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Forage yield, nutritive value, feed intake and digestibility of three grass species as affected by harvest frequency

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Abstract

Two experiments on the effects of cutting interval on forage production, nutritive value, feed intake and digestibility of elephant grass (Eg) and two guinea grass (Gg) cultivars 280 and I.429, were carried out. Three grasses harvested at 4 cutting intervals (4, 6, 8 and 10 weeks) were compared in a split plot design in the production experiment. In the feed intake and digestibility experiment, 3 grasses and 3 cutting intervals (4, 6 and 8 weeks) were examined in a 3 × 2 change-over design with 6 crossbred Holstein heifers.

Forage DM production increased as length of cutting interval increased and forage quality, in terms of CP and cell wall concentrations, decreased. The yields of DM, CP, digestible DM and digestible CP were highest in Gg 280 followed by Gg I.429 and Eg.

Mean intakes of forage (DM basis) of Eg, Gg 280 and Gg I.429 were 90.4, 104.6 and 94.5 g/kg Lwt$^{0.73}$, respectively, with no effect of cutting interval. With the decline in crude protein concentration in older forage, the CP intake of around 13.4 g/kg Lwt$^{0.73}$ from the 4-week cuts declined to about 6.7 g/kg Lwt$^{0.73}$ in the 8-week cuts. Digestibility of dry matter and crude protein decreased significantly as cutting interval increased, with no differences between grass species.

To obtain the best balance between dry matter yield and forage quality, the optimum cutting frequency seems to be about 6 weeks. There is a possibility that this could be extended to 8 weeks for elephant grass.

Introduction

Dairy production in Vietnam has made good progress in the last decade, and the small-holder system (Devendra 2001) is the typical model, found mainly in the peri-urban areas. Dairy cattle feeds are based mostly on natural grasses and rice straw supplemented with concentrate and agricultural and industrial by-products. Sowing of improved grasses is probably one of the most efficient methods for achieving high forage production and nutritive value for intensive dairy farming in Vietnam. However, grasses are rarely sown and only in small areas due to limited land holdings.

Elephant grass (*Pennisetum purpureum*) cv. King grass, small-leaf guinea grass[1] (*Panicum maximum* cv. 280) and broad-leaf guinea grass[1] (*Panicum maximum* cv. I.429) are cultivated commonly in the intensive cut-and-carry systems in Vietnam. The production and persistency of these grasses depend on soil fertility, fertiliser application, water supply and cutting management. Dry matter yield generally increases with increasing fertiliser rate and cutting interval (Carvalho *et al.* 2000). However, there is a penalty in terms of the quality of forage harvested, and the optimum combination of nitrogen fertiliser level and cutting interval will depend on the relative needs for quantity and quality. It is generally considered that a 6-week interval between harvests is the maximum time compatible with high quality in cut tropical grasses (Singh 1993). However, there is a need to verify this assumption with animal production experiments that take into account

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[1] Introduced by ORSTOM, France in 1974.

losses of forage through stem rejection and differences in nutritional value of the grass eaten.

In this study, we evaluated the effect of cutting frequency on forage yield, nutritive value, feed intake and digestibility of 3 grasses growing in the sandy acid soils of Thu Duc, Ho Chi Minh City, Vietnam, in an endeavour to develop a suitable management system for harvesting forage for dairy cattle.

Materials and methods

Grass production study

The experiment was carried out in 1998 at the University of Agriculture and Forestry Experimental Farm, Ho Chi Minh City, Vietnam. Three grass species [elephant grass (Eg), guinea grass cv. 280 (Gg 280) and guinea grass cv. I.429 (Gg I.429)] and 4 cutting intervals (4, 6, 8 and 10 weeks) were compared in a split plot design (Mead *et al.* 1993) with 4 replicates. Grass cultivar represented the main plot and cutting interval was randomly split over the main plot. An area of 80 m^2 was used for the main plot, 20 m^2 for each split plot and a 1m border was left between the main plots and the blocks. The soil was classified as a sandy, acid soil (Sialit-Feralit) with the following characteristics (UAF Soil Chemistry Lab. data): Sand > 80%; C = 0.54%; N = 0.04%; pH_{KCl} = 4.1; CEC = 3.32 meq/100 g; Ca = 0.1 meq/100 g; Mg = 0.12 meq/100 g; P = 2.2 meq/100 g.

