spring-fall. Also, the pastures grazed in fall had the least cover of in-

Table 2. Percent cover of seasonally grazed crested wheatgrass ranges during the 10-year period 1957–66.

Cover characteristic	Spring only	Fall only	Spring–Fall	Average
Total cover				
1959	55.4	57.1	52.2	54.9
1961	43.2	41.6	43.6	42.8
1964	46.4	38.0	41.0	41.8
1966	51.2	52.8	42.9	49.0
Average	49.0	47.4	44.9	
Crested wheatgrass				
1959	6.1	8.1	6.6	6.9
1961	9.0	10.0	9.6	9.5
1964	6.0	5.4	5.4	5.6
1966	6.2	11.8	6.2	8.1
Average	6.8	8.8	7.0	
Invading species				
1959	1.4	.5	1.8	1.2
1961	4.8	1.0	3.6	3.1
1964	4.5	1.6	3.1	3.1
1966	9.0	3.6	9.3	7.3
Average	4.9	1.7	4.4	
Litter				
1959	47.8	48.5	43.8	46.7
1961	29.5	30.7	30.3	30.2
1964	36.0	31.0	32.4	33.1
1966	35.9	37.4	27.3	33.5
Average	37.3	36.9	33.4	

vading species. By 1961, and due to the effect of grazing, total cover decreased on all pastures primarily because the litter cover had decreased by 13.5% with spring-fall grazing, 17.8% with fall grazing, and 18.3% with spring grazing. Crested wheatgrass cover increased about 2 to 3% on all pastures during this period, and the cover from invading species increased 3.5% or less. These cover increases, for both crested wheatgrass and invading species, were smallest with fall grazing.

The general area suffered a temporary but severe drought during the late winter of 1962 and early spring of 1963. For the first time in over 25 years, no measurable moisture was received in April. This dryness continued into May and sporadically throughout July. Moisture in June, although above average, was received in numerous, ineffective, small thunder showers. It was not until August when 8.79 inches of moisture were received (Table 1) that discernible plant growth began. During the early spring, leaves on the crested wheatgrass plants grew to approximately 1.5 inches, then dried back to the crowns so that grazing was not possible on the spring pastures.

As a result of the drought, ground cover of crested wheatgrass, when measured in 1964, had decreased by one-third on spring-grazed pastures and by approximately one-half on fall and spring-fall pastures (Table 2). The largest decrease was on the fall-grazed pastures; in July of 1963 it appeared that the death loss of the crested wheatgrass plants in this treatment would be severe (Fig. 2). Except for the fall-grazed pastures, there was a small decrease in the basal ground cover of invading species between 1961 and 1964. Litter cover increased a small amount in all pastures as a result of the dead plant material. From 1964 to 1966, crested wheatgrass cover increased under all treatments, with the largest increase, 6.5%, on the fall-grazed pastures.

