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YIELD AND DRY MATTER AND NUTRIENTS OF KING GRASS (*Pennisetum purpurem x P. typhoides*) IN TWO ECOZONES IN CENTRAL JAMAICA

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ABSTRACT. Dry matter (DM) yield, *in vitro* organic matter digestibility (IVOMD) and contents of protein (CP) and fibre (NDF) of King grass (*Pennisetum purpureum x P. typhoides*) were evaluated in two ecozones in central Jamaica - mid Clarendon/Manchester (mCM) and southern Manchester/St. Elizabeth (sME) - in order to determine its suitability as fodder crop for goat production. The parameters were determined on 6-wk (mCM_6 and sME_6) or 9-wk (sME_9) regrowth in a randomized block design with four replicates, and treatment means tested as designed orthogonal contrasts: mCM_6 v sME_6, sME_9 and sME_6 v sME_9. Goat manure was applied at the rate of 10-25 t/ha/yr. CP% (mCM_6 = 16.5; sME_6 = 11.3; sME_9 = 10.8), IVOMD% (61.5; 54.8; 56.2), and yield (t/ha/yr) of DM (30.2; 2.4; 14.3), CP (4.90; 0.27; 1.72) and DOM (18.5; 1.3; 8.1) were all significantly lower ($P<0.05$) and NDF% (64.4; 68.6; 67.8) significantly higher ($P<0.05$) for southern Manchester/St. Elizabeth compared with mid Clarendon/Manchester. Harvesting at 9-wk compared with 6-wk interval in southern Manchester/St. Elizabeth appeared to improve the yield components, but the differences were not significant ($P>0.05$). Nutrient contents were also similar for the two harvesting intervals. It was concluded that under rainfed conditions and low input regime King grass should not be recommended for southern Manchester/St. Elizabeth.

INTRODUCTION

In 1990 the Caribbean Agricultural Research and Development Institute (CARDI) began a multi-facet project - CARDI/Technology Transfer and Applied Research Project (CARDI/TTARP) - in six territories (Antigua, Barbados, Dominica, Guyana, Jamaica, and Trinidad) in the CARICOM region. The project was conceptualized with emphasis on the transfer of known appropriate technologies in selected agricultural commodities and services of interest to the region. The CARDI Unit in Jamaica was involved in the Sheep and Goat Development Sub-project - one of the six constituent sub-projects of CARDI/TTARP.

About 95% of goat producers in Jamaica are classified as small producers (herd size 1 - 19, MINAG, 1991). They operate on small parcels of land (<2 ha, Robertson, 1991) which are devoted primarily to crop production. At the commencement of CARDI/TTARP the feeding systems employed by producers in the target area were free grazing and tethering (Robertson, 1991), which did not facilitate high levels of productivity. However, owing to land constraint it was determined that the development and/or transfer of any improved feeding technology should emphasize materials which accumulate a great amount of biomass vertically. King grass, Sugar cane and Leucaena are some of the crops which satisfy this requirement.

King grass (*Pennisetum purpureum* x *P. typhoides*) was introduced, along with other *Pennisetum* hybrids into Jamaica in 1983 (Logan 1986). However at the commencement of CARDI/TTARP there had not been any evaluation on it, although it had been determined (Motta, 1950; 1951) that forage yield of *P. purpureum* - one of the parents of King grass - was high from June-November and low from February-May. On the other hand, King grass has been evaluated in several other countries. In Venezuela the minimum yield of King grass in dry locations was 5.41 t/ha/yr and that in wet locations was 37.9 t/ha/yr (Guzman, 1983). In China King grass has been found to tolerate dry conditions (Bai *et al.*, 1994) and in Cuba the dry matter yield of the grass is reported to reach 50 t/ha/yr (Ramos *et al.*, 1979, cited by Garcia-Trujillo and Cáceres, 1982) with good yields even during the dry season (Hernández *et al.*, 1979, cited by García-Trujillo and Cáceres, 1982). These reviews suggested positive production attributes for King grass and on the strength of that it was posited that King grass production and utilization technology could be transferred to the farmers serviced under the CARDI/TTARP.

