NITROGEN-FERTILIZED PASTURES OF NAROK SETARIA AND SAMFORD RHODES GRASS GIVE SIMILAR BEEF PRODUCTION IN S.E. QUEENSLAND

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ABSTRACT

*Pastures of Narok setaria (*Setaria sphacelata *var.* sericea *cv. Narok) and of Samford Rhodes grass (*Chloris gayana *cv. Samford) fertilized with 250 kg single superphosphate, 125 kg KCl and 336 kg N/ha/yr were compared at a set stocking regime of 5 steers/ha over a 4-year period.*

Pastures of Narok gave higher yields of total pasture dry matter and of green dry matter on most sampling occasions.

The N, P and K concentrations in the yield on offer were similar for both pastures, although N in the Samford Rhodes grass was higher than for Narok in summer/autumn. Over this period, however, samples plucked to simulate herbage grazed by cattle were significantly higher in N and K for the Narok pastures. Faecal N levels were also higher for steers grazing Narok throughout the year. Plucked pasture samples of Narok in spring, summer and autumn were higher in N, K, Na and Zn whereas those of Samford Rhodes grass were higher in Ca and S.

Despite differences in yield and mineral concentration the pattern of weight gain of steers was similar for both pastures in 3 of the 4 years although Narok tended to give reduced weight loss in winter and spring with Samford giving better weight gain in summer/autumn. The marked superiority of Narok over the winter/spring period of 1970 was associated with an exceptionally cold winter which retarded the spring growth of Samford Rhodes grass. However, annual liveweight gains did not differ significantly in any year. Mean gains per annum were 160 and 159 kg/head for Narok and Samford respectively.

Possible reasons for the lack of difference in animal gain on the 2 pastures are discussed.

RESUMEN

*Pasturas de Narok setaria (*Setaria sphacelata *var. sericea cv. Narok) y Samford Rhodes grass (*Chloris gayana *cv. Samford) fertilizadas con 250 kg de superfosfato simple, 125 kg KCL y 336 kg N/ha año fueron comparadas con un régimen fija de carga de 5 novillos/ha durante periodo de 4 años.*

En la mayoria de los muestreos, el pasto Narok produjo los más altos rendimientos de materia seca total y materia seca verde.

La concentraciones de N, P y K en el rendimiento de la oferta fueron similares en ambas pasturas, aunque N en el pasto Samford Rhodes grass fue más alto que en Narok durante verano/otoño. Durante éste periodo, sin embargo, muestras arrancadas para simular plantas pastoreadas por el ganado fueron significativamente más altos para los novillos pastoreando Narok a través de todo el año. Muestras de pasto Narok arrancadas en primavera, verano y ontoño fueron más altas en N, K, Na y Zn mientras Samford Rhodes grass fue más alto en Ca y S.

A pesar de las diferencias en rendimiento y concentración mineral, la tendencia en las ganacias de peso en los novillos fue similar para ambas pasturas en 3 de los 4 años, aunque Narok tendiendo a dar reducidas pérdidas de peso en invierno y primavera y Samford dando mejores ganancias de peso en verano/otõno. La marcada superiordad de Narok durante el periodo invierno/primavera de 1970 fue asociada al inverno, el cual

fue excepcionalmente frio retardando el crecimiento de Samford Rhodes grass durante la primavera. Sin embargo, las ganancias anuales de peso vivo no fueron significativamente diferentes en ningun año. El promedio de las ganancias por año fueron 160 y 159 kg/cabeza para Narok y Samford respectivamente.

Posibles razones por la falta de diferencia en ganancia animal sobre las 2 pasturas son discutidas.

INTRODUCTION

In 1969 Narok setaria was released to the industry as a leafy, productive and frost tolerant species for coastal sub-tropical pastures (Barnard 1972). It had good palatability and was seen as a suitable alternative to Nandi setaria, particularly in frosty areas. Although well grazed by cattle in small plots, no animal production data had been obtained. The experiment described here was the first animal production experiment to be conducted with Narok. There was little point in comparing its production with Nandi setaria since, in the low lying areas of the CSIRO Samford Research Station, previous experience had shown that Nandi setaria did not persist under heavy grazing. It was therefore decided to compare its production in terms of pasture yield and steer growth with that of Samford Rhodes grass (previously CPI 16144) which, with the Nandi setaria, had shown most promise in an earlier cutting and small sward grazing experiment (Jones *et al.* 1969) and in an earlier grazing comparison (Jones 1976) at Samford.

