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# EFFECT OF APPLIED NITROGEN ON LEAF PRODUCTION INTERVAL, EXTENSION RATE AND LEAF LONGEVITY OF NORTHERN GAMBA AND GUINEA GRASSES

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## ABSTRACT

Effect of four levels of N-application on field swards of Northern gamba *(Andropogon gayanus)* and Guinea grasses *(Panicum maximum* c.v. S112) were studied during 20 and 30-weeks period in 1985 and 1986 respectively. Northern gamba grass was compared with Guinea grass c.v. S112 during the two periods, July – November, 1985 and April to October, 1986.

The application of N fertilizer significantly ($P < 0.05$) increased the rate of production of leaf premordia and the extension rate but retarded leaf longetivity in the two species. During the 1985 study period, Northern gamba grass on the average, took 12 days to produce one leaf without N-application and 8.7 day where 450 KgNha$^{-1}$ was applied, and in 1986, it took 12.6 days without N-application and 9.9 days where 450KgN/ha$^{-1}$ was applied. Guinea grass took 10.0 days and 7.8 days in 1985 and 1986 to produce a leaf on the average, with 450KgN/ha$^{-1}$ compared with 12.7 and 9.4 days for 1985 and 1986 respectively with no N.

The study on leaf extension rate was undertaken for 1986 only because that was the longest growing season that had 30 weeks in this study. Species differences in terms of N application on leaf extension rate was significant ($P < 0.05$). The average effect of N application for Northern gamba gass (2.48 cm/day) was significantly higher than 1.79 cm/day obtained from Guinea grass where 450KgNha$^{-1}$ was applied. The effect of N application on leaf longevity for the two study periods, 1985, (20 weeks) and 1986 (30 weeks) was not significant ($P<0.05$). The increased leaf production interval and leaf extension rate followed closely, the high rates of N application. The implications of these findings are discussed.


**KEYWORDS:** Nitrogen fertilizer, leaf production, leaf extension rate and leaf longevity of two grass species.

## INTRODUCTION

Northern gamba grass *(Andropogon gayamus)* and Guinea grass *(Panicum maximum)* are very productive tropica: grass species. Many researches have been conducted with these and several other tropical species as well as some temperate species to determine the influence of applied nitrogen fertilizer on grass leaf initiation, development and longevity (Wilman and Mohammed, 1980, Wilman *et al*, 1999) but there seems to be little information on the effects of N-application on the physiological basis of leaf production interval, extension and longevity. An insight into the ways in which applied nitrogen affects grass new leaf production, development and how long a leaf can survive at different levels of N-application should lead to greater efficiency of sward management. The present work was therefore designed to test the influence of applied nitrogen on grass leaf production interval, extension rate and longetivity on Northern gamba and Guinea grasses.

## MATERIAL AND METHODS

The experiments were conducted in 1985 and 1986 using swards of grasses establishment in march 1985 on the University of Nigeria Farm at Nsukka, (Lattitude 06$^0$52'N and Longitude 07$^0$24'6 at an attitude of 447m above sea level) on the Ferrallitic fine sandy loan soil of the Nkpologwu series. The experimental site was previously cropped with maize for 3 years, followed by four year-fallow in which Guinea grass *(Panicum maximum)*, was a dominant fallow species.

The trial was planted in a 3 x 4 x 6 split-split-plot in a randomized complete block (RCB) design and replicated three times. There were 6 main plots (species) viz: Northern gamba (Ngg) and Guinea (Gg) CV S112 grasses, 24 sub-plots (fertilizer rates) viz, 150, 300 and 450KgNha$^{-1}$144 sub-sub plots (harvesting intervals). Each year a single application of both phosphorous and potash fertilizer was made to all plots after clearing cut, at the beginning of each growing season at the rate of 122.2Pha$^{-1}$ and 375kha$^{-1}$ respectively.

