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Effect of cutting frequency and nitrogen application on herbage yield and nitrogen content of a degraded *Panicum maximum* pasture.

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Abstract

The effects of cutting frequency and levels of nitrogen on revitalization of a run-down pasture were investigated in 2000 and 2001 at Nsukka, Nigeria. Grass swards were cut at intervals of 3, 6, 9 and 12 weeks and received 0, 150, 300 and 450 kg N ha^{-1} nitrogen. Grass dry matter yield was increased from 52 to 75% at the 3 and 6-weeks intervals of cutting, respectively. Weed proportion was reduced from 48 to 25% with 6-weekly cuts compared with more frequent cutting at 3 weeks interval between cuts. Cutting interval did not affect the total herbage yield. The dry matter yields of leaf blade, stem and inflorescence fractions increased significantly with increase in interval between cuts in the second year. The percentage nitrogen content was highest with 3-weekly interval of cut and decreased with high interval of cuts in the second year. Crude protein yield (kg ha^{-1}) was highest with 6- and followed by 3- and 9-weekly intervals of cut and decreased with lax cutting of 12-weekly interval. Fertilizer-N treatment significantly increased total annual herbage dry matter yield from 3,460 kg ha^{-1} yr^{-1} where no fertilizer N was applied to 5,233 kg ha^{-1} yr^{-1} with application of 450 kg N ha^{-1}. Grass dry matter as proportion of the total herbage dry matter was increased from 57 to 80% with the highest N rate of 450 kg N ha^{-1} compared with where N was not applied, while the weed dry matter as proportion of the total herbage dry matter was reduced from 43 to 20% with the highest N rate of 450 kg N ha^{-1} compared with where N was not applied at the second year. A combination of 6-weeks interval of cutting with 450 kg N ha^{-1} gave the highest dry matter yield. It was also adequate in suppressing weed. Frequent cutting at higher levels of fertilizer N (300 - 450 kg ha^{-1}) increased the nitrogen and crude protein percentages of forage foliage while 6-weekly interval of cuts when combined with higher N levels gave the highest crude protein yield per hectare per year in the foliage herbage.

Keywords: Grass dry matter, Weed invasion, Crude protein, Interval between cut, N – Fertilizer.

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Introduction

The bulk of Nigeria's indigenous cattle, sheep and goat have for long subsisted on bush-grazing of natural pasture of low nutritive value found in savanna lands. These animals in consequence grow slowly, produce small milk and reproduce at long interval (Oyenuga and Olubajo, 1975). Most pastures in Nigeria lack proper management in terms of optimum defoliation and fertilization. They are often subjected to burning and extreme grazing, which have resulted in serious deterioration of pastures (Dev, 2001). There is therefore the need to improve the already existing natural pastures through proper management practices such as the use of fertilizers and cutting management (Bamikole *et al.*, 2004). In many instances, fertilizer application has been shown to increase the contents of minerals or of compounds of high biological value of pastures which increase animal production (Venuto *et al.*, 1998; Bamikole, *et al.*, 2004). The accumulation of nitrogen (N) in storage organs, which is enhanced by applied N, is an important adaptation of many perennial species for recovering from occasional, complete defoliation (Barber *et al*,. 1996). It has been shown that the dry matter yield of herbage is inversely related to the frequency of defoliation (Venuto *et al.*, 1998). However, lengthening the interval between defoliation is accompanied by a decline in the nutritive value of the herbage harvested (Binnie *et al.*, 1997; Venuto *et al.*, 1998).

Earlier study to test the effects of cutting frequency and initial cutting date on pasture production at Nsukka conditions was on sown pastures (Omaliko, 1983). This study however, lacked information on different nitrogen fertilizer rates in combination with cutting frequencies needed for reclamation of run-down pastures typified by *Panicum maximum*. This study aimed at filling that information gap.

The objective of the present investigation was therefore:
to evaluate the effect of N application and cutting frequency on herbage yield and quality of a run-down *P. maximum* pasture.