MATERIALS AND METHODS

Site

The experiment was located on the CSIRO Research Station, Samford, S.E. Queensland (lat. 27°22′S, long. 152°53′E, altitude 50 m, mean annual rainfall 1150 mm) on a level secondary alluvial terrace on gleyed podzolic soils developed on South Pine River Alluvium (Thompson and Murtha 1960). The area was Replicate B of the experiment described by Jones (1976), and was fertilized with 250 kg single superphosphate, 125 kg KCl and 336 kg N (as urea)/ha/yr. By 1969 the sown grass in the Nandi setaria paddocks had declined markedly, whereas the Samford Rhodes grass paddocks still retained a good cover of the sown grass. It was decided to replace the grass in the 4 paddocks originally sown with Nandi setaria with Narok and to retain the 4 Samford Rhodes grass paddocks for the comparative study.

Establishment

Narok seed was sown at 2 kg/ha on to a firm seedbed prepared in October 1969 by discing, harrowing and rolling. Plant counts were made on November 5, 1969. Paddocks were intermittently grazed to induce tillering and to encourage establishment of a dense pasture prior to experimental stocking in May 1970.

Experimental treatments

The experiment compared the 2 grasses in 4 replicates arranged as randomised blocks. As in the earlier experiment (Jones 1976) there were 4 × 0.6 ha paddocks, and 4 × 0.8 ha paddocks, 2 replicates had paddock sizes of 0.6 ha and 2 replicate paddocks of 0.8 ha. The smaller paddocks carried 3 steers and the larger paddocks 4 steers, giving an overall stocking rate (SR) of 5 steers/ha. This stocking rate was chosen on the basis of earlier results on the site which showed that with Samford Rhodes grass gain per animal was less at 5 steers/ha than at 3.5 steers/ha, although gain/ha was similar (Jones 1976). The SR was therefore judged to be high enough to allow increased animal gain if the production of Narok exceeded that of Samford Rhodes, yet not too high to necessitate removal of animals or the provision of supplementary feed to maintain animals year-round on the pastures.

Pasture measurements

Pastures were sampled at approximately 2-monthly intervals to obtain presentation yields of total dry matter and the yield of green material. Five 0.47 m strips of 9.6 and 12.8 m were cut in the 0.6 and 0.8 ha paddocks respectively. Pastures were cut to 7 cm and weighed material was subsampled to determine dry matter percent and sorted to obtain the percent green component.

Yield samples in 1970, 1971 and 1972 were analysed for N, P and K. In addition, samples were plucked to simulate the diet of the cattle on 12 occasions and then analysed for N, P and K. On 3 of these occasions multi-element analyses (Johnson and Simons 1972) were performed on the samples.

In 1971 and 1972 faeces were collected and analysed for N, P and K on eight occasions.

On July 18, 1973, two adjacent paddocks in replicate 3, one of Narok and the other of Samford, were sampled by cutting five 1 m × 1 m quadrats per paddock to 2 cm. The material was sorted into green and dead, and each fraction dried, ground and analysed for a range of elements.

Botanical composition of the pastures was measured by trained observers on May 19, 1970 and March 21, 1974. Species composition on a dry matter yield basis was visually estimated in sixty 25 cm × 25 cm randomly-placed quadrats per paddock.

Animal measurements

Steers were weighed every 4 weeks after an overnight fast. Four batches of steers were used. These entered the experiment on May 20, 1970, March 24, 1971, March 22, 1971, and March 21, 1973. This phase of the experiment ended on April 17, 1974.

