Influence of Grazing on Crude Protein Content of Blue Grama

D. W. URESK AND PHILLIP L. SIMS

Highlight: *Grazing intensities of light, moderate, and heavy by cattle did not affect the protein content of blue grama herbage in northeastern Colorado. Crude protein content of live herbage changed with phenological development and with season, but no change occurred in dead herbage. During the early vegetative growth period, a high of 18% crude protein occurred in the plant tissues. Additional precipitation during the growing season did not appear to affect the content of protein in herbage.*

Blue grama (*Bouteloua gracilis* (H.B.K.) Lag. ex. Steud.) is the most important forage species within the shortgrass ecosystem of the Great Plains in the United States. However, its crude protein content changes with season and plant maturity. These changes have been reported by Clarke and Tisdale (1945) in Alberta and Saskatchewan, Runyon (1943) in Kansas, Fudge and Fraps (1945) working in Texas, Vorachek (1966) and Sims et al. (1971) in Colorado. Little data on the influence of grazing on the protein content of blue grama herbage have been reported.

This paper reports seasonal and annual changes in crude protein content of blue grama under three grazing intensities on the shortgrass range in northeastern Colorado.

Study Area and Procedures

The study was located within a shortgrass ecosystem on the Pawnee National Grassland and the Central Plains Experimental Range about 8 miles NE of Nunn, Colorado. The climate of the area is semiarid with an average annual precipitation of 31 cm, ranging between 11 cm and 58 cm during the period of 1939 to 1967 (Bement, 1968). The frost-free season averaged 135 days.

Cattle were used to maintain three grazing intensities (light, moderate, and heavy) on the shortgrass prairie between May 1 and September 30 each year since 1939 (Kipple and Costello, 1960). The number of cattle was regulated so that 60% of the current herbage growth of the dominant forage grasses was grazed at the end of the season under heavy use, 40% under moderate use, and 20% under light use. A fourth treatment consisted of areas excluded from grazing by cattle since 1939.

Two replicates on each of the three grazing intensities and the no-grazing treatment were sampled during 1969 and 1970 (Uresk et al., 1975). Blue grama herbage was clipped from each replicate by treatments and analyzed for crude protein. Only the combined live and dead herbage was analyzed in 1969. In 1970, live (green portion) and dead (tan portion) blue grama herbage was separated and analyzed separately in addition to analysis of the combined live and dead herbage.

The samples of blue grama herbage were dried at 65°C in 1969 and at 50°C in 1970 in a forced-air oven for 48 hours. the samples were ground through a Wiley mill and a 1-mm sieve. A subsample was ashed in a muffle furnace for 4 hours at 650°C, and protein values were corrected to an ash-free basis. The live, dead, and combined live and dead standing vegetation were analyzed for Kjeldahl nitrogen according to the procedure outlined by Assoc. Offic. Agr. Chem. (1965), and crude protein was determined by N X 6.25. Statistical analysis followed Snedecor and Cochran (1971) for analyses of variance.

Results and Discussion

In both 1969 and 1970, the average content of crude protein for combined live and dead herbage of blue grama did not respond ($P \cong 0.34$ in 1969 and $P \cong 0.13$ in 1970) to grazing when comparing the four treatments—ungrazed, light, moderate, and heavy grazing. Average crude protein content for each of the four treatments was 7, 8, 7, and 8%, respectively. The crude protein content (mean of four treatments) increased from a seasonal low in 1969 of 5% on March 27 when blue grama was in the dormant stage to a high of 10% on June 30 when the herbage was in the early stages of flowering (Fig. 1). After June 30, the protein content progressively decreased to 6% on December 16 when blue grama was dormant (Table 1). In 1970 crude protein increased from a low of 7% on April 9 to a high of 9% on June 1 when the plants were in the early vegetative stage of development, and then decreased during the remainder of the sampling season (Fig. 1).

The percent of crude protein in live blue grama herbage during 1970 averaged 10% for all treatments and dates. Average percentages of protein were much higher in the live herbage, especially during the early part of the growing season, than in the dead herbage (Table 2). Grazing intensity had no significant effect ($P \cong 0.35$) on the percentage of protein present in live blue grama herbage in a comparison of the four treatments. Average percentage crude protein was 10, 10, 9, and 11% for none, light, moderate, and heavy grazing, respectively. Significant differences ($P \cong 0.001$) were observed in the protein content of live blue grama herbage with changes in phenological development. A high was recorded on May 5 (18%) during the early vegetative growth with a low on September 8 (8%), prior to frost when blue grama was in a semidormant stage (Fig. 1). The high protein content of 18%

Table 1. Crude protein content (% ± SE) of combined live and dead blue grama herbage in 1969 (mean of four treatments by dates).

Date	Protein content
Mar. 27	5.1 ± 0.3
May 18	9.2 ± 0.4
June 21	9.2 ± 0.3
June 30	9.6 ± 0.3
July 14	8.1 ± 0.3
July 29	7.8 ± 0.3
Aug. 11	7.1 ± 0.3
Aug. 24	6.5 ± 0.3
Sept. 8	6.7 ± 0.2
Oct. 25	6.1 ± 0.2
Dec. 16	6.0 ± 0.4

Authors are graduate research assistant and associate professor, Department of Range Science, Colorado State University, Fort Collins. The senior author at present is research scientist, Ecosystems Department, Battelle-Northwest, Richland, Washington 99352.