In the autumn of 1991 the project started to assist farmers with the establishment of King grass fodder banks. The grass was maintained under rainfed conditions and without any additional input. However, empirical assessment during the first year revealed apparent low production in the dry project areas. A study was, therefore, initiated in 1993 to undertake a mechanistic evaluation of the grass in the two principal ecozones in which CARDI/TTARP was located.

MATERIALS AND METHODS

The study was undertaken on six farms in the parishes of Clarendon, Manchester and St.Elizabeth in the central region of Jamaica. Three farms were located in the mid section of Clarendon and Manchester (mCM, average rainfall 1750 mm/yr) while the other three were in southern Manchester and St. Elizabeth (sME, average rainfall 980 mm/yr,

Figure 1). Rainfall distribution is bimodal in both ecozones (April - June and September - November). The soils in the two zones vary from St. Ann Clay Loam (over limestone) to Four Paths Loam and Agualta Sandy Loam, both alluvial soils (Stark, 1963).

Experimental design and forage sampling:

Sampling plots in the established King grass pastures were demarcated and cut back in the spring of 1993, and for the next two years forage yield and nutritive value were determined on the regrowth. In mCM the evaluation was done on six weeks regrowth (mCM_6) while in sME the samples were cut at six weeks (sME_6) and nine weeks (sME_9) intervals. Sample size ranged from 4 to 12 m^2 depending on the area sown in King grass. Goat manure was applied to the sampling sites at the rate of 25 t/ha/yr in mCM and 10 t/ha/yr in sME because there were fewer rainy days.

The experiment was structured as designed orthogonal contrast and set up as a randomized block design with four replications. The two sets of contrasts were: mCM_6 v sME_6, sME_9 and sME_6 v sME_9. On each sampling date (Table 1) the forage on each plot was cut to leave a stubble with one node above ground level, and the total forage weighed. Subsamples 200-500 g were taken and oven-dried at 65°C for 48 hours for dry matter (DM) determination.

Chemical analyses:

The dried subsamples were milled through a 1 mm mesh screen and analysed for crude protein (CP, AOAC, 1984), *in vitro* organic matter digestibility (IVOMD, Moore and Mott, 1974) and neutral detergent fibre (NDF, Goering and Van Soest, 1970).

Statistical analyses:

The data for forage yield and nutritive value were subjected to analyses of variance using MINITAB (MINITAB Inc., 1992) and the means for the contrasts, mCM_6 v sME_6, sME_9 and sME_6 v sME_9 were tested by t-test for designed orthogonal contrasts (Gill, 1978).

Table 1. Sampling dates

Sampling Dates		mCM_6 and sME_6	sME_9
1993/94	Cut 1	June 4	June 7
	Cut 2	July 16	August 9
	Cut 3	August 27	October 11
	Cut 4	October 8	December 13
	Cut 5	November 19	February 14
	Cut 6	December 31	April 18
	Cut 7	February 11	June 20
	Cut 8	March 25	August 22
	Cut 9	May 6	October 24
1994/95	Cut 10	June 17	December 26
	Cut 11	July 29	February 27
	Cut 12	September 9	May 1
	Cut 13	October 21	
	Cut 14	December 2	
	Cut 15	January 13	
	Cut 16	February 24	
	Cut 17	April 7	
	Cut 18	May 19	

RESULTS AND DISCUSSION

Nutritive value (CP%, IVOMD% and NDF%) and the yield of dry matter, crude protein and digestible organic matter (DOM) are shown in Table 2. Figure 2 shows the distribution of the dry matter yield over the two experimental years.

Crude protein content (% DM), IVOMD% and yield of DM, CP and DOM were all significantly lower ($P<0.05$) and NDF (% DM) significantly higher ($P<0.05$) for sME compared with mCM (Table 2). Harvesting the grass at 9-week intervals compared with 6-week intervals in sME appeared to improve the yield components (Table 2) but the differences were not significant ($P>0.05$). Nutrient contents were also similar for the two harvesting intervals in sME. These site-specific similarities between six-week and nine-week harvesting intervals for yield and nutrient content appear to be characteristic of King grass. At the Bodles Agricultural Research Station in Jamaica (17 56'N, 77 06'W, average rainfall 1070 mm/yr, Figure 1) Thompson (1992) noted that the number of tillers per King grass plant was seven for both six-week and nine-week harvesting intervals. The percent leaf, CP (% DM), IVOMD% and NDF (% DM) were 45.4 v 41.9, 10.3 v 9.6, 62.3 v 60.9 and 69.4 v

68.8, for six- and nine-week cutting intervals respectively (Thompson, 1992).

