Varieties and Soil Amendments (Poultry Manure) effect on growth and yield of Bambara Groundnut in Owerri, Southeastern Nigeria

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Abstract— *Bambara groundnut is an underutilize legume with poor yield because of inadequate knowledge about high yielding varieties and soil amendment rates. This experiment was carried out at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri, to determine the growth and yield potentials of five varieties and different poultry manure rates of Bambara groundnut. The five varieties used were TVSU 1482, TVSU 688, TVSU 921, Black local and White local, while the soil amendment rates were 0kg/ha, 4000kg/ha, 6000kg/ha, and 8000kg/ha of poultry manure. The experiment was set up in a split block using a randomized complete block design (RCBD). Data collected include plant height, 50% flowering, days to 50 % maturity, pod per ha and Seed yield per hectare. The data collected were analyzed using the GLM SAS software while the means were separated using the Duncan's multiple range test as described. Result showed that variety TVSU 688 had higher performance than other varieties but not significantly better (P<0.05). The manure rates were also significantly better than control (0kg/ha) in growth and yield parameters. The experiment revealed that TVSU 688 has the highest growth and yield traits in Owerri, while poultry manure applied at 4000 kg/ha is also the most effective poultry manure rate to be considered in Bambara groundnut cultivation.*

Keywords— Bambara Groundnut, Manure, Poultry, Variety.

I. INTRODUCTION

The Bambara groundnut (*Vigna subtarranea (*L) Verdc) belongs to the family *Fabaceae*, subfamily *Papilionoidea*. It is an indigenous African legume (10) which originated in the Sahel region of present day West Africa. Its name originated from the Bambara tribe who now live mainly in Mali (6). Bambara groundnut is the third most important grain legume after groundnut. Although considerably less popular throughout the world, cultivation of Bambara groundnut has remained common in all of West Africa. It is has also been established that the crop is one of the most underutilized in the developing world (6). The micronutrients and amino acids in Bambara groundnut is comparable to that of soybean. Seeds and nuts can be eaten raw or cooked while the protein extracts can be used in making cosmetic formulations. Bambara groundnut is a good source of human protein. It also contain high amount of phosphorus and potassium. It helps in bone development and proper functioning of kidney (4, 11). They also play a role in nutrition of many people in Africa where they can be processed into flour, *akara, okpa, moin-moin*, milk, *tubani,* and *dawadawa*, which provide nutrients to fight malnutrition across the continent (12).

As having access to proper balanced diet continues to be a challenge across Africa continent as a result of the rapid growth in population, migration crisis, depletion of soil nutrients and effects of climate change (13). There is a need for diversification of diet and Agricultural production system in other to fully maximize crop output. This also underscores the importance of

using different approach in improving the growth and yield of underutilized crops like Bambara groundnut. Therefore, the aim of this experiment was to determine the effect of poultry manure rates as soil amendment on selected growth and yield parameters of Bambara groundnut varieties.

II. MATERIALS AND METHOD

2.1 Study and planting area

The experiment was carried out at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri. A land area of 27.5m x 13m was cleared and prepared for the experiment. The field was marked out into five main plots and each plot further divided into 4 sub plots. The sub plots were well prepared seed beds of dimension 3m x 0.8m (0.00034ha).

2.2 Treatments and Experimental Design

2.2.1 Collection and sowing of seeds:

A total of five varieties were used for this experiment. Three of them TVSU 1482, TVSU 688 and TVSU 921 were sourced from IITA, Ibadan, the other two, Black and White were collected from local farmers in Mubi Adamawa State. Three seeds were sowed directly on the field which was latter tinned down to one per stand. The sowing was done at a spacing of 60cm x 30 cm and 2-3cm depth. It was sown at the rate of 1 seed per hole. This gave a planting density of 55,555 plants/ha

2.2.2 Treatment application and experimental design:

The soil ammendment used was a Poultry manure (broiler droppings) collected from Ubochi Farm in Aboh-Mbaise Imo State. The poultry manure (PM) was cured for four weeks while application was carried out four days before sowing at the rates of 0kg/ha, 4000kg/ha, 6000kg/ha, and 8000kg/ha. A Split Plot in Randomized Complete Block Design (RCBD) with three replications was used and planting was done twice. The first planting was September while the second was late October. The Five varieties of Bambara groundnut were allocated to the main-plot while the four levels of Poultry manure were applied to the sub-plots: forming a 5 x 4 x 3 split plot in RCBD.