In April, grasses were planted by cuttings (Eg) or sprigs (Gg) with a 40 cm × 50 cm spacing. Ten tonnes of cow manure/hectare and phosphorus and potassium fertilisers at 41 kg P and 83 kg K per ha were applied before planting. Nitrogen fertiliser was applied 5 days after planting and after each cutting to supply 200 kg N/ha/growing season, with 50 kg N at planting and the remainder divided equally between cuttings. Twice during the establishment period, weeds were removed from between rows using hand hoes. Rainfall during the study plus the long-term mean and mean monthly temperature are shown in Figure 1.

All grasses were slashed to a height of 10 cm, 8 weeks after planting, when the cutting study commenced. A total of 6, 4, 3 and 2 harvests were taken during the growing season for cutting intervals of 4, 6, 8 and 10 weeks, respectively. Forage samples from 7.2 m^2 in each split plot (2 outer rows not included), were cut by sickle at a cutting height of 10 cm. The cutting was done in the growing season (May–December). The fresh forage was weighed and a pooled sample from the 4 replicates (1.5–2 kg of fresh material) was placed in a porous paper bag for dry matter determination and chemical analyses. A similar sample was collected to determine the ratio of leaf blade: total forage on a DM basis. The following chemical concentrations were determined: crude protein (CP), crude ash and ether extract (EE), using procedures described by AOAC

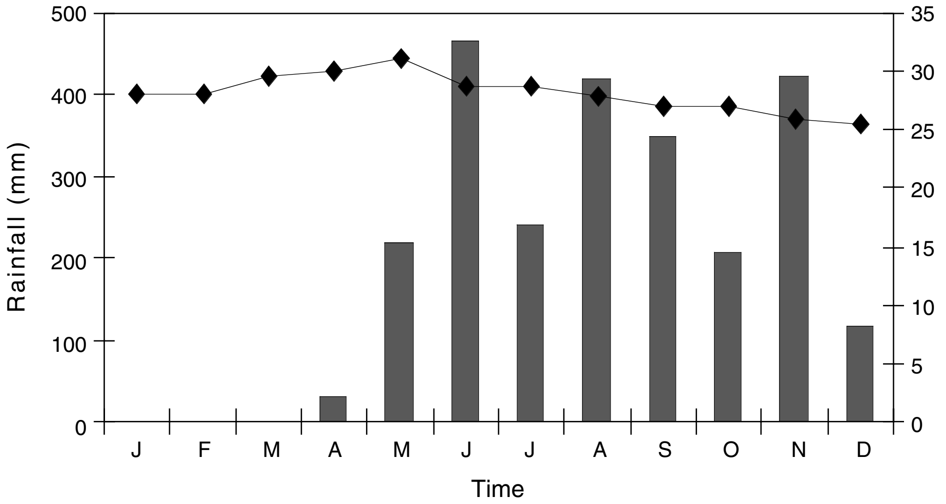

Figure 1. Monthly rainfall (▬) and mean monthly temperature (—◆—) at the time of the experiment.

(1984). ADF, ash-free NDF and permanganate lignin were analysed according to Van Soest and Robertson (1980).

Feed intake and digestibility study

Experimental conditions. Three grasses (Eg, Gg 280 and Gg I.429) harvested at 3 cutting intervals (4 w, 6 w and 8 w) were compared in a 3 × 2 change-over design (Patterson and Lucas 1962) for each cutting interval treatment. The 3 grasses were produced in 3 plots (3600 m^2 each) in the same area as the first experiment. The cultivation and practice were as for the first experiment. Cutting management of the forage followed a schedule to supply fresh forage daily at the correct experimental grass age. The experiment started in July 1999 with the study of the 6-week cutting interval, followed by intervals of 8 weeks and 4 weeks.

Six crossbred Holstein heifers, 14–16 months of age and 200–240 kg liveweight, were randomly allocated in 2 blocks to the 3 grass treatments for each experimental cutting interval. Each period included a preliminary period of 7 days for adaptation, 5 days for feed intake measurement, 3 days for diet adaptation and 6 days for digestibility measurement. During the intake studies, the amount of grass offered was 20% higher than the mean voluntary grass DM intake of each animal during the 7-day pre-experiment period for Gg 280 cut at 6 w of age. For the digestibility determinations, feed offered was limited to 85% of mean DM intake measured during the intake studies.

