

Effect of Cutting Frequency on Forage Growth and Yield in Elephant Grass in the Southern Rainforest of Nigeria

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Abstract— Pot experiment was conducted at Ndele, Rivers state, southern rainforest of Nigeria to determine the effect of cutting frequency on forage growth and yield in elephant grass, *Pennisetum purpureum*. The study was a single factor experiment of cutting intervals (5 days; 10 days; 15 days and 20 days) replicated 3 times, arranged in a randomized complete block design using replicates as blocks. Data collected were plant height, number of leaves, leaf area, forage fresh weight and dry weight. Results showed that cutting frequency significantly influenced plant height or growth rate, leaf area and number of leaves. Leaf area and number of leaves reduced with higher frequency or shorter interval of cutting. Grasses cut at 20 days interval recorded the greatest number of leaves and highest leaf area. Cutting frequency markedly affected forage fresh weight and dry matter production (dry weight) and there was noticeable forage yield reduction in grasses cut at 5 days interval (higher frequency) with progressive cuttings as against those cut at 20 days interval (low frequency). Grasses cut at 20 days interval recorded the highest growth and leaf production, the most forage fresh weight and dry matter yield. 20 days interval is hereby recommended for cutting *Pennisetum purpureum* cutting or grazing in southern rainforest of Nigeria.

Keywords— Cutting interval, forage production, *Pennisetum purpureum*, southern rainforest, Nigeria.

I. INTRODUCTION

Elephant grass (*Pennisetum purpureum* Schumach) is a popular, valuable and high yielding tropical grass that can survive in dry and wet growing conditions or in smallholder or large-scale production system (Rusdy, 2016). Though it derived its name from been the forage used to feed elephants in Africa (Cook *et al.*, 2005), the high productivity of elephant grass has made it suitable for livestock grazing and also a major source of herbage in zero grazing, fed in stalls and the making of silage and hay (FAO, 2015).

In addition to factors such as grass species, soil quality and growing season, cutting frequency has been shown to influence forage characteristics like forage yield, chemical composition and nutritive value of herbage (Njarui and Wandera, 2004; Enoh *et al.*, 2005). According to Ansa and Iyagba (1999), cutting frequency affects forage production, re-growth potential and species survival among other factors; the plants gets weak and thin out probably as a result of reduction in carbohydrate storage levels.

Cutting frequency studies have been carried out in most grass species including *Pennisetum* spp in different agro-ecological zones but, literature is scarce about such studies in the southern rainforest of Nigeria

The objective of this study is therefore to determine the effects of cutting frequency on forage growth and yield of elephant grass in the southern rainforest zone of Nigeria.

II. MATERIALS AND METHODS

The study was carried out at the Teaching and research farm of the department of Agriculture, Ignatius Ajuru University of Education, (Ndele Campus) Port Harcourt, Rivers State, Southern Rain Forest zone of Nigeria, characterized with about 10 months rain over 100mm and a solar radiation of 120-160 kcal/cum per annum that favors crop performance (Ansa 2015 and 2016)

2.1 Materials

Materials used included polybags, sandy loam soil, shovel, wheelbarrow, hand gloves, meter rule, watering can and weighing scale.

The propagule used for planting was 20 cm long stems of elephant grass with 3 nodes.

2.2 Methods

2.2.1 Experimental design

The cutting frequencies or interval of 5days, 10days, 15days and 20days were the treatments; replicated 3 times and arranged in a randomized complete block design.

2.2.2 Agronomic Practice and layout

The poly bags with height 25 cm were perforated and filled with sandy loam soil to a soil depth of 23 cm and arranged such that same treatment replicate don't occur in same column or blocks and placed in open field. Two stem cuttings were inserted directly into the perforated poly bags and later thinned to one stand of elephant grass per pot after the propagule established. N.P.K. 20:10:10 fertilizer was applied at the rate of 20 grams to all treatments units or pots. The established stands were rain fed and weeds were controlled by direct hand removal.

2.2.3 Data collection and Analysis

All measurement of parameters was taken just before clipping of the prescribed cutting intervals. Parameters measurement were plant height, number of leaves, number of tillers, leaf area, herbage fresh weight and dry weight. Values of measurement collected were subjected to analysis of variance of the randomized complete block design and means were separated by Duncan Multiple Rang Test (DMRT) using SPSS 18th statistical software.

