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Effects of Organic and Inorganic Fertilizers on Mineral Composition of Cynodon Dactylon

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Research Article

Effects of Organic and Inorganic Fertilizers on Mineral Composition of *Cynodon Dactylon*

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ABSTRACT

The study was carried out at the Nyankpala Campus of the University for Development Studies in the Northern region of Ghana. The objectives of the study were to compare selected (Calcium, Phosphorus, Potassium and Magnesium) mineral levels under applications of fertilizer (organic cow dung and inorganic NPK) and also to assess the variations of these mineral levels at two different cutting stages; 4 and 8 Weeks After Planting (WAP). Randomized complete block was the experimental procedure used in the field, three treatments NPK and cow dung application and control were replicated three times each. Fresh sprigs of C*ynodon dactylon* were planted on 2m x 2m beds. Samples of *Cynodon dactylon* were taken from each bed at four WAP and eight WAP for analysis. Results from the study indicated that *Cynodon dactylon* planted under NPK and cow dung application responded better and yielded higher levels of the selected minerals. Nominal figures showed that NPK had higher levels than cow dung but the difference was very minimal. *Cynodon dactylon* cut at four weeks were relatively high in mineral levels than those cut at eight weeks. However considering the long term effects of NPK on the soil, we recommend that cow dung should be considered for incorporation in soils to improve the levels of minerals in forage plants and preferably harvesting should be done at 4 WAP for animal consumption.

Keywords: cow dung, NPK, livestock, forage, minerals.

INTRODUCTION

The inability of small scale livestock farmers to provide sufficient and quality feeds to their livestock on a consistent basis is a major constraint facing livestock production systems across the world (Hall *et al.,* 2008). Livestock production which is an integral part of subsistence crop-livestock systems of northern Ghana is a source of cash, draught power, transport, nutrition, manure, and an asset. However, livestock production is considerably affected by the quantity and quality of feed which may cause malnutrition as a result of insufficient concentrations of minerals present in feeds (Tilahun, *et al*., 2005). It is important to note that poor growth and reproductive problems can be directly related to mineral deficiencies caused by low concentrations of minerals in forages even when forage supply is adequate (McDowell, 1997).

Although minerals yield no energy, they play a significant role in body activities such as the maintenance of certain physiochemical processes essential to animal life (Malhotra, 1998; Eruvbetine, 2003). Proper mineral nutrition contributes to a strong immune system, reproductive success, improved milk production and growth among animals. The most important source of minerals for animals is pasture and forages since these feeds contribute the highest percentage of their diet. The mineral composition of forages varies according to various factors such as plant age, soil, fertilization practice, species, variety, seasons, and grazing pressure (Gomide, 1978; Aregheore, 2002). The ability of these minerals to meet grazing livestock mineral requirements depends upon the concentration of minerals in the plant and their bioavailability.

The use of high levels of chemical fertilizers on grasslands has enormous adverse effects on animal health and creates fertility problems. For example, a high potassium load can lead to reduction in fertility, disturbance of carotene metals and reduced feed intake, while a chronic high nitrate level during pregnancy has been linked to milk fever and other diseases (Lampkin, 1990). There is no doubt that organic manure contributes a lot more than just nutrients to the soil (Rupa *et al*. 2001; Chaudary & Ramphal 2005; Gurpreet Singh *et al*. 2007). Organic manure is known to modify the physical conditions of the soil by improving water holding capacity, aeration, drainage and friability (Schjønning *et al*., 1994; Maheswarappa *et al*. 1999; de Silva & Cook, 2003). Most importantly, it helps in protecting crops from a temporary gross excess of mineral salts and toxic substances by decreasing their bioavailability (Chamon *et al*. 2005; Indoria and Poonia, 2006; Kungolos *et al*., 2006; Neubauer *et al*. 2006).