Table 2. Nutrient content, and yield of dry matter and nutrients of King grass, mean of two years.

	mCM	sME	sME	SE[1]		EDF[2]
	6 wk	6 wk	9 wk	mCM$_6$ v sME$_6$, sME$_9$	sME$_6$ v sME$_9$	
Manure (t/ha/yr)	25	10	10			
CP (% DM)	16.5	11.3	10.8	1.29	1.49	150
IVOMD (%)	61.5	54.8	56.2	1.68	1.95	150
NDF (% DM)	64.4	68.6	67.8	0.84	0.98	150
DM yield (t/ha/yr)	30.2	2.4	14.3	9.13	10.53	186
CP yield (t/ha/yr)	4.90	0.27	1.72	1.595	1.842	186
DOM yield (t/ha/yr)	18.5	1.3	8.1	6.52	7.54	186

[1]SE = standard error for comparing contrast means differences
[2]EDF = error degrees of freedom

In mCM dry matter accumulation tended to be greatest during the period April-July (1120 kg/ha/d, Figure 2, cuts 1-3, 9-10 and 17-18), and it was maintained at an average rate of 360 kg/ha/d during the dry season (December-March). This is in agreement with the observation by Cuban workers (Hernández *et al.*, 1979) that where moisture is not very limiting King grass has good yields even during the dry season. On the contrary for sME, apart from the spike in December 1994 due to exceptionally heavy rainfall in November of that year (sME$_9$, cut 10), dry matter accumulated at an average rate of 140 kg/ha/d. This was lower than even the accumulation rate for mCM during the dry season.

The low productivity of King grass in the southern ecozone could be attributed to the rainfall pattern *per se* of the zone, as well as its effect on the manure applied. The amount of rainfall in the area is low and this generally results in slow crop growth and productivity. Additionally, because of the low rainfall regime only relatively small amount of manure could be applied, and even this small amount appeared to have decomposed slowly leading to slow mobilization and uptake of nutrients by the grass.

The negative effect of the low dry matter yield of King grass in the southern ecozone on stocking rate is quite obvious. It is estimated that in the southern ecozone 1 ha of King grass may provide dry matter for only 1.78 Animal Units per year, compared with 6.61 AU/yr for the mid parish ecozone (assuming dry matter intake = 3% body weight, 20% additional allowance for selection and King grass accounting for 85% of the daily dry matter intake). The other negative dimension is the effect of low nutrient content on the intake of animals. There is a clear positive relationship between forage intake and crude protein and digestibility contents (Van Soest, 1965; Minson, 1980) and a negative association with fibre content (Van Soest, 1965). Therefore it can be extrapolated that goats offered King grass in sME may not be able to consume as much as those in mCM.

CONCLUSION

The results of the study showed that under rainfed conditions and low input of manure the yield of DM, CP and DOM of King grass in southern Manchester/St. Elizabeth was low indicating that few goats could be fed from a given pasture/fodder bank area. The utilization of the relatively small quantities of nutrients would be further constrained by the limitation that would be imposed on intake by the relatively low content of CP and IVOMD, and high content of NDF. Therefore under these conditions King grass should not be recommended for pastures and fodder banks in southern Manchester/St. Elizabeth of Jamaica.