Tillers marked for leaf longetivity study were equally used to determine leaf production rate. This was recorded as the interval between emergence of the first new leaf to that of the last leaf on the marked tillers. Equally, the same marked tillers for leaf longevity study were used for leaf extension study. The date that a new leaf appeared was recorded and the initial length taken. The final leaf length was when the ligules appeared, as this indicates full expansion. The additional length acquired was taken as the mean expansion rate (Wilman and Mohammed, 1981).

Dates and numbers of leaves which emerged and dates and numbers which died were recorded from marked tillers using a total of 24 tillers per plot in the 10-week harvest plots only. The tillers were not harvested during the 10-week harvest period. Two young tillers were selected in each and marked at one leaf stage with a double ring of soft, plastic covered wire around the base. A leaf was regarded as having emerged when any part of it could be seen and it was regarded as dead when more than half of its length has lost the green colour. The total number of tillers examined in this way were 144. the number of leaves recorded as having emerged did not include leaf which had already emerged when the tillers were marked. Leaf longevity for any marked tiller was determined as the number of days between the date of leaf emergence and the data of leaf death (Wilman and Pearse, 1984).

## STATISTICAL ANALYSIS

Analysis of variance for split-split plot factorial arrangement of RCB design was used to assess treatment effect and means were compared with Fisher's Least significance difference (LSD) at 5% level, Little and Hills, (1977).

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**RESULTS**

The results of leaf production interval on marked tillers when growth was uninterrupted in Northern gamba and Guinea grasses as shown in Tables 1 and 2 for 1985 and 1986 study periods respectively. Interval between leaf appearance tended to be similar in both species in the 1985 but differed significantly in 1986. during the 1985 study period, both species showed a consistent increase up to the last leaf, but in 1986, the interval of leaf production for Northern gamba grass significantly (P = 0.05) increased from 8.3 days for leaf 1 to 13.8 days for leaf 10 on the average, then dropped to 10.8 days for leaf 12; and for Guinea grass there was a significant increase from days for leaf 3 to 11.0 for leaf 6 and dropped to 7.5 for leaf 9.

The effect of N application on leaf production interval was significant (P=0.05) in both years. For the two-year studies, Northern gamba grass, had a gradual drop in intervals at which leaves appeared as the level of N increased, and this effect was similar in Guinea grass except in leaf 5 and leaf 6 having 12 days each, where 150 and 300KgNha$^{-1}$ were applied. The SP x N interaction was significant (P<0.05). The Northern gamba grass recorded a faster extension rate of 2.01cm/day compared with 1.60cm/day for guinea grass. Leaf 8 in Northern gamba had a mean extension rate of 2.3cm/day, this was significantly higher than 1.82cm/day for leaf 7 recorded for Guinea grass. The lowest extension rates were for flag leaves – 1.21cm/day in leaf 12 for Northern gamba grass and 1.24 cm/day each in leaf 2 and 9 for Guinea grass. Between leaves 5 and 9 the rate of leaf extension in Northern gamba using any N-rate was significant. The application of 150kgNha$^{-1}$in leaf 5 for Northern gamba grass recorded 2.10cm/day extension rate which was equal to that obtained in leaf 3 where 300kgNha$^{-1}$ was applied. This indicates that N application at lower rate (150kgNha$^{-1}$) could be used to increase extension rate in certain leaves and in some species.

The longevity of leaves in the 1985 and 1986 study periods for the two species are presented in tables 4 and 5. The average effects of N rate on leaf longevity for the two species were not significant (P=0.05). The number of days leaves survived at plant maturity decreased progressively but not significantly with applied N.

