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INFLUENCE OF N-FERTILIZER APPLICATION ON WEIGHT, NUMBER AND LONGETIVITY OF TILLERS OF NORTHERN GAMBA, GUINEA AND STAR GRASSES 1. TILLER GROWTH AND DEVELOPMENT

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ABSTRACT

Two periods of study (1985 and 1986) were conducted at the University of Nigeria, Nsukka farm, to estimate the influence of Nitrogen Fertilizer application (0, 150, 300, and 450kgN/ha) on weight per tiller of Northern gamba (Ngg) *Andropogon gayanus,* Guinea (Gg) *Panicum maximum* and Star grasses (Sg) *Cynodon polystarchyus* and two periods of study (1985 and 1986) for number of tillers and longetivity of tillers of Northern gamba and Guinea grasses. Star grass is a runner and was considered for tiller weight study only. Northern gamba and guinea grasses have erect and bunch growth habit and were also used for the study of tiller population and longetivity of tillers. The application of N- fertilizer significantly ($P < 0.05$) increased weight/tiller (g) in the three species. There was on the average a 17.1% (42.4 – 36.2) unit increase in weight/tiller (g) in 1985 and a 19.5% (43.5 – 36.4) unit increase in 1986 when N – rate was increased from 150kgN/ha-^{1} to 300kgN/ha-^{1}. Sg had the highest weight/tiller 43.2(g) for each of the growing seasons and was significantly ($p< 0.05$) higher than those of either Ngg or Gg. Tiller number and longetivity of tillers were significantly ($P < 0.05$) increased by increasing N- rates in the two species compared with no N. Seasonal effect showed that potential weight/tiller and tiller population was associated with high levels of N. These results are discussed in relation to management of the sward throughout the growing season.

KEYWORDS: N-Fertilizer Application, Tiller Growth and Development of grasses.

INTRODUCTION

Interest in grassland research with a view to providing all season feed for the livestock industry has continued to be sustained over several decades (Oyenuga, 1959; 1960; Haggar, 1970; Omaliko, 1980 ;Miller, 1984;Wilman et al 1998;Leitch and Sahi 1999). Grasses such as Northern gamba grass (Andropogon gayanus), Guinea grass CV.S112 (Panicum maximum) and Star grass (Cynodon polystarchyus) have been found to be generally adopted to wide range of soils in the savannah zone of Nigeria.

Nitrogen fertilizer has been an effective means of improving plant growth and development but from the point of view both of economic and energy conservation, efficiency of fertilizer use is however required. Studies have shown the application of N-fertilizer to affect sward productivity, (Ryle, 1964; Saleem, 1972 ; Wilman, 1980;) and potentially enhance tiller growth and development,(Pearse, 1983; and Wilman et. al , 1996;Leitch and Kurt 1999) in field sward.

The objectives of this study was to determine the influence of N-fertilizer application on weight per tiller on three grass species and tiller population and longetivity on two grass species, using treatment combinations.

MATERIALS AND METHODS

Two experiments were conducted in 1985, and 1986 using swards of grasses established in March 1985 on the University of Nigeria Farm at Nsukka, (Latitude 06^{0}52'N and Longitude 07^{0}24'E at an altitude of 447.3 above mean sea level) on Ferrallitic sandy loam soil of the Nkpologwu series. The experimental site was previously cropped with maize followed by four years fallow in which Guinea grass (*Panicum maximum*), Star grass, (*Cynodon Polystarchyus*) and *Panicum repens* were dominant fallow species.

The trial was planted in a 3 x 4 x 6 split-split-plot in a randomized complete blocks (RCB) design and replicated three times. Fertilization consisted of application of 0.150,300, and 450kgN/ha-^{1} in addition, a single application of $p_2 05$ and $K_2 0$ fertilizers was made to all plots after clearing cut, at the beginning of the growing season at the rates of 122.2kg p/ha and 375kgK/ha-^{1} respectively. The N – applications were made after each harvest except the last cut for each period of study.

The species used for the study were Northern gamba (Ngg) (Andropogon gayanus) Guinea CV. S112 (Gg) *Panicum maximum*) and Star grasses (Cynodon polystarchyus) (Sg). At the start of the study in 1985, 2 tillers at the discard areas of each harvested plot were tagged with a red ring of soft, plastic covered wire around the base. Growth of marked tillers for this study was uninterrupted throughout the growing season. At each weekly inspection of new tillers, already emerged and labeled tillers were also observed for record of dead tillers. At the death of each tagged tiller the number of days between its emergence and death was computed as its longetivity. All tillers produced irrespective of being dead or alive at the end of growing season represented the total number of tillers. Ten tillers, were randomly selected from the heap after harvest and the fresh weight determined. The tillers were subsequently dried in the Gallen Kamp air laboratory oven at the temperature of 60^{0}C for 48 hours. Mean weight per tiller was then determined by dividing the total weight of 10 tillers by 10.

