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Full Length Research Paper

Harvest frequency effect on plant height, grass tiller production, plant cover and percentage dry matter production of some forage grasses and legumes in the derived savannah, Nigeria

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Four legumes, *Lablab purpureus, Stylosanthes hamata, Centrosema pascuorum* and *Stylosanthes guyanensis* and 4 grasses, *Sorghum almum, Panicum maximum, Chloris gayana* and *Andropogon gayanus* were investigated in a 2-year study at Nsukka, derived savannah, Nigeria. The response of these species to cutting management (4 and 8-weekly intervals) was evaluated. Increasing the interval between harvests increased (P<0.05) plant height and percentage dry matter production in the grass and legume species. Cutting treatment did not influence the extent of legume cover; however, the extent of grass cover was increased (P<0.05) by 30% when the interval between harvests was increased from 4 to 8 weeks. Weed cover in the grass plots was depressed (P<0.05) by 21% with increased interval of cut from 4 to 8 weeks. The tallest (P<0.05) plants among the legumes were obtained in *S. guianensis* when cutting was done at the interval of 8 weeks. Harvesting the grasses at the interval of 8 weeks produced the tallest plants in *A. gayanus* in 2007. The highest (P<0.05) tiller number per meter square was produced in both years when *A. gayanus* was harvested at 4-weekly interval. *S. guyanensis* and *S. hamata* suppressed (P<0.05) weed growth more than *L. purpureus* or *C. pascuorum*. Percentage dry matter production was lower (P<0.05) in *L. purpureus* compared with the other legumes. Grass cover remained relatively high with *P. maximum* and *A. gayanus*.

Key words: Cutting frequency, forage species, seasonal yield, dry matter content.

INTRODUCTION

Improved grasses and legumes have been recommended for intensive livestock production in Nigeria due to their high forage production and nutritive value (De Leeuw and Brinckman, 1974; Olubajo, 1974). Various grass species at present exist in Nigeria and the notable ones include *Andropogon gayanus, Panicum maximum, Chloris gayana* and *Sorghum almum* (Agishi, 1979). The legumes, which include; *Stylosanthes guyanensis, Lablab purpureus, Stylosanthes hamata* and *Centrosema* spp. have proved very valuable (Onifade and Agishi, 1988).

The productivity, chemical composition and nutritive value of grasses and legumes found in Nigeria vary greatly according to species, the nature and fertility of the soil, water relations, season, disease control and the stage of growth at which the forage species are cut or grazed (Aregheore, 1996; Nuru, 1996). Cutting frequency has been shown to produce different effects on the quantity and quality of forage grasses and legumes at different seasons of the year depending on the species of forage (Njarui and Wandera, 2004; Enoh et al., 2005). The response to cutting of a forage plant depends upon its seasonal yield of carbohydrate storage, its growth

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Table 1. Plant cover score of legume, grass and weed species.

Score	Percentage cover	Degree of cover
1	< 20	Very low
2	20 - 39	Low
3	40 - 59	Medium
4	60 - 79	High
5	80 - 100	Very high

habit and extent of inflorescence development (Dev, 2001). As pastures mature they are characterized by high content of fibre with a higher grade of lignification and low protein content (Enoh et al., 2005). Most improved grasses fed at early stages of maturity are more digestible and are eaten in larger quantities than at more mature stages (Mero, 1985). Legumes contain higher crude protein (CP) and minerals than grasses and increase total dry matter intake when used as supplements to low CP grass diets (Mero and Uden, 1990). Some of the available forage grass and legume species have not been evaluated under frequent cutting regimes in the derived savannah of Nigeria. The need thus arises to device better means of maximizing the performance of these pasture species without compromising either the dry matter production or quality. This paper reports the results of a study that was conducted to investigate the seasonal grass tiller production, percentage dry matter production, persistence and plant growth under two cutting regimes of four selected herbaceous legumes and four grasses in Nsukka, derived savanna of Nigeria.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Teaching and Research Farm of the Department of Crop Science, Faculty of Agriculture, University of Nigeria, Nsukka. Nsukka is located at Latitude 06° 52' N and Longitude 07° 24' E, and on altitude of 447.2 m above sea level. Four herbaceous legumes (*L. purpureus, S. hamata, C. pascuorum*, and *S. guyanensis*) and 4 grasses (*S. almum, P. maximum, C. gayana* and *A. gayanus*) were evaluated in 2006 and 2007.

