Effect of Organic Manure on the Growth and Yield of Bambara Groundnut in a Derived Savannah Zone of Nigeria

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ABSTRACT

Bambara groundnut (Vigna subterranean) is a leguminous crop widely grown across Sub-Saraha Africa due to its nutritional and economic benefits. The study evaluated the effect of poultry and goat manure on various growth parameters, and was conducted using the statistical method; Analysis of Variance (ANOVA) to access the significance of the effects of manure types and rate on the plant growth and plant yield parameters. The experiment was a 2 x 4 factorial experiment comprising two main treatments: manure types (goat manure and poultry manure) and the application rates of 0t/ha, 5t/ha, 10t/ha and 15t/ha. This resulted to (8) treatment combinations using RCBD (Randomized Complete Block Design) and the experiment was replicated four (4) times. For mean separation, Least Significant Difference (LSD) test was applied to identify the difference between treatment groups when ANOVA showed significant effects. The results for growth parameter showed that a 5-ton manure rate consistently resulted in the lowest growth, while the 10-ton manure rate generally yielded the highest plant (7.61 cm), plant width (2.823 cm), leaf number (114.1), number of stems (38.05), plant height (34.82 cm), and stem girth (8.82 cm) for growth parameters. The result for yield parameter showed that the effect of poultry and goat manure on fresh and dry fodder weights, pod number and weight showed that 15-ton manure rate resulted in the highest fresh fodder weight (80.6 g) and dry fodder weight (68.1 g), while the 10-ton manure rate had the lowest fresh fodder weight (72.5 g) and dry fodder weight (64.7 g); overall. The study recommends applying a 10- ton manure rate for optimal growth and a 15- ton manure rate for maximizing Bambara groundnut yield.

INTRODUCTION

Vigna subterranean is commonly known as Bambara Groundnut and is very popular in African countries, specifically in the West African sub- region. Bambara Groundnut is a leguminous crop belonging to the family *Fabaceae*; subfamily *Papilionoideae* that develops underground fruit and mainly grown in the Arid lands of Africa. (Obidiebube *et al*., 2024).

Bambara groundnuts are also known by various other names in Africa, including Congo groundnut, Congo goober, Madagascar groundnut, earth pea, baf-in pea, voandzou, indhlubu, and underground bean (Ndiaye *et al.,* 2014). Bambara groundnut is a crop which is adapted to a wide range of conditions and it is popular with African farmers due to its ability to yield on poor soils where other crops fail. The crop has advantage over more favoured species in terms of nutritional value and tolerance to adverse environmental conditions (Obidiebube, *et al.,* 2019). The crop has the potential to contribute to food security in view of its ability to withstand drought (Chai *et al*., 2016). The crop is an important source of food and income for small-scale

farmers in many parts of Africa. Despite its nutritional and economic value, Bambara groundnut remains an underutilized crop with limited research and development, according to Ndiaye and Faye (2014).

Despite the nutritional importance and adaptability of Bambara groundnut, its full potential remains untapped in these regions. The research on the specific impact of Organic manure as soil amendment on Bambara groundnut growth and yield presents a significant knowledge which helps in the development of effective and sustainable agricultural practices tailored to semi-arid conditions, thereby impending efforts to improve food security and livelihoods in the region. This research project is motivated by the urgent need to address food security and sustainable agriculture in Ifite-Ogwari (Southern Nigerian).

The research is not only scientifically significant but also directly addresses the pressing needs of the local community. It aligns with broader goals of promoting sustainable agriculture, reducing waste, and empowering communities to achieve self-sufficiency in food production. Ultimately, the success of this project could have a lasting impact on the livelihoods and well-being of the people of Ifite-Ogwari and as such a good endeavor.

MATERIALS AND METHODS

Experimental Site: The field experiment shall be carried out at the research Farm of Crop Science and Horticulture, in the faculty of Agriculture, Nnamdi Azikiwe University, Ifite-Ogwari in Ayamelum local government area, Anambra State, Nigeria. Ifite-Ogwari is located on latitude 6.6041°N and longitude 6.9507° East.

Experimental materials and experimental layout: The Bambara groundnut seeds, goat manure, poultry manure, hoe, cutlass, measuring scale, meter rule, hand gloves, measuring tape were used in this project. The total land area is 120m^2 with each bed being 2x2 cm.