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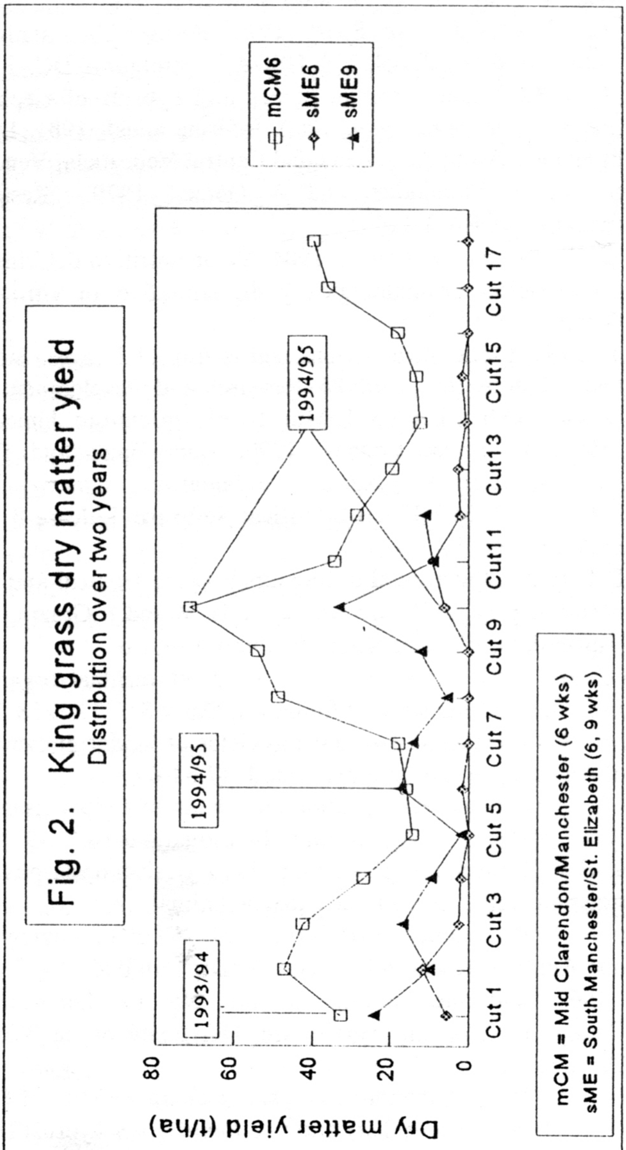

Fig. 2. King grass dry matter yield
Distribution over two years

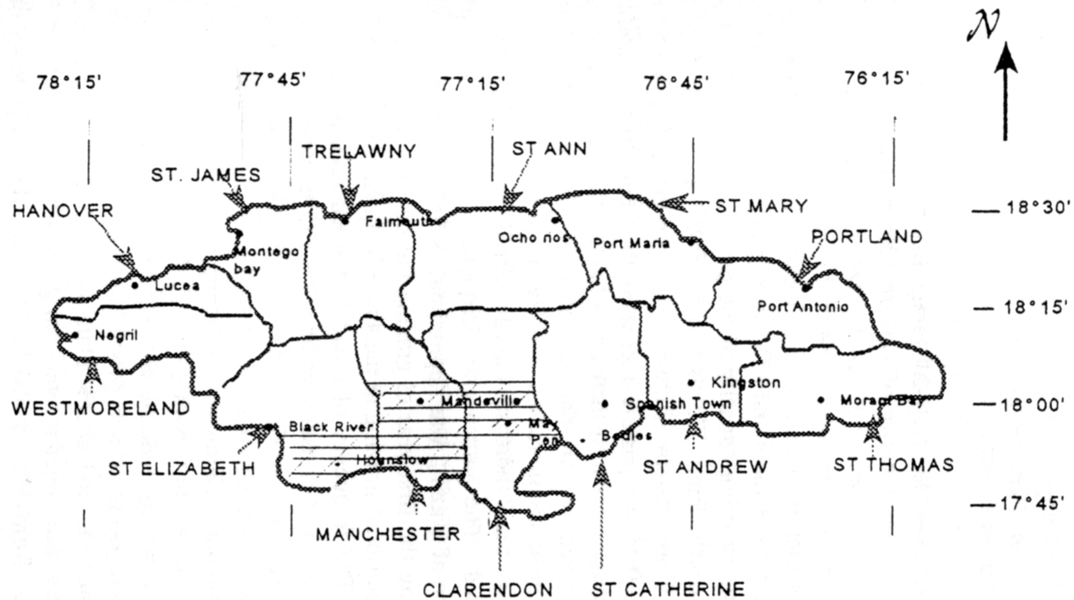

Fig. 1. Map of Jamaica showing experimental area