
EFFECTS OF INORGANIC FERTILIZER APPLICATION METHODS ON CHEMICAL COMPOSITION OF MAIZE LEAVES AS FODDER FOR LIVESTOCK

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ABSTRACT

Fodder production requires nutrients for its tissue and cell developments, however its productivity is hampered by low nitrogen contents in the soil. Inorganic fertilizers are becoming expensive daily and beyond the reach of many livestock farmers that use maize leaves as fodder for their livestock. Foliar method of fertilizer application is expected to use less quantity of inorganic fertilizers compared to placement method, however, its effect on chemical composition needs to be investigated. This experiment was therefore conducted to determine the effect of method of fertilization on chemical composition of maize leaves as feed for livestock. The experiment consisted of four treatments, Treatment 1 (T1) was the application of inorganic fertilizer using side placement while Treatments 2 (T2), 3 (T3) and 4 (T4) were 20%, 40% and 60%, respectively of total amount of fertilizer applied in T1 using foliar method of application. The treatments were replicated three times making the total of 12 experimental units. The experimental design adopted was Randomized Completely Block Design (RCBD). The maize leaves were then analyzed for organic matter (OM), dry matter (DM), ASH, acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL), and crude protein (CP). The result revealed that, there was significant ($p \leq 0.05$) effect of method fertilization on the chemical composition of maize leaves (DM= 94.32-95.40%), (OM= 90.83-94.73%), (ADF= 25.15-29.04%), (NDF= 19.05-31.72%), (ADL= 3.10-4.33%), and (CP= (7.41-10.29%). It was concluded that application of fertilizer using foliar method at the rate of 100kg/ha NPK 20:10:10 and 50kg/ha urea could reduce rate of leaching and cost of maize production as forage for livestock.

Keywords: Maize leaves, Chemical composition, Side placement, Foliar, Fertilizer.

INTRODUCTION

Maize is an important crop in Nigeria, mainly as an energy giving food with a total production of 7.3 million tons. (FAO, 2007). Being a versatile crop, constituting about fifty percent in the poultry feed ingredients it is widely cultivated in all the agro-ecological zones in Nigeria. The diverse use of maize as food for man, livestock and raw materials for industries has made the crop in continuous production. Compared to other arable crops such as millet and sorghum, the nutrient requirement of maize is quite higher and hence constituting major constraints to its production as fodder crop. Fodder production requires fertilizers for its tissue and cell developments, however its productivity is hampered by low nitrogen contents in the soil (Naik *et al.*, 2013). This low nitrogen can be replenished with inorganic fertilizers, however, their prices are becoming prohibitive recently.

The practice of applying liquid fertilizer to plant leaves (foliar fertilization), is recently done in Nigeria and gradually gaining popularity among peasant farmers (Rafeal *et al.*, 2013). This method of fertilizer application has been reported to increase the growth, yield and quality of crops such as okra (Selvi and Rani, 2000), soyabean (Barge, 2001) and tomato (Alexander *et al.*, 2004). Philips (2004) reported that these techniques apart from supplying the micronutrients, it also acts as a catalyst in the uptake and use of certain macronutrients. According to Rafael *et al.* (2013), foliar fertilization with micronutrient has been intensively used in late years because these practices allow the application of minerals at the appropriate time during plant development. It also allows uniformity in nutrient distribution and increase the nutrient absorption and consequently it avoids losses in the environment. The general objectives of this research was to determine the effect of methods of fertilizer applications on CP, NDF), ADF, ADL, OM, DM and Ash contents of maize leaves as fodder crop for livestock.

MATERIALS AND METHODS

Experimental Site for Fodder Production

The experimental site was at Teaching and Demonstration Farm of the Federal College of Education (Technical), Gusau, (latitude 07° and 12° W and longitude 4° S 17° N, 139.5 m above sea level) in the northern Guinea Savanna ecological zone of Nigeria.

Treatments and Experimental Design

The experiment consisted of four treatments. Treatment 1 (T1) was the application of fertilizer using side placement while treatments 2 (T2), Treatment 3 (T3) and Treatment 4 (T4) were the 20%, 40% and 60%, respectively of the total amount of fertilizer applied in T1 r using foliar method of application, The treatments were replicated three times making a total of 12 experimental units. The experimental design adopted was Randomized Completely Block Design (RCBD).

Land preparation and field layout of maize seed for fodder production

The land was ploughed, harrowed and ridged at 75cm apart to obtain a fine tilt and then marked out into required plot sizes with 1.0 m spacing between replications and 0.50 m spacing between plots. The total field size was 13.25m × 6.5m (86.125m²) and the plot size was 3.75m × 1.25 m (4.6875m²) constituting 5 ridges in each plots.

Seed treatment and sowing of maize seed for fodder

The seeds were dressed with Apron- star at the rate of 10 g of the chemical per 2.0 kg of seed before sowing in order to protect the seeds from soil borne diseases and pests. The seeds were established at an intra and inter row spacing of 25 cm x 75 cm for each crop, respectively. Two seeds of maize were sown per hole and thinned to one plant per stand at two weeks after sowing.

Fertilizer application and weed control of fodder crop

Compound fertilizer (NPK 20:10:10) was applied to maize by side placement at the rate of 250 kg ha⁻¹ 2 weeks after planting for T1 while 50, 100 and 150 kg ha⁻¹ were applied using foliar method for T2, T3, and T4 respectively . Urea was applied by side placement at the rate of 125 kg ha⁻¹ 6 week after planting for T1 while 25, 50 and 75 kg ha⁻¹ were applied using foliar method for T2, T3 and T4 respectively to supply total nutrients of 95.0 N; 37.5 P₂O₅; 37.5 K₂O kg ha⁻¹ for T1, and 19.0 N; 7.5 P₂O₅; 7.5 K₂O kg ha⁻¹, 38.0 N; 15.0 P₂O₅; 15.0 K₂O kg ha⁻¹, 57.0 N; 22.5 P₂O₅; 22.5 K₂O kg ha⁻¹.for T2, T3 and T4 respectively. Weeds were controlled manually by hoeing 2 weeks after planting and 6weeks after planting.