Materials and Methods

The experiment was conducted from August 2000 through November 2001 on an old-degraded pasture measuring 0.7 hectare located at the Research Farm, University of Nigeria, Nsukka. Nsukka is located at latitude 06° 52' N and longitude 07° 24' E, and on altitude of 447.2m above sea level. The pasture at the Research Farm had been used for grazing cattle for three years from 1997 till the start of the experiment in 2000 season. Originally the pasture was a mixture of guinea grass - *Panicum maximum* and *Centrosema pubescens*. The pasture was considered degraded with high weed cover and bare ground. A 4 x 4 factorial trial, laid out in a randomized complete block design with three replications was imposed on the degraded pasture land. Treatments comprised four levels of nitrogen fertilizer at 0, 150, 300 and 450 kg N ha^{-1} and four harvesting frequencies of 3-, 6-, 9-, and 12-weekly interval resulting in sixteen treatment combinations per block. .

A portion of the degraded pasture land was marked out into three blocks of 19.2 x 2.4 metres each. Each block was further divided into 16 plots of 2.4 x 1.2 metres each with a sampling area of 0.9 x 1.8 metres. Each block was separated by one metre pathway. The treatment combinations were allocated randomly in each of the three blocks. Basal application of 75 kg K ha^{-1} and 44 kg P ha^{-1} as muriate of potash and single super phosphate, respectively was made by broadcasting.

Botanical Studies
The various species in the swards were identified at the begining of the experiment. Each plot was scored to determine the extent of cover by the grass species, the weed species and bare ground. Scoring was done using five point grading score as suggested by Snedecor and Cochran (1967) for subjective evaluation.

The scoring was as follows:

Score	Degree of cover	
1	L20%	Very low
2	20-39%	Low
3	40-59%	Medium
4	60-79%	High
5	80-100%	Very high

Soil Sampling: Soil samples were collected from twelve representative locations of the field with the use of soil auger to the depth of 0-20cm. These were bulked to form a composite sample from which a sub-sample was taken for soil analysis to determine the physical and chemical characteristics of the site. The samples were taken in July 2000 and June 2001.

Harvesting: Cutting was done at uniform height of about 7 cm. The harvested materials were separated into grass and weed fractions only in the second year. The grass was in turn separated into leaf blade, stem and inflorescence fractions using a 500g sub-sample of the grass sample. The harvest intervals of 3-, 6-, 9- and 12-weeks gave 6-, 3-, 2- and 1- samples respectively in 2000 (that is 18 weeks from August-December), and 8-, 4-, 2-, and 2-harvest samples respectively in 2001 (that is 24 weeks from May-November). The required quantity (0, 150, 300 and 450 kg ha^{-1}) of nitrogen as urea (46% N) was divided according to the number of cuts in a year for each harvest interval and evenly applied on the plot after each cut.

Yield of Dry Matter and Chemical Analysis: The sub-samples of leaf, stem and inflorescence fractions of the grass species and sub-samples of the weed species were put in paper envelopes, dried in a forced air oven set at 80°C and weighed after attaining constant dry weight. These were used for dry matter determinations. The content of total nitrogen in the leaf based on FAO (1986) were estimated in 2001. Data collected were subjected to analysis of variance according to the procedure for a factorial experiment in randomized complete block design.

Results

The total annual rainfall was higher in 2000 than in 2001 (Table 1). The distribution pattern was always bimodal in both years with the heaviest rainfalls in June and August or September. The minimum air temperatures ranged from 20.5-24.3°C and 19.4-22.8°C for 2000 and 2001 seasons, respectively. The maximum air temperatures were highest in the months of November to March while the minimum temperature was comparatively high as it never fell below 20°C in any month. The relative humidity observed was above 70 % during the rainy season in both years from April to October.