Since forages in many parts of the world constitute a major diet of livestock, it is necessary to know the effects of fertilizer on the levels of the mineral composition and how these minerals will help increase the production for livestock and wildlife. The study aimed at assessing the effect of cow dung and NPK fertilizer on the levels of some mineral elements; Potassium, Phosphorus, Calcium and Magnesium in *Cynodon dactylon.*

MATERIALS AND METHODS

Study area

The study was conducted at Nyankpala Campus of the University for Development Studies (UDS). Nyankpala falls under the Tolon District of the Northern Region of Ghana within the Guinea Savannah Agro-ecological zone. Geographically, the district lies within latitudes 9º 25'N and longitude 0º 58' W. Nyankpala is 16km (10 miles) away from Tamale, the capital of the region with an altitude of 183m above sea level (SARI, 2004). It has an annual rainfall of 1034mm distributed fairly from April to late November with a uniform mean monthly temperature of 22 ºC during the rainy season and maximum of 34ºC during the dry season. The vegetation of the area is guinea savannah type with extensive shrubby grassland and few sparse populations of *Vitellaria paradoxa* (Shea tree) and *Parkia biglobosa* (Dawadawa)

Research design

A randomized complete block design was used to conduct the experiment. Three (3) treatments which comprised of 2 kg decomposed cow dung (treatment 1), 1 kg of NPK 15:15:15 fertilizer (treatment 2), and a control with no application (treatment 3) was used for the experiment on 2 m x 2 m beds prepared from top soil of the same location. The treatments were replicated thrice to give a total of nine (9) experimental plots. The fresh sprigs of *Cynodon dactylon* (Bermuda grass) were planted at a distance of 0.5cm within the rows and 10cm between the rows with two sprigs planted per hole to the depth of 1 to 2 inches. This was done to ensure early establishment and easy cover in order to protect the soil surface. Cultural practices such as watering and weed control were routinely performed on the plots.

Harvesting of grass samples

Samples of *Cynodon dactylon* were harvested at two inches above the ground from each experimental unit four weeks and eight weeks after planting (WAP). The samples were then sun dried for six days and ground into powder for mineral analysis in the laboratory.

Laboratory analysis of P, K, Ca, and Mg

The powdered samples were weighed into digesting tubes, placed on a block digester to heat to a temperature of 360^{o}c for 4 hours by which time the digested samples solution looked colourless and clean, it was then transferred into a 100ml volumetric flask and topped to the mark. This solution contains: P, K, Ca & Mg. The potassium concentration was then measured using a flame photometer whiles calcium and Magnesium were determined directly using an Atomic Absorption Spectrophotometer (AAS).

The phosphorus blue colour was developed using Molybdate, Ascorbic acid and a sample solution derived from the previous laboratory analysis for K, Ca, and Mg. The blue colour intensity was then measured on the ultra violet visible spectrophotometer.

Data analysis

The data collected from the various samples during laboratory tests were analyzed with the help of GENSTAT software by running ANOVA. The mean values for the various parameters were compared and with error bars showing the significant difference among the treatments.

RESULTS

Mineral composition of Cynodon dactylon

There was significant difference (P< 0.05) in the levels of Ca in *Cynodon dactylon* under NPK and cow dung treated plots and the control between the fourth and eighth week after planting. The levels of calcium were also observed to be significantly higher under NPK treated plot than under cow dung and control plots. However, there was no significant difference between cow dung and control plots (Fig. 1).

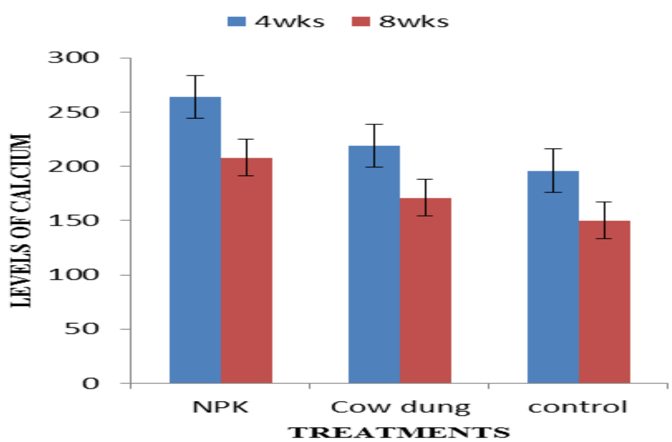

Fig. 1: Ca levels (mg/kg) under NPK, cow dung and control 4 & 8WAP

The results as shown in figure 2 revealed that P levels in *Cynodon dactylon* were significantly higher at 5% in the fourth week after planting than in the eighth week. However there was no significant difference in P levels among the NPK and cow dung treated plots and control plot in both the fourth and eighth week after planting.

