Influence of Fertilizer Type on Mineral Profile of Guinea Grass
(Panicum maximum)

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ABSTRACT
The mineral concentration of field grown Panicum maximum (Guinea grass) treated with organic and organic fertilizer type (poultry dropping, cattle dung, sheep dung, Goat dung and N.P.K, fertilizer) and harvested at week 8,10,12,14 after planting was assessed. The results showed contents of Phosphorus(P) in grass increased up to week 10 and then decline (p<0.05). Content of Magnesium (Mg) declined from week 8 after planting (p<0.05). Variation in Calcium (Ca) content were not influenced by age of harvest (p>0.05). fertilizer type on the other hand had a significant (p<0.05) effect on the contents of Ca, P and Mg. Poultry dropping promoted the highest Ca, P and Mg concentration as the lowest Ca was recorded with N.P.K, P with sheep dung and Mg with goat dung. Age at harvest of grass and interaction with fertilizer types had an appreciable effect (p<0.05) on content of Ca and P in grass. The highest Ca concentration (0.418%DM) was recorded at week 12 after planting when fertilizer with poultry dropping and lowest (0.16 %DM) was also at week 12 when N.P.K was applied. Similarly P, maximum fertilizer with poultry dropping recorded the highest value (0.248%DM) of P in grass at week 12 while the lowest value (0.111 %DM) was recorded week 14 with goat dung. Values of Mg in grass on the other hand was not significant (P<0.05) influence by age of cutting and fertilizer type interaction. Grass planted and fertilized with poultry dropping at week 8 recorded the highest value (0.690%DM) of Mg and grass on goat dung at week 12 recorded the lowest value (0.214%DM).In general, result showed that P. maximum contained adequate contents of Ca, P and Mg needed to satisfy the minimum requirements of grazing animals in South-Western Nigeria. These minerals could be enhanced by fertilizing the soil with animal dungs.

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Introduction
Small ruminant production is a farming system that is common in all parts of Nigeria. It forms a significant component of most farming system in the country whether pastoral Agro pastoral or agricultural. In Southern Nigeria, small ruminants are integral components of the household where they contribute to the food, cultural and socio-economic life of the people. Upton (1984) reported that the potential returns from keeping small ruminants under the traditional systems are high. However, their production is fraught with the problems of scarcity of forage during the dry season. Maximizing yield of pasture herbage is of critical importance and needs adequate supplies of soil nutrient. When mineral nutrients are herbage are marginal in respect to animal requirements, changes in concentrations through about by climatic, managerial or seasonal influences as well as plant maturity can be significant factors in incidence or severity of deficiency states by livestock wholly or largely dependent on these plants (Underwood, 1981).

Fertilizer application has marked effects on herbage mineral concentration hence the need to improve soil fertility to boost the soil status. This has become necessary with the ever increasing population pressure on a fixed land base. This ever-expanding animal and human population on a fixed land base in most countries is gradually driving agriculture into greater intensification (Smith et. al., 1997). The consequent introduction of intensive management system has led to an increase in the number of animals and high availability of animal manure. The excess manure produced by intensive livestock farming often poses problems of disposal or use. The recycling of these materials as a fertilizer is hence an important agronomic, economic and environmental object. Also as a result of this agricultural intensification, there is a reduction in available natural range land that supplies the bulk ruminant feed.
Fertilizers which are needed to improve soil fertility, quality and quantity of pasture are high. In Nigeria, inorganic fertilizer are expensive, despite government subsidy, difficulties are often encountered in transportation and distribution. Besides, they may not be available when required. Fertilizer application to pasture production is limited because of the scarcity, financial implication and the greater importance of arable crops. Livestock farmers, many of whom are also crop producers prefer to use the little fertilizer they can afford to buy to boost grain yields rather than for pasture production. In order to source cheaper alternative nutrient for crop production, this is very expensive and difficult to come by, hence the need to consider alternative to inorganic fertilizer.