The design of the experiment was an 8 × 2 factorial in randomized complete block arrangement, with 3 replications. Treatments comprised eight forage species and two cutting frequencies (4 and 8 weeks). The marking of the field into blocks (2.2 × 36 m per block) and plots (2.25 × 2.2 m per plot) was done on 15 June 2006. Planting was done from 19 to 24 June 2006 with $1m^2$ sampling area. The seeds of *L. purpureus* were planted by broadcast at the rate of 15 kg ha^{-1} while 5.6 kg ha^{-1} was the seed rate for the other 3 legume species. The seeds of *S. almum*, *C. gayana,* and *A. gayanus* were planted at the rate of 15, 5 and 5.6 kg ha^{-1}, respectively. *P. maximum* rooted cuttings were planted at 20 × 30 cm spacing. Basal application of 75 and 44 kg P ha^{-1} as potassium chloride and single superphosphate, respectively, was made by broadcasting in 2006 and 2007.

Measurements

Cutting was done at uniform height of about 15 cm with shears. The harvest intervals of 4 and 8 weeks gave 2 and 1 samples, respectively in 2006 (that is 8 weeks from September 22 to November 17) and 6 and 3 samples, respectively in 2007 (that is 24 weeks from June 12 to November 27). Fresh samples of the grass and legume species weighing 100 g were put in paper envelops and dried in a forced air oven set at 80°C and weighed after attaining constant dry weights. These were used to calculate the dry matter content of the forage species. Plant height (cm) was taken using the mean of three readings taken at random from the sample area in each plot. Tiller counts for the grass species were made on each plot using a 25 cm square quadrant. The mean of three throws per plot was used to calculate tiller population per m^2. Plant scoring of the plots was done to determine the extent of cover by the forage species, weed species (that is, any plant other than the species planted) and bare ground cover. The scoring is shown in Table 1

Scoring was done using five point grading score as suggested by Snedecor and Cochran (1967) for subjective evaluation.

Statistical analysis

All data collected were statistically analysed using the procedure outlined by Steel and Torrie (1980) for factorial experiment in a randomized complete block design using GENSTAT (1995) statistical package. Separation of treatment means for statistical significance was done using the standard error of the difference between two means (s.e.d.). Square root transformation of the form $\sqrt{x + 0.5}$, where x is the observation, was used whenever there is zero value. The 4- and 8-week intervals of cut each spanning the yearly harvest period were separately analysed and compared for effect of season as done by Omaliko (1980).

RESULTS

In 2006, cutting interval, species and their interactions showed no significant effects on the height of the legumes (Table 2). The longer interval of 8 weeks significantly ($P<0.05$) increased plant height by 46% over situations where cutting was frequent in 2007. *S. guyanensis* was significantly ($P<0.05$) taller than the other legume species, followed by *L. purpureus* and *S.hamata* which did not differ with each other statistically ($P>0.05$) but were significantly ($P<0.05$) taller than *C. pascuorum.* Cutting interval × species interactions showed no significant ($P>0.05$) effects on the height of the legumes in 2007.

Cutting the legumes at 8-weekly interval during the first harvest period of 2007, resulted in plants that were statistically ($P<0.05$) taller than those harvested every 4 weeks (Table 3). Plant height was not significantly affected by cutting treatment in the last two periods. The legume species showed significant ($P<0.05$) variability in plant height in all the harvest periods. During the first two harvest periods of 2007, *C. pascuorum* produced plants that were statistically ($P<0.05$) shorter compared with those from other legumes. There was significant cutting interval and species × cutting interval interaction effect on

Table 2. Plant heights of 4 legumes defoliated at 4 and 8-week intervals.

