SHORT COMMUNICATION

Effects of cutting frequency and fertilizer-N application on growth and production on guinea grass (*Panicum maximum* Jacq) sown pasture

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Abstract

A study was conducted to determine the effects of cutting frequency and fertilizer-N rates on growth and production of guinea grass (Panicum maximum Jacq). The experiment was conducted in Nsukka, Nigeria. Treatments comprised four levels of fertilizer N (0, 150, 300 and 450 kg N ha^{-1}) and four cutting intervals (3, 6, 9 and 12 weekly intervals). Plant height, tiller number and herbage dry matter yields were significantly increased by 6%, 44% and 53%, respectively, during the establishment year when fertilizer-N rate was increased from 0 to 450 kg N ha^{-1}. The extent of weed cover was significantly ($P < 0.05$) reduced by 33% in 2000 when fertilizer-N rate was increased from 0 to 450 kg N ha^{-1}. Increase in interval between cuts from 3 to 12 weeks significantly ($P < 0.05$) increased plant height in all the years. Plant height was increased ($P < 0.05$) by 28%, 34% and 28% in 2001, 2002 and 2004, respectively, when fertilizer N was increased from 0 to 450 kg ha^{-1}. Application of N at 450 kg ha^{-1} produced similar plant heights in 2001 with the 300 kg N ha^{-1} but differed from the 150 kg N ha^{-1}. Increase in nitrogen application progressively increased ($P < 0.05$) plant height in 2002 and 2004.

Key words: Cutting regime, nitrogen fertilizer, plant height, establishment

Introduction

Improvement of feed availability for the future requires development of sown pastures that are to be sustained under intensive systems of management. Intensive production system involves the use of forage species that must prove their superiority in terms of their bulk productivity (dry matter yield per unit area), persistence under defoliation regimes and inclement climatic conditions (Muhammad and Abubakar, 2004). Some knowledge of the effect of management, such as fertilization and cutting regimes on aspects of pasture growth and productivity could help to make many tropical pastures more productive and efficient for animal production (Wilman *et al.*, 1976a; Onyeonagu and Asiegbu, 2005).

Nitrogen application has been shown to significantly enhance yield and yield-related components of pastures (Mumero and Below, 1993; Asiegbu and Onyeonagu, 2008). Considerable experimental work has been conducted on the response of tropical sown pastures to fertilization (Haggar, 1971; Humphreys, 1980; Bamikole *et al.*, 2004). However, little is known about how guinea grass pasture swards grown in Nsukka south eastern Nigeria will respond to different N- fertilizer application rates and cutting regimes. This present study aimed at determining the effects of cutting frequency and nitrogen application on growth and production of guinea grass (*Panicum maximum*) grown and maintained under Nsukka, Nigeria condition.

Materials and Methods

The experiment was carried out in the Department of Crop Science Research and Teaching farm, University of Nigeria, Nsukka. Nsukka is located at latitude 06^0 52' N and longitude 07^0 24' E, and on altitude of 447.2m above sea level. The experiment was a 4 x 4 factorial experiment, laid out in a randomized complete block design with three replications. Treatments comprised

four levels of nitrogen fertilizer of 0, 150, 300 and 450 kg ha^{-1} and four harvesting frequencies of 3-, 6-, 9- and 12- weekly intervals resulting in sixteen treatment combinations per block. An area of land 21.2 meters long by 11.2 meters wide with an area of 226.24m^2 was marked out into three blocks of 19.2 x 2.4 meters each. Each block was further divided into 16 plots of 2.4 x 1.2 meters each with a sampling area of 0.9 x 1.8 meters. Each block was separated by one meter path-way. Basal application of 75 kg K ha^{-1} and 44 kg P ha^{-1} as muriate of potash and single superphosphate, respectively, was made by broadcasting. Rooted cuttings of *Panicum maximum* with height of 15cm were planted in August 2000 at 20cm x 30cm spacing. The treatment combinations were allocated completely at random in each of the three blocks. Basal application of 75 kg K ha^{-1} yr^{-1} and 44 kg P ha^{-1} yr^{-1} as muriate of potash and single supper phosphate, respectively, were made by broadcasting. Cutting was done at uniform height of about 15cm with shears. Nitrogen treatment effect was considered during the first 8 weeks to allow root establishment which lasted for 85 days (21 August to 15 November, 2000). There was cut back at the beginning of rain in the following year before sampling commenced. The harvest intervals of 3-, 6-, 9- and 12- weeks gave 8-, 4-, 2- and 2- samples, respectively in 2001, 2002, 2003 and 2004. The required quantity 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. The fresh weight of grass herbage was taken by weighing the fresh herbage harvested within the 0.9 x 1.8 meters sample area. A sub-sample (100g) of the grass species per plot was put in paper envelop and dried in a forced air oven set at 80°C and weighed after attaining constant dry weight. This was used to calculate the total dry weights of the total grass herbage. Plant scoring of the plots was done before the first general cut in November 15, 2000 to determine the extent of cover by the grass species, the weed species and bare ground area. The scoring was as follows:

