EFFECT OF SUPERPHOSPHATE APPLICATION ON THE NUTRITIVE VALUE OF STYLOSANTHES SPP.- NATIVE GRASS PASTURE FOR CATTLE. 2. NUTRITIVE VALUE OF THE DIET SELECTED

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SUMMARY

A study was made on the effect of superphosphate fertilizer on digestibility of OM and CP in diets selected by cattle grazing Stylosanthes-native grass pastures during the wet, wet-dry transition and dry seasons. Fertilizer application had significant (P(0.01) effects on intakes of DOM and CP and on faecal CP only during the wet season. There were marked seasonal effects on most parameters with a decline in nutrients consumed throughout the year for both unfertilized and fertilized pastures. DOMI from fertilized pastures would support high levels of production during the wet season and should maintain live weight in the dry. Adequacy of N supply during the dry is not clear; use of relationships obtained with sheep fed temperate forages does not clarify the matter. The need to derive predictive relationships for cattle grazing tropical pastures is discussed. Keywords: Stylosanthes, superphosphate, nutritive value, cattle .

INTRODUCTION

Greater beef cattle production can be achieved from Stylosanthes-native grass pastures when they are fertilized with superphosphate (Edye et al. 1971, Winks et al. 1974). In studies with Stylosanthes-grass pastures in Northern Territory, McLean et al. (1981) found that superphosphate applications both increased the content of legume in the forage and the preference of cattle for the fertilized herbage. These findings have been investigated in a study on the effects of superphosphate application on the botanical and chemical composition of Stylosanthes-native grass pastures and the nutritive value of the diets selected by grazing cattle during the wet, wet-dry transition and dry seasons. In the previous paper, Gardener et al. (1988) reported that superphosphate increased total dry matter (DM) yield and improved chemical composition of forage on offer and that intake of most constituents was greater from fertilized pastures in all seasons. Further, they found that the proportion of legume in the fertilized pastures was less than in the unfertilized pastures (14-26% versus 45-49%). They indicated that any increased liveweight gain might be associated with increased intakes of phosphorus (P) and digestible organic matter (DOM).

This paper presents preliminary results from the study on effects of superphosphate application and season on digestibility of organic matter (OM) and crude protein (CP) in the diets selected by grazing cattle with an aim to determining the adequacy of the pastures to meet the NH3 needs of rumen microbes and to provide amino acids for body tissues.

MATERIALS AND METHODS

The work was undertaken at "Lansdown", CSIRO Pasture Research Station, 50 km south of Townsville. The Stylosanthes-native grass pastures (Gardener et al. 1988) were established in 1974 by sowing a mixture of Stylosanthes species into the native perennial grass (Heteropogon contortus, Themeda triandra and Bothriochloa sp.) pasture. Eight 0.5 ha paddocks were created to give 4 replicates of the 2 fertilizer treatments (with and without 300 kg superphosphate/ha annually).

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Yearling steers (replaced annually) grazed the pastures at a rate of one beast/ha from 1977 to 1980.

Four 5-year old (450 kg LW) Brahman X Shorthorn bullocks with rumen and oesophageal fistulae were used to measure the nutritive value. Measurements were made during three 4-week periods, April 1979, August/September 1979 and February 1980, chosen to represent the wet-dry transition, dry and wet seasons respectively. Each paddock was grazed for one week, twice during each period.

Oesophageal fistula extrusa samples were collected from animals grazing each pasture at three times (0600, 0900 and 1600 h) on the last day of each sampling week giving 24 samples per treatment per period (3 collections x 2 animals x 4 paddocks). Samples were dried (70°C), ground (1 mm screen) and analysed for OM, nitrogen (N) and in vitro DOM. For each pasture, faecal output was estimated from each animal once per period (8 observations per treatment) using the marker ratio technique following intra-ruminal infusion of Cr-EDTA from portable pumps harnessed to each animal (Corbett et al. 1976). Grabbed faecal samples collected twice daily for 5 days were bulked by animal, dried (70°C), ground (1 mm screen) and analysed for OM and N. Faecal output and in vitro digestibility were used to calculate intake. Twice daily for 2 days each week, strained rumen fluid was collected from several sites within each animal, immediately acidified and stored frozen until bulked by animal for analysis for ammonia-N (NH_3-N). Data were analysed for difference by ANOVA.

Intestinally digested CP (DCPi) was calculated as the difference between the CP leaving the stomach and faecal output of CP of dietary origin. CP leaving the rumen (g/day) was calculated as 36 g/100 g CP intake + 16 g/100 g digestible OM intake (DOMI) (Hogan and Weston 1981) while it was assumed enogenous CP added at the abomasum was 30 g/day. Faecal metabolic N was considered to be 1.0 g/kg OM intake (Weston and Hogan 1968).

RESULTS

Superphosphate application significantly increased DOMI, CP intake and faecal CP only during the wet season (Table 1). There were marked seasonal effects on most parameters. DOMI from fertilized pastures was very high during the wet season then fell by 34% to the wet-dry and a further 12% by the dry period. However, unfertilized pastures were poor in the wet but improved slightly (8%) by the wet-dry transition then declined by 33% to the dry. Faecal CP declined throughout the year to reach 10.5 and 9.8 g/100 g DM during the dry season for unfertilized and fertilized pastures respectively. Apparent CP digestibility fell sharply from the wet to dry seasons in both treatments.