The soil of the experimental site was a sandy loam and was acidic in reaction (Table 2). The soil had low amounts of nitrogen, potassium, magnesium contents and base saturation in both 2000 and 2001. Organic matter was moderate in 2000 but depressed in 2001. The soil was moderate to good in cation exchange capacity, and high in available phosphorus. Nitrogen, potassium, phosphorus and base saturation were increased in 2001 while C.E.C., pH and calcium were depressed.

The extent of grass and weed cover and bare ground in plots before the application of N fertilizer and cutting management showed grass and weed covers to be mostly medium (Table 3). Increasing the interval between cuts increased grass cover significantly ($P < 0.05$) in both seasons. Grass cover was highest when cutting interval was at 12 weeks in 2000 and at 9 weeks in 2001. On the other hand, weed cover and bare ground were depressed with increased interval of cuts in both years. Fertilizer-N application had no significant effect on grass cover in 2000. The grass cover were lowest in 2001 where high N rates of 300 - 450 kg ha^{-1} were applied every 3 weeks. Cutting at 9 weeks interval produced the highest grass cover when the moderate rate of 150 kg N ha^{-1} was applied. There was no significant difference in weed cover among the

Table 1: Meteorological data for Nsukka[1]

Month	Jan	Feb	March	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec	Total rain fall (mm)	Total days
2000														
Rain fall (mm)	1.27	0.0	21.08	136.4	161.29	413.01	253.29	314.17	235.72	172.22	3.01	0.00	1712	
Rain days	1	0	2	7	9	16	17	22	20	15	1	0		119
Max. Air temp. (°C)	30.0	34.3	33.5	31.5	29.4	29.8	27.7	28.2	26.9	27.6	31.5	29.8		
Min. Air temp. (°C)	21.2	24.3	23.3	22.4	21.6	21.3	20.8	20.5	21.5	20.9	24.0	22.1		
Soil Temp(°C)	26.7	27.5	30.6	29.5	27.4	26.5	25.7	26.4	26.5	26.1	27.5	23.4		
Solar radiation (Cal/cm²/day)	667.8	821.8	658.5	706.2	633.8	523.4	479.5	417.5	513.7	570.1	578.5	760.1		
Relative humidity (%)	65.1	54.8	67.7	74.9	78.1	79.5	79.6	76.8	80.1	79.1	70.3	65.5		
Day length (hours)	11.46	11.54	12.04	12.12	12.25	12.30	12.29	12.20	12.11	12.0	11.49	11.45		
2001														
Rain fall (mm)	0.25	0.00	33.27	143.50	102.10	262.13	109.45	126.26	305.03	126.22	45.72	0.00	1254	
Rain days	1	0	5	10	10	15	16	21	25	7	2	0		112
Max. Air temp. (°C)	32.4	33.8	32.9	31.8	30.1	29.0	27.1	26.7	27.2	29.0	31.4	32.5		
Min. Air temp. (°C)	19.4	21.3	22.8	22.4	22.0	21.0	21.1	20.7	20.4	20.8	21.4	20.4		
Soil Temp(°C)	26.6	28.2	29.9	28.8	28.1	26.6	25.5	24.5	25.3	26.9	28.6	28.0		
Solar radiation (Cal/cm²/day)	1004.9	853.9	954.2	909.3	849.8	821.8	559.0	433.5	566.7	777.4	904.7	1019.7		
Relative humidity (%)	61.7	60.8	71.6	73.7	77.0	77.0	76.5	77.5	77.5	76.5	71.00	61.5		

[1] From the University of Nigeria, Nsukka, Meteorological Centre, about 200m from the experimental site

Table 2: Physical and Chemical Properties of the soil at the Experimental Site

	2000	2001
Physical Properties		
Coarse sand (%)	49	43
Fine sand (%)	30	36
Clay (%)	12	13
Silt)%)	9	8
Chemical Properties		
P^H in water	4.0	3.6
P^H in KCl	3.7	3.2
Organic carbon (%)	1.46	1.09
Organic matter (%)	2.51	1.89
Total nitrogen (%)	0.06	0.10
Total phosphorus (ppm)	122.5	145
Base Saturation	31.07	51.44
Exchangeable Cation (mg/kg soil)		
Potassium	0.01	0.03
Magnesium	0.50	0.40
Calcium	0.76	0.40
Sodium	1.15	0.25
Hydrogen	2.4	4.0
Aluminium	0.4	Trace
Cation exchange capacity (C.E.C.)	16.8	10.4

different N-rates in 2001. Increase in applied N led to increase in bare ground area especially in the second season. The 3-weekly cut interval had the highest bare ground when 450 kg N ha^{-1} was applied.