RESULTS

Climatic factors

In all 4 years of the experiment, rainfall in summer was higher than average; 2 of the 4 autumn and winter periods were, however, far drier than average. Spring rainfall was higher than average for 3 of the 4 years (Table 1).

TABLE 1

Rainfall at Samford for the period of the experiment.

	1970-71	71-72	72-73	73-74	Long term Mean
			(mm)		
Autumn	*209.8*	*175.7*	523.5	*108.5*	286.3
Winter	*46.9*	*88.2*	*61.8*	427.5	146.6
Spring	371.2	*191.4*	695.2	238.1	222.1
Summer	1101.5	717.6	557.0	1526.0	444.3
TOTAL	1729.4	1172.9	1837.5	2300.0	1099.3

Note: Figures in italics indicate lower than average rainfall.

The 1970 winter was one of the coldest on record for Samford with at least 49 frosts in the period June to September.

Pasture performance

Narok established rapidly. Mean establishment on November 5, 1969 was 23 ± 3 plants/m^2. Pastures were dominated by the sown species throughout the experiment (Table 2).

TABLE 2

Botanical composition of the Narok and Samford paddocks in May 1970 and in March 1974 (mean percentage composition and standard deviation).

	May 1970		March 1974	
	Narok	Samford	Narok	Samford
Sown grass	98.2 ± 2.1	85.7 ± 10.2	97.6 ± 1.5	89.9 ± 6.5
Paspalum dilatatum	tr	9.3 ± 8.3	tr	1.2 ± 1.6
Digitaria didactyla	tr	2.7 ± 3.0	0.6 ± 0.7	2.0 ± 1.9
Cynodon dactylon	tr	0.2 ± 0.3	0.6 ± 0.7	2.9 ± 2.7
Axonopus compressus	tr	tr	0.4 ± 0.8	1.8 ± 3.7
Other*	1.8 ± 0.42	2.0 ± 2.7	0.8 ± 1.1	2.2 ± 1.9

* These included *Trifolium repens*, *Digitaria* spp., *Sida* spp., *Setaria sphacelata* (in Rhodes paddocks) and *Chloris gayana* (in Setaria paddocks).
tr = trace < 0.2%.

The pattern of yield for both grasses was similar (Fig. 1). Total yields varied seasonally; they reached a peak in autumn then declined through winter and spring. Yield of green material also varied seasonally for both grasses, but with much greater amplitude, and with green yields near zero for from 2 to 4 months depending on rainfall and frost incidence. Narok consistently outyielded Samford in terms of both total and green yield except at the start of the experiment. The green yields in winter were 2 to 4 times higher for Narok (48 v 8, 73 v 42 and 525 v 164 kg/ha for the July/Aug. samplings in 1971, 1972 and 1973 respectively), but since yields were sometimes very low the differences are not discernible for every harvest shown in Fig. 1. Mean yield advantage of Narok over all samplings was 850 kg/ha (22%) and 770 kg/ha (42%) for total and green yield respectively.

Chemical composition

The analyses for yield samples and faecal samples readily fell into 2 groups—those for winter/spring and for summer/autumn. The analyses for these periods have therefore been grouped for comparison. In summer/autumn, Samford pastures had a higher N concentration ($P < 0.05$) than Narok pastures (Table 3).

In contrast, animals grazing Narok produced faeces with a higher N concentration in both winter/spring and summer/autumn. Similarly Narok had significantly higher levels of N, and K, in plucked samples in the summer/autumn period (Table 3). Narok also had consistently higher Na and Zn values and Samford consistently higher Ca and S values in plucked samples (Table 4).

TABLE 3

Nitrogen, phosphorus and potassium concentrations in yield samples, faecal samples and plucked herbage from grazed pastures of Narok setaria and Samford Rhodes grass.

	Element	Winter/Spring			Summer/Autumn		
		Narok		Samford	Narok		Samford
				(%)			
Pasture yield samples	N	1.25		1.28	1.36	*	1.49
	P	0.15		0.17	0.27		0.30
	K	0.68		0.56	2.35		1.86
Faecal samples	N	1.85	*[1]	1.61	2.48	*	2.02
	P	0.37		0.37	0.76		0.73
	K	0.62		0.72	0.96		1.01
Plucked pasture samples	N				2.98	*	2.65
	P				0.35		0.37
	K				3.62	**	2.11

[1] *, ** significant at $P < 0.05$; $P < 0.01$.