In the dry areas of the world, the feeding of ruminants mostly depends on the native forage, some crop residues and agro-industrial by-products. Thus grazing animal under these conditions may be exposed sometimes to the danger of deficiencies and/or over intake of some minerals (Fujihara et al. 1997; Kumagai et al., 1990). In the absence of mineral supplement, forage should contain sufficient macro and micro elements essential for the growth and reproduction of grazing animals. Otherwise the animals are greatly affected resulting to disorder in productivity of the animal due to deficiency of one or more of the essential element in forage or feedstuff (Master et al.,1993). These forages are subject to season variable in quality and quantity. There is therefore the need to improve pasture quality, which is influenced by climate, soil fertility, and stage of maturity as well method of feeding.

Panicum maximum (Panicum) is one of the most common grasses in the derived savannah region of Nigeria. Under good conditions, its nutritional value is high, having up to 12.5 % crude protein, total digestible nutrients (TDN) of 10.2 % and calcium, phosphorus and magnesium (Agishi 1985; McDonald et al., 1995).

This study was therefore conducted to examine the influence of fertilizer type on mineral profile of guinea grass (Panicum maximum)

**Materials and Methods**

The experiment was carried out at the Teaching and Research farm, University of Agriculture, Abeokuta, Nigeria. The climate is humid and located in the interphase between the Tropical rain forest zone and Derived savanna zone of south- Western Nigeria.

A local variety of Guinea grass (Panicum maximum) was selected. Crown split of P. maximum local was planted at the spacing of 0.6m and 0.4m between and within row respectively. The different organic fertilizers (Poultry droppings from caged layers, Cattle dung, Sheep manure and goat manure) were collected from the various units of the Teaching and Research farm, University of Agriculture, Abeokuta, while the inorganic fertilizer (NPK) was collected from the department of Pasture and range management of the same university.

The fertilizers were evenly spread over each plot measuring 5m X 5m. The different organic fertilizers were thoroughly mixed with the soil on different treatment basis with the use of a hoe. Adequate rainfall was allowed prior to sowing to reduce the temperature of the manure in the soil. The inter and intra plot were kept weed free throughout the growing season.

**Experimental design and procedure**

A 5 X 4 factorial experiment was employed. Five fertilizer types (Poultry droppings from caged layers, Cattle dung, Sheep manure, goat manure and N.P.K. fertilizer) and 4 age of cutting of two weeks intervals (8, 10, 12 and 14 weeks).

Plant materials were harvested at different ages (8, 10, 12 and 14 weeks) at about 15cm above soil level from each plot representing the five replicates of each treatment. Sub-samples of the materials were weighed and oven dried at 65 °C to for dry matter (DM) determination. The dry grass samples were milled and stored in cellophane bags until required for chemical analysis.

The contents of Ca, P and Mg in the grass were analyzed after wet ashing with perchloric acid and Nitric acid using atomic absorption spectrophotometer for Ca and Mg while P was determined as Vanadomolybdate using calorimetric method (A. O.A.C., 1995)

**Statistical analysis**

Data collected were subjected to analysis of variance (ANOVA). The interaction between manure type and cutting age was determined. Significant means were separated using Duncan Multiple Range Test (SPSS, 1999)

**Result and Discussion**

Table 1 shows that the effect age of cutting was not significant (p> 0.05) on the content of Ca but significantly affected P and Mg. Highest values were recorded for Ca (0.294 % DM) and P (0.193 % DM) at 10 weeks while Mg was highest at 8 weeks after which there was a decline. This is due to the fact that as grasses advance in age, mineral concentration decreased with the exception of Ca content. This agrees with Fleming (1973) and Gomide (1978) studies that Ca level remained relatively constant. Pedromo et al. (1977) also observed that Ca concentration of Guinea grass and Bermuda grass did not change with increasing maturity.