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Statistical analysis: Data was subjected to analysis of variance (ANOVA) and means compared with Fisher's Least Significant difference (LSD) at 5% level.

Table 1: Average Rainfall value from 200/2001

Months	Rainfall(mm) 1985	1986	10 years average
January	0.2	0.4	0.4
February	0.8	2.7	1.8
March	27.6	38.1	10.6
April	62.3	53.3	36.1
May	77.5	76.2	53.4
June	68.9	84.5	55.7
July	59.7	112.2	68.9
August	69.9	73.1	59.2
September	73.3	47.9	82.1
October	24.6	29.2	68.5
November	5.1	4.8	22.6
December	0.3	0.2	0.5

Source: Meteorological Unit, Crop Science Department, University of Nsukka, Nsukka.

Table 2: Effect of species and nitrogen on weight/Tiller(g)

Species	1985 N – Rates (kgN/ha) 0	150	300	450	Species Mean.
Ngg	29.2	33.4	38.7	41.8	35.7
Gg	32.6	36.7	42.1	46.3	39.4
Sg	36.4	38.5	46.3	51.4	43.2
Mean	32.7	36.2	42.4	46.5	

	1986				
Ngg	28.6	34.1	40.5	42.8	36.5
Gg	31.7	35.8	43.1	46.5	39.2
Sg	37.0	39.2	47.0	49.6	43.2
Mean	32.4	36.4	43.5	46.3	

LSD (0.05) between treatment means

	1985	1986
Species	2.3	2.3
Nitrogen	3.1	3.0
Species x Nitrogen	3.6	3.5

RESULTS

The average rainfall values (mm) for 1985, and 1986 and 1977 – 1986 (10 years) are represented in Table 1. From the observation, between March and April, rainfall was sufficiently high to support crop growth and development.

The main effect of treatment combinations on weight/tiller is presented in Table 2. Variations between species and Nitrogen rates were significant ($P < 0.05$). For the three species, weight/tiller was highest in plots fertilized with 450kgN/ha^{-1} while the lowest values occurred in plots where no N was applied.

Table 3: Effect of species and nitrogen on number of tillers which emerged on marked tillers

Species	Nitrogen – Rates (Kg/Ha) 0	150	300	450	Species Mean.
Ngg	11.1	25.1	31.0	36.1	26.0
Gg	10.3	15.4	24.3	28.2	19.5
Mean	10.7	20.2	27.6	32.1	
			1986		
Ngg	12.7	27.0	33.2	37.2	27.6
Gg.	11.3	16.4	25.1	27.4	20.1
Mean	12.0	22.0	29.2	32.3	

LSD (0.05) between treatment means

	1985	1986
Species	3.4	4.5
Nitrogen	5.7	5.2
Species x Nitrogen	6.1	6.3

There was on the average a 17.1% (42.4 – 36.1) unit increase in weight/tiller (g) in 1985, a 19.5% (43.5 – 36.4) unit increase in 1986 when N – rate was increased from 150kgN/ha^{-1} to 300kgN/ha^{-1}. There was a further unit increase, on the average, of a 9.6% (46.5 – 42.4) in 1985, and a 6.4% (46.3 – 43.5) units increase in 1986, when N–rate was increased from a 300kgN/ha^{-1} to 450kgNha^{-1}. The highest aftermath and average weight/tiller were obtained from plots that received high levels of N-fertilizer compared with other treatments. Weight/tiller differences between species were clearly marked with the species producing their maximum weight/tiller at similar levels of N- application.

The effect of species and Nitrogen on the number of tillers, which emerged on marked tillers, is presented on Table 3. The highest number of tillers that emerged 32 each for 1985 and 1986 was obtained from plots that received highest rate of N (450kgN/ha^{-1}) and this was significantly ($P = 0.05$) higher than those of other treatments. Ngg had the highest number of tillers (26.0 in 1985 and 27.0 in 1986) and these were significantly higher than that of Gg.

The effect of species and nitrogen application on the longetivity of tillers (days) is presented in Table 4. Nitrogen application significantly ($P = 0.05$) increased tiller longetivity in the two species throughout the study period. There was on the average, a 48.8% (112.7 – 75.7) unit increase in longetivity in 1985 and a 37.8% - (124.5 – 90.3) unit increase in 1986 when N – application was increased from 150kgN/ha^{-1} to 300kgN/ha^{-1}. There was a further unit increase from a 17.9% (132.9 – 117.7) in 1985 and a 16.6% (145.2 – 124.5) unit increase in tiller longetivity in 1986 when N-rate was increased from 300kgN/ha^{-1} to 450kgN/ha^{-1}.