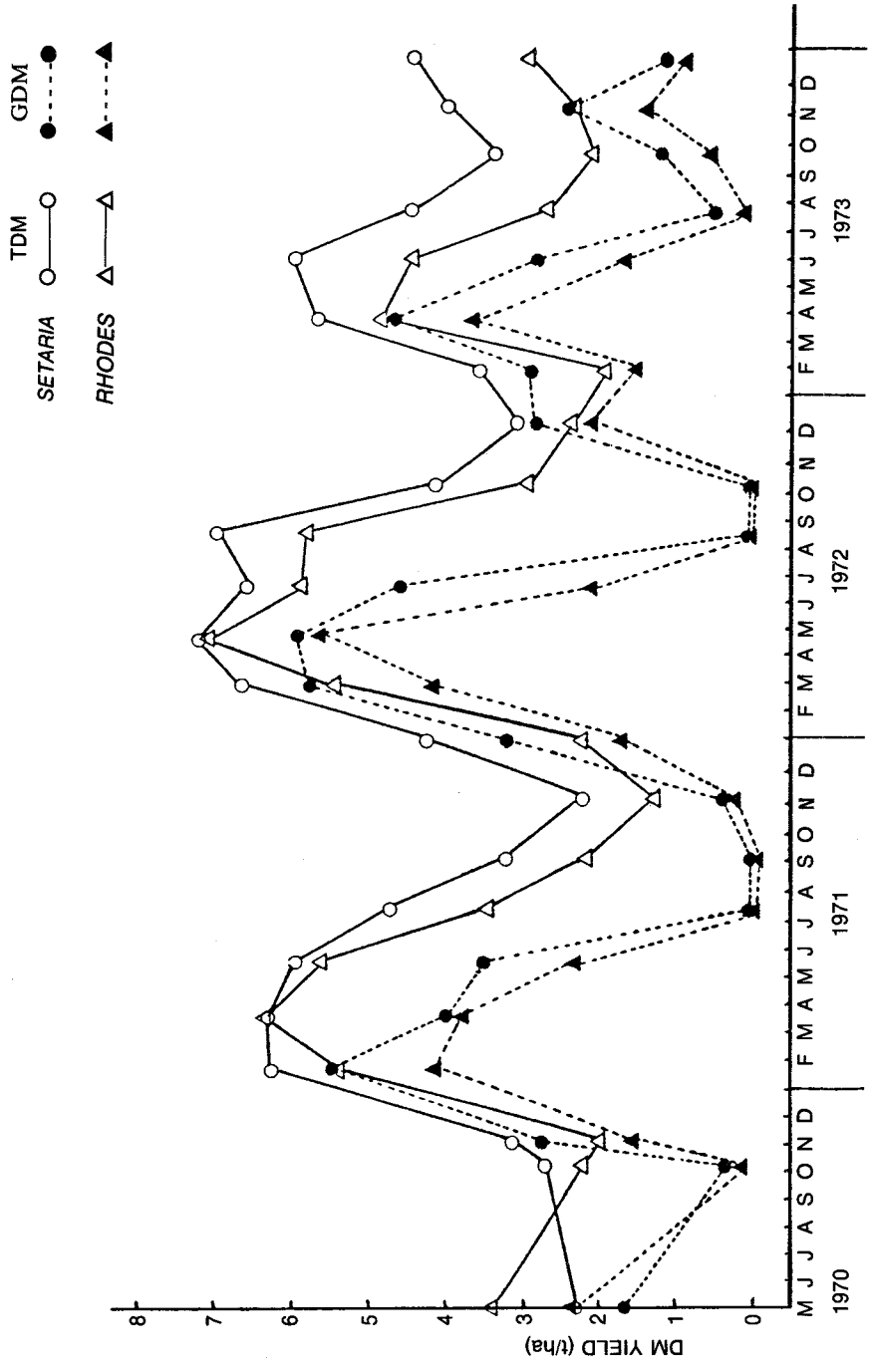

FIGURE 1

Mean yields of total dry matter (TDM) (open symbols) and of green dry matter (GDM) (closed symbols) for Narok setaria (○ ●) and Samford Rhodes grass (△ ▲) over the period 1970-1973 (means of 4 replicates).

