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RESPONSE OF BAMBARA GROUNDNUT (*VIGNA SUBTERENAE* (L.) VERDC) TO ORGANIC AND INORGANIC FERTILIZER APPLICATION

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ABSTRACT: Effects of organic and inorganic fertilizer applications on the growth and yield of Bambara groundnut (*Vigna subterrenae* (L.) Verdc) was investigated at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Evan Enwerem University Owerri Nigeria, to evaluate the possible differences in the agronomic and yield performance of Bambara groundnut as influenced by nutrient source and to ascertain the best nutrient source for optimum performance of the crop. The experiment was conducted in the field in a Randomized Complete Block Design (RCBD) with four replications and treatments (poultry manure, goat manure, NPK fertilizer and urea fertilizer) and an unamended plot which served as the control. The treatments were applied in split doses. First at two weeks prior to planting and at forty days after planting at the rate of 200kg/ha for each application. Data were collected on the germination percentage, number of leaves per plant, vine length (cm), number of nodules per plant, number of pods per plant, 100 seed weight(g) and seed yield (kg/ha) and these were subjected to analysis of variance at 5% level of significance. Results showed that plants treated with urea preformed better than plants treated with other sources of nutrient (poultry, goat manure and NPK). In terms of vine length, number of leaves per plant and number of nodules per plant, plants treated with urea gave the highest values of 17.550cm, 75.89 and 10.000 respectively, which were not significantly different from the results obtained from other treatment plots. In terms of number of pods per plant, urea gave the highest (12.500) mean number of pods and also produced the highest weight of 100 seeds (65.875g) and in turns produced the highest (454.47kg/ha) yield of Bambara groundnut and these values were significantly different at $p < 0.05$ from results obtained from other treatment plots according to LSD. It was concluded within the limits of the experiment that urea fertilizer had greater influence on the yield potentials of Bambara groundnut and thus was recommended as the best nutrient source for optimum performance of Bambara groundnut.

KEY WORDS: Organic and inorganic fertilizer, Bambara groundnut, Response, Seed yield, Nodulation.

INTRODUCTION

Bambara groundnut, *Vigna subterranea* (L.) verdc., is an indigenous grain legume grown mainly by subsistence women farmers in drier part of sub Saharan Africa (Baryeh, 2001). The crop produces an almost balanced food. It is a drought tolerant and an easy-to-cultivate crop which makes very little demand on the soil. (Alakali and Salimelun, 2007). According to Turner *et al*. (2003), it grows in soils of 5.0-6.5 pH with 600-1200mm annual rainfall. It is very adaptable to hot temperature but also tolerates rainfall (Turner *et al*., 2003). Hence it is not prone to the risk of total crop failure, especially in low and uncertain rainfall regions.

Bambara groundnut, serves as an important source of protein in the diet of a large percentage of the population in Africa, particularly to poor people who cannot afford expensive animal protein, because it is the least expensive, most easily stored and most easily transported non-processed protein source for rural and urban dwellers. Bambara groundnut is ranked the third most important grain legume after groundnut and cowpea (Diabate *et al*., 2005). The average yield is 650-850kg/ha and it matures in four to five months (Baryeh, 2001).

However, the performance of crops such as Bambara groundnut is dependent on the availability of nutrients. It is possible to generalize about the response of plants to limited amount of most nutrients (Vanlauwe *et al*., 2002). Recent reports have shown that in many subsistence crop production systems, soil nutrient mining, especially of soil organic matter, is a common phenomenon (Fraga & Salcedo, 2004). This occurs when export of nutrients in harvested produce and from losses through leaching and erosion are greater than the input of these same nutrients and hence soil reserves become increasingly depleted (Okito *et al*., 2004). Under intensive farming system, most tropical soils exhibit rapid depletion of organic matter and consequently soil nutrient (Okito *et al*., 2004), such soils need nutrient replenishment for optimum crop yield.

The use of inorganic fertilizer alone cannot solve the problem of low soil fertility status of most tropical soils, in addition, essential fertilizers are frequently unavailable and unaffordable by most farmers due to high cost of imported materials. Many of the manufactured inorganic fertilizers are known to contain certain number of micronutrients vital for crop growth and development (Adediran *et al*., 2005). Since, the deficiency of these elements has been reported in some major tropical soils, there is need to apply nutrient sources that will reduce or eliminate such deficiencies. This study therefore is aimed at comparing the effect of mineral fertilizer and organic manure applications on the performance of Bambara groundnut.

MATERIALS AND METHOD

The study was carried out during the planting season (April August) of 2009 at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Evan Enwerem University Owerri. Owerri lies between latitude 5° 10'N and 6° 0'N and longitude 6° 10'E and 7° 0'E within the southeast agricultural zone of Nigeria and the climatic

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data indicates that the average annual rainfall, relative humidity and temperature are 2500mm, 75% and 27°C, respectively (NIMET, 2008).

