

TECHNICAL NOTES

The Effect of Nitrogen, Phosphorus and Potassium Fertilization on Chemical Content of Sheep Diets

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Abstract

Sixteen mixed breed sheep, 1-2 years old and fitted with esophageal fistulas, were allotted at random to four range pastures in southeastern South Dakota. Two of the pastures (4.9 and 5.3 ha) were treated with 67.2 kg of N, 33.6 kg of P, and 89.7 of K/ha, whereas the other two pastures (6.9 and 7.3 ha) received no fertilizer treatment. Esophageal extruded samples were collected at two time periods (June-July and August) from all animals in the four pastures. Ash, N, cellulose and energy content were determined on all extruded samples. Fertilizer treatment had no significant effect on the nutritive content of the diet selected by the sheep. However, time of collection had significant effects on the protein and energy content of the diet selected. A significant fertilizer-collection period interaction was observed for percentage of ash.

Measurement of the nutritional value of the diet of grazing animals is difficult. Grazing animals commonly have available to them a wide range of potential food in the form of different plant species, each with its particular physical and chemical characteristics and each with different densities and growth forms. From this available forage, the grazing animal exercises a high degree of selection, the mechanisms of which appear to be based on subtle chemical and physical differences affecting smell, taste and touch (Kreuger et al. 1974). The methods used for measuring the nutritional value of diets of grazing animals have been reviewed by Harris et al. (1967), Van Dyne (1969), and Theurer et al. (1976).

Because little information is available concerning the diets of grazing animals in South Dakota, the following experiment was conducted to determine the effect of N,P, and K fertilization of a lowland native pasture on the nutritional value of the diet of grazing fistulated sheep.

Experimental Procedures

The experiment was carried out on a range pasture in southeastern South Dakota. The climate is a continental type. The mean annual temperature is 6.5°C; the range in monthly mean temperature is from -11.3°C in January to 22°C in July. The mean temperature was 17.5°C during the first collection period and 22°C during the second. The average annual precipitation is 51.8 cm; of this, 41.4 cm or 80% fell during the growing season (April to September).

The experimental area was a native pasture with wet, poorly drained soils of the Solomon and Lamoure series (Westin et al. 1959). The most important plants in the pasture were bluegrasses (*Poa* spp.), red top (*Agrostis alba* L.), prairie cordgrass (*Spartina pectinata* Link),

wheatgrasses (*Agropyron* spp.), sedges (*Carex* spp.), and a variety of forbs. The pasture had been overgrazed for many years and was in poor range condition when rated according to the method of Dyksterhuis (1949).

Sixteen mixed-breed sheep, 1-2 years old and fitted with esophageal fistulas, were allotted at random to four range pastures. Two of the pastures (4.9 and 5.3 ha) were treated with 67.2 kg of N as ammonium nitrate, 33.6 kg of P as treble superphosphate, and 89.7 kg of K as potassium chloride/ha. The other two pastures (6.9 and 7.3 ha) received no fertilizer.

Experimental data were collected during two periods. Period 1 was in June-July, and period 2 was in August. In late July, all pastures were mowed for hay because the stocking rate of the sheep was not high enough to prevent the pastures, especially those fertilized, from maturing early. The herbage available during period 2 was consequently of higher nutritional value than that available during period 1 because pastures during period 2 had less mature forage and more young succulent growth.

Esophageal samples were collected on four mornings and four afternoons during each experimental period by means of plastic-lined, screen-bottom bags strapped to each animal's neck. A representative subsample of each esophageal sample collected was frozen for chemical analyses at a later date. Dry matter determinations on all samples were made by drying them at 60°C for 48 hours in a forced-air oven. Representative samples of the dried material were analyzed in duplicate for N, energy, and ash using standard procedures (A.O.A.C. 1960). Energy content of composite duplicates was determined in a Parr Adiabatic Bomb Calorimeter¹. Cellulose was determined in duplicate by the method of Crampton and Maynard (1938).

Analyses of variance using least squares procedures were conducted on all measurements (Harvey 1960).