Species	Cutting intervals (weeks)		
	4	8	Mean
		2006	
Dolichos bean (*L. purpureus*)	70.4	59.9	65.1
Verano stylo (*S. hamata*)	31.6	51.9	41.7
Centro (*C. pascuorum*)	28.7	48.2	38.5
Cook stylo (*S. guyanensis*)	35.9	67.1	51.5
Mean	41.6	56.8	49.2
		2007	
Dolichos bean (*L. purpureus*)	30.6	43.2	36.9
Verano stylo (*S. hamata*)	26.7	41.7	34.2
Centro (*C. pascuorum*)	24.2	30.4	27.3
Cook stylo (*S. guyanensis*)	33.5	52.0	42.7
Mean	28.7	41.8	35.3
	2006		**2007**
s.e.d. between 2 cutting frequency means (C)	10.99		1.85
s.e.d. between 2 species means (S)	15.54		2.62
s.e.d. between 2 C × S means	21.98		3.70

Table 3. Plant heights of 4 legumes at various periods of the year 2007 for 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)		
	4	8	Mean
	June12 to August 7		
Dolichos bean (*L. purpureus*)	40.9	51.3	46.1
Verano stylo (*S. hamata*)	30.4	53.7	42.1
Centro (*C. pascuorum*)	32.7	40.6	36.7
Cook stylo (*S. guyanensis*)	34.6	55.3	45.0
Mean	34.7	50.2	42.5
	August 7 to October 2		
Dolichos bean (*L. purpureus*)	20.3(4.6)[1]	18.7(3.8)	19.5(4.2)
Verano stylo (*S. hamata*)	26.9(5.2)	41.9(6.5)	34.4(5.9)
Centro (*C. pascuorum*)	20.6(4.5)	16.6(3.6)	18.6(4.0)
Cook stylo (*S. guyanensis*)	37.0(6.1)	57.3(7.6)	47.1(6.9)
Mean	26.2(5.1)	33.6(5.4)	29.9(5.2)
	October 2 to November 27		
Dolichos bean (*L. purpureus*)	0.0(0.7)	0.0(0.7)	0.0(0.7)
Verano stylo (*S. hamata*)	22.8(4.8)	29.4(5.5)	26.1(5.1)
Centro (*C. pascuorum*)	13.3(3.2)	10.2(2.9)	11.8(3.1)
Cook stylo (*S. guyanensis*)	28.7(5.4)	43.2(6.6)	36.0(6.0)
Mean	16.2(3.5)	20.7(3.9)	18.5(3.7)
	1st period	**2nd period**	**3rd period**
s.e.d. between 2 cutting means (C)	2.09	0.49	0.40
s.e.d. between 2 species means (S)	2.95	0.69	0.56
s.e.d. between 2 C x S means	4.18	0.98	0.79

Values in parentheses are square root transformed values to which s.e.d. are applicable.

plant height in all the harvest periods of 2007. *S. guyanensis* harvested at 8-weekly interval significantly ($P<0.05$) produced the tallest plants in all the harvest periods of 2007.

Table 4. Plant heights of four forage grasses defoliated at 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)		
	4	8	Mean
		2006	
Columbus grass (*S. almum*)	110.1	125.8	117.9
Guinea grass (*P. maximum*)	127.2	144.9	136.1
Rhodes grass (*C. gayana*)	119.0	138.6	128.8
Gamba grass (*A. gayanus*)	140.1	100.0	120.1
Mean	124.1	127.3	125.7
		2007	
Columbus grass (*S. almum*)	78.4	119.4	98.9
Guinea grass (*P. maximum*)	60.9	121.3	91.1
Rhodes grass (*C. gayana*)	58.2	90.1	74.2
Gamba grass (*A. gayanus*)	68.4	130.7	99.5
Mean	66.5	115.4	90.9
	2006		**2007**
s.e.d. between 2 cutting frequency means (C)	15.51		3.92
s.e.d. between 2 species means (S)	21.93		5.54
s.e.d. between 2 C×S means	31.01		7.84

In 2006 harvest season, plant height remained statistically (P>0.05) similar among the grass species (Table 4). Cutting interval and species × cutting interval interactions did not show any significant (P>0.05) effects on grass height. Increasing the interval between harvests in 2007 from 4 to 8 weeks significantly (P<0.05) increased plant height by 74% on average. *A. gayanus* had significantly (P<0.05) taller plants than *C. gayana* but had similar height values with *S. almum* and *P. maximum*. Cutting *A. gayanus* at 8 weekly intervals significantly (P<0.05) increased plant height relative to the 4 week cutting interval.