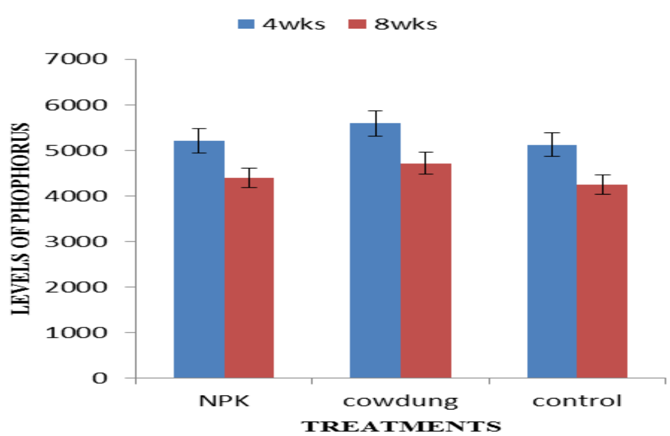

Fig. 2: P levels (mg/kg) under NPK, cow dung, and control 4 & 8 WAP

From figure 3, K levels were significantly higher in the fourth week of harvest than in the eighth week under NPK and cow dung treated plots (p<0.05) but no significant difference in the level of K was recorded between the two harvesting regimes under the control. Also, the level of K in the fourth week of harvest was noted to be significantly higher under NPK treated plot than under cow dung and control plots. No significant differences were however observed in K levels between cow dung and control plots in the fourth week of harvest.

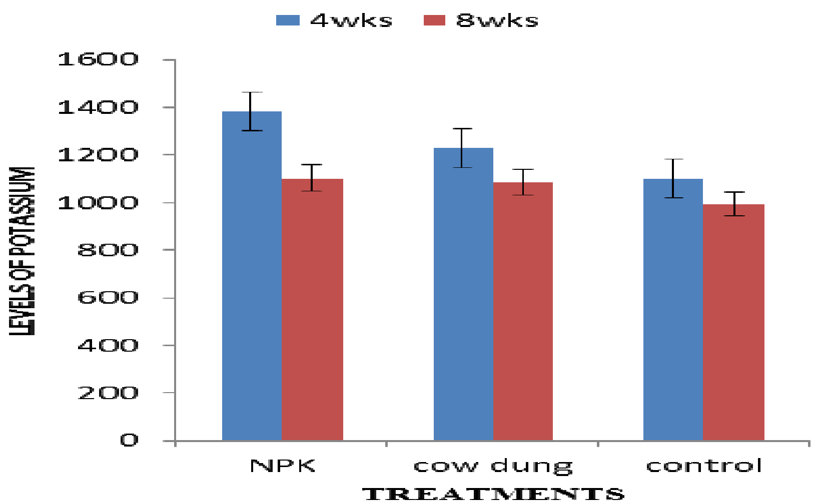

Fig. 3: K levels (mg/kg) under NPK, cow dung, and control 4 & 8 WAP

It can be noticed from figure 4 that, the levels of Mg in *Cynodon dactylon* at the fourth week of harvest was significantly higher than the eighth week under NPK treated plots. There was no significant difference in Mg level between the fourth and eighth week of harvest under cow dung and control plots ($p<0.05$). Furthermore, Mg levels in the fourth week of harvest was shown to be significantly higher under NPK treated plot than under cow dung and control plots at 5 %.