TABLE 4

Multi-element analysis of plucked pasture samples for Narok setaria and Samford Rhodes grass on 3 occasions.

Element	21.xii.71			27.xi.72			19.iii.73		
	Narok		Samford	Narok		Samford	Narok		Samford
				(%)					
N	3.45	*[1]	3.17	3.25	*	2.32	2.85	*	2.20
P	0.24		0.26	0.40		0.40	0.36		0.39
K	3.10	**	2.25	3.60	*	1.90	3.45	*	1.70
Na	0.64	*	0.38	0.14	*	0.10	0.13	*	0.09
Ca	0.26	**	0.53	0.30	*	0.48	0.28	*	0.45
Mg	0.15	*	0.19	0.17		0.16	0.16		0.16
S	0.20	**	0.33	0.21	*	0.37	0.20	*	0.34
				(ppm)					
Zn	44		43	43	*	36	39		31
Cu	12		14	12		11	11		10

[1] *, ** indicates a significant difference at $P < 0.05$, $P < 0.01$ respectively.

In July 1973 the dead material had far lower concentrations of nutrients than did the green material; approximately only 25% of the N, P and K levels and 50% of the S levels, but green yield was only 28% and 16% of total yield for the Narok and Samford paddocks respectively (data not presented).

Animal production

Except for the first 6 months of the experiment, the pattern of steer gain was very similar on both grasses in each year (Fig. 2).

The atypical feature of the 1970-71 period was the very heavy weight loss of 58 kg from May to November by steers grazing the Samford Rhodes paddocks. Over this period steers on Narok lost only 15 kg. In subsequent years there was a tendency for steers on Samford Rhodes to gain more weight in autumn-early winter and lose more in late winter and spring. The lower weight loss in winter for steers grazing Narok may have been associated with their lower weight entering winter. In 1971-72 and 1973-74 steer weight increased linearly from spring (September) to autumn (March/April) at approximately 0.6 kg/day. In 1970-71 and 1972-3, gains did not commence until November, but were again linear, reaching 0.9 and 0.6 kg/day respectively (Fig. 2). The very large gains in summer and autumn in 1970-71 were probably the result of compensatory gain following the very poor gains from May to November described above. Mean annual gains were almost identical for both grasses at 160 kg/head (447 g/day) or 800 kg LWG/ha/yr (Table 5).

TABLE 5

Steer gains on pastures of Narok setaria and Samford Rhodes grass fertilized with 336 kg N/ha/yr and stocked continuously at 5 steers/ha over 4 years.

Grass	1970-71	1971-72	1972-73	1973-74	Mean
Gain (kg/head)					
Narok	109	169	164	197	160
Samford	86	186	162	203	159
LSD ($P < 0.05$)	38	33	38	14	20
Grazing days	308	364	364	392	357
Gain/day (g)	316	488	488	510	447
Gain/ha/year (kg)	577	891	891	931	816

In no year was there a significant difference between grasses in annual LWG. Mean daily LWG varied from 316 g/day in 1970-71 to 510 g/day in 1973-74.

