Commercial Fertilizers Influence Crude Protein Content of Four Mixed Prairie Grasses[1]

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Highlight

Nitrogen applied at 33, 100, and 300 lb/acre, alone and with phosphorus, increased crude protein content of blue grama, buffalograss, windmillgrass, and silver bluestem. Addition of nitrogen caused a retention of protein above the level recommended for wintering pregnant beef cows in blue grama, buffalograss, and windmillgrass. Phosphorus fertilization failed to significantly increase protein content or retention.

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The majority of studies involving fertilization of native rangeland have beeen conducted in humid areas. The increase in forage yield has been the established criterion for success in these fertility experiments.

Results of fertilizer experiments on the rangelands of the Great Plains of the United States have illustrated great variance in forage yield with environmental factors. However, in most studies, crude protein content of fertilized range grasses appeared to increase independently of yield and was apparently less affected by environmental factors than was the increase in dry weight (Clark and Tisdale, 1945; Kapp, Smith, and Potts, 1949; Williams, 1953; Carter, 1955; Rogler and Lorenz, 1957; Klages and Asleson, 1959; Klipple and Retzer, 1959; Huffine and Elder, 1960; Taylor and Rudman, 1960; Casper and Thomas, 1961; Mason and Miltimore, 1964).

Taylor and Rudman (1960) noted that nitrogen fertilization increased protein contents of forage throughout a portion of the winter. Other investigators have noted that weathering or leaching of protein from mature grass plants is a primary cause of low value winter forage (Fudge and Fraps, 1945; Williams, 1953).

This paper reports the influence of nitrogen and phosphorus fertilization on crude protein content of four mixed prairie grasses during the winter weathering period.

Methods and Procedures

Two replications of each of 10

fertilizer treatments were established on grass stands dominated by blue grama (*Bouteloua gracilis* H.B.K.), buffalograss (*Buchloe dactyloides* Nutt.), windmillgrass (*Chloris verticillata* Nutt.), and silver bluestem (*Andropogon saccharoides* Swartz) respectively. These four grass stands were common on the research area, the Texas Technological College Research Farm, Pantex, Texas, and represented large areas of rangeland on the Southern Mixed Prairie.

The 10 fertilizer treatments were:

N_1	33 lb N/acre
N_2	100 lb N/acre
N_3	300 lb N/acre
P_1	33 lb P/acre
P_2	100 lb P_2O_5/acre
P_3	300 lb P_2O_5/acre
N_1P_1	33 lb N
	33 lb P_2O_5/acre
N_2P_2	100 lb N
	100 lb P_2O_5/acre
N_3P_3	300 lb N
	300 lb P_2O_5

and a control plot receiving no fertilizer.

Nitrogen was applied as pelleted 33% ammonium nitrate. Phosphorus was supplied from granulated 20% superphosphate. Fertilizer was broadcasted over grass stands in June, 1963.

Leaves and culms of each grass were collected from each treatment on September 1, October 1, November 7, and December 29, 1963, and March 7, 1964. These samples were dried immediately and the protein content of each determined by the Kjeldahl method (A.O.A.C., 1950). Differences between treatments were tested by analysis of variance and Duncan's multiple range tests.

Results

Differences between grasses.—The four grasses selected showed a decline in crude protein content throughout the study period (Fig. 1).

Silver bluestem was significantly lower ($P < .05$) in crude protein content than the other plants studied. September content of 6.6% was significantly higher than the October percentage of 3.0%. The November and December percentages of 2.5% and 2.6% were significantly lower than the October percentage and the March content of 3.0%. The increase in the spring protein level was caused by green re-growth in protected portions of the grass clone.

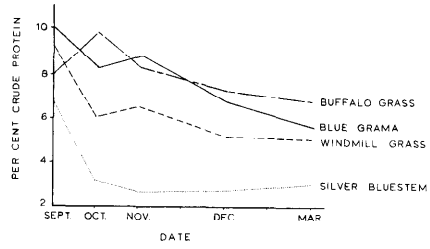

FIG. 1. Percent crude protein of four grasses September - March.

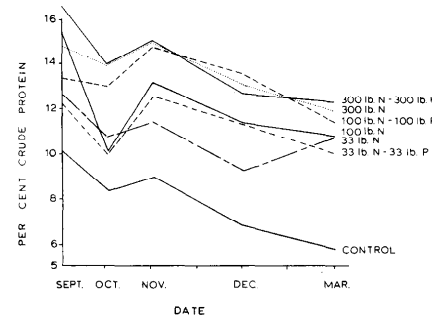

FIG. 2. Percent crude protein of treated blue grama from September - March.

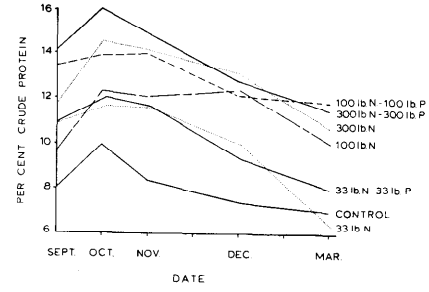

FIG. 3. Percent crude protein of treated buffalograss from September - March.

Windmillgrass varied from 9.3% protein in September to a low of 5.1% in March. The protein percentages in September, October, and November were significantly different ($P < .05$) from each other and were all significantly different from the December and March dates. However, there was no significant decline in protein content from December to March.

