# Plant Response and Cattle Gains on Sherman Big Bluegrass[1]

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## Highlight

**Under season-long grazing of Sherman big bluegrass, utilization to a 4-inch stubble height was better than lighter or heavier grazing for sustained forage production and ground cover. Heavy grazing associated with drought resulted in severe deterioration of the grass stands. Beef gains from the recommended rate of grazing averaged 78 lb/acre. This beef gain was higher than for any other seeded or native species tested at the Manitou Experimental Forest, Colorado.**

Although Sherman big bluegrass (Hanson, 1965), a selection of *Poa ampla* Merr. has not been used widely in range seedings in Colorado, it has several characteristics that make it desirable for range improvement programs. In Oregon, Hyder and Sneva (1963) found that big bluegrass was highly palatable for grazing during July and August, and that it also grew some in the winter, began growth very early in the spring, and was ready for spring grazing about a month earlier than crested wheatgrass (*Agropyron cristatum* Schult.). Lavin and Springfield (1955) reported an average yield of 2,010 lb/acre for big bluegrass in the southwestern pine zone of Arizona and New Mexico. They rated this species as good for early spring grazing, fair for late spring and summer use, but poor for fall grazing. Big bluegrass was one of the more successful species tested in Colorado adaptability trials (Hull and Johnson, 1955; McGinnies et al., 1963), and showed promise for range seedings in the ponderosa pine zone. Therefore, it was selected for grazing experiments to determine how well it withstood livestock use at three different levels of herbage removal. Evaluation was based upon both vegetation and livestock responses from the three intensities of use.

## Study Area and Methods

The study was conducted at the Manitou Experimental Forest, 28 miles northwest of Colorado Springs, Colorado. The Forest is situated in the pine zone at an elevation of 7,800 ft. Precipitation during the past 25 years has averaged 15.73 inches, with 11.25 inches from April through August. Temperatures are cool, and the growing season is short. Overnight temperatures are often below freezing early or late in the growing season, and daytime temperatures seldom exceed 90 F in midsummer. Winters are open but cold, with temperatures as low as -40 F.

Soils of the area are alluvial. They are derived from Pikes Peak granite, and are classified as sandy loams or sandy clay loams. They have a granular structure, and are porous when wet but firm when dry. Surface soils range from 8 to 10 inches thick, and either lack a subsoil or have a coarse, gravelly loam subsoil that grades into unconsolidated parent material at a depth of 3 to 4 ft. These surface soils are slightly acid, low in fertility, and contain only moderate amounts of organic material.

The study was located in two natural openings of the pine zone that had been farmed and later abandoned. One area, designated Nursery, was last farmed in 1934; the other, designated the Sinclair, was last farmed in 1936. Prior to the study, these abandoned fields were in the process of revegetating. Species of low forage value such as fringed sagebrush (*Artemisia frigida* Willd.), trailing fleabane (*Erigeron flagellaris* A. Gray), and hairy goldaster (*Chrysopsis villosa* (Pursh) Nutt.) were common.

*Stand establishment and treatments.*—The two study areas were plowed, cultipacked, and seeded to Sherman big bluegrass in 1957. A single-disc grain drill with a 7-inch row spacing was used to plant the seed at 8 lb/acre. Plants in the new seedings were then allowed two growing seasons to develop before grazing began in the spring of 1959.

A 10-acre block was established at each of the two locations. These blocks were subdivided into three experimental pastures, which were given different grazing treatments based upon stubble-height objectives:

| | |
|---|---|
| 6 inches | 3 acres |
| 4 inches | 5 acres |
| 2 inches | 2 acres |

*Stocking system and livestock measurements.*—Yearling Hereford heifers, furnished by local livestock operators, were used to graze the pastures. Four animals were used at each location. When grazing began in the spring, two heifers were put in the 4-inch stubble-height treatment, which was stocked season-long with the same animals. The other two heifers were put in the 6-inch stubble treatments, but were moved back and forth between it and the 2-inch stubble treatments at weekly intervals throughout the season. Since pasture size, stocking rate, and stubble height were constant but forage production fluctuated each year, it was necessary to divide the grazing season into two periods during most years. In those years with split seasons, the same heifers were returned to their respective treatments in the second half of the season.

Grazing was scheduled to begin when maximum leaf lengths on the bluegrass plants averaged 4 inches in the most lightly used units. The heifers were removed from the pastures when the respective stubble-height objectives were reached. The heifers were weighed "on" and "off" following an overnight shrink. Daily gains and gain per acre from the 4-inch stubble treatment were compared with gains from other seeded ranges previously tested at Manitou.