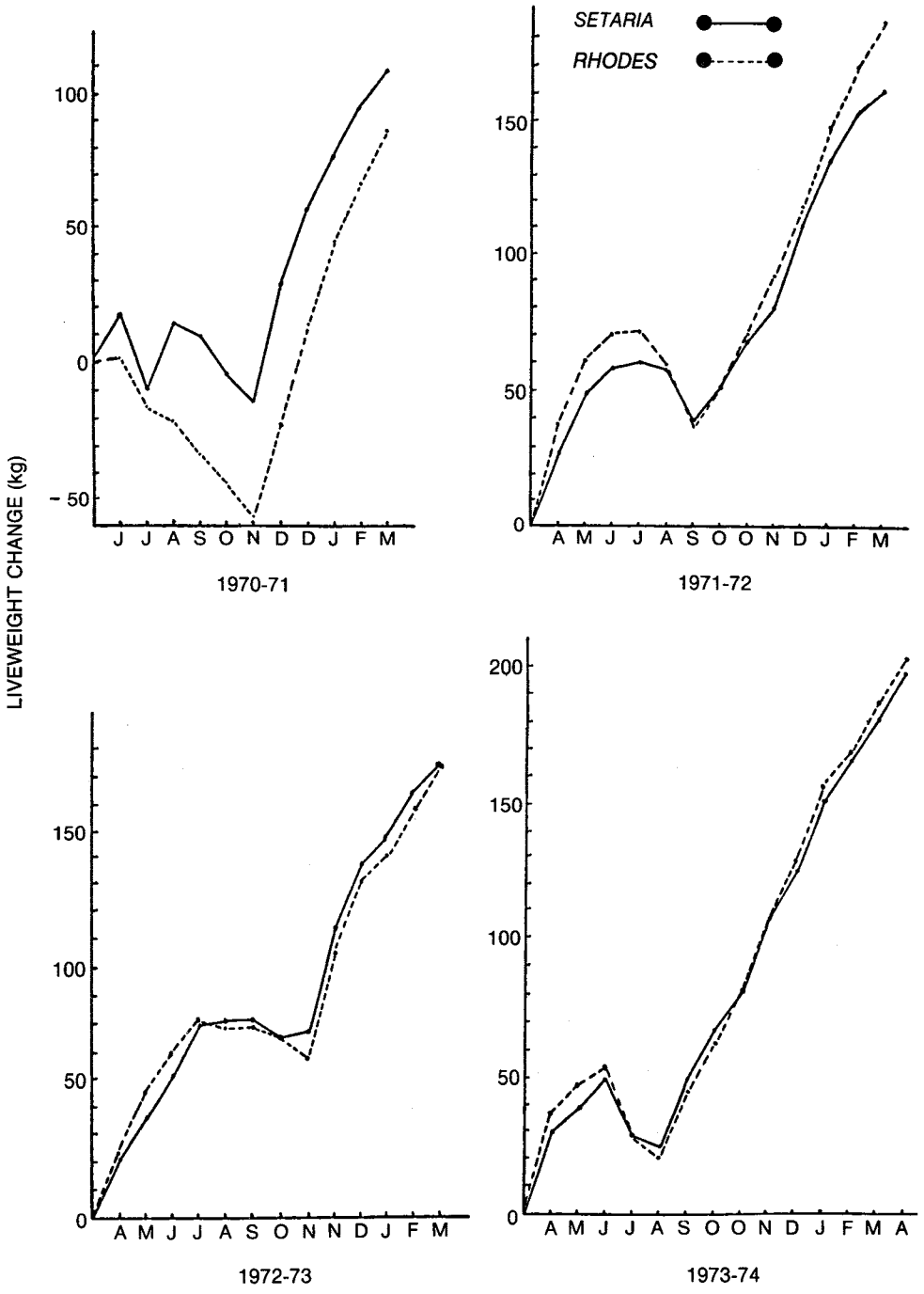

FIGURE 2

Cumulative liveweight changes (kg) of steers grazing Narok setaria ——— or Samford Rhodes grass - - - - - - over 4 years.

