GLOBAL JOURNAL OF AGRICULTURAL SCIENCES VOL. 5, NO. 1, 2006: 71 - 76
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# INFLUENCE OF N-FERTILIZER APPLICATION AND CUTTING INTERVAL ON THE CHEMICAL COMPOSITION OF NORTHERN GAMBA, GUINEA AND STAR GRASSES

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(Received 18 March 2004; Revision Accepted 30 August 2005)

## ABSTRACT

Three experiments were carried out in 1985, 1986 and 1987 to estimate the influence of N-fertilizer application and cutting intervals on the chemical composition of Northern gamba, Guinea and Star grasses. The investigation showed that increasing delay in date of harvest progressively decreased the chemical composition of herbage. The chemical composition studied included: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca) and Magnesium (mg).

Harvesting frequencies and N fertilizer application exerted significant (P = 0.05) effect on the nutritive value of swards such that cutting every 3 weeks where 450KgN/ha was applied significantly gave the highest N content of 3.32%, on the average compared with other treatments. Increasing intervals between harvest significantly (P = 0.05) decreased the N, P, K, Ca and Mg contents of herbage except in Star grass where K rather increased with increase in cutting intervals. The high N, K, Ca and Mg content of herbage investigated, followed closely, high levels of applied N, while P content significantly decreased for every addition of 150KgN/ha. Seasonal effect showed that high quality herbage was reduced by delaying cutting and low level of N. Species differences in quality as influenced by cutting intervals and N-levels were noted. The implications of these findings are discussed.

**KEYWORDS:** Nitrogen fertilizer, Chemical Composition of three grass species

## INTRODUCTION

Three-year field experiments were carried out in 1985, 1986 and 1987 to determine the response of applied nitrogen and interval between harvests on the chemical composition in field swards of Northern gamba, Guinea and star grasses. The N-application was at the levels of 0,150,300 and 450KgN/ha. The intervals between harvests were 3, 4, 5, - weekly cuts and doubling the intervals to 6, 8 and 10 weekly cuts.

In the present paper, we report other investigations carried out in the same experiment. These were centered on the effect of the experimental treatment combinations on the chemical composition of herbage.

The required concentration range of some nutrient elements in the diet of ruminants livestock (Cow, sheep and goat) is as follows: (ARC, 1980).

| Nutrient | Required Concentration (%) | | |
|---|---|---|---|
| Nitrogen | 1.2 | - | 2.7 |
| Phosphorus | 0.11 | - | 0.35 |
| Potassium | 0.5 | - | 0.34 |
| Magnesium | 0.08 | - | 0.21 |
| Calcium | 0.14 | - | 0.67 |

With the potentials for increased use of N-fertilizer on range management, consideration must be given to the species, age and elemental composition. In grasses, the individual element tends with some exceptions, to diminish in concentration as the plants approach maturity (Van Riper and Smith, 1959; Pritchard *et al*, 1964). As grass species vary in their tendency to accumulate these nutrients so they may also vary in their efficiency with which they use fertilizer containing these nutrients. Some effects of interval between harvest and N-fertilizer application on the performance of some Nigerian grasses have been reported (Oyenuga, 1960; Ademosun, 1973; Omaliko, 1980) but there seems to be little information on the combined effects of interval between harvests and N-application on nutritive quality. This study therefore was designed to determine the responses of three grass species to N-application and harvest management on herbage quality.

## MATERIALS AND METHODS

The experiment was carried out in 1985, 1986 and 1987, using swards of grasses established in March, 1985 in the university of Nigeria's Farm, Nsukka, (Latitude 06°52'N and Longitude 07°24E' at an altitude of 447.3m above sea level), on the Ferrallitic sandy soil of the Nkpologwu series.

The experiment site was previously cropped with maize for three years followed by another four years in which Guinea grass (*Panicum maximum*) was the 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. The main plot treatments consisted of three grass species, the sub-plots were the N-fertilizer rates and the sub-sub-plots were the harvesting intervals. Plot size was 3 x 48m sub-plot size was 3 x 12m and sub-sub-plot size was 3 x 6m. An area of 2m$^2$ at the center of each sub-sub-plot unit was marked and harvested as sample. The three species of grasses used were: Northern gamba grass (*Andropogon gayanus*), Guinea grass c.v. S112 (*Panicum maximum*) and Star grass (*Cynodon polystachus*). Vegetative propagules of each species were planted at 25cm by 25cm spacing, within and between rows and were symbolized Ngg, Gg and Sg.