Results and Discussion

Ash Content of Esophageal Extrusa

The over-all mean value of the esophageal extrusa ash content was 12.5% on an oven-dry basis (Table 1). The ash content was higher in the diet selected by the sheep grazing the unfertilized pastures than in those grazing the fertilized pastures in June (12.6 vs 11.2%) but was higher (13.5 vs 12.8%) in the diet of the sheep grazing the fertilized pastures in August ($p < 0.05$, Table 1). The mean ash content values were greater in August than in June. This finding agrees with data reported by Van Dyne and Heady (1965), who found that sheep grazing dry annual ranges selected forage higher in ash content in August and September than in July.

Protein Content of Esophageal Extrusa

The over-all mean protein content of the esophageal extrusa was

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Table 1. Means of esophageal extrusa chemical components.

Period and treatment	Ash oven dry (%)	Protein (%)	Cellulose, (%) organic matter	Energy, (Kcal/g organic matter)
June				
Unfertilized	12.60 ^{ab}	14.89 ^{ab}	28.63 ^a	4.51 ^{ab}
Fertilized	11.16 ^{a*}	16.33 ^{ab}	28.05 ^a	4.60 ^{ab}
Mean	11.88 ^{ab}	15.61 ^{a**}	28.34 ^a	4.56 ^{a*}
August				
Unfertilized	12.80 ^{ab}	18.38 ^{ab}	26.83 ^a	4.72 ^{ab}
Fertilized	13.52 ^{b*}	20.64 ^{ab}	24.73 ^a	4.69 ^{ab}
Mean	13.16 ^{ab}	19.51 ^{b**}	25.78 ^a	4.72 ^{b*}
Unfertilized mean	12.70 ^{ab}	16.64 ^{ab}	27.73 ^a	4.62 ^{ab}
Fertilized mean	12.34 ^{ab}	18.49 ^{ab}	26.39 ^a	4.65 ^{ab}
Over-all mean	12.52 ^{ab}	17.57 ^{ab}	27.06 ^a	4.64 ^{ab}

Data with different letters as superscripts are significantly different.

* $p < 0.05$

** $p < 0.01$

17.6% protein on an organic matter basis (Table 1). The highly significant difference ($p < 0.01$) found between collection periods (Table 1) in the protein content of the forage selected by the sheep is to be expected. After mowing in late July, regrowth occurred in all pastures, and the sheep selected a higher protein diet than in June when the pastures were long. This finding is a reversal of the usual trend of a decline in protein intake with advancing date of harvest. Van Dyne and Heady (1965) found that the protein content of the diet selected by sheep on dry annual range was higher in early summer than in later summer. However, the data in this study included the effects of fertilization and mowing.

In both collection periods, the protein percentage of the esophageal extrusa was highest from sheep grazing the fertilized pastures than from sheep grazing the unfertilized pastures (Table 1). Woolfolk et al. (1975) reported similar data for cattle grazing nitrogen-fertilized bluestem ranges.

Cellulose Content of Esophageal Extrusa

The mean cellulose percentage of the diet selected by the sheep was 27.1% on an organic matter basis (Table 1). In comparison, Cook et al. (1965) found that the cellulose content of the diet of sheep grazing good summer range pasture was 25% on an organic matter basis. There was no significant differences due to fertilization or to collection periods. Woolfolk et al. (1965) reported that N fertilization had no effect on the cellulose content of the diet selected by esophageal fistuled cattle grazing bluestem ranges. Grimes (1967), however, found that the cellulose content was lower on N fertilized pastures than on pastures not fertilized with N.

Energy Content of Esophageal Extrusa

The mean energy content of the diet selected by the sheep was 4.6

Kcal/g on an organic matter basis (Table 1). This value is somewhat lower than the 4.9 Kcal/g in July and 4.7 Kcal/g in August (assuming 12% ash) reported by Van Dyne and Heady (1965) for sheep grazing dry annual range. The diet selected by sheep in June was 0.16 Kcal/g lower in energy content than that selected by the sheep in August ($p < 0.05$, Table 1). Van Dyne and Heady (1965) reported contrasting data for sheep on dry annual summer range. However, the cutting of the pasture in late July influenced the results reported here.

In conclusion, it may be stated that under the conditions of this study, no significant effect of fertilizer treatment on the nutritive content of the diet selected by grazing sheep was found. Time of collection, however, did have a highly significant ($p < 0.01$) effect on the protein content and a significant ($p < 0.05$) effect on the energy content of the diet selected. A significant ($p < 0.05$) fertilizer-collection period interaction was observed for percentage ash.

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