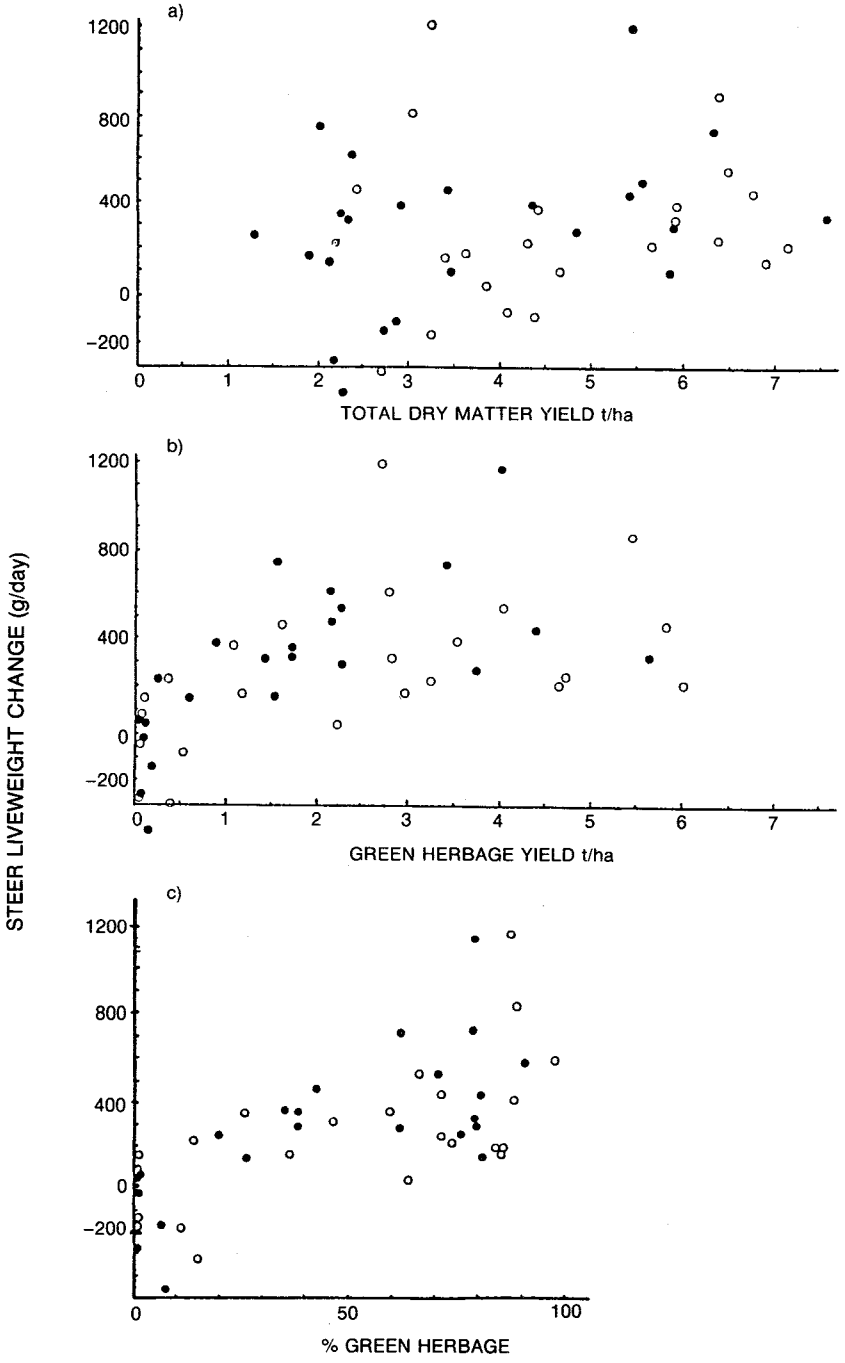

FIGURE 3

Relation between steer liveweight change (g/day) and pasture characteristics (a) total dry matter yield, (b) green dry matter yield, and (c) % green herbage in the pasture for Narok setaria (○) and Samford Rhodes grass (●).

DISCUSSION

The results clearly show the superiority of Narok setaria over Samford Rhodes grass in terms of total presentation dry matter yield under grazing. In addition Narok had a higher percentage of green material at most times of the year leading to consistently higher yields of green dry matter on offer to the cattle. Narok also had a consistently higher nitrogen percentage in plucked samples than Samford.