The animals were confined in individual stalls indoors one month before the trial to accustom them to the experimental conditions, and were treated to control internal and external parasites. During the experiment, the animals were fed 4 times per day at 08.30, 11.00, 16.00 and 20.00h.

The total amount of forage for each animal was cut in the morning, stored and chopped into 4–6 cm lengths before feeding. The daily amounts given were based on DM concentrations determined using quick microwave dryers (Undersander *et al.* 1993). A mineral supplement, produced by the Department of Animal Nutrition (University of Agriculture and Forestry), was used in the experiment. It contained salt, dicalcium phosphate, $MgSO_4$, $CuSO_4$, $CoCl_2$, K_2SO_4, casein iodine, $MnSO_4$ and selenium and was fed at 56g/100 kg Lwt per day. Water was freely available.

Data collection and laboratory analysis. The animals were weighed prior to and after the 5-day feed intake period in the morning, before the first feeding. The mean weight was used in calculating the feed intake per kg liveweight$^{0.73}$. Feed samples and refusals were collected daily for laboratory analysis. During the collection period, refusals were collected at 08.00 h, weighed, mixed, sub-sampled and bulked for each animal. During the digestibility study, faeces from each animal were collected immediately after defaecation throughout the day, and placed in pre-tared covered plastic basins until 08.30 h the following morning. The 24-h faecal output was weighed, mixed and sub-sampled, and 10% of daily output was sampled from each individual heifer and stored in a deep freeze. The 6 samples from each animal during the collection period were thawed, mixed, sub-sampled and dried in a forced draught oven at 60°C for 72 h prior to laboratory analysis. Samples were prepared using procedures described by Goering and Van Soest (1970). Feed, refusals and faecal samples after oven drying were ground using a laboratory hammer mill with a 1mm screen. The following determinations were made: dry matter, ash, crude protein, ether extract, ADF, ash-free NDF and permanganate lignin, using the same methods described in the production study. Digestible energy (DE) content of the diets was calculated from the *in vivo* OM digestibility (OMD) according to Butterworth (1964): $DE = 0.1705*OMD+0.637$.

Statistical analysis

The data were subjected to analysis of variance (ANOVA) by using the General Linear Model (GLM) procedure of Minitab (1998). When the F test was significant ($P<0.05$), Tukey's test for paired comparisons was used (Minitab 1998).

Results

Grass production under different cutting frequencies

Dry matter yields of grasses increased significantly as length of cutting interval increased (Table 1). It should be noted that the 10-week

Table 1. Grass production under different cutting frequencies for a 24-week (4 wk, 6 wk and 8 wk) or 20-week (10 wk) season.

Species	Frequency of cutting				
	4 wk	6 wk	8 wk	10 wk	Mean
DM yield (kg/ha/week)					
Elephant grass	179 A[1]	236 A	345 B	525 C	321 a
Guinea grass 280	460 A	564 B	598 B	747 C	592 b
Guinea grass I.429	262 A	381 B	426 B	552 C	405 c
Mean	300 a	394 b	456 c	608 d	
DM yield (kg/ha/season)					
Elephant grass	3980 A	5357 AB	7757 BC	10248 C	6836 a
Guinea grass 280	10504 A	12813 AB	13496 AB	14502 B	12829 b
Guinea grass I.429	5897 A	8164 AB	9579 B	10944 B	8646 c
Mean	6794 a	8778 b	10277 c	11898 d	
CP yield (kg/ha/season)					
Elephant grass	617 A	611 A	597 A	697 A	631 a
Guinea grass 280	1324 A	1243 AC	972 BC	1001 C	1135 b
Guinea grass I.429	778 A	808 A	680 A	733 A	750 c
Mean	906 a	887 a	750 b	810 ab	

[1] Values in rows followed by different upper case letters and means in rows and columns followed by different lower case letters are significantly different ($P < 0.05$).

cutting interval had total yields for only 20 weeks, while the other treatments were for a 24-week season. Overall, cutting every 10 weeks produced nearly twice as much DM as cutting every 4 weeks, but responses differed with each grass species. Eg cut every 10 weeks produced 2.6 times as much DM as 4-weekly cutting, while the relative yields for Gg I.429 and Gg 280 were 1.9 and 1.4 times, respectively. The growth rates of the grasses (kg DM/ha/week) increased significantly with longer cutting intervals, but no significant difference was found between 6 and 8-week cutting in the guinea grass species. Significant differences were found in DM yields between grasses (Gg 280 > Gg I.429 > Eg).