Experimental field of 20m x 11m was cleared using conventional farm implement such as cutlass and hoe. Soil samples were collected and analysed to ascertain the physic-chemical properties. Two organic manure sources (poultry droppings and goat dung) and two inorganic fertilizers (NPK 15:15:15 and Urea) and a non-amended plot which served as control were used as treatment for the study. The test crop, Bambara groundnut was sourced from the Eke-ukwu market Owerri.

The experimental layout were based on a Randomized Complete Block Design (RCBD) replicated four times. There was a split applications of both the organic and inorganic fertilizers; first at two weeks prior to planting and secondly at forty days after planting (at flowering). The inorganic fertilizers (NPK and Urea) were applied at the rate of 200kg/ha per application. Organic fertilizer were also applied by split application of 200kg/ha per application time, first at two weeks before planting and another at forty days after planting. The Bambara groundnut seeds were planted at a depth of two to three centimeter (2 3cm) with fifty by fifty centimeter (50cm x 50cm) spacing and at the rate of four seeds per stand which was thinned down to two seedlings per stand seven days after germination. The field was weeded as the need arose. The following parameters were monitored: Germination percentage, vine length, number of leaves per plant, number of nodules per plant, number of pods per plant, 100 seeds weight, and seed yield. Data collected was subjected to analysis of variance (ANOVA) procedure and treatment means were separated using the Least Significance Difference (LSD) as applied by Onuh and Igwemma (2000).

RESULTS

Physical and Chemical Properties of the Soil

Table 1 below shows the physical and chemical properties of the experimental site. The soil type is a loamy sandy soil with percentage sand of 80%, silt 4.0% and clay 16.0%. The total nitrogen is at 0.07% with organic carbon content of 0.891 and organic matter status which stood at 1.55%. The soil had a total exchangeable acid 0.70meq/100gsoil. The aluminum ion value stood at 0.40meq/100gsoil (Table 1). Other cation in the soil were calcium ion (Ca^{2+}), magnesium ion (Mg^{2+}), Potassium ion (K^{+}) and Sodium ion (Na^{+}) which stood at 2.60, 1.60, 0.11 and 0.21meq/100gsoil respectively with a cation exchange capacity (CEC) of 5.17meq/100gsoil. Available phosphorus was 9.25ppm with base saturation of 86.4% (Table 1).

Effect of Fertilizer Source on the Germinability of Bambara Groundnut

Fertilizer and manure application did not have a significant effect on the germinability of the Bambara groundnut seed. Thus 100% germination was obtained in plots treated with both organic and inorganic fertilizer (Table 2).

Effect of Fertilizer Source on the Vine Growth of Bambara Groundnut

From the analysis conducted, the result shows that there were no significant effects of the treatment source on the length of vine of the Bambara groundnut. The highest mean vine length (17.550cm) was recorded from the urea treated plots which was not significantly different ($p<0.05$) from the minimum (13.335cm) mean vine length recorded from the N.P.K. treated plots (Table 2).the mean vine length recorded from Goat manure treated plots (17.493cm), control segment (14.963cm) and poultry manure treated plots (14.388cm) were also found to be statistically at par ($p<0.05$) with the highest (17.550cm) observed from the urea fertilizer treated plots (Table 2).

Effect of Fertilizer Source on the Leaf Production of Bambara Groundnut

Means recorded for number of leaves per Bambara groundnut plant did not show significant difference at $p=0.05$ according to LSD. The maximum number of leaves (75.89) was recorded from plots treated with urea fertilizer which was not statistically different from the minimum (54.97) observed from the NPK treated plot (Table 2). Also, means recorded from control (62.59), poultry manure (59.19) and Goat manure (71.36) treated plots were found to be statistically at par with the 75.89 observed as the maximum number of leaves (Table 2).

Effects of Fertilizer Source on the Nodulating Potentials of Bambara Groundnut

From the results obtained, there was no significant difference($p<0.05$) seen on the nodulating ability of the test crop (Bambara groundnut) by the treatment sources. The highest (10.000) means number of nodules was recorded from the urea treated plots but it was not significantly different from the 9.500, 8.750 and 7.250 mean number of nodules recorded from NPK , poultry manure and control plots respectively. Also the 10.000 recorded as highest was not significantly difference ($p<0.05$) from the 6.000 mean recorded from Goat manure treated plots (Table 3).

Table 1: Physical and Chemical Properties of the Soil

Soil Properties	Status
pH (H_2O)	5.16
Sand (%)	80.0
Silt (%)	4.0
Clay (%)	16.0
Organic carbon	0.89
Organic matter	1.55
T.E.A.	0.70
Al^{3+}	0.40
H^{+}	0.30
Total Nitrogen (%)	0.70
Ca^{2+} (Meq/100g soil)	2.60
Mg^{2+} (Meq/100g soil)	1.60
K^{+}	0.11
Na^{+}	0.21
CEC	5.17
Base saturation (%)	86.4
Available phosphorus (ppm)	9.25

Effects of Fertilizer Source on the Number of Pods Produced by Bambara Groundnut

Urea treated plots produced the maximum (12.500. Mean number of pods per plants which was statistically and significantly different ($p<0.05$) from the 8.500 and 6.250

Produced by the plants in the control and poultry manure treated plots respectively. However, poultry manure treated plots produced the minimum number of pods (Table 3). Also, number of pods produced by goat manure, NPK and urea treated plots did not vary significantly (Table 3).