Grass height was significantly (P<0.05) increased with the cutting interval of 8 weeks relative to the 4 week interval for all the harvest periods of 2007 (Table 5). Plant height varied statistically (P<0.05) among the grass species at the second and third periods of 2007. *A. gayanus* had statistically, similar plant height with *S. almum* for all the harvest periods.

Grass tiller population was not significantly (P>0.05) influenced by cutting frequency in both 2006 and 2007 (Table 6). In 2006, *A. gayanus* produced significantly (P<0.05) higher number of tillers relative to *P. maximum* but was statistically (P>0.05) similar to *S. almum* or *C.gayana*.. In 2007, *P. maximum* and *C. gayana* had significantly (P<0.05) lower number of tillers compared with *S. almum*. Cutting interval × species interaction showed significant effect on the number of grass tillers in 2006 and 2007. Harvesting *A. gayanus* at 4-weekly intervals resulted to number of tillers that were statistically higher than those of the other grass species.

Cutting at the 4 weeks interval significantly (P<0.05) increased grass tiller number relative to the 8 week cutting interval during the first two periods of 2007 (Table 7). Cutting interval did not influence tiller number at the third period of the year. *A. gayanus* significantly (P<0.05) produced higher number of tillers than *P.maxmum* and *C. gayana* in the first two periods but had values that were statistically similar with *S. almum* in all the harvest periods.

The extent of legume and weed cover and bare ground area in plots before application of cutting management in 2006 showed legume cover to be mostly very high (Table 8). The extent of weed cover and bare ground area were relatively very low. Cutting interval did not significantly (P>0.05) influence the extent of legume cover in 2007. Species comparison showed that *S.guyanensis* significantly (P<0.05) covered more of the plot than the other legumes. *S. hamata* also significantly covered the plot more than *L. purpureus* and *C. pascuorum* which did not differ with each other. The highest plot cover was obtained when *S. guyanensis* was harvested either at the 4- or 8-weekly interval, while harvesting at either the 4- or 8-weekly interval produced the least (P<0.05) plot cover in *L. purpureus*. Weed cover and bare ground area where not influenced by cutting management in 2007. *S. guyanensis* and *S. hamata* had significantly (P<0.05) lower weed covers compared with *L. purpureus* and *C. pascuorum*, which did not differ with each other.

Except for *S. almum* the other three grasses had similarly high grass cover in the establishment year and there were no clear effects of cutting frequency (Table 9). However, by the end of the first harvest year, grass cover was on average depressed (P<0.05) by 24% although

Table 5. Plant heights of four forage grasses at various periods of the year 2007 for 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)		
	4	8	Mean
	June12 to August 7		
Columbus grass (*S. almum*)	65.5	69.0	67.3
Guinea grass (*P. maximum*)	65.2	109.6	87.4
Rhodes grass (*C. gayana*)	63.5	101.2	82.3
Gamba grass (*A. gayanus*)	65.6	123.3	94.5
Mean	64.9	100.8	82.9
	August 7 to October 2		
Columbus grass (*S. almum*)	61.3	138.6	99.9
Guinea grass (*P. maximum*)	64.2	161.1	112.7
Rhodes grass (*C. gayana*)	60.9	85.5	73.2
Gamba grass (*A. gayanus*)	64.2	124.8	94.5
Mean	62.7	127.5	95.1
	October 2 to November 27		
Columbus grass (*S. almum*)	108.3	150.7	129.5
Guinea grass (*P. maximum*)	53.4	93.1	73.3
Rhodes grass (*C. gayana*)	50.3	83.4	66.9
Gamba grass (*A. gayanus*)	77.1	143.0	110.0
Mean	72.3	117.5	94.9
	1st period	**2nd period**	**3rd period**
s.e.d. between 2 cutting frequency means (C)	10.76	7.27	6.45
s.e.d. between 2 species means (S)	15.22	10.28	9.12
s.e.d. between 2 C × S means	21.52	14.54	12.90