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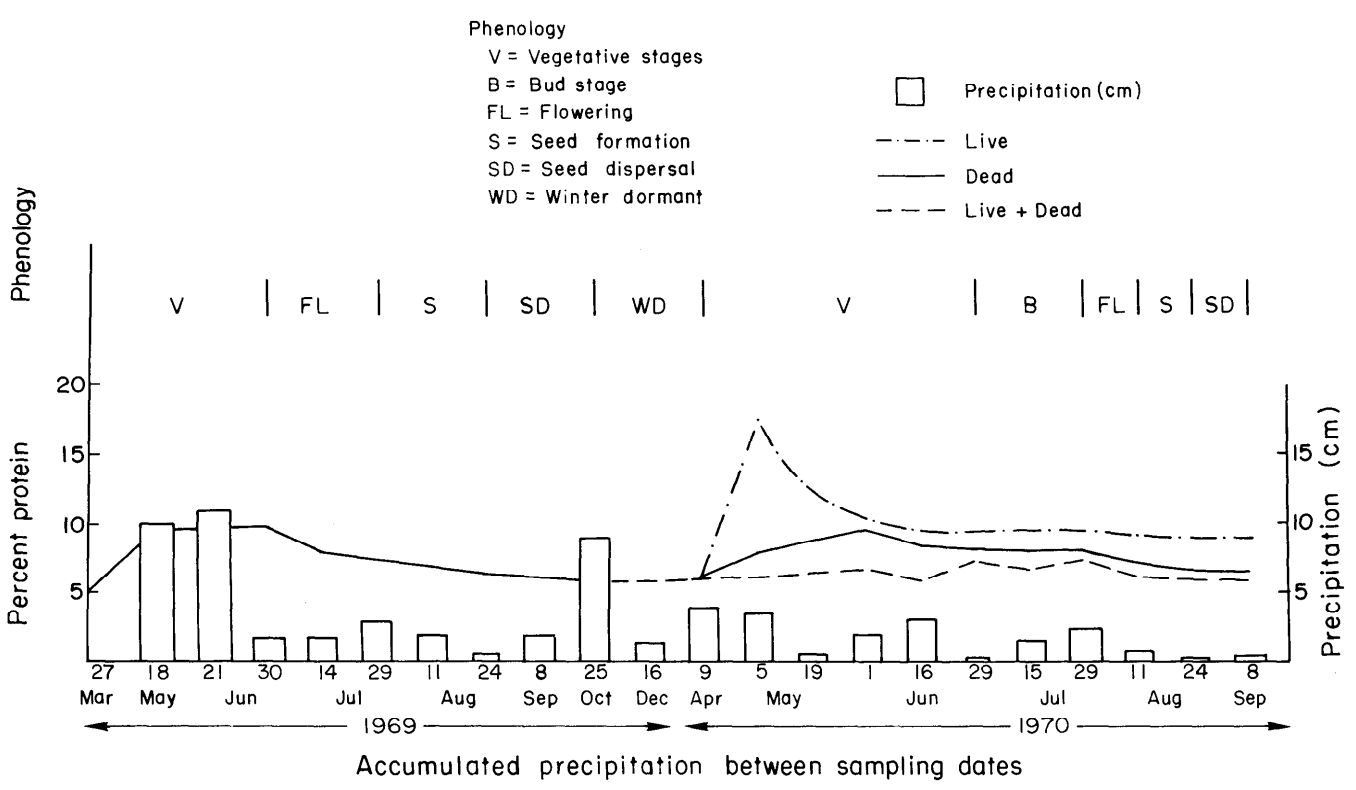

Fig. 1. *Seasonal and annual changes in protein content of blue grama herbage in relation to phenology and precipitation.*

during the early vegetative stage of growth indicates a high uptake of nitrogen by the young plants in relation to the amount of herbage present.

A mean of 7% protein was found in dead herbage (mean for treatments and dates combined). Protein in dead herbage was not influenced ($P \cong 0.75$) by grazing. Thus, intensity of grazing had no effect on the protein content of herbage. The content of crude protein did not change with season in the dead vegetation.

Comparison of the percent crude protein in combined live and dead herbage showed no differences ($P \cong 0.22$) between the 2 years, with an average of 7% in 1969 and an average of 8% in 1970. Peak standing crop of combined live and dead was 50 g/m^2 in 1969 as compared to 55 g/m^2 in 1970, so total amount of crude protein may not have differed. Bokhari and Singh (1974) in a nitrogen synthesis of prairies found nitrogen to decrease with increasing precipitation showing a dilution effect. The amount of precipitation during the growing season of 1969 was approximately 9 cm higher than that of 1970, but did not appear to influence the amount of crude protein or the amount of standing crop for both years (Uresk, 1971). Thus, the amount of protein produced per acre did not increase with increased precipitation. These results indicate that the crude protein content of blue grama herbage was not influenced by grazing. However, the protein content in the herbage changed with plant maturity during both years.

Table 2. Crude protein content (% ± SE) of live, dead, and live + dead blue grama herbage in 1970 (mean of four treatments by dates).

Date	Protein content		
	Live + dead	Live	Dead
Apr. 9	6.6 ± 0.4	– –	6.6 ± 0.4
May 5	7.9 ± 0.5	18.1 ± 0.4	6.3 ± 0.4
May 19	8.8 ± 0.5	13.2 ± 0.7	6.6 ± 0.4
June 1	9.4 ± 0.4	10.9 ± 0.5	6.6 ± 0.4
June 16	8.9 ± 0.3	10.0 ± 0.3	6.4 ± 0.4
June 29	8.3 ± 0.2	9.2 ± 0.3	7.3 ± 0.4
July 15	8.3 ± 0.3	8.8 ± 0.3	6.8 ± 0.4
July 29	8.4 ± 0.3	8.8 ± 0.3	7.3 ± 0.4
Aug. 11	7.8 ± 0.3	8.6 ± 0.4	6.3 ± 0.4
Aug. 24	7.6 ± 0.3	8.3 ± 0.3	6.3 ± 0.4
Sept. 8	6.9 ± 0.3	7.8 ± 0.3	6.2 ± 0.3

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