EFFECT OF SUPERPHOSPHATE APPLICATION ON THE NUTRITIVE VALUE OF STYLOSANTHES SPP.- NATIVE GRASS PASTURE FOR CATTLE. 1. COMPOSITION OF THE DIET SELECTED.

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SUMMARY

This paper presents preliminary data on diet selection of cattle grazing Stylosanthes-native grass pastures, either unfertilized or fertilized with superphosphate. Total DM yield and chemical composition of forage on offer were improved and intake of most constituents greater from fertilized pastures in all seasons. Fertilizer encouraged growth of the grass component, the legume content of these pastures being 26% or less compared to 45% or more for unfertilized pastures in all seasons. Legume content of the pasture largely determined the frequency of legume in the diet,and availability could explain the differences, in botanical composition of the diets. Changes in chemical composition of forage from the wet to dry seasons reflected increasing plant maturity, with levels of N, P, S and DOM decreasing appreciably. Selected diets showed similiar trends,but contained more than twice the N, up to 38% more P and were 5 units more digestible. Keywords: Stylosanthes, superphosphate, diet selection, cattle

INTRODUCTION

In the semi-arid tropics of northern Australia large increases in animal production have been achieved by sowing pastures with Stylosanthes together with the application of superphosphate (Gillard and Winter 1984). The animal production from unfertilized Stylosanthes-grass pastures is frequently no better than from unfertilized native grass pastures (Winks et al. 1977).

The mechanisms by which, superphosphate increases animal production are important. If the increases are due to improved supply P, S and Ca through the plant to the animal, then it would be cheaper to provide these minerals directly to the animal via supplement. However, if the superphosphate has indirect effects such as increases in herbage production, legume yield, N content of the legume, herbage digestibility or preference for more nutritious species, then similar effects can not be achieved by feeding supplement.

In a study of Stylosanthes-grass pastures with and without 'fertilizer at 'Lansdown', liveweights of steers immediately diverged and those on fertilized pasture made 3 times the liveweight gain (LWG) over the year (33 vs 99 kg/ha;. Gardener 1979). In this experiment, we studied the effects of superphosphate on yield and composition of the pastures, composition and nutritive value of the diet and the voluntary intake of steers. Preliminary results are presented here.

MATERIAL AND METHODS

A native perennial grass (Heteropogon contortus, Themeda triandra and Bothriochloa sp.) pasture at Landsdown Research Station, 50 km south of Townsville was subdivided into eight 0.5 ha paddocks and oversown in 1974 with a mixture of Stylosanthes species.' The paddocks were either unfertilized or, received 300 kg superphosphate/ha annually. They were grazed from 1977 to 1980 by yearling steers (replaced annually) at a rate of one beast/ha.

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Measurements were made during 1979 and 1980. Annual rainfalls were 665 and 637 mm respectively which was almost entirely restricted to December-March (annual mean 850 mm). Pasture yield and chemical composition were determined in each period from twentynine quadrats (0.5 X 0.5 m) per paddock. Samples were divided into eight components - green and dry X leaf and stem X legume and grass. Components were dried at 70°C, weighed for dry matter (DM) yield, ground (1 mm screen) and analysed for organic matter (OM), nitrogen (N), phosphorus (P), sulphur (S) and in vitro digestible OM (DOM). The values for nutrient concentration were weighted according to quadrat dry weight and the means analysed for difference by ANOVA.

Four 5-year old (450 kg LW) Brahman X Shorthorn bullocks with rumen and oesophageal fistulae were used to measure dietary selection. Three 4-week periods, April 1979, August/September 1979 and February 1980, were chosen to represent the wet-dry transition, dry and wet seasons respectively. Each paddock was grazed for one week, twice during each period. Dietary samples were collected from animals on each pasture at three times (0600, 0900 and 1600 h) on the last day of each sampling week giving a total of 24 samples per treatment per period (4 paddocks X 2 animals X 3 collections). Phosphorus was corrected for salivary contamination using ^{32}P (Little 'et al. 1977). Botanical composition and plant fraction frequency were determined microscopically (Heady and Torell 1959). Samples were then dried (70°C), ground (1 mm screen) and analysed for OM, N, P, S and in vitro DOM. Faecal output was estimated from each animal once per period (8 observations per treatment) for each pasture using the marker ratio technique following intraruminal infusion of Cr-EDTA from a portable peristaltic pump (Corbett et al. 1976) harnessed to each animal. Grabbed faecal samples collected twice daily for 5 days were bulked by animal, dried (70°C), ground (1mm screen) and analysed for OM, N, P and s. Intake was calculated from faecal output and in vitro digestibility. Data were analysed for difference by ANOVA.

RESULTS

Superphosphate significantly ($P<0.01$) increased both total dry matter and amount of grass in the pasture. The unfertilized pasture had a higher proportion of legume and this was reflected in higher frequencies of legume in the diets selected by cattle on the unfertilized treatment (Table 1). The highest legume frequency in the diet occurred during wet-dry transition on both treatments.