Overall, CP yields were similar for cutting frequencies of 4, 6 and 10 weeks but significantly ($P<0.05$) lower for the 8-week cutting. CP yields differed significantly between grasses, with Gg 280 > Gg I.429 > Eg.

As the grasses matured, stem development increased resulting in a reduction in leaf blade percentage with longer cutting intervals (Figure 2). The decline was greater with elephant grass. Gg 280 was a leafy grass and retained a high leaf blade percentage at maturity (> 70% in an 8-week cut), compared with 50% in elephant grass.

DM concentration in the grasses increased as the cutting interval increased (Table 2). Guinea grasses had a higher DM% than elephant grass. CP concentration decreased and NDF and ADF concentrations increased with advancing maturity. Eg was higher in CP at 4 and 6-week cutting and lower in NDF and ADF concentrations than the guinea grasses, but differences between the two guinea varieties were small.

Daily intake of grasses

The DMI of grasses (Table 3) was not significantly ($P>0.05$) affected by cutting interval, but NDF intake tended to increase with longer cutting interval. DMI of Gg 280 exceeded that of elephant grass ($P<0.05$).

The CPI of grasses decreased significantly ($P<0.05$) with longer cutting intervals, and CPI of 4-week grass was twice that of 8-week grass. The CPI of elephant grass and Gg 280 exceeded that of Gg I.429.

Digestibility of the grasses under different cutting intervals

The results for apparent digestibility of the proximate chemical components of the grasses are summarised in Table 4. The digestibility of DM, CP, NDF and ADF decreased as cutting interval increased, and 8-wk cutting intervals significantly reduced digestibility compared with the earlier cuttings. No significant difference ($P>0.05$) was found between the 4 and 6-week cutting in DM, NDF and ADF digestibility. CP digestibility decreased significantly with advancing maturity, while EE digestibility was highest at 6 weeks.

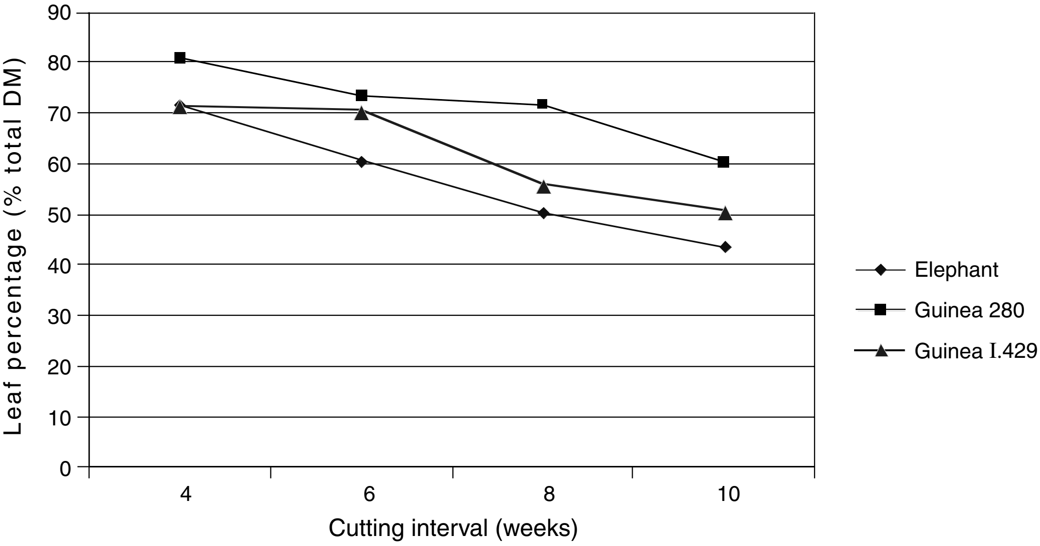

Figure 2. Effect of cutting interval on leaf blade percentage in DM produced by 3 grasses.

Table 2. Chemical analysis of grasses under different cutting frequencies.