Table 6. Tiller population per square metre of four forage grasses defoliated at 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)		
	4	8	Mean
		2006	
Columbus grass (*S. almum*)	534.9	432.0	483.5
Guinea grass (*P. maximum*)	354.7	428.3	391.5
Rhodes grass (*C. gayana*)	764.8	439.2	602.0
Gamba grass (*A. gayanus*)	1034.1	748.3	891.2
Mean	672.1	511.9	592.0
		2007	
Columbus grass (*S. almum*)	796.3	890.0	843.1
Guinea grass (*P. maximum*)	538.9	404.8	471.9
Rhodes grass (*C. gayana*)	443.0	197.0	320.0
Gamba grass (*A. gayanus*)	895.6	675.6	785.6
Mean	668.5	541.8	605.1
	2006		**2007**
s.e.d. between 2 cutting frequency means (C)	98.51		65.09
s.e.d. between 2 species means (S)	139.31		92.05
s.e.d. between 2 C×S means	197.02		130.18

remained relatively high with *P. maximum* and *A. gayanus*. In 2006, the dry matter content of legume herbage was significantly ($P<0.05$) increased by 19% when the interval between cuts was increased from 4 to 8

Table 7. Tiller population per square metre of four forage grasses at various periods of the year 2007 for 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)		
	4	8	Mean
	June12 to August 7		
Columbus grass (*S. almum*)	500.3	535.5	517.9
Guinea grass (*P. maximum*)	392.0	325.3	358.7
Rhodes grass (*C. gayana*)	661.6	163.2	412.4
Gamba grass (*A. gayanus*)	941.3	346.7	644.0
Mean	623.8	342.7	483.2
	August 7 to October 2		
Columbus grass (*S. almum*)	944.8	408.5	676.7
Guinea grass (*P. maximum*)	706.7	348.3	527.5
Rhodes grass (*C. gayana*)	488.0	234.1	361.1
Gamba grass (*A. gayanus*)	939.2	515.7	727.5
Mean	769.7	376.7	573.2
	October 2 to November 27		
Columbus grass (*S. almum*)	943.7	1725.9	1334.8
Guinea grass (*P. maximum*)	518.1	540.8	529.5
Rhodes grass (*C. gayana*)	179.5	193.6	186.5
Gamba grass (*A. gayanus*)	806.4	1164.3	985.3
Mean	611.9	906.1	759.0
	1st period	**2nd period**	**3rd period**
s.e.d. between 2 cutting frequency means (C)	68.57	45.66	144.42
s.e.d. between 2 species means (S)	96.98	64.57	204.24
s.e.d. between 2 CxS means	137.15	91.32	288.84

weeks (Table 10). *S. hamata* had significantly higher dry matter content than *L. purpureus* and *S. guyanensis* but did not differ statistically with *C. pascuorum*. In 2007, cutting management did not influence the percentage dry matter of legumes. Species comparison showed that *L. purpureum* had significantly ($P<0.05$) the least percentage dry matter compared with the other legumes. *S. hamata* though similar to *S. guyanensis*, produced percentage dry matter that was statistically higher than that of *C. pascuorum*. The legume dry matter content was not significantly affected by species × cutting interval interactions in both years.

Whether for 4- or 8-week interval of cuts, legume dry matter content in 2007 was greater later in the season than earlier (Table 11). Increasing the interval between harvests from 4 to 8 weeks in 2006 significantly ($P<0.05$) increased the percentage dry matter of grass species by 29% (Table 12). Grass dry matter content did not vary statistically among the grass species in 2006. In 2007, the dry matter content of grass increased significantly ($P<0.05$) by 21% with increase in interval between cuts from 4 to 8 weeks. *S. almum* produced significantly ($P<0.05$) higher dry matter content than *C. gayana* though similar to *P. maximum* or *A. gayanus*. Percentage dry matter was not significantly affected by cutting interval × species interaction in any of the years. Whether for 4- or 8-week interval of cuts, grass dry matter content was greater late in the season than earlier (Table 13).

DISCUSSION

The outstanding performance of the two *Stylosanthes* species in this study area over the other legumes in plant height, plot cover, weed control and percentage dry matter production agreed with the report by de Andrade et al. (2004). This has been attributed to the ability of the *Stylosanthes* species to adapt to low fertility soils of the tropics (Hall and Glatzle, 2004). Among the grasses, *A. gayanus* and *P. maximum* adapted better in this study area than the other tested grass species with better performance in plant height, plot cover and weed control. The outstanding performance of *A. gayanus* and *P. maximum* in this study area could be attributed to their ability to thrive well in acid and infertile soils of the tropics (Grof, 1981; Okeagu, 1991). *A. gayanus* have been shown to be relatively free of major pest and disease problems, resistant to drought and fire and generally adapted to savannah environment (Grof, 1981).

