# Chemical Composition of *Panicum maximum* as Influenced by Poultry Manure Rate and Age at Harvest

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## ABSTRACT

The effects of poultry manure rate and age at harvest on the chemical composition of *Panicum maximum* was investigated in 2015 at Abeokuta, Nigeria. The N rates were 0, 100, 200, and 300 kgN ha$^{-1}$ and the age at harvest was at 4, 8, and 12 weeks after cutback. The results showed that the manure rate had significant ($P<0.05$) effect on the crude protein (CP) content of the grass, which ranged between 5.88 and 7.88%. The CP content significantly decline with increased age at harvest which ranged from 3.31 and 9.98%. The Neutral Detergent Fiber (NDF) as affected by the manure rate ranged from 62.48 and 64.63% and the Acid Detergent Fiber (ADF) ranged between 41.74 and 44.05%. The calcium content as affected by manure rate ranged between 0.25% and 0.35%. The age at harvest ($P<0.05$) affected the calcium content, which ranged from 0.27% in the grass harvested at 12WAC and 0.34% in the grass harvested at 4WAC. Manure rate influenced the phosphorus content which ranged from 0.12% in the unfertilized grass to 0.20% in the grass to which 200 kgNha$^{-1}$ was applied.

(Keywords: manure, salinity, chelate, fiber, guinea grass)

## INTRODUCTION

Forage is considered the cheapest major nutritional component in the diets of ruminant animals particularly in rural and sub-urban areas of the tropics (Akinsoyinu and Onwuka, 1988). In underdeveloped and developing countries of the tropics, ruminant animals depend majorly on forage as concentrate rations are expensive and unaffordable to most stockowners. In most of these countries, the forages that supply the nutrition of animals are provided by the natural vegetation, commonly referred to as natural pastures, which for most of the year do not retain sufficient nutrient and biomass to satisfy the requirements of the animals (Ademosun, 1973; Mohammed-Saleem, 1994). In order to mitigate the problem of poor nutrition for ruminant animals, the use of sown and purposely managed pastures have been widely suggested (Olanite, 2003; Onifade *et al*., 2005; Dele, 2008).

One major factor militating against the adoption of sown pasture is the generally low nutrient status of tropical soils, especially nitrogen and phosphorus (Martínez- Sánchez, 2005). Heavy inputs of inorganic fertilizers have been recommended by various researchers in order to achieve reasonable levels of nutritive quality and dry matter yields (Olanite *et al*., 2004; 2006; Dele, 2008).

In Southwest Nigeria, large quantities of animal manures are generated daily from high volume of animal production activities on varying scales (Osuhor *et al.*, 2002; Fasae *et al*., 2009). These manures constitute environmental hazards as a result of pollution from gas emissions as they decay and in some cases through discharge of effluent into water bodies and underground water.

In some cases, the manures have built up over the years and are occupying considerable spaces that could otherwise be profitably used. Some pilot studies (Onifade *et al*., 2005; Sodeinde *et al*., 2009) have shown that some of these manures can be profitably used for improved production of some forage grasses. Utilization of manures from various animal species for increase production of pasture may provide a means of recycling these “animal waste” for environmental sustainability and may, on the long run, revolutionize ruminant livestock production in Nigeria. It has been generally recognized that the nutritive value of tropical pasture falls as they mature due to a rise in fiber content with increasing maturity and fall in the crude protein content. Maturity through its effects on plant composition is recognized as a major determinant of forage quality (Deetz *et al.*, 1996).

## MATERIALS AND METHODS

The research work was carried out at the Organic Research farms and laboratory of the Department of Pasture and Range Management, Federal University of Agriculture, Abeokuta, Nigeria.

### Establishment and Management

The experimental site was ploughed twice and harrowed. Composite soil samples were randomly collected from the site at the depth of 0-15 cm and 15-30 cm to represent the top and sub–soils respectively. The soil samples were thoroughly mixed together, and sub-samples taken for analysis to determine the pre – planting nutrient status of the soil as well as post-harvest nutrient status. The manures were applied and incorporated into the soil two weeks prior to planting to encourage mineralization and the plots were kept weed free throughout the period of the experiment. The Guinea grass was planted via vegetative materials which were sourced from established plots. The grass was planted at 50 cm intra rows and 50 cm inter rows with each plot having a dimension of 3 m x 5 m. The experimental area measured 1680 $m^2$ and divided into four blocks.

### Experimental design

The study was a 4 x 3 factorial experiment in a split-plot design making a total of twelve (12) treatments with four (4) replicates. The manure rate (0,100, 200 and 300 $KgNha^{-1}$) was allotted to the main plot while the age at harvest (4, 8, 12 weeks after cutback (WAC)) was allotted to the sub-plot.

### Chemical Analysis

At each age at harvest, samples were harvested and oven-dried at $60^0C$ until constant weight was achieved and the dried samples were milled to pass through a 2 mm sieve. The Proximate composition parameters of the contents of the Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), and ash was determined according to AOAC (1995). The fiber fraction content, that is, Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL) (Van Soest *et al*., 1991). The mineral contents (Ca, P, Mg, K and Na) determination of the samples of the grass was done according to the procedure of A.O.A.C. (2006). Data collected were analyzed using the General Linear Model Procedure of SAS (1999) computer package.