**Table 1: EFFECT OF N-APPLICATION ON INTERVAL FOR LEAF APPEARANCE (DAYS) OF TWO GRASS SPECIES OVER 20 WEEKS IN THE YEAR OF ESTABLISHMENT, 1985.**

| Species | Leaf Number | N 0 | RATES (Kg/ha$^{-1}$) 150 | 300 | 450 | Species Mean |
|---|---|---|---|---|---|---|
| Northern Gamba | 1 | 10.0 | 9.0 | 8.0 | 7.0 | 8.5 |
| | 2 | 9.0 | 9.0 | 8.0 | 7.0 | 8.5 |
| | 3 | 10.0 | 9.0 | 7.0 | 7.0 | 8.3 |
| | 4 | 10.0 | 9.0 | 8.0 | 7.0 | 8.3 |
| | 5 | 12.0 | 11.0 | 10.0 | 8.0 | 10.3 |
| | 6 | 12.0 | 11.0 | 10.0 | 9.0 | 10.5 |
| | 7 | 12.0 | 11.0 | 10.0 | 9.0 | 11.3 |
| | 8 | 14.0 | 12.0 | 11.0 | 9.0 | 12.3 |
| | 9 | 13.0 | 12.0 | 11.0 | 9.0 | 11.5 |
| | 10 | 14.0 | 13.0 | 12.0 | 10.0 | 12.3 |
| | 11 | 14.0 | 13.0 | 12.0 | 11.0 | 13.0 |
| | 12 | 14.0 | 13.0 | 12.0 | 11.0 | 13.0 |
| | Mean | 12.0 | 13.0 | 10.3 | 8.7 | |
| Guinea Grass | 1 | 11.0 | 11.0 | 9.0 | 9.0 | 10.0 |
| | 2 | 12.0 | 12.0 | 11.0 | 9.0 | 11.0 |
| | 3 | 12.0 | 12.0 | 11.0 | 9.0 | 11.0 |
| | 4 | 12.0 | 12.0 | 11.0 | 10.0 | 11.3 |
| | 5 | 13.0 | 12.0 | 12.0 | 10.0 | 11.8 |
| | 6 | 13.0 | 12.0 | 12.0 | 10.0 | 11.8 |
| | 7 | 13.0 | 13.0 | 11.0 | 10.0 | 11.8 |
| | 8 | 14.0 | 13.0 | 12.0 | 11.0 | 12.5 |
| | 9 | 14.0 | 14.0 | 13.0 | 12.0 | 13.3 |
| | Mean | 2.7 | 12.3 | 11.3 | 10.0 | |

LSD (0.05) between treatment means

| | |
|---|---|
| Nitrogen | NS |
| Species | 0.4 |
| Species x Nitrogen | 0.6 |

**Table 2: EFFECT OF N-APPLICATION ON INTERVAL FOR LEAF APPEARANCE (DAYS) OF TWO GRASS SPECIES OVER 30 WEEKS, 1986.**

| Species | Leaf Number | N RATES (Kg/ha⁻¹) 0 | 150 | 300 | 450 | Species Mean |
|---|---|---|---|---|---|---|
| Northern Gamba | 1 | 10.0 | 9.0 | 8.0 | 7.0 | 8.3 |
| | 2 | 10.0 | 9.0 | 9.0 | 7.0 | 9.0 |
| | 3 | 11.0 | 10.0 | 9.0 | 8.0 | 10.0 |
| | 4 | 12.0 | 11.0 | 10.0 | 9.0 | 11.3 |
| | 5 | 12.0 | 11.0 | 10.0 | 9.0 | 10.0 |
| | 6 | 13.0 | 12.0 | 11.0 | 10.0 | 11.5 |
| | 7 | 13.0 | 12.0 | 11.0 | 10.0 | 12.0 |
| | 8 | 14.0 | 13.0 | 11.0 | 10.0 | 12.0 |
| | 9 | 14.0 | 13.0 | 11.0 | 10.0 | 12.8 |
| | 10 | 15.0 | 14.0 | 13.0 | 12.0 | 13.8 |
| | 11 | 14.0 | 12.0 | 11.0 | 10.0 | 11.5 |
| | 12 | 14.0 | 12.0 | 9.0 | 8.0 | 10.8 |
| | Mean | 12.6 | 11.5 | 10.6 | 9.8 | |
| Guinea Grass | 1 | 8.0 | 8.0 | 7.0 | 7.0 | 7.5 |
| | 2 | 9.0 | 9.0 | 8.0 | 7.0 | 8.3 |
| | 3 | 9.0 | 9.0 | 8.0 | 7.0 | 8.3 |
| | 4 | 10.0 | 10.0 | 9.0 | 8.0 | 9.3 |
| | 5 | 10.0 | 9.0 | 9.0 | 9.0 | 9.3 |
| | 6 | 12.0 | 12.0 | 10.0 | 10.0 | 11.0 |
| | 7 | 10.0 | 10.0 | 9.0 | 9.0 | 9.5 |
| | 8 | 9.0 | 8.0 | 8.0 | 7.0 | 8.0 |
| | 9 | 8.0 | 8.0 | 7.0 | 7.0 | 7.5 |
| | Mean | 9.4 | 9.2 | 8.3 | 7.8 | |