To supplement water during the dry spell, surface irrigation was applied to the October planting at the rate of 0.5 litres per plant every 48 hours. This water was sourced from the IMSU farm borehole. Manure weeding was done throughout the period of the experiment to reduce the competition with weeds for nutrients, water and sunlight.

2.3 Data Collection and Analysis

Data were collected include days to plant height, 50% flowering, days to 50 % maturity, and Seed yield per hectare. The data collected were analyzed using the GLM SAS software. The means were separated using the Duncan's multiple range test as described by Onuh and Igwemma (2007).

III. RESULTS

Table 1 shows the effect of five varieties and different rates of poultry manure on the plant height of Bambara groundnut in September and October. Result showed that the varieties were not significantly different from each other in September and October. However, the plant height of TVSU 688 was higher than other varieties in both months (22.9 and 21.2 for September and October respectively). Result also indicated that all varieties performed than local varieties in September, however, the local varieties performed than improved varieties in October (although not significant) except TUSV 688.

For the manure rates, result showed that height of plants treated with poultry manure were significantly higher than control. Among the manure treatments, 6,000 (kg/ha) had the highest plant height for September (25.7) and October (23.8), although the differences were not significant.

TABLE 1
EFFECT OF VARIETIES AND MANURE RATES ON PLANT HEIGHT

	August					October		
Treatment	**3WAP**	**5WAP**	**7WAP**	**9WAP**	**3WAP**	**5WAP**	**7WAP**	**9WAP**
TVSU 1482	13.3	15.4	17.36	20.1	10.5	12.8	15.2	16.5^{ab}
Black local	10.6	13.2	14.2	17.9	11.2	13.8	16.4	17.7^{ab}
TVSU 921	12.1	16.4	18.6	19.3	11.8	12.4	14.6	15.0^{ab}
White local	12.8	14.9	16.4	17.5	10.1	14.6	17.9	18.4^{ab}
TVSU 688	14.8	18.9	20.4	22.9	12.8	14.6	18.9	21.2 ^{a}
Manure rates (kg/ha)								
0	10.1	12.6	13.9	15.5 ^{b}	10.6	11.4^{b}	13.9^{b}	14.6^{b}
4000	14.1	15.8	18.3	24.8 ^{a}	12.2	17.5^{ab}	19.6^{ab}	22.9 ^{a}
6000	13.9	16.2	20.7	25.7 ^{a}	12.4	18.3^{ab}	19.5^{ab}	23.8 ^{a}
8000	13.2	15.5	19.8	24.4 ^{a}	11.8	19.5 ^{a}	21.4^{a}	22.1 ^{a}

Table 2 shows the effect of varieties and poultry manure rates on emergence, days to 50% flowering and days to 50% maturity of Bambara groundnut. The result of August planting shows that TVSU 688 recorded the highest mean number of days (10 days) to 50% emergence. This was not significantly different (P<0.05) from the other varieties. The black local variety which had the shortest mean number of days (9 days) to emergence was also not significantly (P<0.05) different from the other varieties (10 days). manure rate of 8000kg gave the highest mean number of days to emergence (9.9) which was not significantly different (P<0.05) from the other treatments. Meanwhile, 4000kg/ha of poultry manure which had the lowest mean number of days (9.6 days) to 50% emergence was statistically similar to 0kg/ha and 6000kg/ha with 9.7 days respectively.

In October planting, TVSU 1482 recorded the highest mean number of days to emergence (7.5days) which was not significantly different (P<0.05) from other varieties. Apart from the black local variety which took 7.1 mean numbers of days, TVSU 921, TVSU 688 and white local varieties took 7.0 days to attain 50% emergence. There was a more uniform germination in October planting than in August planting. Though 4000kg/ha poultry manure recorded the highest mean number of days to emergence (7.2days), there was no significant difference (P<0.05) between the poultry manure means in October planting.