Table 1. Total DM yield (kg/ha), percent legume on offer (%) and frequency of legume in the diet

	Unfertilized pasture			Fertilized pasture		
Season	Total DM yield	Legume on offer	Legume in diet	Total DM yield	Legume on offer	Legume in diet
Wet	1619	45	0.25	2276	26	0.13
Wet-dry	3278	48	0.46	3588	23	0.28
Dry	1828	49	0.35	2277	14	0.11

. There was a high selectivity for green leaf regardless of fertilization or amount on offer. The ratio of leaf to stem within the selected legume fraction changed from 2: 1 to 1:1 to1:2 for the 'wet, wet-dry and dry seasons respectively. The ratios were similiar for both treatments.

Fertilizer significantly altered chemical composition of the: forage on offer and to a lesser extent, diet selected (Table 2). P concentration of forage o n

offer doubled ($P<0.01$) and S increased by 50% ($P<0.01$), while DOM was up to 3 units higher ($P<0.05$) during the wet and wet-dry seasons. The changes in available forage from the wet to dry seasons reflected increasing-plant maturity with levels of all nutrients decreasing appreciably. The cattle selected diets with on average 114% more nitrogen, 38% more P and 5.5 units higher in digestibility than the feed on offer. The differences in digestibility and N, P, S in the pasture resulting from fertilization were maintained in the diet (Table 2).

Table 2. Concentration (g/100 g CM) of N, P, S and DOM in forage on offer and diet selected plus intakes of N, P and S (g/day) and DOM (kg/day) for unfertilized (U/f) and superphosphate fertilized (F) pastures

		On offer		In diet		Intake	
		U/f	F	U/f	F	U/f	F
N:	Wet	1.40	1.18*	2.91	2.44	150	225
	Wet-dry	1.02	0.97	2.51	2.14	163	149
	Dry	0.57	0.56	1.20	1.15	49	69**
P:	Wet	0.11	0.20**	0.15	0.27**	8.0	24.7*
	Wet-dry	0.08	0.14**	0.13	0.18*	8.6	11.9*
	Dry	0.04	0.08**	0.06	0.09*	2.3	5.0**
S:	Wet	0.15	0.25**	0.15	0.21**	7.9	20.3**
	Wet-dry	0.12	0.17**	0.13	0.13	8.8	8.9
	Dry	0.07	0.10**	0.08	0.10	3.5	5.9**
DOM:	Wet	58.6	61.5*	63.9	66.6**	3.4	6.1**
	Wet-dry	53.1	57.2*	56.8	59.4*	3.7	4.0*
	Dry	45.4	46.5	53.3	55.3	2.3	3.3**

* Treatment means differ significantly; *= $P<0.05$, **=$P<0.01$

Intake of most nutrients was greater from fertilized pastures in all seasons with the exception of N during the wet-dry transition. These increases were generally significant. Intake of DOM and to a lesser extent minerals from unfertilized pastures increased from the wet to wet-dryseason then declined in the dry season. With fertilized pasture, intakes of both DOM and minerals were quite high during the wet, declining thereafter to the dry season.

DISCUSSION

Although the application of super-phosphate significantly increased pasture yield, the increase was modest due to the relatively high yield of Stylosanthes on the unfertilized treatment. Stylosanthes has the ability to extract more P from low P soils-than most -other pasture plants (Andrew 1966). 'However, unlike findings for most temperate and sub-tropical legumes (Evans 1970), legume yield was depressed by fertilization. This has been-reported by other 'workers with Stylosanthes-grass pastures (Winks et 'al. 1977) and arises from a progressive increase in grass yield over time (McIvor 1984) presumably as soil fertility rises with the 'input of nitrogen (Vallis and Gardener 1984). Sites with an increased Stylosanthes yield from fertilization (McLean et al. 1981; Hendericksen et al. 1987) probably have grass growth limited by N deficiency.

The greater legume content of unfertilized pasture was reflected in greater legume content in the diet, but there was no further effect on animal preference. This was in marked contrast to work at Katherine where superphosphate greatly

increased the preference of cattle for the legume (McLean et al. 1981). There was however a seasonal effect on preference, as found by McLean et al. (1981) and Gardener (1980), with an increase in preference for legume from the wet to the wet-dry. To confuse the picture further, Hendricksen et al. (1987), found no seasonal effect with the cattle always preferring legume.

The P concentrations of 0.06 and 0.09 g/100 g OM for the unfertilized and fertilized treatments respectively in August-September appeared low but cattle weights were either falling or stationary at this time and the cattle probably had relatively low P requirements. Conversely, the concentration of 0.15 g P/100 g OM on the unfertilized treatment in the wet season, while exceeding the 0.12% suggested by Little (1980) for maintenance plus 0.5 kg LWG/day, appeared below that needed for the maximum LWG of 1.6 kg/day recorded on the experiment (C.J. Gardener, unpubl. data). The cattle could well benefit from the provision of P supplement in the wet season as suggested by Winks et al. (1977). Neither S or N appeared limiting in either treatment.

The digestibility of the diet was significantly increased by the application of superphosphate, and digestibility was positively correlated with intake. The increases in intake with fertilization were, however, so large that other factors correlated with digestibility may have been involved. In pen studies, there are several instances where the application of superphosphate or its constituents (Ca, P and S) to the pasture raised the intake of cut material above that which could be attributed to the extra Ca, P or S in the diet (Rees and Minson 1977). The digestibility of the diet was also highly correlated with the liveweight gains of the cattle on the experiment (C.J. Gardener, unpubl. data).

These results suggest, at least under the conditions of the experiment, that the effects of superphosphate on LWG could probably not be achieved by the provision of supplement alone.

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