The observed decrease in the heights of grasses and legumes with increase in cutting frequency agrees with the report by Adams et al. (1991) that frequent defoliation

Table 8. Legume and weed covers and bare ground area of four forage legumes defoliated at 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)			Cutting intervals (weeks)		
	4	8	Mean	4	8	Mean
	Initial assessment (10 - 7 - 06)			Final assessment in 2007 (27 - 11 - 07)		
	Legume cover			Legume cover		
Dolichos bean (*L. purpureus*)	5.0	5.0	5.0	1.0	1.0	1.0
Verano stylo (*S. hamata*)	5.0	5.0	5.0	5.0	3.7	4.3
Centro (*C. pascuorum*)	5.0	5.0	5.0	1.3	1.3	1.3
Cook stylo (*S. guyanensis*)	4.7	4.7	4.7	5.0	5.0	5.0
Mean	4.9	4.9	4.9	3.1	2.8	2.9
	Weed cover			Weed cover		
Dolichos bean (*L. purpureus*)	1.3	1.3	1.3	4.7	4.7	4.7
Verano stylo (*S. hamata*)	1.3	1.3	1.3	2.0	2.7	2.3
Centro (*C. pascuorum*)	1.0	1.0	1.0	4.3	4.7	4.5
Cook stylo (*S. guyanensis*)	1.3	1.3	1.3	1.0	1.3	1.2
Mean	1.2	1.2	1.2	3.0	3.3	3.2
	Bare ground area			Bare ground area		
Dolichos bean (*L. purpureus*)	1.0	1.0	1.0	1.7	1.7	1.7
Verano stylo (*S. hamata*)	1.0	1.0	1.0	1.0	1.0	1.0
Centro (*C. pascuorum*)	1.0	1.0	1.0	1.3	1.3	1.3
Cook stylo (*S. guyanensis*)	1.0	1.0	1.0	1.0	1.0	1.0
Mean	1.0	1.0	1.0	1.2	1.2	1.2
	2006			2007		
	Legume	Weed	Bare ground	Legume	Weed	Bare ground
s.e.d. between 2 cutting frequency means (C)	0.11	0.19	0.00	0.15	0.34	0.21
s.e.d. between 2 species means (S)	0.15	0.27	0.00	0.21	0.48	0.30
s.e.d. between 2 C × S means	0.22	0.38	0.00	0.30	0.68	0.42

Table 9. Grass and weed covers and bare ground area of four forage grasses defoliated at 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)			Cutting intervals (weeks)		
	4	8	Mean	4	8	Mean
	Initial assessment (10 - 7- 06)			Final assessment in 2007 (27 - 11 - 07)		
	Grass cover			Grass cover		
Columbus grass (*S. almum*)	3.7	4.0	3.8	1.7	4.3	3.0
Guinea grass (*P. maximum*)	5.0	5.0	5.0	4.0	4.7	4.3
Rhodes grass (*C. gayana*)	5.0	4.7	4.8	2.3	2.0	2.2
Gamba grass (*A. gayanus*)	4.7	5.0	4.8	4.0	4.7	4.3
Mean	4.6	4.7	4.6	3.0	3.9	3.5
	Weed cover			Weed cover		
Columbus grass (*S. almum*)	2.3	2.0	2.2	5.0	3.7	4.3
Guinea grass (*P. maximum*)	1.0	1.0	1.0	2.7	2.0	2.3
Rhodes grass (*C. gayana*)	1.3	1.3	1.3	4.7	4.7	4.7
Gamba grass (*A. gayanus*)	1.3	1.0	1.2	2.7	2.0	2.7
Mean	1.5	1.3	1.4	3.9	3.1	3.5
	Bare ground area			Bare ground area		
Columbus grass (*S. almum*)	1.7	1.3	1.5	1.0	1.0	1.0
Guinea grass (*P. maximum*)	1.0	1.0	1.0	1.7	1.0	1.3
Rhodes grass (*C. gayana*)	1.0	1.0	1.0	1.0	1.0	1.0
Gamba grass (*A. gayanus*)	1.0	1.0	1.0	1.3	1.0	1.2
Mean	1.2	1.1	1.1	1.2	1.0	1.1

Table 9. Contd.