## RESULTS AND DISCUSSION

Table 1 showed the proximate composition of *P. maximum* as influenced by poultry manure rate and age at harvest. The Dry Matter (DM) content was significantly ($P<0.05$) affected by the manure rate. The DM content of the grass ranged significantly ($P<0.05$) from 92.12% in the grass fertilized with 100kgN/ha to 92.52% in the unfertilized grass. The DM content as affected by age at harvest significantly ranged from 91.95% in the grass harvested at four weeks after cutback (WAC) to 92.52% for the grass harvested at 8 WAC

The crude protein (CP) content as affected by the manure rate and age at harvest were significantly ($P<0.05$) different. The CP content increased with increased nitrogen rate and decreased with advancement in age at harvest. The increase in the CP content with increased rate of N up to 300 $kgNha^{-1}$ could be a result of better plant growth (Kering *et al.*, 2011), which could be resultant effect of increased leaf nitrogen as well as tissue protein. Except for the unfertilized grass, others were slightly above the critical limit which intake of forages by ruminants and rumen activity would be adversely affected (Van Soest, 1994). The decline in the CP contents with the advancement of plant age in this study agrees with the reports of Bilal *et al.* (2001) on *Pennisetum purpureum* and Olanite *et al*. (2006) on two varieties of *P. maximum*. This might be due to increase in the cell wall structure and a decrease in the leaf-stem ratio of the grasses with the advancement in the age of the grasses.

**Table 1:** Effect of Poultry Manure Rate and Age at Harvest on the Proximate and Fiber Composition (%) of *P. maximum.*

| Manure rate (Kg Nha$^{-1}$) | DM | CP | Ash | EE | NDF | ADF | ADL |
|---|---|---|---|---|---|---|---|
| 0 | 92.52a | 5.88b | 10.25 | 8.17 | 64.63a | 44.05a | 7.69a |
| 100 | 92.12b | 7.09ab | 10.17 | 6.38 | 64.30ab | 42.92ab | 6.71ab |
| 200 | 92.19b | 7.12ab | 10.23 | 6.65 | 62.48c | 42.46b | 6.39b |
| 300 | 92.20b | 7.88a | 9.92 | 7.39 | 63.13bc | 41.74b | 7.13ab |
| SEM | 0.13 | 0.90 | 0.37 | 0.77 | 1.14 | 1.29 | 0.63 |
| **Age at harvest (WAC)** | | | | | | | |
| 4 | 91.94c | 9.98a | 11.47a | 8.34a | 59.41c | 37.74c | 4.91c |
| 8 | 92.52a | 7.69b | 10.27b | 5.72b | 64.09b | 43.33b | 7.03b |
| 12 | 92.32b | 3.31c | 8.75c | 7.37ab | 67.41a | 47.31a | 9.00a |
| SEM | 0.10 | 0.21 | 0.14 | 0.64 | 0.46 | 0.42 | 0.36 |
| **P-value** | | | | | | | |
| Manure rate | 0.0040 | 0.1164 | 0.4767 | 0.3710 | 0.0067 | 0.0231 | 0.1571 |
| Age at harvest | <0.0001 | <0.0001 | <0.0001 | 0.0293 | <0.0001 | <0.0001 | <0.0001 |
| Manure rate x Age at harvest | <0.0001 | 0.0424 | 0.0028 | 0.5446 | 0.0005 | 0.1619 | 0.5737 |

a-c: means with same letter along same column are not significantly different (P>0.05); SEM=Standard error mean
DM=Dry Matter; CP=Crude Protein; EE=Ether Extract; NDF=Neutral Detergent Fiber; Acid Detergent Fiber; Acid Detergent Lignin

The Ash content was not significantly (P>0.05) affected by the manure rate but was significantly (P<0.05) affected by the age at harvest. The Ash content decreased with increase in age at harvest. The decrease in the ash content in this study is in line with the report of Dele (2012) and Onyeonagu *et al.* (2012) that reported that with advancement in age, total ash content decreases. This might be due to a major component of the total ash content called silicic acid which reduces with reduction in water uptake with maturity thereby reducing total ash content of the plant (Quigley and Anderson, 2014).

The NDF content was significantly (P<0.05) affected by the manure rate with the unfertilized grass having the highest NDF (64.63%) content and the grass fertilized with 200 kgNha$^{-1}$ of poultry manure had the least NDF (62.48%) content though statistically similar with the grass fertilized with 300 kgNha$^{-1}$ poultry manure.

The age at harvest also influenced (P<0.05) the NDF content, with the grass harvested at 4WAC having the least (59.41%) content and that harvested at 12WAC with the highest NDF (67.41%) content. The ADF content was significantly (P<0.05) influenced by the manure rate and age at harvest. The ADF content decreased with increase in manure rate and it also increased with advancement in age at harvest. The trend of result of ADL was similar to that of the ADF.