Species	Cutting frequency	DM	CP	EE	NDF	ADF	Ash
	(wk)	(%)	(% DM)				
Elephant grass	4	13.2	15.5	3.5	63.6	35.8	9.4
	6	13.2	11.4	3.4	69.6	39.5	7.8
	8	14.9	7.7	2.9	72.6	42.4	6.1
	10	17.7	6.8	2.8	75.3	45.5	4.7
	Mean	14.8	10.3	3.1	70.3	40.8	7.0
Guinea gr. 280	4	19.4	12.6	2.8	73.8	42.1	8.2
	6	20.4	9.7	4.0	76.8	46.0	7.2
	8	22.8	7.2	2.3	77.6	48.0	6.3
	10	23.8	6.9	3.6	79.3	49.8	5.7
	Mean	21.6	9.1	3.2	76.9	46.5	6.8
Guinea gr. I.429	4	14.8	13.2	3.0	72.0	39.7	10.2
	6	17.0	9.9	2.5	77.0	44.2	7.2
	8	20.2	7.1	3.0	79.2	47.2	6.1
	10	22.3	6.7	2.8	79.8	49.8	5.5
	Mean	18.6	9.2	2.9	76.9	45.2	7.2

Table 3. Daily voluntary DM, NDF and CP intakes of grasses under different cutting frequencies.

Parameter/Species	Frequency of cutting			
	4 wk	6 wk	8 wk	Mean
DMI (g DM/kg Lwt$^{0.73}$)				
Elephant grass	90.6	94.5	86.0	90.4 a[1]
Guinea grass 280	110.9	104.1	98.7	104.6 b
Guinea grass I.429	90.3	99.6	93.6	94.5 ab
Mean	97.6	99.4	92.8	
NDF intake (g/kg Lwt$^{0.73}$)				
Elephant grass	57.9	65.8	62.5	62.1 a
Guinea grass 280	81.7	79.9	76.5	79.4 b
Guinea grass I.429	65.6	76.5	74.2	72.1 b
Mean	68.4 a	74.1 b	71.1 ab	
CP intake (g/kg Lwt$^{0.73}$)				
Elephant grass	14.04 A	10.63 B	6.66 C	10.44 a
Guinea grass 280	14.09 A	10.10 B	7.01 C	10.40 a
Guinea grass I.429	12.07 A	10.03 A	6.45 B	9.52 b
Mean	13.40 a	10.25 b	6.70 c	

[1] Values in rows followed by different upper case letters and means in rows and columns followed by different lower case letters are significantly different ($P < 0.05$).

Table 4. Digestibility of proximate components in grasses under different cutting frequencies.

Component	Frequency of cutting			
	4 wk	6 wk	8 wk	Mean
DM digestibility (%)				
Elephant grass	65.2 A[1]	64.6 A	57.7 B	62.5
Guinea grass 280	60.4 A	61.6 A	57.8 A	60.0
Guinea grass I.429	64.0 A	63.1 A	55.8 B	60.9
Mean	63.2 a	63.1 a	57.1 b	
CP digestibility (%)				
Elephant grass	69.7 A	53.7 B	44.9 B	56.1
Guinea grass 280	60.5 A	52.5 A	47.1 A	53.4
Guinea grass I.429	71.0 A	68.3 A	38.9 B	59.4
Mean	67.1 a	58.2 b	43.6 c	
EE digestibility (%)				
Elephant grass	64.7	71.6	60.2	65.5 a
Guinea grass 280	62.0	68.5	49.2	59.9 ab
Guinea grass I.429	44.8 A	73.3 B	35.6 A	51.3 b
Mean	57.2 a	71.2 b	48.3 a	
NDF digestibility (%)				
Elephant grass	67.5 A	68.0 A	61.6 B	65.7
Guinea grass 280	66.4 A	67.4 A	64.6 A	66.2
Guinea grass I.429	67.7 A	68.8 A	61.1 B	66.9
Mean	67.2 a	68.0 a	62.4 b	
ADF digestibility (%)				
Elephant grass	62.4	64.9	57.0	61.4
Guinea grass 280	62.4	62.6	58.1	61.0
Guinea grass I.429	62.0	64.1	57.1	61.1
Mean	62.3 a	63.9 a	57.4 b	
Ash digestibility (%)				
Elephant grass	39.9	34.1	22.8	32.3
Guinea grass 280	21.7	31.0	16.4	23.0
Guinea grass I.429	40.5 A	36.7 AB	17.7 B	31.6
Mean	34.0 a	33.9 a	19.0 b	

[1] Values in rows followed by different upper case letters and means in rows and columns followed by different lower case letters are significantly different ($P < 0.05$).