Effect of Fertilizer Sources on 100 seed Weights of Bambara Groundnut Seeds

The weight of 100 seeds of Bambara groundnut treated with urea fertilizer (65.875g) was significantly different ($p<0.05$) from the fresh weight recorded from plots treated with poultry manure (40.840g) and NPK fertilizer (40.225g) treated plots (Table 3). The 40.840g and 40.225g recorded from poultry manure and NPK fertilizer treated plots did not vary significantly at $p=0.05$ according to LSD. Also the 48.400g recorded from control, 57.150g recorded from goat manure and 65.875g from urea fertilizer treated plots are statistically similar (Table 3).

Effects of Fertilizer Source on the Yield of Bambara Groundnut

Urea fertilizer treated plots produced the maximum (454.47kg/ha) mean yield of Bambara groundnut seed and the value was significantly different ($p<0.05$) from the yield recorded from poultry manure (291.57kg/ha) and NPK fertilizer (287.32kg/ha) treated plots. But not significantly different from the mean yield recorded from control (345.65kg/ha) and goat manure (408.21kg/ha) treated plots. The yield produced by poultry manure and NPK treated plots did not vary significantly (Table 3).

Table 2: Effects of organic and inorganic manure application on germination percentage, vine length and number of leaves on Bambara groundnut Plant.

Treatment	Germination (%)	Mean Vine Length (cm)	Mean Number of Leaves
Control	100	14.963[a]	62.59[a]
Poultry manure	100	14.388[a]	59.19[a]
Goat manure	100	17.493[a]	71.36[a]
N.P.K. fertilizer	100	13.335[a]	54.97[a]
Urea fertilizer	100	17.550[a]	75.89[a]
LSD	ns	4.590.	24.90

Means having the same letter(s) are not significantly different at $p<0.05$ according to LSD.

Table 3: Effects of organic and inorganic manure application on yield and yield components of Bambara groundnut

Treatment	Mean Number of Nodules	Mean Number of Pod/Plant	100 Seed Weight (g)	Mean Yield (kg/ha)
Control	7.250[a]	8.500[c]	48.400[ab]	345.65[ab]
Poultry manure	8.750[a]	6.250[c]	40.840[b]	291.57[b]
Goat manure	6.000[a]	11.000[ab]	57.150[ab]	408.21[ab]
N.P.K. fertilizer	9.500[a]	9.250[abc]	40.225[b]	287.32[b]
Urea fertilizer	10.000[a]	12.500[a]	65.875[a]	454.47[a]
LSD	4.463	3.594	20.285	146.83

Means having the same letter(s) are not significantly different at $p<0.05$ according to LSD.

DISCUSSION

In terms of vine length, number of leaves and number of nodules, no significant difference was observed as influenced by the treatment sources. However, urea fertilizer treated plots were seen to perform better than the other treated plots. While the NPK treated plots were generally observed to have the poorest influence. Although, organic and inorganic fertilizer applications did not influence the physiological aspects of the test crop (Bambara groundnut) so significantly, significant differences were observed in the number of pods, 100 seeds weight, fresh seeds weight and yield of Bambara groundnut. The high yield of Bambara groundnut observed in the urea treated plots can be attributed to the ability of the plant to produce more leaves and nodules.

However, the best performed plants were found in the urea treated plots with the highest number of pods (12.500), 100 seed weight (52.500g) fresh seeds weight (65.87g) and yield (454.47kg/ha) of Bambara groundnut. While the minimum performance were found on the poultry manure and NPK treated plots which produced 27.625g and 27.050g of 100 seeds weight, 40.840g and 40.225g of fresh seed weight and 291.57kg/ha and 287.32kg/ha yield respectively. This trend in the performance of the Bambara groundnut could be attributed to the fact that urea may have been readily converted during pod production and filling which made enough nutrient available at the time and thus resulted in the improved quality of seeds produced and thus better yield. This can be linked to the finding of Mallory and Griffin (2007) which stated that plants require more nutrients at the reproductive stage of growth so as to produce good quality products.

Also the results seen in terms of nodule formation could be as a result of the fact that the condition suitable for the development and performance of organisms associated with nodule formation and subsequent nitrogen fixation was induced by the application of urea which resulted in the greater number of nodules and subsequently, greater yield. This confirms the findings of Madukwe *et al*. (2008) which stated that legumes' yield is associated with their nodulation potentials.

CONCLUSION

The performance of Bambara groundnut plant was significantly influenced by the application of organic and inorganic fertilizer. However, the urea source of nutrients showed greater potentials in improving the performance of the plant as it generally, influenced every yield component of Bambara groundnut plant. It is therefore recommended that urea fertilizer be used for improved Bambara groundnut production.

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