**Table 1: AVERAGE RAINFALL VALUES (MM) FOR 1985, 1986 AND 1977 – 1986 (10 YEARS)**

| MONTHS | 1985 RAINFALL | 1986 RAINFALL | 1977-86MEAN |
|---|---|---|---|
| January | 0.2 | 0.4 | 0.4 |
| February | 0.8 | 2.7 | 1.8 |
| March | 27.6 | 38.3 | 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 | 73.2 | 59.2 |
| September | 78.3 | 47.7 | 86.1 |
| October | 24.6 | 29.2 | 68.5 |
| November | 5.1 | 4.8 | 22.6 |
| December | 0.3 | 0.2 | 0.5 |
| Total | 475.2 | 517.9 | 463.8 |
| Mean | 39.6 | 43.2 | 38.6 |

**Source:** *Meteorological Station, University of Nigeria, Nsukka, Nigeria.*

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Four different levels of nitrogen fertilizer in the form of Urea were:- 0, 150, 300 and 450KgNha. In addition there was a single application of 122.2KgP/ha from single super phosphate (SSP) and 375KgNha from muriate of potash (MOP) to all plots each year, including those not to receive nitrogen fertilizer. These were applied after taking clearing cut of all plots at the beginning of the growing season.

There were six harvesting intervals used; namely: 3, 4, 5 weeks then doubling the intervals to 6, 8 and 10 weeks after planting. Chemical analyses were done at Crop Science and Soil Science Laboratories of the University of Nigeria, Nsukka, and at Soil Science. Plant Science and Animal Science Laboratories of Alabama Agricultural and Mechanical University, U. S. A. using the standard procedures employed by AOAC (1980).

Data were subjected to analysis of variance (ANOVA) and the means were compared with Fisher's Least Significance Difference (LSD) at 5% level, Little and Hills, (1977).

## RESULTS

The main effect of quality attributes of this study as influenced by treatment combinations on N content of herbage are presented in Tables 2a and b.

Increasing harvesting intervals significantly ($P < 0.05$) reduced N content of herbage. The drop in N content of herbage by increasing the intervals was clearly marked in the three species and in the three study periods. The N concentration was highest when the sward was cut every 3 weeks and least when cut every 10 weeks in the three species, throughout the growing season. Increasing the intervals from 3 to 4 or 4 to 5 and from 5 to 6 and 6 to 8 weeks significantly reduced the N content of herbage during the experimental period. The responses of the species to harvesting intervals followed a similar trend but the mean N content was significantly ($P < 0.05$) higher in Ngg than in either Gg or Sg (Table 2a).

**TABLE 2a EFFECT OF SPECIES AND HARVESTING INTERVALS ON % N OF HERBAGE (Mean of 4 N Levels)**

| Species | Harvesting Intervals (Weeks) | | | | | | Species Mean |
|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 8 | 10 | |
| | | | 1985 | | | | |
| Ngg. | 2.40 | 2.25 | 2.16 | 1.90 | 1.38 | 1.28 | 1.88 |
| Gg. | 2.43 | 2.00 | 1.60 | 1.48 | 1.33 | 1.20 | 1.67 |
| Sg. | 2.05 | 1.78 | 1.55 | 1.35 | 1.15 | 1.05 | 1.49 |
| Mean | 2.30 | 2.01 | 1.77 | 1.57 | 1.20 | 1.18 | |
| | | | 1986 | | | | |
| Ngg. | 2.33 | 2.10 | 1.30 | 1.23 | 1.13 | 1.05 | 1.52 |
| Gg. | 2.48 | 2.10 | 1.65 | 1.35 | 1.33 | 1.13 | 1.63 |
| Sg. | 1.93 | 1.75 | 1.35 | 1.23 | 1.18 | 1.05 | 1.41 |
| Mean | 2.24 | 1.58 | 1.41 | 1.27 | 1.21 | 1.07 | |
| | | | 1987 | | | | |
| Ngg | 2.83 | 2.63 | 2.40 | 2.30 | 2.03 | 1.95 | 2.35 |
| Gg. | 2.83 | 2.60 | 2.50 | 2.30 | 2.18 | 2.00 | 2.40 |
| Sg. | 2.68 | 2.53 | 2.30 | 2.08 | 1.85 | 1.73 | 2.19 |
| Mean | 2.78 | 2.58 | 2.40 | 2.22 | 2.02 | 1.89 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Species | 0.03 | 0.02 | 0.04 |
| Harvest | 0.04 | 0.03 | 0.05 |
| Species x Harvest | 0.06 | 0.05 | 0.08 |

The harvesting interval x nitrogen interaction in terms of N content of herbage was significant ($P < 0.05$). High rate of N (450KgNha) recorded the highest N content from the 3 weekly cut to the 8 – weekly cut plots, and this effect was significantly higher than all other N treatments and unfertilized plots throughout the growing season. (Table 2b).

The main effects of treatment due to harvesting interval, species and the nitrogen fertilizer x species interactions as they effect P content of herbage are presented