Experimental Design and Treatments: The experiment was a 2 x 4 factorial experiment comprising two main treatments: manure types (goat manure and poultry manure) and the application rates of 0t/ha, 5t/ha, 10t/ha and 15t/ha. This resulted to eight (8) treatment combinations using RCBD (Randomized Complete Block Design) and the experiment was replicated four (4) times. The treatment consists of the combination of both organic manures and their application rates. T1. control rate (no manure applied) T2. Goat manure at 5t/ha, T3. Goat manure at 10t/ha, T4. Goat manure at 15t/ha, T5. control rate (no manure applied), T6. Poultry manure at 5t/ha, T7. Poultry manure at 10t/ha and T8. Poultry manure at 15t/ha.

Data Collection: Growth parameters included, emergence, percentage emergence, plant height, leaf area, leaf number etc.; Flowering parameters: days to flowering and fifty percent flowering. Then yield parameters, the following were collected: biomass weight, number of pods per plant, weight dry pod and seeds per plant, hundred pods and seeds weight, pod and seeds yield ton/ha.

Statistical Analysis: All data collected were subjected to analysis of variance (ANOVA) using GenStat 2012 and significant differences among treatment means were separated using the least significant difference (LSD) at a 5% level of significance.All the data that was collected was subjected to analysis of variance (ANOVA), with the edition GenStat 10.3DE, copyright 2011.

RESULT

Effect of Organic Manure (poultry and goat) on Leaf

The effect of organic manure (poultry and goat) is presented in (Table 1). It was observed that at 6(WAS), 10 tons (114.1) had the highest number of leaves followed by 15 tons (111.8), while 5 tons (103.5) had the least number of leaves. The number of leaves on manure type (MT) and rate (MR) did not vary significantly at 2,4,6 and 8(WAS). The interactions between manure type and rate (MT.MR) was not significant at all weeks.

Effect of Organic Manure (poultry and goat) on Plant Height

The effect of organic manure (poultry and goat) on plant height is presented in (Table 2). It was observed that at 6(WAS) 10 tons (34.82) had the tallest plant followed by 15 tons (32.70), while 5 tons (33.27) had the shortest plant height. The plant height on manure type (MT) did not vary significantly at 2(0.498), 4(0.639), 6(0.469) and 8(0.329) (WAS). It was also observed that the manure rate was not significant on plant height

at 2(0.876), 4(0.168), 6(0.238), 8(0.931) (WAS). The interaction between manure type and manure rate was significant at 4(0.141) and not significant at 2(0.327), 6(0.184), 8(0.675) (WAS).

Interaction Effect of Organic Manure (poultry and goat) on Plant Growth at Ifite – Ogwari

Under plant height parameter in Table 3, 10 tons was observed to give the highest plant length of 8.36cm, followed by 0 ton with mean value of 8.24cm and 15 tons had mean value of 8.24cm. The least recorded plant height was 5 tons with mean value of 8.06cm. The Interactions between manure type and manure rate (MT.MR) was not significant at 8 WAS with the mean value of 0.985cm. Then from the table below, it was observed that 15 tons had the widest plant width of 3.242cm followed by 5 tons had 3.183cm, while 0 ton had 3.025cn had the least plant width. The Interactions between manure type and manure rate (MT.MR) was significant at 8 WAS with mean value of 0.3723cm.

In the same Table 3, the highest leaf number recorded was from 10 tons with the mean value of 233.8cm, followed by 15 tons with the mean value of 228.5cm, while the lowest was observed from 5 tons with the mean value of 213.7cm. The Interactions between manure type and manure rate did not vary significantly at 8 WAS with mean values of 86.6cm.

On number of Stem in the same Table 3 below, it was observed that 10 tons had the highest number of stems with value of 77.7 followed by 15 tons with the mean value of 76.1, while 5 tons had 71.0 as mean value and was the least. The Interactions between manure type and manure rate (MT.MR) was not significant also with the value of 28.86.

Table.1 Effect of organic manure (poultry and goat) on leaf number ar Ifite-Ogwari

TREATMENTS	WEEK 2	WEEK 4	WEEK 6	WEEK 8
Manure type(MT)				
G.M	21.33	57.6	110.8	225.0
P.M	18.31	54.0	111.2	223.3
NoMa	17.50	48.2	102.8	215.7
LSD (0.05)	5.968	10.32	12.29	70.7
Manure rate(MR)				
0 ton	19.49	54.7	109.8	223.7
5 tons	18.92	50.5	103.5	219.3
10 tons	19.13	58.3	114.1	232.5
15 tons	20.42	55.4	111.8	217.8
LSD(0.05)	6.330	10.94	13.03	75.0
InteractinMT.MR	7.310	12.64	15.05	86.6

G.M = Goat manure; P.M= Poultry manure; NoMa= No manure; 0T= 0t/ha; 5T= 5t/ha; 10T= 10t/ha; 15T= 15t/ha; NS= Not significant at 5% probability level.