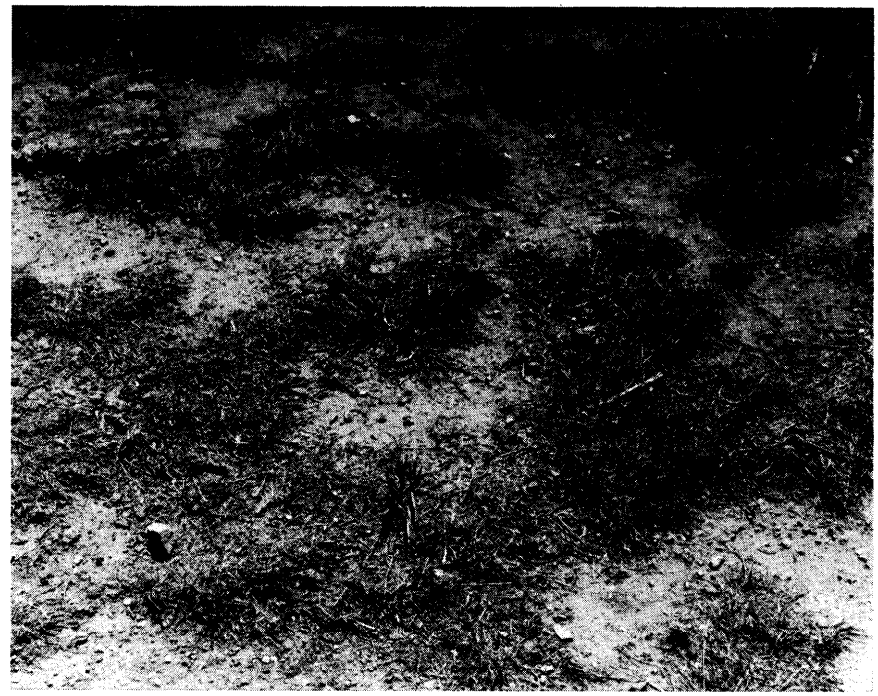

FIG. 2. Ground cover appearance of a fall-grazed pasture on June 27, 1963, during spring–summer drought. Note the sparsity of living tissue on formerly large clumps. This pasture recovered from drought effects and produced 1,572 lb/acre of forage in 1965.

Table 3. Basal intercept (%) and number of crested wheatgrass plants along permanent transect lines to evaluate aggregation, dispersal and changes in plant numbers on ranges grazed seasonally for 10 years, 1957–66. Manitou Experimental Forest, Colorado.

Year	Basal intercept			Number of plants intercepted		
	Spring only	Fall only	Spring–Fall	Spring only	Fall only	Spring–Fall
1959	6.3	8.5	6.1	21	21	24
1961	13.0	17.4	14.7	22	17	22
1964	4.5	5.7	4.5	12	11	14
1966	4.1	9.3	4.6	13	13	13
Average	7.0	10.2	7.5	17.0	15.5	18.2

Only small increases of 1% or less occurred on the other pastures. The most noticeable change was the increase in cover by invading plants. Percentagewise, the largest increase was only 6.2% on the spring-fall grazed pastures, but in terms of previous measurements, the cover from the invading species on all pastures in 1966 was two to three times greater than in 1964.

Except for the increase in litter cover as a result of drought, the amount of litter decreased from all treatments during the course of the study. In 1959, both the spring and fall pastures had approximately 5% more litter than the spring-fall pastures. By 1966, litter cover had decreased 11 to 16.5% from the 1959 level. The spring-fall grazed pastures showed the largest decrease, and had approximately 10% less litter than the other pastures. Thus grazing both spring and fall on the same pastures reduced total cover, but it did not materially influence crested wheatgrass cover or total production of the pastures.

Basal intercept of plants in 1959 was comparable in all pastures, with plants in the fall-grazed pastures occupying about 2% more area than in the others (Table 3). The number of plants contributing to this intercept was identical for the spring and fall pastures. The spring-fall pastures had 24 plants per 20-ft transect, or 3 more than the other pastures. By 1961, intercept had approximately doubled under all treatments, with plant numbers staying about the same on the spring and spring-fall grazed pastures. On the fall-grazed pastures, however, basal intercept doubled while plant numbers decreased, which showed an aggregation of fewer plants into larger clumps from this treatment.

The effect of the 1963 drought was evident in all of the stands, and in 1964 the measurements showed a reduction in intercept of approximately two-thirds from the 1961 level. Plant numbers decreased also, which confirmed visual observations that a large number of plants or parts of plant clumps were killed by the drought. This in turn led to a temporary reduction in forage yields between 1961 and 1964.

Between 1964 and 1966, however, neither plant crown intercept at ground level nor plant numbers changed appreciably. Thus a decrease in both crown intercept and plant numbers did not lead to a corresponding long-term decrease in production (Table 1). In fact, forage yields in 1966 were larger than pre-drought yields of 1962 except on the spring-grazed pastures, and 1965 yields were within 100 lb/acre of 1958 yields under all treatments. The fewer and smaller crowned plants apparently made up for their smaller size through additional height growth to recover to a good production level in the crested wheatgrass stands.

Livestock weights.—Since vegetative characteristics of the crested wheatgrass pastures did not differ significantly as a result of the seasonal grazing treatment, livestock weights became of prime importance in evaluating treatment and for management consideration. In this respect, daily gains in the present study were much less than those reported for crested wheatgrass range in both Colorado and New Mexico. Johnson (1959) reported an average daily gain of 1.70 lb from crested wheatgrass pastures grazed at several intensities in Colorado. For ranges at elevations of 7,000 to 8,500 ft and grazed during the spring in New Mexico, Springfield and Reid (1967) reported a daily gain of 1.98 lb for yearling animals. As shown below, weight gains during spring in the present study averaged 0.6 to 0.8 lb/day less than those for ranges grazed during a comparable time and season in New Mexico. In addition, daily gains from the spring-fall pastures were only 40–50% and the fall gain 5–6% of the gains reported in either the Colorado or New Mexico studies.