**TABLE 2b EFFECT OF HARVESTING INTERVALS AND NITROGEN ON % N OF HERBAGE (Mean of 3 Species)**

| Nitrogen Rates (Kg/ha) | Harvesting Intervals (Weeks) | | | | | | Nitrogen Mean |
|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 8 | 10 | |
| | | | 1985 | | | | |
| 0 | 1.60 | 1.60 | 1.30 | 1.20 | 1.08 | 1.10 | 1.30 |
| 150 | 1.98 | 1.93 | 1.60 | 1.46 | 1.23 | 1.60 | 1.57 |
| 300 | 2.40 | 2.20 | 1.80 | 1.63 | 1.36 | 1.30 | 1.75 |
| 450 | 2.28 | 2.53 | 2.40 | 2.00 | 2.13 | 1.30 | 2.15 |
| Mean | 2.31 | 2.06 | 1.77 | 1.57 | 1.19 | 1.32 | |
| | | | 1986 | | | | |
| 0 | 1.36 | 1.30 | 1.20 | 1.10 | 1.01 | 1.00 | 1.11 |
| 150 | 2.06 | 1.90 | 1.33 | 1.23 | 1.16 | 1.01 | 1.45 |
| 300 | 2.33 | 2.06 | 1.36 | 1.36 | 1.28 | 1.10 | 1.61 |
| 450 | 3.20 | 2.53 | 1.50 | 1.36 | 1.36 | 1.10 | 1.89 |
| Mean | 1.23 | 1.95 | 1.39 | 1.26 | 1.20 | 1.01 | |
| | | | 1987 | | | | |
| 0 | 2.00 | 1.86 | 1.73 | 1.63 | 1.50 | 1.40 | 1.69 |
| 150 | 2.76 | 2.53 | 2.30 | 2.10 | 1.26 | 1.72 | 2.12 |
| 300 | 2.83 | 2.56 | 2.46 | 2.10 | 1.70 | 2.20 | 2.33 |
| 450 | 3.50 | 3.26 | 3.10 | 2.70 | 2.63 | 2.50 | 2.97 |
| Mean | 2.77 | 2.55 | 2.39 | 2.15 | 1.77 | 1.95 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Harvest | 0.03 | 0.02 | 0.02 |
| Nitrogen | 0.04 | 0.03 | 0.06 |
| Harvest x Nitrogen | 0.06 | 0.05 | 0.08 |

in tables 3a and b. Extending the interval between harvests from 3 to 10 weeks significantly ($P < 0.05$) reduced the P content of herbage in the three species during the growing season. The highest P content of herbage, 0.38% in 1985, 0.47% in 1986 and 0.46% in 1987 were recorded in plots cut every 3 weeks while the least occurred in plots cut every 10 weeks. A drop in the P content of herbage with crop maturity was consistent and highly significantly ($P < 0.05$). The three species were influenced by cutting frequencies in terms of P content in the 3, 4 and 5 weeks cuts early in the season while the least occurred in the 6, 8 and 10 weeks cut. (Table 3a). Seasonal effect showed that the potential P content of herbage was increased by short intervals early in the season, but not later in the season.

Star grass had the highest P content and this was significantly higher than those of either Ngg or Gg.

Increasing N-fertilizer application significantly reduced the % P content during the growing season, (Table 3b). The Nitrogen x harvest interaction was significant ($P < 0.05$) such that there was a drop in % P for every addition of 150KgNha and almost a two-fold reduction by extending the interval between harvests from 3, 4 and 5 weeks to 6, 8 and 10 weeks. The highest P content on the average occurred in the unfertilized plots while the least occurred in plots that received highest level of N, 450KgNha.

**TABLE 3a EFFECT OF SPECIES AND HARVESTING INTERVALS ON % PHOSPHORUS (P) CONTENT OF HERBAGE (Mean of 4 N Levels)**

| Species | Harvesting Intervals (Weeks) | | | | | | Species Mean |
|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 8 | 10 | |
| | | | 1985 | | | | |
| Ngg. | 0.39 | 0.30 | 0.27 | 0.24 | 18 | 0.17 | 0.26 |
| Gg. | 0.32 | 0.30 | 0.22 | 0.21 | 0.20 | 0.18 | 0.23 |
| Sg. | 0.53 | 0.47 | 0.43 | 0.40 | 0.36 | 0.32 | 0.41 |
| Mean | 0.38 | 0.35 | 0.30 | 0.28 | 0.25 | 0.22 | |
| | | | 1986 | | | | |
| Ngg. | 0.43 | 0.34 | 0.28 | 0.25 | 0.20 | 0.17 | 0.28 |
| Gg. | 0.32 | 0.29 | 0.24 | 0.20 | 0.18 | 0.15 | 0.23 |
| Sg. | 0.54 | 0.48 | 0.44 | 0.40 | 0.34 | 0.27 | 0.41 |
| Mean | 0.47 | 0.37 | 0.32 | 0.28 | 0.24 | 0.20 | |
| | | | 1987 | | | | |
| Ngg | 0.49 | 0.42 | 0.36 | 0.31 | 0.26 | 0.20 | 0.34 |
| Gg. | 0.36 | 0.33 | 0.28 | 0.24 | 0.19 | 0.16 | 0.26 |
| Sg. | 0.54 | 0.48 | 0.42 | 0.36 | 0.28 | 0.23 | 0.39 |
| Mean | 0.46 | 0.41 | 0.35 | 0.30 | 0.24 | 0.20 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Species | 0.02 | 0.02 | 0.02 |
| Harvest | 0.02 | 0.02 | 0.02 |
| Species x Harvest | 0.03 | 0.03 | 0.03 |