In 2001, the 3-weekly harvest schedule had the least ($P < 0.05$) yield of grass while the difference in yields between the 6- and 9-weeks cutting intervals were not significant (Table 4). Nitrogen treatment significantly ($P < 0.05$) increased yield compared with the control. The yields of grass with 150 and 300 kg N ha^{-1} were similar. The combination of 6-weekly interval with 450 kg N ha^{-1} produced the highest grass yield in 2001. The proportion of weed in total herbage (grass + weed) declined with less frequent cutting schedule and by incremental application of N fertilizer. Combining the fertilizer application of 450 kg N ha^{-1} with 12- 9- or 6-weekly cutting schedules gave the lowest proportions of weeds. Cutting interval did not influence ($P > 0.05$) total herbage yield. Nitrogen application significantly ($P < 0.05$) increased yield compared with the control treatment. Nitrogen applied at 300 and 450 kg ha^{-1} gave similar total herbage yield. Total dry matter yield was highest where cutting at 9-weekly interval was combined with 300 kg N ha^{-1} application.

In 2001, cutting every 3 and 6 weeks produced the least and highest DM yield of leaf blade respectively (Table 5). Application of higher levels of N significantly ($P < 0.05$) increased the DM yield of leaf blade. Cutting at intervals of 6-, 9- or 12-weeks at the highest N rate gave higher leaf yields than other treatments. The least and highest stem yields were from the 3 and 9 weeks

Table 3: Effect of cutting frequency and nitrogen application (kg N ha^{-1}) on cover[1] and bare ground in 2000 and 2001

		Grass Cover					Weed Cover					Bare ground				
		Levels of Nitrogen					Levels of Nitrogen					Levels of Nitrogen				
Cutting Frequency (Weeks)	*No. of records*	*0*	*150*	*300*	*450*	*Mean*	*0*	*150*	*300*	*450*	*Mean*	*0*	*150*	*300*	*450*	*Mean*
Initial assessment (6-8-2000)																
3		2.3	3.0	3.0	3.3	2.9	3.3	3.0	2.7	1.7	2.7	1.3	1.0	1.7	1.7	1.4
6		2.3	3.0	2.3	2.7	2.6	3.3	3.0	3.7	3.0	3.2	1.0	1.0	1.0	1.7	1.2
9		3.3	2.7	3.3	3.3	3.1	2.3	3.0	2.3	2.3	2.5	1.3	1.0	1.3	1.7	1.3
12		3.3	3.0	2.7	3.3	3.1	2.3	2.3	3.0	2.3	2.5	1.3	1.0	1.0	1.3	1.2
Mean		2.8	2.9	2.8	3.1	2.9	2.8	2.8	2.9	2.3	2.7	1.3	1.0	1.3	1.6	1.3
Final assessment for (11-12-2000)																
3	6	1.7	2.0	2.0	1.3	1.8	2.0	2.3	1.3	1.3	1.8	2.0	1.7	2.7	3.0	2.3
6	3	2.7	3.7	2.7	3.3	3.1	1.3	1.3	1.3	1.7	1.4	2.0	1.3	2.3	1.3	1.8
9	2	3.3	4.0	3.0	4.3	3.7	1.7	1.7	1.3	1.0	1.4	1.3	1.0	1.7	1.0	1.3
12	1	5.0	4.3	4.7	4.0	4.5	1.0	1.7	1.3	2.0	1.5	1.0	1.0	1.0	1.0	1.0
Mean		3.2	3.5	3.1	3.2	3.2	1.5	1.8	1.3	1.5	1.5	1.6	1.3	1.9	1.6	1.6
Final assessment for (27-1-2001)																
3	8	1.7	2.3	1.3	1.3	1.7	2.3	1.7	1.7	1.3	1.8	2.0	2.3	3.0	3.3	2.7
6	4	2.7	3.0	2.0	2.0	2.4	1.3	1.3	1.0	1.0	1.2	2.0	1.7	3.0	3.0	2.4
9	2	3.0	3.3	3.0	2.7	3.0	1.0	1.0	1.0	1.0	1.0	2.0	1.7	2.3	2.3	2.1
12	2	2.7	2.3	2.0	2.3	2.3	1.0	1.0	1.3	1.0	1.1	2.3	2.7	2.7	2.7	2.6
Mean		2.5	2.7	2.1	2.1	2.4	1.4	1.3	1.3	1.1	1.3	2.1	2.1	2.7	2.8	2.4