*Vegetation measurements.*—Forage production was measured each year by clipping the grass within six 9.6 ft$^2$ plots in each treatment which were caged to prevent grazing. Cages were not moved within the season, so regrowth was not accurately measured. When it was necessary to divide the grazing season into two periods, however, production

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**Table 1. Precipitation and annual forage production (lb/acre) of Sherman big bluegrass pastures grazed to different stubble heights for 7 years.**

| | Stubble height treatment (inches) | | | Precipitation (inches) | |
|---|---|---|---|---|---|
| | 2 | 4 | 6 | Apr.-Aug. | Annual |
| 1959 | 1649 | 1693 | 1564 | 7.83 | 12.29 |
| 1960 | 1226 | 1344 | 1234 | 6.69 | 14.37 |
| 1961 | 2330 | 2492 | 2361 | 16.25 | 22.31 |
| 1962 | 1201 | 1623 | 1596 | 6.36 | 9.79 |
| 1963 | 776 | 818 | 898 | (13.20)[1] | 18.68 |
| 1964 | 606 | 1080 | 1155 | 7.57 | 11.94 |
| 1965 | 164 | 706 | 729 | 15.04 | 20.56 |
| Average | 1136 | 1394 | 1362 | 9.16 | 15.71 |

[1] August precipitation was 8.79 inches.

was sampled independently in each period. Plots were clipped soon after grazing terminated.

Grazing readiness, relative plant vigor, and stubble height for each treatment were determined by measuring plants along pace transects. Vigor measurements were taken in conjunction with grazing readiness. The maximum leaf length of plants on the pastures grazed to 2- and 4-inch stubble heights were measured whenever that in the most lightly used pastures averaged 4 inches. These measurements were made on a total of 60 plants in each treatment by determining the leaf length of 20 plants along three random pace transects. Stubble heights were measured in the same manner to determine when to terminate grazing on the respective treatments.

## Results

During the first 3 years of grazing, precipitation received during April through August largely determined the yields of Sherman big bluegrass (Table 1). In these early years grazing intensity had little effect in determining yields on any of the treatments. Precipitation remained the major influence in determining yields on the 4-inch or 6-inch treatments. Forage production fluctuated but was maintained for the 7 years of study. The 4-inch level was better, however, because it produced more than twice as many days of grazing and a more uniform use of the plants without seriously reducing annual or long-term yields.

In 1962 and thereafter, yields decreased appreciably on pastures grazed to the 2-inch level, and precipitation had little influence in modifying the yields from this treatment. Forage production from the most heavily grazed pastures averaged about 400 lb/acre less than from pastures grazed more lightly in 1962 (Table 1). Production continued to decrease, and in 1964 when moisture was favorable, yields from the 2-inch stubble treatment did not increase as they did with the other levels of grazing. By 1965, yields from these most heavily grazed pastures were only about one-fourth those from either of the other treatments, and forage production was so small that almost no grazing was provided.

FIG. 1. Adjacent heavily grazed and ungrazed plants were common under light grazing. This resulted in spot depletion of the stands, and invasion by undesirable plants such as fringed sagebrush.

The growing season of 1963 had a pronounced detrimental influence on the bluegrass stands. Although annual precipitation averaged 18.68 inches, only 4.41 inches was received from May through July in small, ineffective thunder showers (Table 1). No moisture was received in April, but 8.79 inches fell in August. With this unusual precipitation pattern, the plants suffered a severe drought for most of the growing season. The plants in the 2-inch stubble height treatment suffered most, while plants grazed to the 4- and 6-inch levels were able to recover from the short-term but severe moisture shortage. Production deteriorated about the same under the heaviest grazing at both pasture locations.

Grazing to different stubble heights resulted in utilization patterns that were detrimental to the plants in both the 6-inch and 2-inch levels of treatment. The heavily grazed pastures deteriorated simply because of the heavy and uniform grazing of all bluegrass plants, which depleted their competitive vigor and opened the stands to establishment of other species. On the other hand, the lightly grazed pastures were depleted in spots because grazing was not heavy enough for uniform use of all plants. In some areas of these pastures, the same plants would be heavily grazed to a short stubble height year after year, while adjacent plants were not grazed at all (Fig. 1). Utilization was also somewhat "patchy" in the 4-inch treatment, but the use was more uniform and the grazing was not concentrated on so few plants.

Relative vigor of plants in the 6-inch and 4-inch levels of grazing was similar. During the 7 years of study, leaf lengths averaged 4.24 inches on plants in the 6-inch level compared with 4.10 inches in the 4-

Table 2. Density changes (plant/ft²) with grazing intensity for Sherman big bluegrass and invading species, 1963, 1965.

| Grazing intensity | Big bluegrass | | | Invading species | | |
|---|---|---|---|---|---|---|
| | 1963 | 1965 | Average decrease | 1963 | 1965 | Average increase |
| 2-inch stubble | 2.12 | 1.47 | 0.65 | 1.01 | 4.39 | 3.38 |
| 4-inch stubble | 3.28 | 2.26 | 1.02 | .30 | 1.90 | 1.60 |
| 6-inch stubble | 2.47 | 2.04 | .43 | .74 | 2.72 | 1.98 |

inch treatment. Under the 2-inch level, leaf length averaged 3.64 inches.