P and Mg content on the other hand declined with increasing age of cutting. This also agrees with Permodo et al (1977), Gomide (1978) and Minson (1982) that P and Mg Concentration declined with age in tropical forage.

<table>
<thead>
<tr>
<th>Mineral content</th>
<th>Age of cutting</th>
<th>±SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>0.269</td>
<td>0.269</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.179</td>
<td>0.150</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.737</td>
<td>0.078</td>
</tr>
</tbody>
</table>

**Table 2. Effect of fertilizer type on mineral concentration (% DM) of P. maximum.**

<table>
<thead>
<tr>
<th>Mineral concentration</th>
<th>Fertilizer type</th>
<th>Poultry dropping</th>
<th>Cattle dung</th>
<th>Sheep dung</th>
<th>Goat dung</th>
<th>N. P.K fertilizer</th>
<th>±SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>0.363&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.306&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.251&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.238&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.200&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.0255</td>
<td></td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.198&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.171&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.158&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.162&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.177&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.0063</td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.610&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.592&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.294&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.250&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.255&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.737</td>
<td></td>
</tr>
</tbody>
</table>

<sup>abc</sup> Means within the same column with different superscript, differ significantly (P<0.05)

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**References**

- Fujihara et al. 1997
- Kumagai et al., 1990
- Master et al., 1993
- Agishi 1985
- McDonald et al., 1995
- Fleming (1973)
- Gomide (1978)
- Pedromo et al. (1977)
- Minson (1982)
This decline may be due to the effect of dilution of the elements in a greater quantity of dry matter that is produced and accumulated with advancing age. The soil fertility and variety of Guinea grass used in this study could have resulted in the variation in mineral concentration at different cutting age. Fertilized Guinea grass in this study had Ca and Mg concentration close to those reported by Bamikole et al. (1998) as 0.28 % Ca and 0.39 % Mg for Guinea grass at 6 weeks.

The different fertilizer type had significant (P<0.05) effect on the content of Ca, P and Mg in the P. maximum (Table 2). Content of Ca, P and Mg were highest when fertilized with Poultry droppings (0.363, 0.198 and 0.616 % DM respectively) while N.P.K. fertilized grass gave the lowest Ca content (0.200 % DM). The lowest P and Mg content were recorded with grass fertilized with goat dung (0.162 and 0.250 % DM respectively). The application of a given nutrient usually increases the concentration of that nutrient as found in the grass. Fertilizers also have an effect on plant mineral concentration not present in the fertilizer whether these concentration not present in the fertilizer whether these concentration increased or decreased depends largely on the soil status with respect to the mineral in question (Fleming, 1973). Plant Mg concentration increases with high rate of nitrogen application (Reid et al., 1974). These support the result of this study where poultry dropping with the highest nitrogen content gave the highest Mg content. This also supports the observation of Fontenot et al. (1983) that poultry droppings had appreciable effect on P content. Also, it has been reported that a large proportion of minerals in organic manure are combined with organic substances and are released over along period of time as they decay (Cooke, 1980; Maynard 1991). This could be the reason for the lower effect of cattle, sheep and goat dung on Ca, P and Mg concentration. This could be due to the fact that complete decomposition of the fertilizer had not fully taken place during this experimental period leading to the gradual availability to the grass when investigated after a number of years, a clearer effect on the mineral concentration would be revealed supporting Maynard (1991) that adequate dressing of organic fertilizer can sustain crop yield under continuous cultivation on most soil unlike equivalent amount of N. P. K. fertilizer.