LSD (0.05) between treatment means

| | |
|---|---|
| Species | 0.3 |
| Nitrogen | 0.4 |
| Species x Nitrogen | 0.5 |

**Table 3: EFFECT OF N-APPLICATION AND SPECIES ON LEAF EXTENSION RATE (CM/DAY) OVER 30 WEEKS, IN 1986**

| Species | Leaf Number | N RATES (Kg/ha⁻¹) 0 | 150 | 300 | 450 | Species Mean |
|---|---|---|---|---|---|---|
| Northern Gamba | 1 | 1.25 | 1.60 | 1.88 | 2.13 | 1.72 |
| | 2 | 1.28 | 1.68 | 1.94 | 2.13 | 1.83 |
| | 3 | 1.35 | 1.85 | 2.10 | 2.55 | 1.96 |
| | 4 | 1.41 | 1.88 | 2.30 | 2.68 | 2.07 |
| | 5 | 1.53 | 2.10 | 2.32 | 2.72 | 2.17 |
| | 6 | 1.58 | 2.21 | 2.42 | 2.76 | 2.24 |
| | 7 | 1.62 | 2.32 | 2.56 | 2.79 | 2.32 |
| | 8 | 1.68 | 2.42 | 2.60 | 2.83 | 2.39 |
| | 9 | 1.54 | 2.10 | 2.40 | 2.56 | 2.15 |
| | 10 | 1.32 | 1.85 | 2.28 | 2.36 | 1.96 |
| | 11 | 1.28 | 1.71 | 1.92 | 2.12 | 1.76 |
| | 12 | 1.21 | 1.43 | 1.81 | 1.89 | 1.59 |
| | Mean | 1.42 | 1.93 | 2.21 | 2.48 | |
| Guinea Grass | 1 | 1.81 | 1.32 | 1.41 | 1.56 | 1.37 |
| | 2 | 1.24 | 1.38 | 1.52 | 1.68 | 1.46 |
| | 3 | 1.29 | 1.42 | 1.67 | 1.72 | 1.63 |
| | 4 | 1.37 | 1.54 | 1.80 | 1.81 | 1.63 |
| | 5 | 1.43 | 1.65 | 1.79 | 1.92 | 1.70 |
| | 6 | 1.47 | 1.72 | 1.87 | 1.96 | 1.76 |
| | 7 | 1.59 | 1.87 | 1.89 | 1.92 | 1.82 |
| | 8 | 1.36 | 1.63 | 1.78 | 1.82 | 1.65 |
| | 9 | 1.24 | 1.37 | 1.58 | 1.75 | 1.49 |
| | Mean | 1.35 | 1.54 | 1.70 | 1.79 | |

LSD (0.05) between treatment means

| | |
|---|---|
| Species | 0.03 |
| Nitrogen | 0.05 |
| Species x Nitrogen | 0.06 |