Density of Sherman big bluegrass and other species established within or invading the stands was not measured when the study was started. Early in the drought in 1963, permanent 1 × 10-ft transects were placed in each of the pastures and plant densities recorded. At that time, density of big bluegrass was greatest on the pastures grazed to a 4-inch stubble height and least on those grazed to a 2-inch level (Table 2). Conversely, the most heavily grazed pastures had almost four times as many invading species as the medium grazing treatment. By 1965, invading species, primarily fringed sagebrush with a smaller number of trailing fleabane and hairy goldaster plants, had increased considerably. The pastures grazed to a 2-inch stubble had nearly 4.5 invading plants/ft² compared with about 2 plants in the 4-inch treatment and 3 plants in the 6-inch treatment. Although the number of big bluegrass plants decreased most in the 4-inch treatment, those pastures retained the most bluegrass plants and had the smallest increase in invaders.

### Comparisons with Other Species

The performance of Sherman big bluegrass may be compared with other seeded species that have been grazed experimentally at the Manitou Experimental Forest.[3] Since these other species were tested in an earlier series of years with different annual weather conditions, a year-to-year comparison would not be valid. It does appear reasonable, though, to compare means and relative performance of big bluegrass and the several species tested previously, because long-term climatic averages, including droughty years, were comparable for the two series of years in which the studies were made. Growing-season precipitation, for instance, which was important in growth and yield for all seeded species, averaged 10.52 inches with a low of 5.71 inches in the 12-year period of the early study, compared to 10.42 inches and a low of 6.36 inches during the 7-year period in which big bluegrass was grazed.

[3] Currie, Pat O., and Dwight R. Smith. Response of seeded ranges to different grazing intensities in the ponderosa pine zone of Colorado. (In preparation for publication, Rocky Mountain Forest and Range Exp. Sta., U. S. Forest Serv., Fort Collins, Colo.)

Table 3. Average forage production of seeded ranges (lb/acre) in relation to grazing intensity.[1]

| Species | Stubble heights (inches) | | |
|---|---|---|---|
| | 2 | 4 | 6 |
| Crested wheatgrass | 1196 | 1270 | 1264 |
| Smooth brome | 674 | 755 | 787 |
| Mixture | 1335 | 1578 | 1479 |
| Intermediate wheatgrass | 557 | 894 | 907 |
| Russian wildrye | 638 | 894 | 875 |
| Big bluegrass | 1136 | 1394 | 1362 |

[1] Averages for bluegrass are for years 1959–65. Other species are 9- to 12-year averages from 1949–60.

The noticeable feature of big bluegrass was its early grazing readiness. It was usually 4 inches tall between April 20 and 27, the same readiness date as that of Russian wildrye (*Elymus junceus* Fisch.), a notably early growing species, and 15 to 20 days earlier than for crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.), intermediate wheatgrass (*A. intermedium* (Host) Beauv.), or smooth brome (*Bromus inermis* Leyss.). In addition, bluegrass pastures provided late fall grazing and often grew some in the winter, as reported by Hyder and Sneva (1963). In 1961, for example, grazing began on April 20, and the pastures were grazed continuously until October 31, when utilization objectives were reached and cattle were removed. By mid-November, plants on the production plots which were clipped to the ground level at the time grazing terminated had regrown and attained a height of between 3 and 4 inches.

A mixture of crested wheatgrass and smooth brome produced from 100 to 200 lb/acre more forage than big bluegrass at the different grazing intensities (Table 3). Crested wheatgrass grazed to 2-inch stubble produced an average of 60 lb/acre more forage than big bluegrass grazed comparably. In these earlier tests, grazing to a 2-inch stubble height was concluded to be optimum or proper use. With big bluegrass, grazing to a 4-inch stubble height was best and this treatment produced an average of 59 lb more forage than the 2-inch treatment on the mixture and almost 200 lb/acre more forage than crested wheatgrass.

For other species or treatments, big bluegrass pastures produced from as little as 92 lb/acre more forage than the crested wheatgrass grazed to a 6-inch level, to as much as 639 lb more than smooth brome pastures grazed to a 4-inch level. Presumably, the consistently higher production of the mixture pastures resulted from their higher fertility, which was brought about by planting yellow blossom sweetclover (*Melilotus officinalis* (L.) Lam.)

**Table 4. Average daily gain and gain per acre (pounds) of yearling heifers on seeded ranges.**

| Species | Daily gain | Gain per acre |
|---|---|---|
| Crested Wheatgrass | 1.67 | 59.2 |
| Smooth Brome | 1.52 | 40.2 |
| Mixture | 1.81 | 71.6 |
| Intermediate Wheatgrass | 1.92 | 52.3 |
| Russian Wildrye | 1.53 | 48.8 |
| Sherman Big Bluegrass | 1.71 | 78.3 |

in the mixture when the stands were initially established. This effect of improved fertility was observed for both herbage production and animal gains throughout the earlier study.

Daily gains of yearling heifers from big bluegrass grazed to the 4-inch level, averaged 0.10 lb/day less than those from the mixture and approximately 0.20 lb less than from intermediate wheatgrass. Gain per acre from big bluegrass, however, averaged from 6.7 lb more than from the mixture to 38.1 lb more than from smooth brome (Table 4). Thus, in terms of total beef production, Sherman big bluegrass rated well with the mixture and was superior to the other species tested.

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