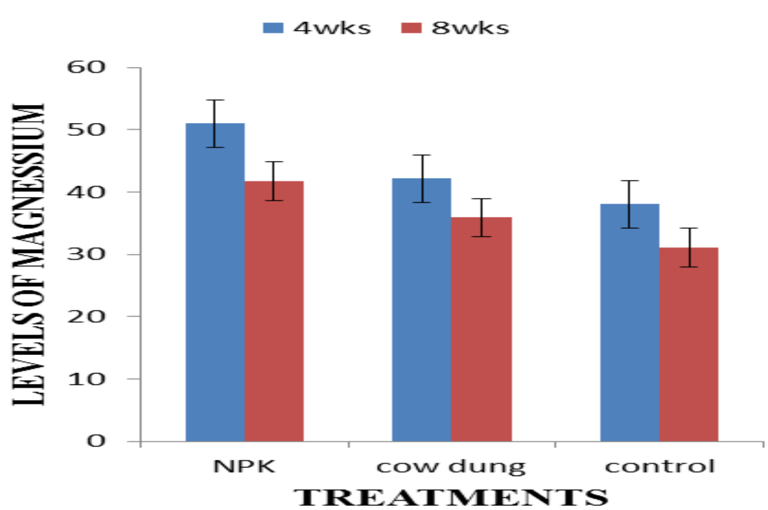

Fig. 4: Mg levels (mg/kg) under NPK, cow dung and control 4 & 8 WAP

DISCUSSION

Calcium level in *Cynodon dactylon*

There was significant difference ($P< 0.05$) in the levels of Ca in *Cynodon dactylon* under NPK and cow dung treated plots and the control between the fourth and eighth week after planting. This means that the level of Ca in *Cynodon dactylon* decreases as the plant matures. However, the finding of Perdomo *et al.* (1977) revealed that Ca concentration in Guinea grass and Bermuda grass does not change with increasing maturity. The level of calcium in

Cynodon dactylon was observed to be higher under the NPK treated plot than under the cow dung and control plots. This could be as a result of the high level of nitrogen supplied by the NPK fertilizer which facilitated the absorption of other nutrients including calcium.

Phosphorus level in *Cynodon dactylon*

The higher levels of Phosphorus at four weeks after planting under each of the treatment could be attributed to low levels of lignin in the plant at four weeks of harvest after planting hence the low levels of phosphorus in *Cynodon dactylon* at eight weeks. Therefore the older the plant the higher the lignin and the younger the plant the lower the lignin concentration. Gomide (1978) reported that when forages neared maturity the lignin content increases, affecting mineral content. There was however no significant difference in the levels of P in *Cynodon dactylon* under the three treatments. This could be attributed to the fact that the amount of P supplied by the NPK and Cow dung fertilizers to the soils could have been leached out through excessive rain or watering and therefore the grass could not take up the P supplied.

Potassium in *Cynodon dactylon*

The higher significant levels of Potassium under NPK treated plots to cow dung treated plots and control plots could be attributed to the high levels of K made available by NPK fertilizer in the soil. This is in line with Adane (2003) who reported that the nutrient of natural grass lands increases with increasing levels of NPK fertilizer application. Halgerson *et al. (2004)* also reported that concentrations of most minerals were greater in leaves than in stems therefore reduction in leaves at eight weeks caused the decline in K levels. The results of the study also recorded high significant difference of K in *Cynodon dactylon* between four and eight weeks after planting under NPK treated plots but there was no significant difference under cow dung treated plots and control plots. The high significant level of K under the NPK treated plot could be due to the fact that at the four weeks of harvest, greater amount of K supplied by the NPK fertilizer could have been taken up by the grass plant. As time went on the amount of K in the soil reduced hence the low level at the eighth week. In the case of the cow dung the K released could have been slow from the fourth to the eighth week of harvest hence the insignificant difference.

Magnesium (Mg) in *Cynodon dactylon*

The high significant level of Mg at four weeks after planting under NPK treated plots than the cow dung treated and control plots could be as a result of the high level of Nitrogen supplied by the NPK fertilizer which facilitated the absorption of other nutrients including magnesium. Bell (2001) and Türk (2007) reported that fertilization enhances not only dry matter production, but also the chemical content of the forage. According to Sultan *et al.* (2008), the Mg concentration decreases with plant age in free grazing rangeland grasses. Therefore the higher significant levels of magnesium at four weeks after planting could be attributed to the age of the grass. Gomide *et al.* (1969) also reported that stage of maturity is probably the most important factor influencing forage mineral composition.

CONCLUSION

The study revealed higher levels of Phosphorus, Calcium, Potassium and Magnesium at four weeks after planting as compared to eight weeks. NPK treated plots also had high levels of Calcium, Potassium and Magnesium at both weeks (4 & 8 WAP) than cow dung treated plots and control plots. However Cow dung had high levels of Phosphorus than NPK treated plots and control plots. Even though NPK treated plots had high levels of minerals, the difference was not vast compared to cow dung. Considering the long term effects of NPK on the soil, cow dung should be considered for incorporation in soils to improve the levels of minerals in forage plants and preferably should be harvested at 4 WAP during which the minerals level is high for animal consumption.

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