Score			Degree of Cover
1	=	< 20%	Very low
2	=	20 – 39%	Low
3	=	40 – 59%	Medium
4	=	60 – 79%	High
5	=	80 – 100%	Very high

Result

Fertilizer-N application had no significant effect on grass cover during establishment in 2000 but weed cover was depressed with fertilizer-N application compared with where N was not applied (Table 1). The extent of weed cover did not vary among the 150, 300 and 450 kg N ha^{-1}.

Plant height increased with N application

Table 1: Effect of fertilizer N treatment on grass cover, weed cover and bare ground at the end of the establishment year (August 21 – November 15, 2000).

Nitrogen Fertilizer (kg N ha^{-1})	Grass cover	Weed cover
0	4.0	1.8
150	4.3	1.3
300	4.0	1.3
450	4.2	1.2
$LSD_{0.05}$ for 2 nitrogen means	–	0.35

(–) = Non-significant F-test at 5% probability level.

Table 2: Effect of fertilizer N treatment on plant height (cm) and plant tiller number per m^2 at the end of the establishment year (August 21 – November 15, 2000).

Nitrogen Fertilizer (kg N ha^{-1})	Plant height(cm)	Tiller/m^2
0	206.1	243.3
150	216.1	292.0
300	218.9	270.7
450	217.5	351.1
$LSD_{0.05}$ for 2 nitrogen means	10.91	77.01

compared with where N was not applied during the establishment year in 2000 (Table 2). There was no significant difference in plant height among the 150, 300 and 450 kg N ha^{-1} fertilizer treatments. Plant tiller number was higher at the N-rate of 450 kg N ha^{-1} compared with the control.

Nitrogen fertilizer treatment significantly increased grass dry matter yield compared with where N was not applied in 2000 (Table 3). There was no significant difference in grass dry matter yield among the 150, 300 and 450 kg N ha^{-1} fertilizer treatments.

Increasing the interval between cuts progressively increased average plant height significantly in all the years (Table 4). All cases of applied N compared with where no N was applied significantly increased plant height in 2001, 2002 and 2004. In 2001, there was no significant difference in plant height between the 150 kg N ha^{-1} and 300 kg N ha^{-1}. The 450 N kg ha^{-1} produced similar plant heights with the 300 kg N ha^{-1} but differed from the 150 kg N ha^{-1}. Increase in nitrogen application progressively increased ($P < 0.05$) plant height in 2002 and 2004. There was no cutting x fertilizer interaction effects on plant height in any of the years.

Discussion

The present study attempted to assess growth and production of a sown pasture with cutting management and fertilizer application. The increase in plant height observed with the longer intervals of cut and with increase in applied N was also reported by Wilman and Asiegbu, (1982). In their work on degraded pasture typified by Panicum maximum, Onyeonagu and Asiegbu, (2005) showed that increasing the interval between harvests from 3 to 12 weeks increased plant height from 31.5 cm to 139.2 cm and from 25.2 cm to 77.6 cm in 2000 and 2001, respectively. They also reported that when fertilizer N was increased from 0 to 450 kg N ha^{-1}, plant height was increased from 48.4 cm to 91.5 cm and 42.6 cm to 68.9 cm, in 2000 and 2001, respectively. In the present study, however, plant height was increased from 57.6 cm to 142.7 cm, 40.1 cm to 121.7 cm, 46.3 cm to 145.7 cm and 39.9 cm to 155.3 cm in 2001, 2002, 2003 and 2004, respectively, when interval between harvests was increased from 3 to 12 weeks.