Grazing Treatment	Daily Gain (lb)
Spring	1.10
Fall	.10
Spring-Fall	.80

Most of this difference in weight gains was probably due to grazing to the 1-inch stubble height in an effort to induce vegetative changes. Thus the heavy utilization was not conducive to good animal production. Since all pastures were grazed to the same level, however, the differences between seasonal gains were not an intensity factor, but were related to seasons. For example, total gain per pasture for the season averaged 143, 10, and 177 lb for spring, fall, and spring-fall grazing, respectively. The heifers consistently made reasonable gains from spring grazing, but gained only a small to moderate amount or lost weight during the fall (Fig. 3). Generally, the larger weight losses in the fall were associated with years of high forage production. For example, 1957, 1958, and 1961 were years in which forage production averaged 1,300 lb/acre

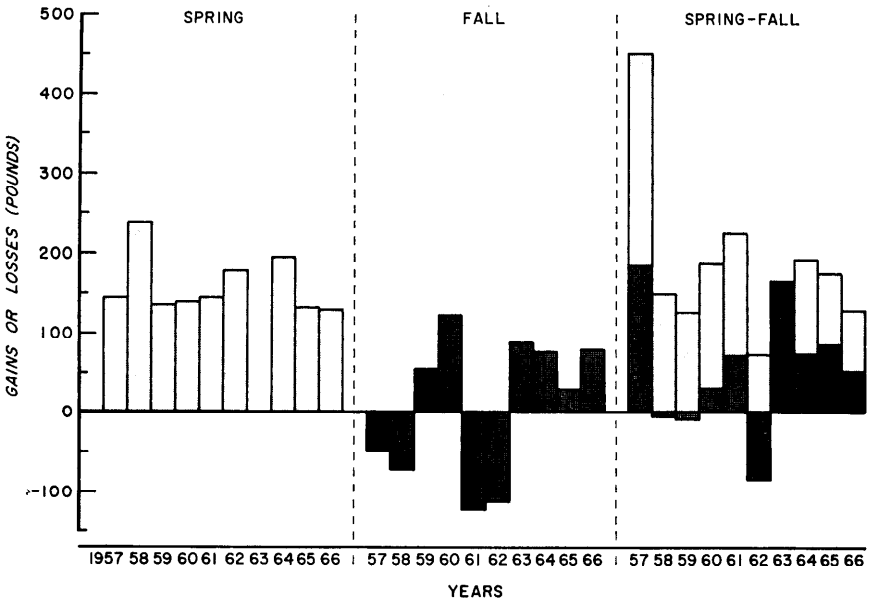

FIG. 3. Total heifer gains or losses per season on pastures grazed in the spring, fall, or spring–fall, 1957–66.

or more, and fall weight losses ranged from 48 to 122 lb. In 1965, which was also a good forage year, the heifers gained weight, but only a modest 29 lb average in each pasture, and this was for 6 heifers grazing a pasture an average of 38 days. The length of time the animals were on the pastures had essentially no influence on weight gains. Three of the 6 heifers in each pasture had been grazing that pasture for 60 days, but gained only 23 lb through the entire period.

The spring gain from spring-fall grazed pastures averaged 134 lb, or 9 lb less than from the pastures grazed only in the spring. Thus, there was very little difference in animal production between these two treatments. In the fall, however, the gains averaged 43 lb from the spring-fall pastures compared with a 10 lb average for the fall grazing treatment. Similar to the fall treatment, weight losses were recorded in 3 out of 10 years. The largest weight loss, 13 lb, was in 1962, the year a weight loss of 112 lb was recorded in the fall-grazed pastures. This was a year of low forage yields, and was an exception to the rule that losses generally were higher in years of high forage production.

For total gain and days of use, the spring-fall grazing treatment was definitely superior to either spring or fall grazing alone. For the 10-year study, days of use averaged 213 for the spring-fall, 159 for the fall, and 131 for the spring pastures. Total weight gains by season averaged 34 lb more than from spring grazing and 167 lb more than from fall grazing. Thus, greater total animal production was obtained from grazing the same pastures twice each year. Furthermore, the better weight gains and more days of grazing were obtained without impairing productivity of the crested wheatgrass stands.

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