TVSU 921 recorded the highest number of days to flowering at both planting dates with 41.9days and 39.5days respectively and these were not significantly different from the black local variety which recorded the lowest mean number of days to flowering at both planting dates with 38.0days and 36.3days respectively. The highest means were not significantly different (P<0.05) from the lowest at both planting dates. There was more uniformity in days to flowering in October than in August planting where there was more significantly different (P<0.05) means.

Poultry manure effects were not significantly different (P<0.05) at both planting dates. In August planting, 8000kg/ha rates of poultry manure recorded the highest (40.3days) while 0kg/ha rates of poultry manure recorded the lowest mean of 38.8 days. In October, 0kg/ha rates gave the highest mean (37.4days) while 4000kgHa- recorded the lowest mean of 37.1. Apart from the control, poultry manure effect followed the same pattern (4000kg/ha<6000kg/ha<8000kg/ha) in both seasons. This indicates delay in flowering with increase in poultry manure rate.

TVSU 1482 and TVSU 921 were observed to be late maturing varieties. Their mean number of days to maturity was very high. TVSU 1482 had the highest number of days to 50% maturity in both planting dates with 126.3 days and 126.2 days. The lowest was TVSU 688 in August (88.1), while the white local variety had the lowest days to maturity in October (88.2).

In August planting, there was a significant difference (P<0.05) between the highest mean 102.1days (8000kg/ha PM) and the lowest mean 97.7 days (4000kg/ha PM) poultry manure mean. 8000kg/ha of poultry manure had the highest mean of 102.1 days which was not significantly different (P<0.05) from those of 0kg/ha and 6000kg/ha rates. The lowest mean was 38.800

recorded by 4000kg/ha rates. In October planting, poultry manure effect was not significant. 8000kg/ha and 4000kg/ha also maintained the highest and lowest means (as in August planting) of 101.6 and 100.5 days.

TABLE 2
EFFECT OF VARIETIES AND POULTRY MANURE RATES ON DAYS TO EMERGENCE, 50% FLOWERING AND 50% TO MATURITY OF BAMBARA GROUNDNUT

	August				October		
Treatment	**Days to emergence**	**Days to flowering**	**Days to maturity**		**Days to emergence**	**Days to flowering**	**Days to maturity**
TVSU 1482	9.8	39.5	126.2[a]		7.5	37.4	126.6[c]
Black local	9.2	38	89.1[c]		7	36.3	92.7[a]
TVSU 921	9.5	41.9	108.5[b]		7.1	39.5	110.2[b]
White local	10	40.5	88.3[c]		7	36.5	88.2[a]
TVSU 688	10.2	39.5	88.4[c]		7	36.8	88.7[a]
Manure rates (kg/ha)							
0kg/ha	9.7[b]	38.8	101.7		7.1[a]	37.4	101
4000kg/ha	9.6[b]	40.8	97.4		7.2[a]	37	100.4
6000kg/ha	9.7[b]	40.2	101.4		7.1[a]	37.2	101.2
8000kg/ha	9.9[a]	40.3	102.1		7.1[a]	37.4	101.6

Means in the column of same letters are not significantly different at P<0.05 according to Duncan's multiple range tests

3.1 Seed yield

Table 3 shows the response of Bambara groundnut to different varieties and poultry manure at different planting seasons on number of pods and the seed yield. In August planting, there were variations in the seed yield of the 5 different varieties. TVSU 688 had the highest seed yield of 620kg/ha which was significantly different (P<0.05) than TVSU 1482, black local, and white local varieties. Similarly in October, TVSU 688 (468.8kg) also had the highest seed yield which was significantly different (p<0.05) to TVSU 1482 (125.3kg) with the lowest seed yield, but statistically not different from other varieties.

In both months, 4000kg poultry manure had the highest mean seed yield of 427kg/ha and 403.24kg/ha respectively. In August the highest mean of 427kg/ha recorded in plants treated with 4000 kg/ha had no significant difference (P<0.05) from other manure rates but significantly higher from the control (202.0 yield/ha). Similarly in October planting, there was no significant difference (P<0.05) between the poultry manure means but the manures were significantly higher than the 0 kg/ha (control) which had the lowest seed yield of 223.1.