The manure type on leaf number did not vary significantly at 2(0.246), 4(0.178), 6(0.350) and 8(0.958) (WAS). It was also observed that the manure rate was not significant on plant width at 2(0.931), 4(0.359), 6(0.224), 8(0.959) (WAS). The interaction was not significant at 2(0.366), 4(0.266), 6(0.048) and 8(0.571) (WAS).

Table.2 Effect of Organic Manure (poultry and goat) on Plant Height at Ifite-Ogwari

TREATMENTS	WEEK 2	WEEK 4	WEEK 6	WEEK 8
Manure type(MT)				
G.M	22.33	38.31	33.47	37.00
P.M	22.96	28.26	34.06	38.28
NoMa	21.35	27.19	32.62	35.93
LSD(0.05)	2.873	2.565	2.478	3.510
Manure rate(MR)				
0 tons	22.46	28.13	33.60	37.39
5 tons	22.44	27.29	33.27	37.64
10 tons	22.96	29.57	34.82	37.70
15 tons	21.98	27.53	32.70	36.84
LSD(0.05)	3.048	2.720	2.629	3.723
InteractinMT.MR	3.519	3.141	3.035	4.299

G.M = Goat manure; P.M= Poultry manure; NoMa= No manure; 0T= 0t/ha; 5T= 5t/ha; 10T= 10t/ha; 15T= 15t/ha; NS= Not significant at 5% probability level.

Table 3 Interaction Effect of Organic manure (poultry and goat) on Plant Growth at Ifite-Ogwari**.**

MT. MR	LENGTH	WIDTH	LEAF NO	NO OF STEM	PLANT HEIGHT	STEM GIRTH
0 tons	8.24	3.025	215.3	71.7	35.95	10.81
5 tons	8.06	3.183	213.7	71.0	37.54	9.15
10 tons	8.36	3.158	233.8	77.7	36.99	10.67
15 tons	8.24	3.242	228.5	76.1	36.46	8.69
LSD(0.05)	0.985	0.3723	86.6	28.86	4.299	1.707

MT.MR = Manure type.manure rate; 0T= 0t/ha; 5T= 5t/ha;10T= 10t/ha; 15T= 15t/ha; NS= Not significant at 5% probability level

Effect of Organic Manure (poultry and goat) on Yield Parameters and their Interactions

In Table 4 on fresh fodder weight, it was observed that 15 tons had the highest fresh fodder weight with the mean value of 80.6g followed by 0 ton with the mean value of 76.2g, while 10 tons with value of 72.5g had the lowest weight. The manure type and rate were not significant (P>0.05) on the weight of Fresh fodder. On no of pods, per plants it was shown in Table 4 that 5 tons had the highest number of fresh pods with e value of 4.60 followed by 10 tons that had 4.59 while 15 tons had 4.08 was the least in of number of fresh pods. The manure type and the manure rate did not vary significantly. In the same Table 4, it was observed that 5 tons had fresh mean weight of 1.82g and was the highest followed by 15 tons that had mean fresh pod weight of 1.65g, while 10 tons had mean value of 1.43g and weighed least among them. For dry fodder weight in Table 4, it was presented that 15 tons had mean dry weight of 68.1g and weighed the highest followed by 0 ton with mean value of 66.2g, while 10 tons had mean value of 64.7g weighed the least.

On dry pod weight in the same Table 4, it was observed that 10 tons with mean value of 0.99g, weighed the highest followed by 0 ton with mean value weight of 0.56g, while 5 tons with mean weight value of 0.37g weighed the least in dry pod weight pod. There was a significant difference on the manure type but manure rate did not vary significantly (P<0.05).

On Table 5, the Interaction effect between manure type and manure rate with the mean pod fresh weight of 1.711g varied significantly on the weight of fresh pods. The Table 5 showed that the interaction effect between manure type and manure rate was not significant.