Digestible yields and digestible energy (DE) values of the grasses

The DE values and digestible yields of grasses under different cutting intervals are summarised in Table 5. Grasses investigated in this experiment were similar in DE, although some differences in other quality parameters were demonstrated (Table 2). DE of the forage was not affected when cut at 4 or 6 weeks but was reduced by 8% when cutting was delayed until 8-week intervals.

Digestible yields were calculated from the pooled data for the two experiments. The digestible DM yields of grasses were increased significantly at the longer cutting interval, but no significant difference was found between the 6-week and 8-week cutting. The same trend was found in each grass. Digestible DM yields differed between the grasses, with guinea grass 280 producing twice as much digestible dry matter as elephant grass.

Digestible CP yield decreased significantly with increased cutting interval in all grasses and differed significantly between grasses, with Gg 280 > Gg I.429 > Eg.

Discussion

The present experiment has shown that the highest yields were generally obtained with the longest cutting intervals (Table 1) as found by Omaliko (1980), Kitamura *et al.*(1982) and Guaragna *et al.* (1993). Possible explanations for the observed responses to defoliation are that the more mature grasses increased leaf area and photosynthesis, thus resulting in higher DM production. Vickery (1981) reported that there is an initial phase in the growing period, when growth rate increases together with the leaf area index (the ratio of leaf area per land area) of pasture. However, with increased maturation, this is reversed when 95% of all incident light is intercepted.

Growth rates are different between grass varieties, resulting in different productive cycles and optimum harvesting times. In this study, the growth rate was higher for young grass, and decreased after 6 weeks of age for guinea grasses. A similar observation was reported by Kitamura *et al.* (1982), who suggested that guinea grass should be cut after re-growing for 30–60 days and after 60 days in elephant grass.

CP yields were lower for the 8-week cutting compared with the other intervals. The possible explanation is that the CP yield is a product of DM yield and CP concentration. Despite the moderate increases in DM yield with longer cutting intervals (Table 1), the marked reduction in CP concentration of all species in the 8-week cutting (Table 2) created a significant reduction in CP yield.

Table 5. Yield of digestible nutrients of grasses under different cutting frequencies.

Component	Frequencies of cutting			
	4 wk	6 wk	8 wk	Mean
DE[1] (MJ/kg DM)				
Elephant grass	12.17 A[2]	12.09 A	10.97 B	11.74
Guinea grass 280	11.54	11.52	11.05	11.37
Guinea grass I.429	11.97 A	11.81 A	10.69 B	11.49
Mean	11.89 a	11.81 a	10.90 b	
Digestible DM yield (kg/ha/season)				
Elephant grass	2595 A	3461 AB	4476 B	3511 a
Guinea grass 280	6344 A	7893 B	7801 AB	7346 b
Guinea grass I.429	3774 A	5151 AB	5344 B	4757 c
Mean	4238 a	5502 b	5874 b	
Digestible CP yield (kg/ha/season)				
Elephant grass	430 A	328 AB	268 B	342 a
Guinea grass 280	799 A	653 B	458 C	637 b
Guinea grass I.429	553 A	552 A	265 B	456 c
Mean	594 a	511 b	330 c	

[1] Digestible energy calculation based on OM digestibility (Butterworth 1964).

[2] Values in rows followed by different upper case letters and means in rows and columns followed by different lower case letters are significantly different ($P < 0.05$).

As plants advance in maturity, their leaf:stem ratio decreases. Similar results to our study (Figure 2) were reported by Omaliko (1980), Kitamura *et al.* (1982) and Mbwile and Udén (1997).

The concentrations of CP, EE, NDF, ADF and ash of the grasses (Table 2) are in the ranges found in tropical forages reported by Göhl (1981) and Aumont *et al*. (1995), except for the higher CP concentrations in 4-week cuttings reported in the present study. This may be a function of the regular application of nitrogen in our study.