The values of the NDF and ADF of the grass as influenced by the manure rate is lower than that reported by Olanite *et al*. (2006) for same variety of Panicum which was fertilized with inorganic nitrogen fertilizer. The age at harvest on the NDF and ADF was also observed to be lower to those reported by Olanite *et al*. (2006) and Man and Wiktorsson (2003).

The NDF recorded is within the range of 60-65% suggested as the critical limit above which efficiency of utilization of tropical forages by ruminants would be impaired (Van Soest, 1982; Muia, 2000) except for the grass harvested at 12WAC and the consistent increase in the concentration of NDF with advancement in plant age is in line with the submission of Arthington and Brown (2005). The moderate fiber levels of the grasses in this study will be of help in facilitating the colonization of ingesta by rumen microorganism which in turn might induce higher fermentation rates, hence improving digestibility, intake and animal performance.

**Table 2:** Effect of Poultry Manure Rate and Age at Harvest on the Macro Minerals (%) of *P. maximum.*

| Manure rate (KgN ha$^{-1}$) | Calcium | Phosphorus | Magnesium | Potassium | Sodium |
|---|---|---|---|---|---|
| 0 | 0.35a | 0.12d | 0.24c | 3.70a | 0.09b |
| 100 | 0.27c | 0.15c | 0.27b | 2.44d | 0.09b |
| 200 | 0.25d | 0.20a | 0.32a | 2.69c | 0.10a |
| 300 | 0.33b | 0.17b | 0.21d | 2.76b | 0.09b |
| SEM | 0.01 | 0.01 | 0.04 | 0.33 | 0.00 |
| **Age at harvest** | | | | | |
| 4 | 0.34a | 0.14c | 0.21c | 3.09b | 0.09b |
| 8 | 0.28b | 0.16b | 0.28b | 3.43a | 0.10a |
| 12 | 0.27c | 0.17a | 0.29a | 2.17c | 0.09b |
| SEM | 0.01 | 0.01 | 0.03 | 0.34 | 0.00 |
| **P-value** | | | | | |
| Manure rate | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Age at harvest | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Manure rate x Age at harvest | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |

a-d: mean with same letter along same column are not significantly different (P>0.05); SEM=Standard error mean

The macro mineral contents were significantly (P<0.05) affected by the manure rate as well as the age at harvest (Table 2). The calcium content as affected by manure rate ranged from 0.25% in grass fertilized with 200 kgN ha$^{-1}$ to 0.35% in the unfertilized grass. The age at harvest (P<0.05) affected the calcium content, which ranged from 0.27% in the grass harvested at 12WAC and 0.34% in the grass harvested at 4WAC.

The trend observed for Ca content of the grass as influenced by the manure rate in this study is in consonance with the report of Chang *et al.* (1994) in which the Ca content of zero manured Barley had higher concentration. This might be as a result of salinity associated with manure application (Chang *et al*., 1991), also chelating properties of manure could be responsible in which elements such as calcium are bond into a chelate with the soil colloids and are release gradually and this is one of the importance of manure as they are known for binding up mineral elements against being washed away during erosion. The requirement of different ruminant animals in terms of Ca concentration ranged between 0.18 to 0.82% as reported by McDowell (1992; 1997). The calcium content of the grass was not less than the critical level of calcium requirement for ruminants according to McDowell (1992; 1997).

The phosphorus content ranged from 0.12% in the unfertilized grass to 0.20% in the grass to which 200 kgNha$^{-1}$ was applied; the grass harvested at 12WAC had the highest phosphorus (0.17%) content. The phosphorus contents of the grass fell below the recommended (0.18-0.48%) requirements for different classes of ruminant animals as stated by McDowell (1992; 1997) except for the grass which 200 kgNha$^{-1}$ was applied. This affirms the report of McDowell *et al*. (1984) that forages in Nigeria have been found to be P deficient.

The trend of result observation for the magnesium content was similar to that recorded for the phosphorus content as affected by manure rate and age at harvest. Following the report of McDowell (1992; 1997), the grass under study is higher in Mg content as the requirements of the different ruminant animals are put between 0.1-0.2%. The increase in the Mg content as observed in this study with advancement in the age at harvest is in line with the report of Wilman and Mzamane (1982). This also affirms the report of Minson and Norton (1984) that Tropical forage contain sufficient amounts of Mg, deficiencies in animal grazing tropical pastures are likely to be rare.

The K concentration in this study is above 0.8% recommended for grazing animals (Underwood, 1981). However, it has been suggested that ruminants with high producing ability in terms of milk and other animal products may require K level above 1% under stress particularly heat stress (McDowell, 1985) of which the grasses in this study fall under. The Na concentration in this study as influenced by the manure rate and age at harvest fell within the recommended requirement as stated by NRC (2001) for lactating cows. The Na concentration in this study as influenced by the manure rate and age at harvest fell within the recommended requirement as stated by NRC (2001) for lactating cows. The higher Na content found with fertilizer grass against the unfertilized grass corroborates the report of (Chang *et al*., 1991) that salinity is associated with manure application.

## CONCLUSION

From the result of this study, it could be concluded that application of organic manure does enhance quality of forage. The CP of the grass at a younger age is higher than the minimum requirement for maintenance of ruminant animals.

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