	2006			2007		
	Grass	**Weed**	**Bare ground**	**Grass**	**Weed**	**Bare ground**
s.e.d. between 2 cutting frequency means (C)	0.25	0.18	0.11	0.37	0.30	0.11
s.e.d. between 2 species means (S)	0.35	0.25	0.16	0.52	0.42	0.16
s.e.d. between 2 CxS means	0.50	0.35	0.23	0.73	0.60	0.23

Table 10. Dry matter contents (%) of four forage legumes defoliated at 4 and 8-weekly intervals.

Species	**Cutting intervals (weeks)**		
	4	**8**	**Mean**
		2006	
Dolichos bean (*L. purpureus*)	16.6	18.2	17.4
Verano stylo (*S. hamata*)	30.3	35.6	32.9
Centro (*C. pascuorum*)	29.6	35.3	32.4
Cook stylo (*S. guyanensis*)	25.2	31.5	28.3
Mean	25.4	30.1	27.8
		2007	
Dolichos bean (*L. purpureus*)	11.5	12.1	11.8
Verano stylo (*S. hamata*)	25.1	29.0	27.0
Centro (*C. pascuorum*)	18.7	19.0	18.8
Cook stylo (*S. guyanensis*)	22.7	26.6	24.7
Mean	19.5	21.7	20.6

	2006	**2007**
s.e.d. between 2 cutting frequency means (C)	1.03	1.73
s.e.d. between 2 species means (S)	1.45	2.45
s.e.d. between 2 C × S means	2.06	3.47

of Himalayan grasslands by large number of cattle reduced the ability of the grasses to replenish leaf area, set seeds and store food reserves in their roots, thereby reducing plant growth. Frequent grazing was simulated by the frequent harvest of 4-week interval in this present study. Poor performance of forage species due to excessive removal of photosynthetic tissues and reduction in root growth and available soil N and other nutrients as a result of accelerated desiccation of surface soil have been associated with frequent cutting regime (Sheley et al., 2002; Donaghy and Fulkerson, 2002).

Grass tiller number per meter square increased with frequent cutting interval as found by Onyeonagu and Asiegbu (2005) with *P. maximum.* They obtained a higher number of tillers with the 3-weekly interval (655 tillers per m^3) compared with the 9 weeks interval of cuts (521 tillers per m^2). Chapman and Lemaire (1993) reported similar increase in tiller population of grass species with frequent defoliation. The significant increase in the percentage dry matter production in the grass and legume species obtained in this present study agree with the report by Wilman et al. (1976) on perennial ryegrass. The increasing proportion of the stem fraction with increasing interval of cuts (Asiegbu and Onyeonagu, 2008) would help to account for increasing dry matter percentage with increasing interval of cut. The observed significant effect of cutting interval on the grass, and weed cover was also reported by Asiegbu and Onyeonagu (2008). They indicated that long cutting intervals produced better competitive ability in the desired pasture species over the weed species and that this could account for the better plot cover by the desired species than the weeds.

Conclusion

Among the legumes, the tallest plants were produced with *S. guianensis* when the 8 weeks cutting interval was used. For the grasses, harvesting at 8-weekly interval gave the tallest plants in *A. gayanus*. The highest tiller number per meter square was obtained in *A. gayanus* with the frequent cutting interval of 4 weeks. *S. guianensis*