Table 4 Effect of organic manure (poultry and goat) on Yield parameters

TREATMENTS	Fresh fodder wt.(g)	No of pods per plant	Fresh pod weight (g)	Dry fodder wt. (g)	Dry pod wt. (g)
Manure type (MT)					
G.M	83.4	4.56	1.61	74.3	0.34
P.M	75.6	5.01	1.84	62.2	0.88
NoMa	56.8	2.26	1.10	53.4	0.25
LSD(0.05)	29.78	3.755	1.397	29.88	0.687
Manure rate(MR)					
0 tons	76.2	4.42	1.63	66.2	0.56
5 tons	75.6	4.60	1.82	65.6	0.37
10 tons	72.5	4.59	1.43	64.7	0.99
15 otns	80.6	4.08	1.65	68.1	0.41
LSD(0.05)	31.59	3.983	1.482	31.70	0.728

G.M = Goat manure; P.M= Poultry manureNoMa= No manure; 0T= 0t/ha; 5T= 5t/ha;10T= 10t/ha; 15T= 15t/ha; NS= Not significant at 5% probability level.

Table 5. Interaction Effect of Organic Manure (poultry and goat) on Yield Parameters

MT.MR	Fresh fodder wt.	No of pods	Fresh pod weight	Dry fodder wt.	Dry pod weight
0 tons	56.8	2.26	1.10	53.4	0.25
5 tons	86.4	4.00	1.49	75.2	0.00
10 tons	73.7	3.78	0.78	66.0	0.69
15 tons	90.1	5.89	2.55	81.7	0.33
LSD (0.05)	36.48	4.599	1.711	36.60	0.841

MT.MR = Manure type.manure rate; 0T= 0t/ha;5T= 5t/ha; 10T= 10t/ha; 15T= 15t/ha; NS= Not significant at 5% probability level .

DISCUSSION

This study investigated the effect of different manure types and rates on the vegetative growth and yield of Bambara Groundnut. The application of different manure types and rate generally did not improve the growth of Bambara groundnut but influenced the yield parameters and this supports the research conducted by Kauossi and Zorobi, (2011), who indicated in their research that goat manure had no impact on Bambara groundnut growth and yield which has been discussed in studies focusing on the nutrient management and fertilizer effects on Bambara groundnut. Contrary to expectations, the study found that the application of goat manure did not significantly enhance the growth parameters such as plant height, leaf area, and biomass accumulation of Bambara groundnut plants.. Research on Bambara groundnut cultivation suggests that poultry manure, while beneficial for other crops, has shown limited or inconsistent effects on Bambara groundnut growth and yield. In another study non-significant differences in Bambara groundnut yields across different poultry manure application rates, indicating that it may not strongly influence its productivity (Shiyam *et al*., 2016).

Application of goat manure at rates of 5 and 10 tons per hectare was found to increase the number of pods per plant compared to untreated controls. However, parameters like seed yield and other growth metrics sometimes showed minimal response to goat manure alone. Goat manure also provides a gradual nutrient release, beneficial for crops requiring sustained nutrient levels, but does not uniformly enhance all growth parameters of Bambara groundnut (Shiyam *et al*., 2016; Jaja and Ikechukwu, 2018). It was observed that high application rates of poultry manure could delay pod formation, potentially limiting yield. The variability in manure effects can be due to differences in nutrient composition and soil compatibility, making these

organic inputs less predictable in achieving high yield outcomes for Bambara groundnut alone (Berchie 2012; Jaja and Ikechukwu, 2018). Effa *et al*. (2022) found that the application of goat manure did not significantly impact key yield parameters, although it did improve plant height and leaf number. Similarly, Wamba *et al*. (2012) reported that while poultry manure can enhance some growth metrics, it often does not significantly influence yield factors like pod count and seed weight. The findings of Effa *et al*. (2022) indicated that the application of poultry and goat manure did not yield significant impact on yield parameters such as fodder weight, pod weight, and the overall number of pods produced in Bambara groundnut cultivation, suggesting that these organic fertilizers may not enhance yield potential under the studied conditions.

CONCLUSION AND RECOMMENDATION

In conclusion, the use of poultry and goat manure as organic fertilizers for Bambara groundnut has shown limited effectiveness, particularly regarding yield parameters such as fodder weight, pod weight, and the number of pods produced. Research indicates that while these manures may offer some benefits for plant growth, they do not significantly enhance overall yield under certain conditions. Future studies should explore alternative fertilization strategies to optimize the cultivation of Bambara groundnut and address nutrient deficiencies in low-fertility soils.

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