	(6-8-2000)			(11-12-2000)			(27-11-2001)		
	Grass Cover	Weed Cover	*Bare ground*	*Grass cover*	*Weed cover*	*Bare ground*	*Grass cover*	*Weed cover*	*Bare ground*
SED Cutting frequency means (C)	0.32[ns]	0.26	0.20[ns]	0.34	0.20[ns]	0.31	0.23	0.17	0.18
SED Nitrogen means (N)	0.32[ns]	0.26	0.20[ns]	0.34[ns]	0.20	0.31	0.23	0.17[ns]	0.18
SED C x N means	0.64[ns]	0.26	0.41[ns]	0.67	0.40	0.62	0.47	0.33	0.36

Note: ns = Not significant ($P > 0.05$)

Table 4: Effect of cutting frequency and N application on proportion of weed and yields of grass and total herbage in 2001

		Levels of Nitrogen (kg N ha^{-1})				
Cutting frequency (Weeks)	*No. of records*	*0*	*150*	*300*	*450*	*Mean*
Grass						
3	8	1346.0	2041.0	2690.0	2661.0	2184.5
6	4	1818.0	3570.0	3850.3	5153.7	3598.0
9	2	2495.7	3976.6	3910.3	3920.0	3575.7
12	2	2130.3	3497.0	1874.0	5152.0	3163.3
Mean		1947.5	3271.2	3081.2	4221.7	3130.4
Weed as proportion of total herbage (%)						
3	8	58.6	46.4	44.1	43.3	48.1
6	4	37.1	22.9	29.5	10.9	25.1
9	2	34.7	20.8	33.2	16.5	26.3
12	2	42.3	14.6	40.7	8.3	26.5
Mean		43.2	26.2	36.9	19.8	31.5
Total herbage (grass + weed) (kg/ha)						
3	8	3273.7	3842.0	4814.7	4893.7	4206.0
6	4	2860.7	4541.3	5608.3	5777.0	4696.8
9	2	3832.7	5094.7	5960.7	4701.0	4897.3
12	2	3874.0	4096.7	3299.0	5561.0	4207.7
Mean		3460.3	4393.7	4920.7	5233.2	4501.9

SED	*Grass forage*	*Weed proportion*	*Total herbage*
Cutting means (C)	266.02	4.65	349.03[ns]
Nitrogen means (N)	266.02	4.65	349.03
C x N means	532.04	9.31	698.07

Note: ns = Not significant (P > 0.05)

Table 5: Effect of cutting frequency and N application on DM yields ($kgha^{-1}$) of leaf blade, stem, inflorescence and total yield of grass in 2001.