Table 3: Effect of fertilizer N treatment on total dry matter yield (kg ha^{-1}) at the end of the establishment year (August 21 – November 15, 2000).

Nitrogen Fertilizer (kg N ha^{-1})	Total dry matter yield (kg ha^{-1})
0	3049.5
150	4737.6
300	4293.2
450	4667.2
$LSD_{0.05}$ for 2 nitrogen means	1149.88

Table 4: Effects of cutting frequency and fertilizer N application on plant height (cm)

Cutting frequency (Weeks)	Nitrogen fertilizer (kg N ha^{-1})				
	0	150	300	450	Mean
			Year 2001		
3	44.2	55.7	60.3	70.2	57.6
6	91.3	94.1	112.0	116.6	103.5
9	116.0	126.2	130.0	133.8	126.5
12	133.3	125.2	141.4	170.9	142.7
Mean	96.2	100.3	110.9	122.9	107.6
			Year 2002		
3	29.7	36.8	43.5	50.5	40.1
6	54.0	64.9	73.0	83.1	68.8
9	72.3	80.5	87.5	90.1	82.6
12	111.6	114.6	125.8	134.8	121.7
Mean	66.9	74.2	82.5	89.6	78.3
			Year 2003		
3	38.1	43.4	48.7	55.0	46.3
6	60.1	71.7	77.5	77.3	72.4
9	93.4	99.9	103.5	108.5	101.3
12	156.7	135.3	141.0	153.3	145.7
Mean	87.1	87.5	92.7	98.5	91.5
			Year 2004		
3	30.4	35.7	43.9	49.5	39.9
6	58.4	76.9	86.8	94.8	79.2
9	115.8	127.3	131.6	139.3	128.5
12	145.1	150.6	159.3	165.8	155.2
Mean	87.4	97.6	105.5	112.3	100.7

	2001	2002	2003	2004
LSD $_{0.05}$ for 2 cutting frequency means (C)	12.77	3.92	11.25	6.46
LSD $_{0.05}$ for 2 nitrogen means (N)	12.77	3.92	–	6.46
LSD $_{0.05}$ for 2 C x N means	–	–	–	–

(–) = Non-significant F-test at 5% probability level.

Plant height was also increased from 92.2 cm to 122.9 cm, 66.9 cm to 89.6 cm, 86.2 cm to 99.3 cm and 87.4 cm to 112.3 cm, in 2001, 2002, 2003 and 2004, respectively, when fertilizer was increased from zero to 450 kg N ha^{-1}. Degraded or run-down pastures have been shown to have shorter growing period when compared with improved and well maintained species. Run-down pastures tend to be unstable and often suffer weed invasion and this could account for the great differences in plant

heights obtained (Kennett *et al.*, 1992).

Wilman and Asiegbu (1982) working with perennial ryegrass (*Lolium perenne*) in a perennial ryegrass-white clover swards obtained the highest plant height with 8 12 weeks interval of cuts and the lowest with 3-weekly interval. They also reported that plant height increased with incremental application of fertilizer N, indicating that higher plant height with increasing application of N could partly be explained with the propensity for greater leaf area with increasing N rates. Adams *et al.* (1991) reported that frequent grazing 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 grass growth. Frequent grazing was simulated by the frequent harvest of 3-week interval in this study.

The significant increase in plant height, tiller number m^{-2}, and grass herbage dry matter yield and reduction in weed cover observed during the establishment year with increase in nitrogen application agrees with the reports by Edokwe (1991) and Onyeonagu (2005). With increased nitrogen level, the guinea grass plants absorbed more nitrogen resulting in increase in the general crop growth attributes and yield of the grass species (Edokwe, 1991).

Conclusion

Grass tiller population and plant height were generally increased with application of fertilizer N. Nitrogen fertilizer application resulted in a decrease in the weed proportion. Plant height increased with increase in interval between cuts.

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Received: 21/06/2010
Accepted: 01/03/2011