TABLE 3b EFFECT OF HARVESTING INTERVALS AND NITROGEN ON % P CONTENT OF HERBAGE (Mean of 3 Species)

| Nitrogen Rates (Kg/ha) | Harvesting Intervals (Weeks) 3 | 4 | 5 | 6 | 8 | 10 | Nitrogen Mean |
|---|---|---|---|---|---|---|---|
| | | | 1985 | | | | |
| 0 | 0.43 | 0.40 | 0.37 | 0.34 | 0.27 | 0.23 | 0.34 |
| 150 | 0.39 | 0.36 | 0.31 | 0.30 | 0.25 | 0.20 | 0.30 |
| 300 | 0.35 | 0.33 | 0.26 | 0.25 | 0.21 | 0.81 | 0.26 |
| 450 | 0.32 | 0.30 | 0.23 | 0.21 | 0.18 | 0.16 | 0.23 |
| Mean | 0.37 | 0.34 | 0.29 | 0.27 | 0.22 | 0.19 | |
| | | | 1986 | | | | |
| 0 | 0.48 | 0.42 | 0.35 | 0.30 | 0.25 | 0.20 | 0.33 |
| 150 | 0.42 | 0.35 | 0.30 | 0.25 | 0.21 | 0.19 | 0.29 |
| 300 | 0.37 | 0.31 | 0.26 | 0.22 | 0.19 | 0.16 | 0.25 |
| 450 | 0.33 | 0.28 | 0.21 | 0.18 | 0.17 | 0.14 | 0.21 |
| Mean | 0.40 | 0.34 | 0.32 | 0.28 | 0.20 | 0.17 | |
| | | | 1987 | | | | |
| 0 | 0.49 | 0.44 | 0.40 | 0.35 | 0.31 | 0.27 | 0.37 |
| 150 | 0.42 | 0.40 | 0.35 | 0.30 | 0.26 | 0.23 | 0.32 |
| 300 | 0.38 | 0.34 | 0.31 | 0.26 | 0.21 | 0.18 | 0.28 |
| 4[illegible]0 | 0.3 | 0.30 | 0.27 | 0.21 | 0.18 | 0.15 | 0.24 |
| Mean | 0.41 | 0.30 | 0.33 | 0.28 | 0.24 | 0.20 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Nitrogen | 0.02 | 0.02 | 0.02 |
| Harvest | 0.02 | 0.02 | 0.02 |
| Nitrogen x Harvest | 0.03 | 0.03 | 0.03 |

The effect of N-application on P content of herbage for 1985, 1986 and 1987 took a similar trend with a significant ($P < 0.05$) reduction in P content for every addition of 150KgNha$^{-1}$, compared with no N. Each of the three years of study had the highest P content at 3-weekly cut where no N was applied (Table 3b).

The K content of herbage was significantly ($P < 0.05$) decreased by increasing the interval between harvests for Northern gamba and Guinea grasses but tended to increase with increase in interval between harvests for Star grass. (Table 4a). The application of N fertilizer significantly increased K content of herbage such that highest K, 3.26% in 1985, 3.18% in 1986 and 3.29% in 1987 were obtained from plots cut every 3 weeks where 450KgNha$^{-1}$ was applied compared with no N (Table 4b).

TABLE 4a Effect of species and harvesting interval potassium (k) content of herbage (% k in dry matter) (Mean of 4 N Levels)

| Species | Harvesting Intervals (Weeks) 3 | 4 | 5 | 6 | 8 | 10 | Species Mean |
|---|---|---|---|---|---|---|---|
| | | | 1985 | | | | |
| Ngg. | 3.37 | 3.22 | 3.11 | 2.10 | 2.00 | 1.81 | 2.60 |
| Gg. | 3.68 | 3.30 | 2.65 | 2.26 | 1.94 | 1.91 | 2.62 |
| Sg. | 1.63 | 2.26 | 2.29 | 2.72 | 3.25 | 3.51 | 2.61 |
| Mean | 2.89 | 2.92 | 2.68 | 2.36 | 2.39 | 2.41 | |
| | | | 1986 | | | | |
| Ngg. | 3.41 | 3.12 | 3.09 | 2.14 | 2.08 | 1.86 | 2.60 |
| Gg. | 3.58 | 3.39 | 2.75 | 2.30 | 2.02 | 1.73 | 2.62 |
| Sg. | 1.83 | 1.97 | 2.31 | 2.75 | 3.33 | 3.53 | 2.62 |
| Mean | 2.94 | 2.82 | 2.39 | 2.39 | 2.47 | 2.37 | |
| | | | 1987 | | | | |
| Ngg | 3.52 | 3.24 | 3.27 | 2.11 | 2.00 | 1.72 | 2.64 |
| Gg. | 3.31 | 3.20 | 2.80 | 2.20 | 2.18 | 2.12 | 2.64 |
| Sg. | 1.87 | 2.54 | 2.68 | 2.91 | 2.90 | 3.04 | 2.64 |
| Mean | 2.90 | 2.99 | 2.91 | 2.37 | 2.36 | 2.29 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Species | N.S | N.S | N.S |
| Harvest | 0.02 | 0.02 | 0.02 |
| Species x Harvest | 0.02 | 0.02 | 0.02 |