III. RESULTS

3.1 Plant Height

The height elongation of *Pennisetum* grass to cutting frequency is shown in Table 1. Grasses cut at 5 days interval or highest frequency had progressively plant height reduction with shortest height, while those clipped at 20 days interval or less frequent, produced the tallest grasses with highest growth rate. Those plant cut at 20 days almost reached the initial cutting height at every clipping. Cutting *Pennisetum* grasses at 10 day or 15 days interval did not express marked height variations in their response to height increment.

TABLE 1
EFFECT OF CUTTING FREQUENCY ON GROWTH RATE (HEIGHT INCREMENT) IN ELEPHANT GRASS *Pennisetum purpureum* (cm)

Cutting frequency	Plant height cm		
	Cut 1	Cut 2	Cut 3
5 days	57.14 ^b	26.22 ^a	15.19 ^a
10 days	60.52 ^b	52.11 ^b	50.56 ^b
15 day	49.72 ^a	47.72 ^b	48.67 ^b
20 day	85.67 ^c	83.17 ^c	84.00 ^c
SE	2.889	2.599	3.007
Fcal	*	*	*

Mean with different alphabetic in the same column are significantly different at p. 05 by LSD * =significant

TABLE 2
EFFECT OF CUTTING FREQUENCY ON NUMBER OF LEAVES IN ELEPHANT GRASS *Pennisetum purpureum*. Schum.

Cutting frequency	No of Leaves		
	Cut 1	Cut 2	Cut 3
5 days	17.17 ^a	7.83 ^a	7.33 ^a
10 days	24.28 ^a	22.33 ^b	28.67 ^c
15 day	24.00 ^a	24.67 ^b	23.00 ^b
20 day	40.33 ^b	38.50 ^c	42.67 ^d
SE	2.514	2.290	1.599
Fcal	*	*	*

Mean with different alphabetic in the same column are significantly different at p. 05 by LSD * = significant

TABLE 3
INFLUENCE OF AND FREQUENCY ON LEAF AREA IN ELEPHANT GRASS *Pennisetum purpureum. schum* (Cm³)

Cutting frequency	Leaf Area		
	Cut 1	Cut 2	Cut 3
5 days	237.79 ^a	47.33 ^a	26.889 ^a
10 days	131.59 ^b	162.11 ^b	147.50 ^b
15 day	164.28 ^b	203.60 ^b	172.00 ^b
20 day	292.00 ^c	281.58 ^c	263.56 ^c
SE	17.321	15.685	11.604
Fcal	*	*	*

Mean with different alphabetic in the same column are significantly different at *p*. 05 by LSD * = significant

3.2 Number of leaves

The influence of cutting frequency on number of leaves produced by elephant grass is displayed in table 2. The cutting frequency had pronounced effect on number of leaves in the grass. The number of leaves produced was strongly affected by cutting interval. Number of leaves reduced with cutting frequency. That is, as the frequency becomes higher (i.e reduced cutting interval) the production of leaves reduced. The frequently cut *Pennisetum* grasses (at 5 days interval) showed progressively marked reduction in number of leaves produced from the first to the third cutting. The difference in the number of leaves reduction between the first clipping and the third cutting was 57.3%. Those cut at widest interval of (20 days interval) were not affected, as the number of leaves produced at the 3rd cut was about the same number produced initially before cutting. The effect of cutting frequencies on leaf production was significant.

3.3 Leaf Area

The effect of cutting frequency on leaf size of *Pennisetum* is highlighted in table 3. Leaf area reduced with cutting at all cutting interval, but the reduction was shape and more obvious in the more frequently cut grasses (short cutting interval of 5 days). The reduction in leaf size was 8 times less between the 1st and 3rd cutting for those cut at 5 days interval while in those cut at 20 days interval it was about a unit less. The variation in leaf area was significantly due to the different cutting frequencies.

3.4 Forage fresh weight

Table 4 reveals the forage yield response of elephant grass *Pennisetum purpureum* to cutting frequency. Cutting frequency had a marked reducing effect on forage yield in the *Pennisetum* grasses in this study. There was significant reduction in weight of forage harvested at all frequencies of cutting. Also grasses cut at 5 days interval showed marked reduction between cut 1 and cut 3 compared to other frequencies. The reduction in forage yield was about 74% less in those cut at 5 days interval, compared to 50% reduction in the grasses cut at 20 days interval.