**Table 4: EFFECT OF N-APPLICATION ON LONGEVITY OF LEAF (DAYS) MARKED TILLERS OF TWO GRASS SPECIES OVER 20 WEEKS IN THE YEAR OF ESTABLISHMENT 1985**

| Species | Leaf Number | N RATES (Kgha⁻¹) 0 | 150 | 300 | 450 | Species Mean |
|---|---|---|---|---|---|---|
| Northern Gamba Grass | 1 | 30.0 | 29.0 | 29.0 | 29.0 | 29.3 |
| | 2 | 30.0 | 28.0 | 27.0 | 25.0 | 27.5 |
| | 3 | 28.0 | 28.0 | 27.0 | 25.0 | 27.3 |
| | 4 | 27.0 | 28.0 | 27.0 | 25.0 | 27.0 |
| | 5 | 27.0 | 26.0 | 25.0 | 24.0 | 25.5 |
| | 6 | 27.0 | 26.0 | 25.0 | 24.0 | 25.5 |
| | 7 | 27.0 | 26.0 | 25.0 | 24.0 | 25.5 |
| | 8 | 26.0 | 26.0 | 24.0 | 24.0 | 26.3 |
| | 9 | 25.0 | 24.0 | 24.0 | 24.0 | 24.5 |
| | 10 | 24.0 | 24.0 | 22.0 | 24.0 | 23.5 |
| | 11 | 24.0 | 23.0 | 22.0 | 23.0 | 23.5 |
| | 12 | 24.0 | 23.0 | 22.0 | 23.0 | 23.0 |
| | Mean | 24.5 | 24.0 | 24.9 | 24.5 | |
| Guinea Grass | 1 | 25.0 | 26.0 | 25.0 | 25.0 | 25.3 |
| | 2 | 26.0 | 27.0 | 25.0 | 26.0 | 26.0 |
| | 3 | 26.0 | 25.0 | 26.0 | 26.0 | 25.8 |
| | 4 | 25.0 | 25.0 | 26.0 | 24.0 | 25.0 |
| | 5 | 25.0 | 25.0 | 24.0 | 24.0 | 24.0 |
| | 6 | 25.0 | 24.0 | 23.0 | 24.0 | 24.0 |
| | 7 | 24.0 | 25.0 | 24.0 | 23.0 | 24.0 |
| | 8 | 25.0 | 24.0 | 23.0 | 24.0 | 24.0 |
| | 9 | 24.0 | 23.0 | 23.0 | 24.0 | 23.5 |
| | Mean | 25.0 | 24.8 | 24.3 | 24.4 | |

LSD (0.05) between treatment means

| | |
|---|---|
| Nitrogen | NS |
| Species | NS |
| Species x Nitrogen | NS |

**Table 5: EFFECT OF N APPLICATION ON LONGEVITY OF LEAF (DAYS) OF TWO GRASS SPECIES OVER 30 WEEKS, IN 1986**

| Species | Leaf Number | N RATES (Kg/ha⁻¹) 0 | 150 | 300 | 450 | Species Mean |
|---|---|---|---|---|---|---|
| Northern Gamba Grass | 1 | 34.0 | 31.0 | 30.0 | 29.0 | 31.0 |
| | 2 | 35.0 | 31.0 | 30.0 | 30.0 | 31.3 |
| | 3 | 32.0 | 32.0 | 30.0 | 29.0 | 31.0 |
| | 4 | 32.0 | 31.0 | 30.0 | 30.0 | 31.0 |
| | 5 | 30.0 | 29.0 | 28.0 | 29.0 | 29.0 |
| | 6 | 30.0 | 28.0 | 29.0 | 28.0 | 28.8 |
| | 7 | 28.0 | 28.0 | 27.0 | 26.0 | 27.3 |
| | 8 | 28.0 | 27.0 | 27.0 | 27.0 | 27.3 |
| | 9 | 27.0 | 28.0 | 26.0 | 27.0 | 27.0 |
| | 10 | 27.0 | 27.0 | 26.0 | 25.0 | 26.3 |
| | 11 | 28.0 | 26.0 | 27.0 | 26.0 | 28.8 |
| | 12 | 28.0 | 27.0 | 26.0 | 25.0 | 26.0 |
| | Mean | 29.9 | 28.8 | 28.0 | 27.6 | 28.6 |
| Guinea Grass | 1 | 29.9 | 28.9 | 28.0 | 27.0 | 28.6 |
| | 2 | 27.0 | 27.0 | 25.0 | 26.0 | 26.3 |
| | 3 | 25.0 | 26.0 | 26.0 | 25.0 | 25.5 |
| | 4 | 25.0 | 25.0 | 23.0 | 23.0 | 24.0 |
| | 5 | 25.0 | 23.0 | 22.0 | 21.0 | 22.8 |
| | 6 | 24.0 | 23.0 | 21.0 | 22.0 | 22.5 |
| | 7 | 25.0 | 23.0 | 21.0 | 22.0 | 22.8 |
| | 8 | 23.0 | 24.0 | 21.0 | 22.0 | 22.5 |
| | 9 | 23.0 | 23.0 | 23.0 | 22.0 | 22.8 |
| | Mean | 25.0 | 24.5 | 23.1 | 23.2 | 22.0 |