The mean effects of treatment combinations on the calcium content of herbage are presented in tables 5a and b. Frequency of harvest and N-application exerted significant ($P<0.05$) effect on the Ca content of herbage. The positive effect of harvesting interval on Ca content of herbage was consistent throughout the experimental period. Highest Ca content was obtained from the short intervals of 3, 4 and 5 weeks early in the season, while the least came from the longer intervals of 6, 8 and 10, later in the season. The species

TABLE 4b EFFECT OF NITROGEN APPLICATION AND HARVESTING INTERVAL ON K CONTENT OF HERBAGE (Mean of 3 Species)

| Nitrogen Rates (Kg/ha$^{-1}$) | Harvesting Intervals (Weeks) 3 | 4 | 5 | 6 | 8 | 10 | Nitrogen Mean |
|---|---|---|---|---|---|---|---|
| | | | 1985 | | | | |
| 0 | 2.61 | 2.30 | 2.20 | 1.18 | 1.09 | 1.02 | 1.73 |
| 150 | 2.85 | 2.34 | 2.24 | 2.16 | 1.63 | 1.05 | 2.04 |
| 300 | 2.88 | 2.37 | 2.28 | 2.17 | 1.94 | 1.16 | 2.13 |
| 450 | 2.26 | 3.03 | 2.29 | 2.01 | 1.43 | 2.26 | 2.20 |
| Mean | 2.90 | 2.51 | 2.23 | 1.89 | 1.52 | 1.12 | |
| | | | 1986 | | | | |
| 0 | 2.59 | 2.14 | 2.16 | 1.15 | 1.12 | 1.08 | 1.71 |
| 150 | 2.67 | 2.41 | 2.24 | 2.18 | 1.22 | 1.15 | 1.97 |
| 300 | 2.90 | 2.58 | 2.34 | 2.25 | 1.52 | 1.39 | 2.16 |
| 450 | 3.18 | 2.94 | 2.82 | 2.51 | 1.75 | 1.63 | 2.47 |
| Mean | 2.83 | 2.52 | 2.39 | 2.02 | 1.40 | 1.29 | |
| | | | 1987 | | | | |
| 0 | 2.91 | 1.92 | 1.20 | 1.21 | 0.02 | 1.00 | 1.54 |
| 150 | 3.13 | 2.00 | 1.44 | 1.24 | 1.15 | 1.04 | 1.67 |
| 300 | 3.19 | 2.24 | 2.10 | 1.73 | 1.42 | 1.30 | 1.98 |
| 450 | 2.29 | 2.35 | 2.20 | 2.00 | 1.67 | 1.38 | 2.15 |
| Mean | 3.13 | 2.12 | 2.20 | 2.00 | 1.67 | 1.15 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Nitrogen | 0.03 | 0.02 | 0.04 |
| Harvest | 0.04 | 0.03 | 0.06 |
| Nitrogen x Harvest | 0.05 | 0.04 | 0.06 |

did not differ significantly in their responses to this treatment (Table 5a). Nitrogen fertilizer increased Ca content for every addition of 150KgNha. Species and Species x nitrogen interactions were not significant ($P<0.05$) (Table 5b).

TABLE 5a: Effect of species and harvesting intervals on calcium (ca) content of herbage (Mean of 4 N Levels)

| Species | Harvesting Intervals (Weeks) 3 | 4 | 5 | 6 | 8 | 10 | Species Mean |
|---|---|---|---|---|---|---|---|
| | | | 1985 | | | | |
| Ngg. | 0.40 | 0.37 | 0.34 | 0.32 | 0.28 | 0.25 | 0.33 |
| Gg. | 0.39 | 0.37 | 0.36 | 0.33 | 0.31 | 0.24 | 0.33 |
| Sg. | 0.45 | 0.36 | 0.31 | 0.29 | 0.27 | 0.25 | 0.32 |
| Mean | 0.41 | 0.37 | 0.33 | 0.31 | 0.29 | 0.25 | |
| | | | 1986 | | | | |
| Ngg. | 0.39 | 0.38 | 0.35 | 0.32 | 0.28 | 0.27 | 0.33 |
| Gg. | 0.41 | 0.40 | 0.34 | 0.32 | 0.30 | 0.28 | 0.34 |
| Sg. | 0.45 | 0.36 | 0.34 | 0.31 | 0.29 | 0.27 | 0.34 |
| Mean | 0.41 | 0.38 | 0.34 | 0.32 | 0.29 | 0.27 | |
| | | | 1987 | | | | |
| Ngg | 0.40 | 0.39 | 0.36 | 0.34 | 0.31 | 0.29 | 0.35 |
| Gg. | 0.43 | 0.38 | 0.35 | 0.31 | 0.28 | 0.26 | 0.34 |
| Sg. | 0.44 | 0.40 | 0.37 | 0.34 | 0.30 | 0.28 | 0.35 |
| Mean | 0.42 | 0.39 | 0.36 | 0.33 | 0.30 | 0.28 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Harvest | 0.02 | 0.02 | 0.02 |
| Species | NS | NS | NS |
| Species x Harvest | NS | NS | NS |