Buffalograss contained 9.8% crude protein in October, compared to lesser amounts in September, November, December, and March. The higher ($P < .05$) amount in October was due to a late rain on the buffalograss area. The protein contents at all other months showed a steady decline from the high in October until sampling was terminated in March.

Blue grama exhibited a steady decline from fall to spring. The crude protein content in March of 5.7% was significantly less than that in September, 10.0%.

Influence of fertilizers.—Nitrogen, applied alone and in combination with phosphorus, increased protein content of grasses studied. Phosphorus applied alone did not increase protein content of treated grasses over the control plants.

All levels of nitrogen fertilization increased crude protein content of blue grama over the control throughout the study (Fig. 2). At the end of the weathering period, the control forage had significantly ($P < .05$) less protein than that receiving 33 lb N, 100 lb N, and 33 lb N and 33 lb P_2O_5/acre. Plants receiving 100 lb N and 100 lb P_2O_5/acre, 300 lb N/acre and 300 lb N and 300 lb P_2O_5/acre contained significantly greater crude protein contents than any others in the test. All treatments showed a seasonal decline similar to that of the untreated plants.

Crude protein percentage for buffalograss followed a pattern similar to that for blue grama (Fig. 3). However, in the case of buffalograss, the 33 lb/acre rate of nitrogen, alone or in combination with phosphorus, did not increase crude protein content significantly. All other levels of fertilization increased protein con-

tent significantly over the low level, but were not different from each other. Seasonal trends in protein loss from treated buffalograss was not different from the controls.

Protein content of windmillgrass increased as nitrogen application increased (Fig. 4). At the spring sampling date, the protein content of control plants, 5.1% was significantly lower than those receiving 33 lb N/acre, either alone or with phosphorus. Treatments receiving 100 lb N/acre were significantly higher than those receiving 33 lb, but were significantly lower than those receiving 300 lb N alone or in combination with phosphorus. Protein content of plants on all treatments declined at a constant rate throughout the study.

Silver bluestem responded differently to fertilizer treatments than the other grasses studied (Fig. 5). The plants receiving 300 lb N and 300 lb P_2O_5 had significantly more protein than all other treatments through the December date. There was little difference between the other treatments. There was an increase in protein content of samples from all fertilizer treatments in March due to new growth in the lower portions of the grass clump. Plants receiving phosphorus in addition to nitrogen increased in protein more rapidly than those receiving comparable levels of nitrogen alone.

Discussion

Nitrogen fertilization increased crude protein content of mixed prairie grasses, but additional phosphorus failed to significantly increase protein percentage. The increase in protein content generally increased as nitrogen levels increased.

Nitrogen fertilization reduced the effects of winter weathering on crude protein content. In all species, crude protein content of fertilized grasses declined at the same rate as untreated plants.

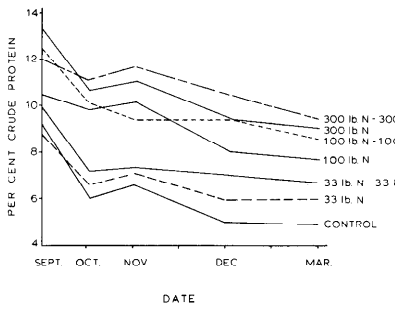

FIG. 4. Percent crude protein of treated windmillgrass from September - March.

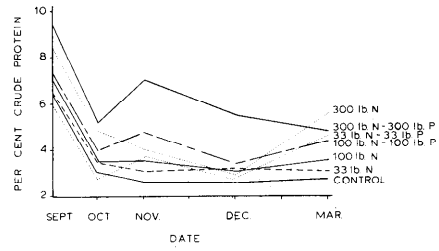

FIG. 5. Percent crude protein of treated silver bluestem from September - March.

Therefore, the main effect of fertilization was to increase the protein content of maturing plants. Although they lost about the same amount of protein to leaching, they remained higher in crude protein during the critical late winter grazing period.

Protein contents of blue grama, windmillgrass, and buffalograss from nitrogen treated plants remained above that recommended by animal nutritionists (National Research Council, 1958) throughout the winter and spring period. However, only those silver bluestem plants receiving 300 lb N and 300 lb P_2O_5/acre remained sufficiently high in protein to meet beef cow requirements for an extended period.

Although data on digestibility of the crude protein are lacking, range fertilization may offer a tool for increasing quality of forage and eliminating the need for winter supplementation of protein on mixed prairie ranges.

Summary

The influence of 10 fertilizer treatments on the protein content of blue grama, buffalograss, windmillgrass, and silver bluestem was studied on the Texas Technological College Research Farm, Pantex. These included nitrogen at 33, 100, and 300 lb/acre, P_2O_5 at 33, 100, and 300 lb/acre, and both nitrogen and phosphorus at the same levels.

All levels of nitrogen, either alone or with phosphorus, increased protein content over the controls. Phosphorus, at any level, when applied alone did not significantly influence protein content.

Nitrogen fertilization influenced protein content of grasses in the late winter through an increase in total protein. Buffalograss, windmillgrass, and blue grama remained sufficiently high in protein through March to meet wintering requirements of pregnant beef cows.

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