	Levels of Nitrogen ($Kg\ N\ ha^{-1}$)				
Cutting frequency (Weeks)	**0**	**150**	**300**	**450**	**Mean**
			Leaf blade		
3	1324.7	2026.0	2627.3	2589.0	2141.8
6	1791.3	3450.7	3362.0	4728.3	3333.1
9	2059.3	3400.7	3118.3	3133.3	2927.9
12	2008.7	3083.7	1721.7	4251.7	2766.4
Mean	1796.0	2990.3	2707.3	3675.6	2792.3
			Stem		
3	18.0	12.0	58.0	66.7	38.7
6	26.7	114.0	446.0	410.0	249.2
9	400.7	550.0	749.7	759.3	614.9
12	119.7	413.3	152.3	900.3	396.4
Mean	141.3	272.3	351.5	534.1	324.8
			Inflorescence		
3	3.3(1.5)[1]	3.0(1.7)	4.7(1.9	5.3(1.8)	4.1(1.7)
6	0.0(0.7)	5.3(2.2)	42.3(4.8)	15.3(3.5)	15.8(2.8)
9	35.7(5.9)	26.0(4.8)	42.3(5.5)	27.3(4.0)	32.8(5.0)
12	2.0(1.3)	0.0(0.7)	0.0(0.7)	0.0(0.7)	0.5(0.9)
Mean	10.3(2.4)	8.6(2.3)	22.3(3.2)	12.0(2.5)	13.3(2.6)
			Total grass		
3	1346.0	2041.0	2690.0	2661.0	2184.5
6	1818.0	3570.0	2850.3	5153.7	3598.0
9	2495.7	3976.7	3910.3	3920.0	3575.7
12	2130.3	3497.0	1874.0	5152.0	3163.3
Mean	1947.5	3271.2	3081.2	4221.7	3130.4

SED	Leaf blade	Stem	Inflorescence	Grass Total
Cutting means (C)	210.73	86.07	0.96	266.02
Nitrogen means (N)	210.73	86.07	0.96[ns]	266.02
C x N means	421.45	172.14	1.91	532.04

[1]( ) = (Transformed means)
Ns = Not significant ($P > 0.05$)

Table 6: Effect of cutting frequency and N application on proportion (%) of leaf blade, stem, and inflorescence to grass DM yield in 2001.

	Levels of Nitrogen (Kg N ha^{-1})				
Cutting frequency (Weeks)	0	150	300	450	Mean
Leaf blade			Leaf blade		
3	98.24	99.40	97.51	97.36	98.13
6	98.57	97.21	88.24	91.84	93.96
9	83.83	85.50	79.28	79.81	82.10
12	93.97	88.36	92.60	83.42	89.59
Mean	93.65	92.62	89.41	88.11	90.95
Stem			Stem		
3	1.42(1.35)[1]	0.48(0.97)	2.30(1.63)	2.45(1.69)	1.66(1.41)
6	1.43(1.20)	2.66(1.69)	10.80(3.17)	7.88(2.86)	5.69(2.23)
9	14.77(3.85)	13.82(3.78)	19.43(4.45)	19.47(4.45)	16.87(4.13)
12	5.94(2.25)	11.64(3.47)	7.40(7.71)	16.58(4.10)	10.39(3.13)
Mean	5.89(2.16)	7.15(2.48)	9.98(2.99)	11.59(3.28)	8.65(2.73)
Inflorescence			Inflorescence		
3	0.33(0.87)	0.13(0.78)	0.19(0.89)	0.19(0.81)	0.21(0.84)
6	0.00(0.70)	0.13(0.79)	0.96(1.11)	0.28(0.87)	0.34(0.87)
9	1.40(1.38)	0.68(1.07)	1.29(1.25)	0.72(1.03)	1.02(1.18)
12	0.09(0.76)	0.00(0.70)	0.00(0.70)	0.00(0.70)	0.02(0.71)
Mean	0.46(0.93)	0.23(0.83)	0.61(0.99)	0.30(0.85)	0.40(0.90)

SED	**Leaf blade**	**Stem**	**Inflorescence**
Cutting means (C)	1.919	0.304	0.109
Nitrogen means (N)	1.919	0.304	0.109^{ns}
C x N means	3.837	0.607	0.217