The interaction between the different fertilizer type and age of cutting had significant effect on Ca and P concentration but not with Mg Concentration. At week 8 , Guinea grass treated with Cattle dung exhibited significantly highest Ca concentration (0.358 % DM) followed by Poultry dropping (0.0308 % DM). But as from week 10, 12 and 14, poultry dropping had the highest Ca concentration (0.414, 0.418 and 0.313 % DM respectively). The lowest concentration at week 8 was from goat dung (0.209% DM) while N.P.K fertilizer recorded the lowest concentration as from week 10, 12 and 14 (0.200, 0.163 and 0.207 % DM respectively). Phosphorus concentration in poultry dropping fertilized guinea grass was significantly (P<0.05) lower (0.149 %) at week 8 compared with the concentration of P in the grass fertilized with other fertilizer type. Concentration of P was however highest in poultry dropping fertilized Guinea grass at week 10 and 12 (0.229 and 0.240 % DM) at week 14.

Phosphorus concentration was lowest at week 10 and 12 in Guinea grass fertilized with N. P. K. fertilizer and at week 14 in Guinea grass fertilized with goat dung. The advantage of the age of cutting and fertilizer type was felt because the resultant Ca, P and Mg concentration were adequate for the optimum performance of ruminant animal. Ca requirement for growth (0.29 % ) and lactation (0.22 % ) in Cattle (ARC, 1980), a range of 0.2- 0.82 % for sheep (NRC, 1981) and 0.15% DM, the desirable concentration of mineral in feed dry matter for maintenance for sheep (SCA, 1990) was met in this study. It also meets the net P requirement for growth (0.29 % ) and lactation (0.17 %) for cattle (ARC, 1980), a range of 0.2- 0.82 % for sheep (NRC, 1981) and 0.15% DM for goat (NRC, 1985) and 0.15% DM for sheep

| Table 4. Correlation coefficient of mineral content of Guinea grass (P .maximum) as affected by age of cutting and fertilizer type. |
|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Mineral content    | Age of cutting (weeks) | Age of cutting (weeks) | Age of cutting (weeks) | Age of cutting (weeks) | Age of cutting (weeks) | Age of cutting (weeks) |
|                    | Vs Poultry dropping  | Vs Cattle dung       | Vs Sheep dung         | Vs Goat dung          | Vs N.P.K fertilizer  | Vs N.P.K fertilizer  |
| Calcium            | 0.04                | -0.57                | -0.07                | 0.83                 | -0.51                |
| Phosphorus         | 0.28                | -0.66                | -0.97*               | -0.88                | -0.53                |
| Magnesium          | -0.50               | -0.72                | -0.85                | -0.97*               | -0.89                |

Means within the same column with different superscript, differ significantly (P< 0.05)SEM.

Table 3. Interactive effect of fertilizer type and age of harvest on mineral concentration (% DM) of P. maximum.

<table>
<thead>
<tr>
<th>Mineral content</th>
<th>Age of cutting (weeks)</th>
<th>Fertilizer type</th>
<th>N.P.K fertilizer</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>8</td>
<td>Poultry dropping</td>
<td>0.308a</td>
<td>0.209d</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Cattle dung</td>
<td>0.358b</td>
<td>0.291b</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Sheep dung</td>
<td>0.200*</td>
<td>0.216*</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Goat dung</td>
<td>0.313*</td>
<td>0.258a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N.P.K fertilizer</td>
<td>0.192*</td>
<td>0.176b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SEM</td>
<td>0.174b</td>
<td>0.148c</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>8</td>
<td>Poultry dropping</td>
<td>0.149c</td>
<td>0.182b</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Cattle dung</td>
<td>0.229*</td>
<td>0.202b</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Sheep dung</td>
<td>0.240*</td>
<td>0.143c</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Goat dung</td>
<td>0.176*</td>
<td>0.157b</td>
</tr>
<tr>
<td>Magnesium</td>
<td>8</td>
<td>Poultry dropping</td>
<td>0.690</td>
<td>0.634</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Cattle dung</td>
<td>0.584</td>
<td>0.594</td>
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<tr>
<td></td>
<td>12</td>
<td>Sheep dung</td>
<td>0.545</td>
<td>0.553</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Goat dung</td>
<td>0.623</td>
<td>0.586</td>
</tr>
</tbody>
</table>

abcMeans within the same column with different superscript, differ significantly (P< 0.05)SEM.
maintenance (SCA, 1990). Phosphorous plays a vital role in normal kidney functioning and transfer of nerve impulse. Phosphorus also plays an important role in carbohydrate, lipids and amino acid metabolism. It is required for blood coagulation (thromboplastin) satisfactory bone classification, optimum growth rate and optimum utilization of both Calcium and phosphorous (Olonu, 2011).