Table 11. Dry matter contents (%) of four forage legumes at various periods of the year 2007 for 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)		
	4	8	Mean
		June12 – August 7	
Dolichos bean (*L. purpureus*)	10.0	10.7	10.4
Verano stylo (*S. hamata*)	21.6	21.3	21.5
Centro (*C. pascuorum*)	17.0	13.9	15.4
Cook stylo (*S. guyanensis*)	16.8	20.5	18.7
Mean	16.4	16.6	16.5
		August 7 – October 2	
Dolichos bean (*L. purpureus*)	6.7(2.0)	9.5(2.8)	8.1(2.4)
Verano stylo (*S. hamata*)	22.2(4.8)	28.9(5.4)	25.6(5.1)
Centro (*C. pascuorum*)	17.9(4.3)	8.9(2.2)	13.4(3.2)
Cook stylo (*S. guyanensis*)	20.7(4.6)	28.1(5.3)	24.4(5.0)
Mean	16.9(3.9)	18.9(3.9)	17.9(3.9)
		October 2 – November 27	
Dolichos bean (*L. purpureus*)	11.5	12.1	11.8
Verano stylo (*S. hamata*)	25.1	29.0	27.0
Centro (*C. pascuorum*)	18.7	19.0	18.8
Cook stylo (*S. guyanensis*)	22.7	26.6	24.7
Mean	19.5	21.7	20.6
	1st period	**2nd period**	**3rd period**
s.e.d. between 2 cutting means (C)	1.46	0.58	1.73
s.e.d. between 2 species means (S)	2.07	0.82	2.45
s.e.d. between 2 C × S means	2.92	1.16	3.47

Numbers in parentheses are square root transformed values to which s.e.d. are applicable.

Table 12. Dry matter contents (%) of four forage grasses defoliated at 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)		
	4	8	Mean
		2006	
Columbus grass (*S. almum*)	28.1	33.5	30.8
Guinea grass (*P. maximum*)	25.4	27.4	26.4
Rhodes grass (*C. gayana*)	28.3	39.9	34.1
Gamba grass (*A. gayanus*)	26.0	37.5	31.7
Mean	26.9	34.6	30.7
		2007	
Columbus grass (*S. almum*)	23.6	27.8	25.7
Guinea grass (*P. maximum*)	22.0	27.1	24.6
Rhodes grass (*C. gayana*)	19.1	22.6	20.8
Gamba grass (*A. gayanus*)	20.2	24.9	22.5
Mean	21.2	25.6	23.4
	2006		2007
s.e.d. between 2 cutting frequency means (C)	1.90		1.06
s.e.d. between 2 species means (S)	2.69		1.50
s.e.d. between 2 C x S means	3.80		2.12

Table 13. Dry matter contents (%) of four forage grasses at various periods of the year 2007 for 4 and 8-weekly intervals.

Species	Cutting intervals (weeks)		
	4	8	Mean
	June12 – August 7		
Columbus grass (*S. almum*)	19.1(4.4)	24.1(4.9)	21.6(4.7)
Guinea grass (*P. maximum*)	19.5(4.5)	12.6(3.2)	16.1(3.8)
Rhodes grass (*C. gayana*)	14.3(3.8)	13.4(3.7)	13.9(3.8)
Gamba grass (*A. gayanus*)	17.7(4.2)	20.4(4.5)	19.1(4.4)
Mean	17.7(4.2)	17.6(4.1)	17.6(4.2)
	August 7 – October 2		
Columbus grass (*S. almum*)	22.1	26.9	24.5
Guinea grass (*P. maximum*)	21.5	24.3	22.9
Rhodes grass (*C. gayana*)	19.1	24.3	21.7
Gamba grass (*A. gayanus*)	18.8	24.9	21.9
Mean	20.4	25.1	22.7
	October 2 – November 27		
Columbus grass (*S. almum*)	23.6	27.8	25.7
Guinea grass (*P. maximum*)	22.0	27.1	24.6
Rhodes grass (*C. gayana*)	19.1	22.6	20.8
Gamba grass (*A. gayanus*)	20.2	24.9	22.5
Mean	21.2	25.6	23.4
	1st period	**2nd period**	**3rd period**
s.e.d. between 2 cutting frequency means (C)	0.40	1.64	1.06
s.e.d. between 2 species means (S)	0.56	2.33	1.50
s.e.d. between 2 CxS means	0.80	3.29	2.12

Numbers in parentheses are square root transformed values to which s.e.d. are applicable.

and *S. hamata* had better plot cover and suppressed weed growth than the other tested legumes. *A. gayanus* and *P. maximum* had better plot cover and suppressed weed growth than the other grass species. Harvesting those species at 8 weekly intervals provides a good management option for higher plant growth and better percentage dry matter production.

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