[1]( ) = (Transformed means)
Ns = Not significant (P > 0.05)

cutting intervals. The addition of nitrogen progressively increased ($P < 0.05$) the yield of the stem fraction. Stem DM yields were highest where cutting every 9 or 12 weeks were combined with the highest N-rate. The yield of inflorescence increased significantly ($P < 0.05$) with increase in interval between cuts up to 9 weeks. Fertilizer-N treatment did not affect ($P > 0.05$) yield of the inflorescence. Yields of inflorescence were highest where cutting intervals of 6 and 9 weeks were combined with application of 300 kg N ha^{-1}. On the whole, herbage DM yield was highest with 6 and 12 weekly interval of cuts and at the highest rate of N.

The proportion of leaf blade to the total herbage was highest ($P < 0.05$) with 3- and followed by 6-weekly cutting interval and decreased with lax cutting of 9 or 12 weeks intervals (Table 6). On the average leafiness decreased with addition of more N fertilizer. The percentage stem fraction followed the opposite trends compared with the percentage of leaf blade. The proportion of inflorescence was below 2 %.

The percentage nitrogen content of the grass was highest with 3-weekly interval of cut and decreased ($P < 0.05$) with higher cutting intervals (Table 7). Effect of N application on herbage N content did not differ amongst the various rates of N. The herbage N percentages were highest when 3-weekly interval of cut was combined with 150 - 300 kg N ha^{-1} rates of fertilizer application. Crude protein yield (kg ha^{-1}) was highest ($P < 0.05$) with 6-, followed by 3 and 9-weekly intervals of cut and decreased with lax cutting of 12 weeks interval. Fertilizer-N treatment increased crude protein yield compared with where N was not applied. Crude protein yield was highest where cutting every 6 weeks was combined with the highest rate of nitrogen.

Discussion

Pasture degradation may result when management or environmental factors impose stress conditions and temporarily reduce yields and animal performance (Austin and Williams, 1988). The present study attempted to assess sward improvement through N fertilizer and cutting treatments.

The cutting intervals of 6 and 9 weeks rather than every 3- or 12-weeks appeared to be a more advisable system of pasture management to adopt in order to improve dry matter yield in a run-down *P. maximum* pasture. Olsen (1974) in Uganda reported that DM yield of grasses (*P. maximum, Brachiaria ruziziensis, Chloris gayana and Hyparrhenia rufa)* from a degraded pasture was increased by 11.2 % with cutting every 8 weeks compared with every 4 weeks. On the other hand, Omaliko (1980) reported that the dry matter yield of guinea grass cutting was significantly higher by increasing the cutting interval from 3 to 4 and from 4 to 5 weeks but not from 6 to 8 weeks. The reduction in yield with cutting every 12 weeks could be explained that the advantage of a very long rest interval in increasing yield in pasture swards may be lessened since light interception would reach a maximum before the end of the long rest interval and growth in the upper strata would be offset rather negatively by decay in the lower stratum (Frame, 1973). The report of Sheley *et al.* (2002) confirmed the decreased dry matter production with very high cutting frequency due to the excessive removal of photosynthetic tissues especially when the height of cut of the pasture is low. In this study, the height of cut was 7 cm.

Total herbage dry matter yield increased with incremental application of fertilizer N. The herbage yield obtained in the present study was comparable to that by Olsen (1974) where no N

Table 7: Effect of cutting frequency and N application on Nitrogen Content (%) and crude protein yield (Kg/ha) of the leaves in 2001

	Levels of Nitrogen (Kg N ha^{-1})				
Cutting frequency (Weeks)	0	150	300	450	Mean
Nitrogen Content					
3	1.66	1.94	1.96	1.63	1.80
6	1.21	1.42	1.28	1.24	1.29
9	1.45	1.38	0.96	1.26	1.26
12	0.72	1.07	1.21	1.17	1.05
Mean	1.26	1.45	1.35	1.33	1.35
Crude protein yield					
3	129.2	250.4	318.7	257.1	238.8
6	132.9	316.0	268.6	370.9	272.1
9	185.3	293.0	184.1	244.0	226.6
12	92.0	207.6	126.7	312.0	184.6
Mean	134.9	266.8	224.5	296.0	230.5