The Mg content of herbage significantly ($P<0.05$) decreased by increasing cutting frequency while increasing N-application significantly increased Mg content (Tables 6a and b). Highest Mg content was obtained from plot cut every 3weeks while the least, (0.21%) was obtained from plots cut every 10 weeks, in 1985 and 1987 in the three species. During the 1986 planting season, highest Mg content (0.36%) was obtained from plots cut every 3 weeks while the least (0.20%) came from plots cut every 10 weeks. Mean effects on species and on harvest x species interaction were not significant. Increasing N-application significantly ($P<0.05$) increased Mg content of herbage. There was about 12% increase in Mg content on the average for every addition of 150KgNha in the three species during the planting season. Mean effects on species and species x nitrogen interaction were not statistically significant (Table 6b).

Table 5b: Effect of species and nitrogen on Ca content of herbage

(Mean of 6 Harvesting Intervals)

| Species | Harvesting Intervals (Weeks) 0 | 150 | 300 | 450 | Species Mean |
|---|---|---|---|---|---|
| | | 1985 | | | |
| Ngg | 0.26 | 0.28 | 0.30 | 0.40 | 0.31 |
| Gg. | 0.25 | 0.30 | 0.36 | 0.40 | 0.32 |
| Sg. | 0.26 | 0.30 | 0.35 | 0.40 | 0.32 |
| Mean | 0.26 | 0.29 | 0.34 | 0.40 | |
| | | 1986 | | | |
| Ngg. | 0.28 | 0.30 | 0.33 | 0.41 | 0.33 |
| Gv. | 0.27 | 0.30 | 0.36 | 0.41 | 0.34 |
| Sg. | 0.25 | 0.33 | 0.38 | 0.42 | 0.34 |
| Mean | 0.27 | 0.31 | 0.36 | 0.41 | |
| | | 1987 | | | |
| Ngg. | 0.29 | 0.32 | 0.34 | 0.40 | 0.34 |
| Gg. | 0.30 | 0.32 | 0.34 | 0.36 | 0.33 |
| Sg. | 0.30 | 0.33 | 0.35 | 0.40 | 0.34 |
| Mean | 0.30 | 0.32 | 0.34 | 0.39 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Species | NS | NS | NS |
| Nitrogen | 0.02 | 0.02 | 0.02 |
| Species x nitrogen | N.S | N.S | N.S |

Table 6a: Effect of species and harvesting interval on magnesium (mg) content of herbage

(Mean of 4 N Levels)

| Species | Harvesting Intervals (Weeks) 3 | 4 | 5 | 6 | 8 | 10 | Species Mean |
|---|---|---|---|---|---|---|---|
| | | | 1985 | | | | |
| Ngg. | 0.35 | 0.32 | 0.26 | 0.25 | 0.23 | 0.20 | 0.27 |
| Gg. | 0.36 | 0.33 | 0.30 | 0.28 | 0.24 | 0.21 | 0.28 |
| Sg. | 0.34 | 0.31 | 0.28 | 0.25 | 0.23 | 0.21 | 0.27 |
| Mean | 0.35 | 0.32 | 0.29 | 0.26 | 0.23 | 0.21 | |
| | | | 1986 | | | | |
| Ngg. | 0.35 | 0.31 | 0.28 | 0.26 | 0.23 | 0.21 | 0.27 |
| Gg. | 0.36 | 0.30 | 0.27 | 0.24 | 0.22 | 0.20 | 0.26 |
| Sg. | 0.37 | 0.34 | 0.28 | 0.25 | 0.23 | 0.20 | 0.27 |
| Mean | 0.36 | 0.31 | 0.26 | 0.26 | 0.23 | 0.20 | |
| | | | 1987 | | | | |
| Ngg | 0.33 | 0.32 | 0.27 | 0.24 | 0.21 | 0.20 | 0.28 |
| Gg. | 0.37 | 0.34 | 0.32 | 0.28 | 0.24 | 0.21 | 0.29 |
| Sg. | 0.35 | 0.32 | 0.30 | 0.26 | 0.23 | 0.21 | 0.28 |
| Mean | 0.35 | 0.32 | 0.30 | 0.26 | 0.23 | 0.21 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Harvest | 0.02 | 0.02 | 0.02 |
| Species | NS | NS | NS |
| Harvest X Species | NS | NS | NS |