However, despite these agronomically desirable attributes there was no overall benefit in terms of animal production except for the winter/spring period of 1970. The superiority of Narok, compared with Samford, in this first winter after establishment may reflect animal performance on a young sward versus an older sward. However, the Rhodes grass was a productive pasture, not a moribund one. Furthermore, the performance of steers on the Narok pasture in this first winter was similar to that in the other 3 winters. What was atypical was the very marked weight loss of steers on the Samford pastures and this warrants further comment, since differences between the 2 grasses may have been expected consistently in the winter/spring period. The 1970 winter was dry and very cold. There were at least (no weekend measurements) 11 frosts in June, at least 20 in July and at least 12 in August with the lowest terrestrial minimum of −6.6°C. There were also 6 frosts in September. Mean terrestrial minimum temperatures for June, July and August were 1.9, −1.2, and 0.9°C. These compare with overall mean values for the Samford Station for June, July and August of 5.1, 2.6, and 3.1. The mean July grass minimum was the lowest on record.

Under these conditions Samford Rhodes grass was more severely affected than Narok setaria. Delayed regrowth was apparent for both grasses, and animals on both treatments lost weight up to November. However, the effect was more marked with steers grazing Samford Rhodes. Poor performance from Samford Rhodes following a cold winter has been reported earlier for this site (Jones 1987).

In this experiment neither plant morphology, total yields, green yield nor % green herbage were related to animal liveweight change. Similar conclusions were drawn from studies on a wider range of native and 'improved' grasses in Queensland (Robbins and Bushell 1985). Gains above 400 g/day were not achieved until yield of green herbage exceeded about 1.5 t/ha or until the % green herbage in the pasture exceeded 40%. However, there was a wide range in animal performance for any given yield of green material. This contrasts with results from other sub-tropical pastures where yield of green material or green leaf was correlated with liveweight change and milk production ('t Mannetje 1974; Davison *et al.* 1985). It may well be that, within species, selection for green yield may give cultivars with higher animal production potential but, across species, this may not hold true. Indeed the experimental evidence for higher animal production from species selected on this basis is lacking.

Several reasons may be advanced for the lack of response to the higher green yields on Narok pastures. Firstly, the stocking rate may not have been high enough for the expression of the superiority of Narok. This may well have been true during peak growth, but was certainly not true throughout the year. Thus in winter and early spring steers grazing Narok should have performed better. As noted earlier, experiments on the same site showed that gains of steers grazing Samford Rhodes and Nandi setaria were lower at 5 beasts/ha than at 3.75 beasts/ha (Jones 1976). For example in 1965-66, gains at 3.5 and 5.0 steers/ha were 179 kg and 156 kg/hd respectively, indicating that gains at 5 beasts/ha were not the maximum that could be achieved.

Secondly, some factors or factor in Narok could have offset the yield advantage. The presence of oxalate (Jones and Ford 1972) and the low Ca level may, separately or together, have reduced performance. However, there were never any clinical signs of oxalate toxicity or of Ca deficiency. In adapted animals, oxalate is rapidly degraded in the rumen so that even additional doses of oxalate do not induce toxicity or affect gain (Jones *et al.* 1970). It seems extremely unlikely therefore that oxalate toxicity would have reduced the performance of steers grazing Narok.

The Ca levels in plucked herbage from Narok were within the range recommended by the NRC (1970) for this class of animal, although the Ca:P ratio was less than unity for the November and March samples. However, at both these times, and for the whole of the spring and summer months, animal gains on Narok and Samford were similar.

Both grasses persisted well under the grazing management adopted and gave good animal gains. The much better steer performance from Narok in autumn and winter which may have been expected from its agronomic qualities was not realised in 3 of the 4 years. Reasons for this could not be determined. However, in 3 of the 4 years, rainfall in autumn and winter was below average and this may have reduced or masked the potential advantage of better frost tolerance and growth at lower temperatures.

The similar animal production from 2 grasses with consistent differences in green yield and chemical composition reflects the difficulty of selecting improved grasses on single attributes which may not be related to intake of digestible nutrients. Until reliable methods for estimating intake on small samples or from small plots are developed it will be difficult to breed superior perennial grasses for year-round grazing.

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