SED	**N Content**	**CP yield**
Cutting frequency means (C)	0.13	25.65
Nitrogen means (N)	0.13^{ns}	25.65
C x N means	0.27	51.31

Note: Ns = not significant (P > 0.05)

was applied but fell short of 29 t/ha/yr. obtained at the highest N application (600 kg/ha). Olsen (1974) reported two peaks of rainfall in April and November. In the present study, rainfall declined in November in both seasons. The difference in results could be due to climate.

The low DM yields of grass obtained in the present study apparently resulted from earlier loss of stands. Toledo and Formoso (1993) had associated run-down pastures with some adverse changes such as loss of plant stands, weed invasion, reduction of seed reserves and soil erosion, owing to overgrazing and bad management. The observed nutrient deficiencies of the site could partly account for the low productivity, weed invasion and pasture degradation (Humphreys, 1980).

The extent of grass cover was improved by cutting every 9 weeks when the moderate rate of 150 kg N ha^{-1} was applied. Humphreys (1980) had shown that run-down pastures respond to management practices and eventually recover or increase in productivity. Furthermore, the significant interaction between cutting interval and nitrogen level on DM yield was reported by Kemp (1976) and had been partly attributed to the ability of fertilizer N to accentuate the beneficial effects of prolonged cutting interval, especially when the growth conditions permitted better N availability and utilization (Chheda and Akinola, 1971).

High weed proportion was regarded as a major characteristics of a run-down pasture (Toledo and Formoso, 1993). The decreased content of weed with increasing levels of N in this study, could be explained by the fact that nitrogenous fertilizers when suitably employed tend to stimulate grass forage growth and create dense vegetation cover than broad leafed weeds and thereby limit weed invasion (Chapman and Carter, 1976). Leafiness is a quality attribute in forage, indicating that the leafier the herbage the better the quality of the species (Omaliko, 1980). The low stem proportion in this study was contrary to that of Lazo *et al* (1996) where stem constituted increasingly great proportion of the herbage after the sward had been growing for periods longer than 3 weeks.

The proportion of inflorescence was low but highest with 9-weekly interval of cuts compared with others. It appeared cutting masked the effect of N levels on the proportion of inflorescence in this study. In addition, the effect of cutting interval would have been confounded by the periodicities of the timing of cuts when some periods coincided with the time of initiation of inflorescences without allowing them develop much (Wilman *et al.*, 1976). The lengths of seasons also limited the number of cuts especially at the lower frequencies.

The N content and crude protein yield were lowest with 12-week cutting interval. On the contrary, Frame (1973) in Scotland reported that with a tall fescue/white clover sward, the crude protein yields were not markedly affected by harvesting frequency.

The increase in CP yields with increase in N application agrees with the report of Reid (1986) with perennial ryegrass-white clover swards at all intervals of cuts. The lack of appreciable difference in the herbage N concentration with N application in the present study was apparently due to dilution effect (Frame, 1973) where more of the nitrogen absorbed was probably used to increase biomass while the N percentage remained constant.

The higher proportion of green leaf and N content with the 3-week cutting interval corroborate the findings of Wilman *et al.* (1976) that cutting every 3-weeks was favourable for conservation (hay), grazing or where grass of very high quality is sought However, where the major objective is to obtain a high yield of digestible material intervals longer than 3 weeks may be more appropriate. Extending the interval between cuts beyond 6 weeks at the high rate of N application may not be advisable.

Conclusion

A combination of 6-week interval between cuts with 450 kg N ha^{-1} gave the highest DM yield. It was also adequate in suppressing weed. Frequent cutting at higher levels of fertilizer N (300 - 450 kg ha^{-1}) increased the nitrogen content and CP yield of forage.

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