The effect of varieties and poultry manure rates on Bambara groundnut is shown in table 3. Result revealed that in August, variety TVSU 688 had the highest pod/ha which was significantly different from other varieties (2,530,067). This was followed by Black local which was also significantly higher than TVSU 1482, TVSU 921 and the White local varieties. TVSU 688 also had the highest pods in October (895,824) which was significantly higher than other varieties except TVSU 921 (472,218).

Result also showed variations in the poultry manure rates and the control. In both August and October, there were no significant differences among the manure rates but performed significantly better than the o kg/ha (control). In August, manure rate of 8000 kg/ha had the highest pod (1,196,284) while 4000 kg/ha had the highest pod/ha (464,810) in October. Notwithstanding, they were not significantly different from the other manure rates in both monts.

IV. DISCUSSION

The annual production of Bambara groundnut is estimated to be 0.3 million metric tons, with majority of them (0.2 million metric tons) produced in Africa (Esan). This is a very low output compared to similar legumes like soybean with annual production of more than 200 million metric tons. It is also noteworthy that Bambara groundnut is drought-tolerant and thrives

well in poor soil conditions. Yet, the outputs remain low. To maximize growth and yield of Bambara groundnuts, many studies have indicated the need to determine the Agronomic performance of different varieties under different environments with a view to identifying the variety with best vegetative and yield traits under specific environment. This was demonstrated in this experiment as the agronomic performance of five varieties of Bambara groundnuts in the Southeast Nigeria was revealed.

Generally, variety TVSU 688 had better performance than other varieties in respect to both vegetative and yield traits. The performance of the variety could be attributed to its ability to adapt well to the agro-climate of the area. Previous study by (2), noted that varieties of Bambara groundnuts that produce high yield do so when all growth and yield factors correlate with environmental factors. This is also similar to the observation of (7), that temperature, rainfall and other biotic factors in a particular environment cause differences in agronomic performance and yield outputs of Bambara groundnut. Another study by (1), showed that environment is the most important source of variation in crops which plant breeders should pay attention to when considering varieties with high growth and yield potentials. The performance of TVSU in this particular experiment showed it was able to utilize the biotic and abiotic factors in the environment relatively better than other varieties. Among the local varieties, Black local seems promising signs in terms of early emergence and days to maturity. In respect to August and October planting dates, previous study by (9), observed that Bambara groundnut planted during the season of extended exposure to photoperiods favour vegetative growth while those with less exposure favours pod and seed growth. This was not particularly the case in this experiment as there was no obvious difference during the August and October planting. It should be noted that those planted in August have less exposure to photoperiod because of rainfall.

The growth and yield parameters of Bambara groundnut showed that application of poultry manure at different rates lead to increase in growth and yield of the plant. All the manure rates applied in this experiment have higher performance than the control. This is could be as attributed to the presence of nutrients present in the manure that supplements the soil nutrients, thereby increasing the growth and yield of the plant. Another author (3), observed that poultry manure contain the highest nitrogen, phosphate and potassium of all animal manure. Interestingly, this elements are also easily accessible by the plant which make them to be useful almost immediately after application. Similarly, poultry manure also helps in improving soil structure which could help in boosting water penetration, especially during dry spells. This is also similar to early study by (8) that reported the increase in growth and yield of Bamabara groundnut by the application of poultry manure. It is also in agreement with (5), which observed increase in nutrient, water intake and growth of plants as a result of poultry manure.

V. CONCLUSION AND RECOMMENDATION

This experiment showed that variety TVSU 688 is the most superior Bambara variety for maximum growth and yield in Imo State Southeastern Nigeria. Result also showed the application of poultry manure increase growth and yield of Bambara groundnut.

We therefore recommend the cultivation of TVSU 688 in the state. However, in places where the variety is not available, local Black variety should be cultivated. We also recommend the application of poultry manure at the rate of 4000 kg/ha to maximize yield.

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