Mg requirement in ewes – late pregnancy (0.14%), early lactation 0.18% and growth (0.12 %) (NRC, 1985). Recommendations by Haelein (1987) for dairy goat (0.2%) (ARC1980) for growing sheep (0.21%) and SCA(1990) for maintenance in sheep (0.12%) were met by the concentration of Mg of Guinea grass in this study. Magnesium plays a major role in relaxing muscle along the air way to the lungs of animals. It plays important role in most reaction involving phosphate transfer (Apple, 1999).

The mineral analysis of plants gives the ideal of possibility either the plant should be used for any feeding trial purpose. Variation in the Ca, P and Mg concentration of Guinea grass fertilized with different fertilizer and harvested at different age of cutting depended upon the species used, stage of growth, soil type, cultivation and fertilizer application. The overall effect of poultry dropping on the mineral concentration at different age of cutting supports the report of Gardini et al. (1992) that poultry dropping is considered to have fertilizing properties intimate between mineral fertilizer and farmyard fertilizer. Follet et al. (1982) also confirmed the superiority (richness and concentration) of poultry droppings over other fertilizer in many experiments.

Results of the correlation analysis between age of cutting and fertilizer type is presented in table 4. Correlation analysis showed that Ca concentration (p=0.05) low positive correlation in the Ca concentration induced between poultry dropping and cutting age (r= 0.04). Age of cutting was also insignificantly (p>0.05) positively correlated the Ca concentration with goat dung (r=0.57), sheep dung(r=0.07) and N.P.K fertilizer n(r=-0.51). In the case of P, consistent negative correlation coefficients were obtained between age of cutting and each of the fertilizer type (age of cutting and cattle, r= -0.66, sheep, r= -0.97, goat, r = -0.85 and N.P.K. fertilizer r=-0.53except for poultry dropping which gave low positive correlation (r= 0.28). Hence a decrease in P concentration as age of cutting increased when fertilized with sheep dung.

Age of cutting and fertilizer type used in fertilizing Guinea grass gave negative correlation coefficient of Mg concentration in the grass. There was a significant negative (P<0.05) correlation coefficient (r = -0.97) on Mg when fertilized with goat dung. Hence as age of cutting of the grass increased Mg concentration decreased accordingly.

This could be as a result of low nitrogen content in the fertilizer. Fertilization of grass is a practice capable of increasing the mineral levels of these plants. Nitrogen fertilization increase the concentration of P and Mg in the plant when these elements are in adequate supply in the soils and to decrease uptake when soil reserves are low (Whitehead, 1980). Nitrogen fertilizer raises P content of the herbage, provided that soil P status is high. Also the gradual decomposition and release of these mineral by these organic fertilizers as reported by Cooke (1980) and Maynard (1991) caused these changes.

**Conclusion**

The effect of age of cutting and fertilizer type on the mineral profile (Ca, P and Mg) of Guinea grass in the present study was significant except for Mg concentration. The grass was adequate in Ca, P and Mg for ruminant feed. Farmers could enhance their forage production appreciably by application of poultry dropping which gave the highest concentration for Ca, P and Mg concentration. The grass can then be preserved as hay or silage for later use. A decision on rate of organic fertilizer to apply would depend on availability of the mineral, the incremental responses obtained with increasing levels. Responses obtained in this study suggest that application between 10-20 t /ha would be effective.

**References**


SCA (Standard Committee on Agriculture) (1990): Feeding standard for Australian Livestock Ruminants, standard committee on Agriculture. CSIRO, Melbourne