NDF concentration can affect feed intake, and Buxton (1996) reported that a critical level of NDF was 75% of DM in grass-only diets, with higher concentrations reducing intake and animal productivity. This critical level occurred in this study with cutting intervals not longer than 6 weeks for the guinea grasses and 10 weeks for elephant grass. However, our data show no marked reduction in intake with 8-week old guinea grass. In field observations, 10-week cutting of grasses resulted in a hard, fibrous forage, with significant numbers of dead leaves. In addition to the poor quality, tall, mature grasses tended to lodge, resulting in large numbers of new aerial shoots developing. Harvesting immature forage to obtain high quality herbage, however, adds to production costs because more harvests are needed. Furthermore, frequent harvesting of immature herbage can reduce the stand life of many perennial species. In our study, similar responses were found for Eg (3% dead clumps in 4 wk cut *vs* 0.4% in 10 wk), although the trend was in the opposite direction for Gg I.429 (3% dead clumps in 4 wk cut *vs* 8% in 10 wk), while no effect was found in Gg 280 (0% dead clumps).

It is significant that grass intake was not affected by cutting interval. The NDF and CP concentrations of diets are the most important factors affecting DMI. In this study, the mean NDF concentration of the oldest grass (8 wk of age) was a little higher than the critical level (Buxton 1996). By allowing animals to select (feeding at 20% above consumption in adaptation period) resulting in low nutritive values of grass residues, we ensured that the NDF concentration in the material consumed would be well under that level. The protein concentration of the diet has also been implicated in limiting the intake of tropical forages. Intake of grass species declines rapidly when the CP concentration of the consumed forage falls below 7% (Milford and Minson 1966). CP concentration in forage of all ages in our study was above or close to this level of nitrogen and, with the feeding regimen, CP concentration in forage eaten would have been even higher. The intake of Gg 280 exceeded that of elephant grass, which may reflect the higher leaf percentage in this forage. Similar results were reported by Laredo and Minson (1973), Poppi *et al.* (1980; 1981) and Mero and Udén (1998), who demonstrated that the leaves may be consumed at substantially higher levels than stems.

The significant decrease in CPI of grasses with longer cutting intervals in this study is a function of the similar DMIs of the forages of different ages but the large reductions in CP concentration of forage as cutting interval increased (Table 2).

The decrease in digestibility of DM, CP, NDF and ADF of the grasses with increased cutting interval may relate to the development of forage structure and composition in maturation. Forages of advanced maturity have lower leaf blade percentages (Figure 2), and contain high fibre levels with a large proportion of non-degradable fibre and less non-structural carbohydrate, resulting in low digestibility. Similar results were reported by Mbwile and Udén (1997) and Sarwar *et al.* (1999). However, in their studies, cutting intervals of the forage were longer than 6 weeks, and no data were available for immature grasses. In our study, the lower variation in forage digestibility in the early stages may relate to the contribution of new shoots that appeared continuously and the low lignification rate in the early growing period. However, the results are not consistent with the findings of Kitamura *et al.* (1982), who showed higher *in vitro* digestibility of forage cut at 1 month compared with 2-month cutting. The fact that crude protein concentration of forage decreased with maturation can be another limiting factor related to forage digestibility. CP in forage-only diets is the main source of N for many species of rumen microorganisms and a low level of N intake in mature grass may limit microbial growth, resulting in low fermentative digestion of grass. However, the effect of CP concentration on fibre digestibility was small, as also reported by Mero and Udén (1990; 1997) and Mtenga and Shoo (1990).

Herbage cutting management strategies are based mainly on biomass production and forage quality. Optimum field management is aimed at getting the highest biomass production which satisfies the animal's needs, as usually determined by animal performance. Using digestible DM yield as the standard, optimum cutting interval seems to be around 6 weeks, and this is consistent with the general recommendation of Singh (1993). In relation to animal requirements, the desirable cutting interval for guinea grasses may be reduced to 4 weeks for supplying forage of high nutritive value to highly productive cattle, and increased to 8 weeks in elephant grass to increase biomass production in productive cattle diets. Several scientists (Kitamura *et al.* 1982; Guaragna *et al.* 1993; Acunha and Coelho 1997) have made similar recommendations.

Conclusions

The present data reinforce the well established principle that cutting management strongly affects yield and quality of grasses. Forage biomass production increased and forage quality decreased with the maturation of the grasses. The yields of digestible DM and digestible CP were highest in Gg 280, followed by Gg I.429 and Eg. To provide a balance between dry matter yield and forage quality, the optimum cutting frequency for dairy heifers seems to be 6 weeks. There is a possibility that this could be extended to 8 weeks in elephant grass.

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