Table 6b: Effect of species and nitrogen on Mg content of herbage

(Mean of 6 Harvesting Intervals)

| Species | N – Rate (Kg/ha) 0 | 150 | 300 | 450 | Species Mean |
|---|---|---|---|---|---|
| | | 1985 | | | |
| Ngg | 0.24 | 0.27 | 0.30 | 0.33 | 0.28 |
| Gg. | 0.24 | 0.26 | 0.28 | 0.31 | 0.27 |
| Sg. | 0.22 | 0.27 | 0.30 | 0.34 | 0.28 |
| Mean | 0.23 | 0.27 | 0.29 | 0.33 | |
| | | 1986 | | | |
| Ngg. | 0.22 | 0.27 | 0.29 | 0.32 | 0.27 |
| Gg. | 0.22 | 0.25 | 0.28 | 0.30 | 0.26 |
| Sg. | 0.23 | 0.26 | 0.28 | 0.31 | 0.27 |
| Mean | 0.22 | 0.26 | 0.28 | 0.31 | |
| | | 1987 | | | |
| Ngg. | 0.23 | 0.25 | 0.27 | 0.32 | 0.27 |
| Gr. | 0.23 | 0.26 | 0.28 | 0.30 | 0.27 |
| Sg. | 0.24 | 0.27 | 0.29 | 0.31 | 0.28 |
| Mean | 0.23 | 0.26 | 0.28 | 0.31 | |

LSD (0.05) between treatment means

| | 1985 | 1986 | 1987 |
|---|---|---|---|
| Species | NS | NS | NS |
| Nitrogen | 0.02 | 0.02 | 0.02 |
| Species x nitrogen | N.S | N.S | N.S |

## DISCUSSION

The positive effect of applied nitrogen and intervals between harvests on herbage quality reported in this study is in agreement with other temperate and tropical results (Oyenuga, 1960; Adegbola and Onayinka, 1966; Akinola and Chheda 1971; Ademosun, 1973; Robson, and Deacon, 1978; Omaliko, 1980; Wilman, D. 1980 and Wilman and Wright, 1983, Field, *et al*, 1999; Jenkins and Ali, 1999, Warren, 2000; Ubi and Omaliko, 2004).

In the present study, high forage quality to some extent followed N application, such that the highest N content of herbage; 2.53%; 3.20% and 3.50% for 1985, 1986 and 1987 were obtained in plots cut every 3 weeks where 450KgNha was applied compared with the value obtained where no fertilizer was applied. This agrees with the reports of Wilman and Wright, (1978), that the N content of younger and older leaf blades were increased within a few days of applying 450KgN/ha$^{-1}$ compared with no N; and again N content of sown swards was increased by applied N fertilizer particularly with the higher rates of 262.5 and 525.5 KgN/ha (Wilman and Pearse, 1984). The investigation in this study also showed that increasing cutting intervals from a 3 – weekly cut to a 10 – weekly cut gave unit drops of 14% of N, 0.06% Mg, 0.8% Ca, and 0.03% K and these effects are insignificant. These results agree with the report of Van Ripper and Smith, (1959); Pritchard *et al*, (1964) that in grasses, individual elements tends with some exceptions, to diminish in concentration as the plants approach maturity.

The relatively larger, thicker and darker green leaves of Guinea grass where 450KgN/ha was treated could be responsible for the higher N content in this species than in others. Again the small leaves of Star grass associated with high 'stem' proportion, could be responsible for the low N content in this species.

The reduction in P due to increased interval between harvests and N application found in this study was earlier reported by Wilman, (1980). The P was higher in young rapidly growing tissue than in older tissue. It was therefore higher in frequently cut plots in this study than delayed harvests, partly because some P has been translocated to the developing seeds, but the amount of available P in the soil is the most important factor affecting the quantity in the plant, particularly in grasses, (*Reith, et al*, 1964).

The K content of herbage reported in this studies was 2.5 – 2.9%, which is far in excess of 0.5% recommended by ARC, (1980), but Wilman and Mzamane (1982) had 3.0% K which is in agreement with that reported in this study. The higher content of K in Star grass reported in this study suggests that Star grass has greater efficiency in K utilization at prolonged intervals of 6, 8 and 10 weeks than either northern gamba or Guinea grass. There could therefore be considerable variation in K among species at varying plant ages, as was earlier reported by Grifftith and Walkers, (1966). The higher K content in Star grass recorded in this study at intervals of 6, 8 and 10 weeks could inhibit floral initiation at matured stage due to varied functions of K in respiration, photosynthesis chlorophyll development and regulation of water content in leaves. The relatively smaller and thicker leaves of Sg with extended stoloniferous rooting system, characterized by spreading growth habit, delayed and sparsed flowering, may be responsible for the high K content of herbage later in the season than earlier in the season with greater efficacy of K utilization by the Cynodon species. The reported high Ca and Mg contents of herbage were due to high N rates and frequency of cuts early in the season and these findings are in agreement with the works of Adesogan *et al*, (1998). While Mg fertilizer may tend to raise the Mg content of herbage, (Woltón, 1960), N-fertilizer has slow positive effect of seasonal increase in this study, and led to periods of high Mg content in herbage.

## CONCLUSION

The purpose of appropriate harvesting interval and N-level had been to obtain maximum yield with good quality herbage. In attempt to provide optimum nutritional conditions for pasture, certain factors such as soil, N-level, age at harvest and animal requirements must be considered very important. In the present study, the best intervals for each species would be that which gave the optimum balance between quantity and quality. This optimum balance would be obtained by cutting every 4, 5 and 6 weeks for northern gamba, guinea and star grasses and fertilizing at 300kgha . The tendency to maintain this balance has created the need for further investigation in order to gain more complete understanding of the stage of nutrient balance in grasses and other species.