Rumen liquor NH -N levels (Table 1) were significantly greater in animals grazing fertilized pastures during the wet season, however, for both treatments levels were below 45 mg/l during the dry season. Patio of DOM:CP in the diet, an indication of adequacy of dietary N supply, was similar for both treatments and increased from the wet to dry season (Table 1). Despite large changes in CP digestibility between seasons, amount of protein calculated to be digested in the intestines (DCPi) was less affected. An indication of the relative supplies of amino acids and energy, the ratio of DCPi:DOMI, was unaffected by fertilizer treatment (Table 1) and fell from 0.17:1 in the wet to 0.12:1 in the dry.

DISCUSSION

The major effect of superphosphate fertilizer application was to increase the intake of DOM and CP and to elevate rumen NH -N concentrations during the wet season. No other digestion parameter was affected; DOM:CP ratios were similar for

Table 1. Measured and calculated parameters of digestion of organic matter (OM) and crude protein (CP) in the stomach and intestines of cattle grazing Stylosanthes - native grass pastures, without (U/f) and with superphosphate fertilization (F) during the wet, wet-dry and dry seasons

	Wet		Wet-dry		Dry	
	U/f	F	U/f	F	U/f	F
DOMI (g/day)	3398	6125**	3666	3973	2284	3323
Intake CP (g/day)	939	1664**	1016	931	304	429
Faecal CP (g/day)	366	631**	533	597	237	311
(g/100 g DM)	12.7	16.4*	15.4	16.1	10.5	9.8
CP digestibility (%)	61.1	62.1	47.6	35.9	22.0	27.5
Dietary DOM:CP (g/g)	3.5	3.7	3.6	4.4	7.1	7.7
Rumen NH_3-N (mg/l)	52	105*	63	80	30	37
DCPi:DOMI (g/100 g)+	17.1	17.4	13.1	11.5	12.8	12.4

* Means within seasons differ significantly. *=P<0.05; **=P<0.01
+ See text for calculations and assumptions

both treatments as were calculated ratios of DCPi:DOMI indicating that dietary N supply and amino acid uptake were unaffected by fertilizer application. Although fertilizer increased levels of CP and minerals (particularly P), these results suggests that the major effect of superphosphate at "Lansdown" was to increase the supply of energy to the animal during the wet season.

Season had a far greater effect than fertilizer on total intake of nutrients throughout the year. With the limitations of P supply removed, cattle responded with remarkedly high intakes of DOM during the wet season. Although there was a tendancy for higher DOMI with improved P supply during the other seasons, the effect was not so pronounced suggesting that other factors must be limiting intake. The most obvious factors are the supply of NH_3 to the rumen microbes and the supply to the tissues of amino acids relative to energy.

Rumen NH_3 levels should have been adequate on the criteria of Winks and Laing (1972) as faecal CP concentrations were greater than 8% in all seasons indicating no need for additional sources of rumen degradable protein. However the requirements of microbes for NH_3 in the present conditions are not clear. Boniface et al. (1986) found that maximum DM fermentation of Spear grass (Heteropogon contortus) occured at rumen NH_3-N concentrations of 45 mg/l, but feed intake increased up to 140 mg/l. Similar observations have been reported by Krebs and Leng (1984) and Kennedy et al. (1987). The NH_3 data in the present experiment suggest clear inadequacy in the dry season but apparently much better status in the other two seasons. There is a need for more detailed studies in this area, especially of the effect of depressed NH_3 levels at different times in the 24 hours.

The situation is not helped by prediction of NH_3 levels from DOM:CP ratio. This relationship is a useful predictor with sheep fed temperate forages (Hogan 1982) and indicates a linear decline in NH_3 levels from 150 to 10 mg/l between DOM:CP ratios of 4:1 and 10:1. The present data show no such relationship. Indeed Romero and Murray (1980) found, for sheep fed Spear grass with a DOM:CP ratio of 11:1, rumen NH_3 levels of 40 mg/l; the same levels have been observed with other tropical forages with DOM:CP ratios as low as of 4:1 (J.P. Hogan pers. comm.). It

has been suggested (Morrison et al. 1988) that the provision of additional NH_3 is associated with extra microbial protein synthesis. If this is so it might be expected that in the dry season, feed intake from both pastures would respond to extra urea through the additional supply of amino acids to the tissues.

The situation regarding requirements for amino acids by cattle grazing tropical pastures however, is not well defined. Maximum feed intake and body growth were observed with lambs when DCPi:DOMI exceeded 0.17: 1 (Weston 1971), but corresponding data for cattle are not available. Using relationships derived for sheep consuming temperate forages (Hogan and Weston 1981), it appears that both pastures provided adequate amino acids for maximum growth during the wet season. However, wet-dry and dry season DCPi:DOMI ratios of 0.12 to 0.13:1 indicate possible deficiency of amino -acids available for the tissues at this time. Mullins et al. (1984) obtained production responses to the supply of protected protein, but the mechanism involved, increased feed consumption or improved efficiency of use of available energy or both, remains to be elucidated.

The above calculations indicate the shortcommings of applying relationships derived with sheep fed temperate'forages to cattle fed tropical forages and highlight the urgent need to develop suitable predictive equations for the latter.

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