Harvesting of fodder crop

The maize crop was harvested when the cobs matured, husk has turned yellow, grains have harden enough and when black layers at the point of attachment to the cob were formed. The ears from the net plots were then manually removed and de-husked. The leaves were then dried and milled for chemical analysis.

Data Collections

Sample of leaves were taken to National Animal Production Research Institute (NAPRI) Shikka, Zaria for determination of their chemical compositions (Dry Matter, Organic Matter, Ash, Acid Detergent Fibre, Neutral Detergent Fibre, and Acid Detergent Lignin).

Data Analysis

Data collected were subjected to analysis of variance as described by Geoff Der-Brain (2015). Significant differences between treatments means were then compared with Least Significant Difference (LSD) using SAS statistical package.

RESULTS AND DISCUSSION

Chemical Composition of Maize Leaves

There was effect ($p \leq 0.05$) of treatment on dry matter content of the leaves. The dry matter content (94.32-95.40%) recorded in this experiment were similar to the value of (92.96%) reported by Fang *et al.* (2014).

Table 1: Effects of method of fertilizer application on chemical composition (%) of maize leaves.

Treatments		Ash	Chemical OM	Composition NDF	(%) ADF	ADL	CP
T1	94.09 ^c	8.91 ^a	91.09 ^c	30.50 ^b	25.15 ^c	3.10 ^c	10.29 ^a
T2	95.38 ^a	6.14 ^b	93.86 ^b	29.04 ^c	28.24 ^b	3.18 ^c	8.30 ^b
T3	95.40 ^a	5.27 ^c	94.73 ^a	19.05 ^d	29.04 ^a	3.66 ^b	7.41 ^c
T4	94.32 ^b	9.17 ^a	90.83 ^d	31.72 ^a	28.02 ^b	4.33 ^a	10.19 ^a
LSD	0.192	0.268	0.030	0.725	0.414	0.464	0.362
SL	***	***	***	***	***	**	***
Mean	94.80	7.37	92.63	27.58	27.61	3.57	9.05
CV (%)	0.101	1.826	0.201	1.326	0.755	6.514	2.017

Means within a column of treatments followed by the same letter are not significantly different at 5% level of probability using LSD, **, *** represent significance at $P \leq 0.01$ and $P \leq 0.001$ respectively, DM= Dry Matter, OM= Organic Matter, NDF= Neutral Detergent Fibre, ADF= Acid Detergent Fibre, ADL= Acid Detergent Lignin, CP= Crude Protein, SL = Significance Level, LSD= Least Significant Difference. T1= 95.0 N; 37.5 P₂O₅; 37.5 K₂O kg ha⁻¹. T2 = 19.0 N; 7.5 P₂O₅; 7.5 K₂O kg ha⁻¹, T3 = 38.0 N; 15.0 P₂O₅; 15.0 K₂O kg ha⁻¹, T4 = 57.0 N; 22.5 P₂O₅; 22.5 K₂O kg ha⁻¹

There was effect ($p \leq 0.05$) of treatment on organic matter content of the leaves. The result indicated that treatment 3 (94.73%) had the highest ($p \leq 0.05$) organic matter followed by T2 (93.86%). The least ($p \leq 0.05$) organic matter was recorded for T4 (90.83%). The organic matter recorded in this experiment ranged from 90.83 - 94.73%, this value were similar to those reported by Fang *et al.* (2003) and Eyob *et al.* (2017) who reported (92.46%) and (90.01%) respectively.

There was effect ($p \leq 0.05$) of treatment on neutral detergent fibre content of the leaves. The neutral detergent fibre recorded in this experiment ranged from 19.05 - 31.72%, and these values were different from those reported by Van Soest *et al.* (2003) and Eyob *et al.* (2017) that reported (51.5%) and (52.0%) respectively. The difference may be attributed to differences in the genetic make-up of the maize plant (Reed *et al.*, 2008) and Climatic factors such as temperature, rainfall and soil type (Prasad *et al.*, 2003).

There was effect ($p \leq 0.05$) of treatment on acid detergent fibre content of the leaves. The acid detergent fibre recorded in the experiment ranged from 25.15 -29.04% these values were in agreement with the values reported by Fang *et al.* (2014) and Eyob *et al.* (2017) that reported (31.12%) and (32.5%) respectively.

There was effect ($p \leq 0.05$) of treatment on acid detergent lignin content of the leaves. The acid detergent lignin recorded in this experiment ranged from 3.10 -4.33%, these values were not in agreement with the findings of Brussard *et al.* (2002) and Logah (2011) that reported (6.8%) and (16.40 - 17.21%). The difference in value may be attributed to difference in factors such as temperature, soil nutrient and type of fertilizer used (Prasad *et al.*, 2003).

There was effect ($p \leq 0.05$) of treatment on crude protein content of the leaves. The crude protein contents recorded in this experiment (7.41-10.29%) were similar to the values of 10.58-11.40% reported by Antonio *et al.* (2012) and (8.75%) reported by David *et al.* (2016).

CONCLUSION

It was concluded that applying NPK and Urea in maize production using foliar method could reduce quantity of fertilizer usage by 40% compared to side applications at the same time improving digestibility of maize leaves as fodder for ruminants.

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