Species differences in terms of tiller longetivity was significant ($P = 0.05$), with Ngg recording on the average, 128 days a tiller survived in 1985, and 141.2 days in 1986 and these were significantly higher than those of Gg. The high levels of N prolonged the lives of tillers and delayed flowering subsequently. Tillering was more profused in 1986 than in 1985 when the swards were established. Among tillers, small younger ones tend to import assimilates from larger ones, and once they can assimilate carbon for themselves there appear to be some interchange of materials between tillers of different ages.

Table 4: Effect of species and nitrogen on the longetivity of tillers (days) over 20 and 30 weeks in 1985 and 1986.

Species	Nitrogen – Rates (Kg/Ha) 0	150	300	450	Species Mean
		1995 (20 weeks)			
Ngg	80.2	96.3	165.0	170.5	128.0
Gg	51.4	55.1	60.4	95.3	65.6
Mean	65.8	75.7	112.7	132.9	
		1986 (30 weeks)			
Ngg	99.2	110.2	175.0	180.3	141.2
Gg.	67.0	70.4	74.1	110.2	80.4
	83.1	90.3	124.5	145.2	
Mean	12.0	22.0	29.2	32.3	

	1985	**1986**
Species	28.2	29.3
Nitrogen	30.5	31.6
Species x Nitrogen	42.0	48.2

DISCUSSION

The increased weight/tiller with increased N-application found in this study was in agreement with the reports of Wilman and Pearse 1984. Wilman (1990) reported positive effect of applied N on tiller growth and development coupled with its effects in retarding senescence early in the season enhancing tiller population and increased weight/tiller.In this study because of the larger, thicker and heavier stem, Sg had a greater weight/tiller than either Gg or Ngg. Wilman and Pearse ,1984;Wilman et al 1999; noted that an increase in the interval of cuts allowed a larger positive response to applied N to develop in respect of weight/tiller.

Wilman 1976; David 1991, reported that N–application at high rates significantly increased tiller population and number of days a tiller survived under green condition. In this study and as evidence in others, (Langer, 1958, 1963), the number of days a tiller survived was increased by N–fertilizer application, such that a tiller was able to survive more days with high rates of N-fertilizer, compared with no N. An increase in live tillers due to N-application at high rates had also been reported, Ryle (1984).

Since N-application has a significant increase effect on the number of days a tiller survived the increase in tiller longetivity reported to be higher in 1986 than in 1985 is suggested to be due to nitrate accumulation in the soil after N-application in the first year of cropping.

The more succulent, thicker and larger leaves of Ngg suggest greater tiller longetivity in this specie than Gg that has a slower rate of leaf turnover. When N supply is ample, however, the whole rate of plant activity including leaf turnover is accelerated and this effect soon overrides the effect N can have in retarding senescence, particularly when the effect of N in increasing tiller size has been carried through the drying tiller. The evidence that applied N can increase the N concentration of the tillers which are drying or close to dying (Wilman and Pearse, 1984) is in accord with the evidence of retarded senescence early in the season after application.
In this experiment, tiller weight and production was sufficiently favoured by high rates of N-fertilizer application. Even at this, the geometry of the sward may change during that development, such that the marked tiller growth and production may be accompanied by a strong decrease in light extinction coefficient, like is suggested to be the case in Gg, and the rate of increase in the respiratory load at the base of the sward, may give rise to restrictions in the biosynthetic activities and may reduce tiller population and longetivity. This condition may vary from specie to specie. Thus, the relationship between canopy architecture, light distribution, air circulation, N-rates and tiller production, clearly changes with time, day, weather, season, stage of crop development, leaf arrangement, and individual plant components.
The period of highest weight/tiller ran closely with the period of highest dry matter production, although the dry matter data is not presented in this report, but it may be suggested that these two events are related.

CONCLUSION

Tiller growth is usually studied from the beginning of emergence to full expansion. According to our evidence in this study, that period represents little less than one fifth of the time in which a tiller is growing. It is a period in which extension rate is greatest, but truly, much has gone before it, including a one hundred fold increase in length and a period in which the percentage increase in length per day is much greater than during emergence. During the period of tiller emergence, tiller length may be only double or possibly trebled. Thus the rate of post emergence extension of tillers seems likely to be related to the rate of extension pre-emergence although data will be required before this relationship could be understood. Tiller death later in the season was a function of age not of N-rate.
Since this study has proved the use of N-fertilizer application at high rates of 450kgN/ha-^{1} beneficial for tiller growth and development in field sward, then a combination of this N-rate (450KgN/ha-^{1}) with sound management system will greatly improve sward productivity and the livestock industry with greater economic returns to the farmer.

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