3.5 Dry matter production

The effect of cutting frequency on forage dry weight in *Pennisetum purpureum* is shown in table 4. Dry matter yield increased with cutting interval. As the number of days between harvesting increased, a corresponding increase in dry matter was observed. *Pennisetum* grasses harvested at 5 days interval had significantly the least dry matter while those harvested at 20 days interval had significant highest dry matter yield.

TABLE 4
EFFECT OF CUTTING FREQUENCY ON HERBAGE FRESH WEIGHT IN ELEPHANT GRASS *Pennisetum purpureum. Schum.*

Cutting frequency	Fresh Weight		
	Cut 1	Cut 2	Cut 3
5 days	31.00 ^a	3.67 ^a	7.83 ^a
10 days	26.67 ^a	29.50 ^b	25.50 ^b
15 day	24.33 ^a	24.61 ^b	22.83 ^b
20 day	86.17 ^b	79.11 ^c	42.83 ^c
SE	3.373	3.069	3.328
Fcal	*	*	*

Mean with different alphabetic in the same column are significantly different at *p*. 05 by LSD * = significant

TABLE 5
EFFECT OF CUTTING FREQUENCY ON HERBAGE DRY WEIGHT IN *Pennisetum purpureum*

Cutting frequency	Dry Weight		
	Cut 1	Cut 2	Cut 3
5 days	5.64 ^a	3.05 ^a	1.53 ^a
10 days	7.29 ^b	7.27 ^b	5.89 ^c
15 day	11.64 ^c	6.92 ^b	4.91 ^b
20 day	14.36	9.68	7.88
SE	.398	.321	.181
Fcal	*	*	*

Mean with different alphabetic in the same column are significantly different at *p*. 05 by LSD * = significant

IV. DISCUSSIONS

4.1 Forage growth

In this study it was observed that cutting frequency had significant effect on plant height or growth rate in the *Pennisetum* grasses. The more frequently cut grasses were increasing getting shorter while the less frequently cut grasses maintained their growth rate. This finding is similar to the observation of Onyeonagu and Asiegbu (2005), who reported higher plant height increment in the grasses they investigated that were harvested at wider intervals or frequencies. The number of leaves and the sizes of leaves i.e leaf area were also significantly influenced by cutting interval. Leaf area and number of leaves increased as the frequency of harvesting reduced. This trend was also observed by Da Silveira *et al.*, (2010) who reported higher leaf production in higher cutting interval. However, the findings were contrary to those of Wen and Jiang (2005) who reported that increased cutting frequency i.e. shorter interval stimulated leaf production in rye grass. This reduction in growth rate and shoot development might be an indication that high cutting frequency may suppress the grass regeneration and reduce re-growth potential.

4.2 Forage Yield

It was observed in this study that cutting frequency had pronounced effects on forage fresh weight and dry matter yield of the *Pennisetum* grasses. There was yield reduction as cuttings progressed and with cutting frequency. Grasses cut too frequently (5 days interval) were increasingly recording lower weights while those cut less frequently (20 days interval) produced higher fresh weight of forage and higher dry matter. Lounglawan *et al.*, (2013) had similar observation and stated that forage and dry matter in Napier grass (*Pennisetum purpureum x Pennisetum americanum*), in Thailand, increased as cutting interval increased. Onyeonagu and Asiegbu (2005), also reported significant increase in dry matter production with increasing cutting interval in *Pennisetum* grasses in Nsukka, Nigeria.

V. CONCLUSION

Cutting frequency significantly influenced plant height or growth rate, leaf area and number of leaves. Leaf area and number of leaves increased by cutting frequency reduced. *Pennisetum* grasses cut 20 days interval in this study, recorded the greatest number of leaves and highest leaf area. Forage yield was markedly influenced by cutting frequency, grasses cut at shorter interval or higher frequency were increasingly recording less forage weight and dry matter weight while those cut at wider interval or shorter frequency had higher forage fresh weight and higher dry matter. Grasses cut at 20 days interval produced the highest fresh weight and dry matter yield. Cutting *Pennisetum* grasses at 20 days interval for the cut system or as grazing interval is recommended in the southern rainforest of Nigeria.

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