LSD (0.05) between treatment means

| | |
|---|---|
| Nitrogen | NS |
| Species | NS |
| Species x Nitrogen | NS |

## DISCUSSION

Langer (1958) reported that intervals of leaf initiation vary within and between species and is in agreement with the results of this study in which species difference was clearly marked with Gg producing a leaf two days earlier than Ngg. It was also observed that the interval of leaf production was more prolonged when tillers were relatively old and tall than in the early growth stage.

Increase in the rate of leaf extension with high N rates reported in this study is in agreement with that reported by Ryle, (1964), Wilman and Fisher (1996) and Pearse (1983). This effect varied within and between species with Ngg having higher extension rate than Gg, Langer 1959) This difference in exposure time of leaves in these species may be based on the pattern of morphological development of individual species. In Guinea grass for instance, early floral initiation appeared to limit the chances of expansion of leaves and photosynthetic activities subsequently, causing sudden loss in green colour. On the other hand, delayed flowering in Northern gamba grass created a greater opportunity for extended exposure time of the leaves and photosynthetic activities, thus prolonging the green colour. Davies (1971) and Robson and Deacon (1978) in similar experiments reported that nitrogen fertilizer can exert significant influence on leaf extension rate and is in difference between plots that received 450KgNha$^{-1}$ compared with where N was not applied in terms of leaf production interval was that it took Northern gamba grass 8.7 days, on the average, to produce a leaf where 450KgN/ha/yr was applied compared with 12 days where N was not applied in 1985. In 1986, Northern gamba grass took 9.8 days on the average to produce a leaf where 450KgNha$^{-1}$ was applied compared with 12.6 days where N was not applied. Guinea grass took 10 and 7.8 days in 1985 and 1986 on the average, to produce a leaf where 450KgNha$^{-1}$ was applied compared with 12.7 and 9.4 days for 1985 and 1986 respectively where N was not applied.

Species differences in terms of leaf production interval was not significant. However, the study revealed that the interval of leaf production was greater during the months of July and August in which fewer days were used to produce a leaf. This period followed closely the period in which the longevity of tillers dropped, but the highest tiller population (June – July) was recorded and the highest dry matter produced.

The response of Northern gamba grass to the 4 N-rates in terms of leaf extension rate was significant, such that the average effect of N for Northern gamba grass was significantly (P=0.05) higher than that of Guinea grass (Table 3).

consonance with the findings in this studies. The display of the photosynthetic surface area favoured leaf extension with applied N, but for how long this effect will last is a subject of another investigation, since this studies covered a period of 20 and 30 weeks, because rains had stopped and serious dry season had set in.

## CONCLUSION

The growth of grass is usually observed at the beginning of appearance to full expansion. From the findings of this study, the period represents about one fifth of the required time in which a leaf is growing. It is the period in which extension rate (CM/Day) is greatest. During the period of leaf appearance, leaf length was only doubled or tripled and the rate of post appearance extension seems likely to be related to the rate of extension pre-appearance, though more findings would be required before the relationship could be understood. The response to N was positive in all stages of growth and development and surely warrant further study in order to gain a more complete understanding of the growth and development of grasses and other forages.

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