## REFERENCES

Adegbola, A. A. and Onayinka, B., 1966. The production and management of grass legume mixture at Agege, Nig. Agric. J. 3: 84 – 91.

Ademuṣun, A. A., 1973. Nutrient evaluation of Nigerian forages, Nig. Agric J. 10; No. 2 pp 172 – 177.

Adesogan, A. T. Given D. I. and Owen E., 1998. The chemical composition digestibility and energy value of fermented and urea treated whole crop wheat harvested at three stages of maturity. Grass and forage science 53: 66 – 75.

Agricultural Research Council, 1980. The nutrient requirement of ruminant livestock. Published on behalf of the Agricultural Research Council (ARC) by the Common Wealth Agricultural Bureau, Farnham Royal.

Akinda and Chheda, Akinola, J. O., Chheda, H. R., and Mackenzie, J. A., 1971. Effect of cutting frequency and levels of applied nitrogen on productivity, chemical composition, growth component and regrowth potentials of three Cynodon strains nig. Agric. J. 8(1):63 – 76.

Association of Analytical Chemists, 1980. Official method of Analysis,10th edition AOAC Washington DC.

Griffith, G. and Walter, R. J. K. 1966. The Sodium and Potassium content of some grass genera, species and varieties. J. Agric. Sc. Camb. 67 : 81 – 89.

Field, M. Wilman, D. and Jones D. J. C., 1999. Chemical composition of clamped and baled grass silage harvested in England and Wales and relationship between dry matter, pH and volatile N. J. of Agricultural Science, Cambridge, 132: 163 – 172.

Omaliko, C. P. E., 1980. Influence of initial cutting date quality of star/elephant and Guinea grasses. Grass and Forage Sc., 35: 139 – 145.

Oyenuga, V. A.., 1960. Effect of growth and frequency of cutting on yield and chemical composition of some Nigerian grasses. *Panicum maximum* (Jacob), J. Agric Sc. 25 : 339 – 350.

Oyenuga, V. A., 1960b. Nutritive composition of some Nigerian forge. W. African J. Bio. Chem. 4: 46-63 .

Pritchard, G. I., Folkins, L. P. and Pigdon, W. J., 1964. The vitro digestibility of whole grasses and their parts at progressive stages of maturity. Canadian J. Plant Sc. 44 : 318 – 324.

Reid J. T., Kennedy, W. K. and Turk, K. L., 1959. Symposium on forage production and evaluation I. What is forage quality form animal stand point. Agron J. (4) 213 – 216.

Reith, J. W. S., Inkson, R. H. E. Honmes, W. , 1964. The effect of fertilizers on herbage production II. The effect of N, P, K on botanical and chemical composition. Agric Sc. 63: 309 – 219.

Robson, M. J. and Deacon, M. J., 1978. Nitrogen deficiency in small communities of 324 rye grass. II changes in weight and chemical composition of single leaves during their growth and death. Annals of Botany 42 : 1199 – 1213.

Stout, P. R. Brownell, J. and Burau, R. G., 1967. Occurrence of transaconitate in range forage species. Agron, journal 59 (1); 21 – 24.

Ubi, W. and Omaliko, C. P. E., 2004. Influence of harvesting management and Nitrogen fertilizer application on plant fractions in field swards. Journal of Pure and Applied Sciences, 10: N04: 535 – 543.

Walker, D. M., 1959. The in vitro digestibility of Wughaged dry matter, J. Agric. Sc. 53: 192 – 197.

Warren, J. M., 2000. The role of white clover in the loss of diversity in grassland habitat restoration. Restoration ecology, 8: 318 – 323.

Ward, G. M., 1959. Effect of soil fertility upon the yield and nutritive value of forages. A review of Dairy Sc. 42 (2): 277 – 297.

Wilman, D. and Rezvani Moghaddam, P. (1998) In vitro digestibility and neutral detergent fibre and lignin contents of plant parts of nine forage species. Journal of Agricultural Science, Cambridge 131: 51 – 58.

Wilman, D. and Nzamane, M. N., 1982. The content and yield of six elements in four grasses as affected by N-application and intervals between harvests. Fert Res. 3 : 98 – 109, Netherlands.

Wilman, D. and Pearse, P. J., 1984. Effect of applied nitrogen on grass yield, nitrogen content, tiller and leaves in Field Swards. J. of Agric. (Cambridge) 103: 201 – 211.

Wilman, D., 1980. Early spring and late autumn response number of tillers and chemical composition, Journal of Agric Sc. (Cambridge) 94 : 425 442.

Wilman, D. and Wright P. J., 1983. Some effect of applied nitrogen on grass growth and chemical composition of \temperate grasses. Herbage Abstrates 53 : 387 – 393.

Wilman D. and Wright, P. T., 1983. some effect of applied nitrogen on the growth and chemical composition of temperate grasses. Herbage Abstr. 53 : 387 – 393.

Wolton, E., 1960 Some factors affecting herbage Mg levels Eight Int. Grass land Cong. Proc. 544 – 548.