Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.13, No.7, 2023

Response of Bambaranut (Vigna Subterranea) to Bio-Slury and Posphorus Fertilizer in Naka, Gwer West Local Goverment Area of Benue State, Nigeria

TER, S.T[1]* ECHE, O[2] OLAJUNTI, O. F[1]
1. Department of Soil Science, Federal University of Agriculture,
P.M.B.2373,Makurdi, Nigeria
2. Department of Plant Breeding and Seed Science, Federal University of Agriculture,
P.M.B.2373, Makurdi, Nigeria
E-mail: terterhide@gmail.com

Abstract
Animal waste is an important nutrient resource necessary to optimized crop yield in many sub-Saharan countries leading to increase in food security. This is mainly because manure improves soil texture, water holding capacity, increases soil nutrients supply and ultimately increase crop yield per unit area of land. However, there is scanty information on the use of bio-slurry as a nutrient source for cultivation of bambaranut. Therefore, a field trial was conducted in 2021 to evaluate the effect of bio-slurry and phosphorus on the yield parameters of bambaranut. The experiment consisted of four (4) levels of bio-slurry (0, 2.5, 5.0 and 7.0) t/ha and three (3) levels of phosphate fertilizer (SSP) at (0, 50 and 100) Kg/ha. The experiment was laid in Randomised Complete Block Design in three (3) replications. The result of the trial indicated that yield (702.5 kg/ha) obtained from applications of bio-slurry at 7.0 t/ha plus SSP at 50 kg/ha was statistically the same with yield (712.1 kg/ha) obtained from SSP at 100 kg/ha. Though combined application of bio-slurry and SSP at all levels gave higher yields compare to sole application of either bio-slurry or SSP, this had no statistical difference. It was inferred that incorporation of bio-slurry could possibly reduce the quantity of mineral fertilizers required for cultivation of the bambaranut. The use bio-slurry plus fortified with phosphate fertilizer should be encourage in bambaranut cultivation in the study area.
Keywords: Manure, pH, organic matter and nutrients
DOI: 10.7176/JBAH/13-7-02
Publication date: May 31st 2023

1.0 INTRODUCTION

Bambaranut is an important crop which supplies protein need of many smallholder farmers in many developing countries in sub-Saharan region. The crop is an indigenous African legume and can be grown on relatively low fertile soils where other crops have failed (Temegne et al.,2018a). Bambara nut even though is one of the most neglected crops it is the third most consumed legumes in Africa after groundnuts and cowpea (Gulzar and Minnar 2016). The proximate composition analysis indicates that bambaranut contains 5.50–6.00% fat, 17–27% protein, 2.80–4.40% ash, 3.30–4.40% crude fiber, 60–63% carbohydrate (Olanipekun et al.,2012). A study by Oyeyinka et al. (2018) indicates that amino acids and micronutrients composition of bambara nut can be compared to the composition of amino acids and micronutrients in soybean. There are varying ways in which bambara nut is utilize among communities in the sub-Saharan countries. For instance, the seeds can be processed into flour and used as ingredients for several traditional foods. Also, the seeds can be processed into milk (Arise et al., 2019; Olatunde et al., 2020).

The capacity of the soil to supply essential nutrients is often enhanced by inorganic fertilizers, which contribute directly to higher crop yield potential with negative consequences on the soil environment (Faheed et al.,2008;Harvelin et al.,2014; Reddy, 2016). Inorganic fertilizer as farm input may cause accumulation of heavy metals in the crop system and has deleterious effects on soil physical properties; depletes soil organic matter, leached soil nutrients and cause soil acidification (Chibueze et al., 2013 and Adediran et al.,2014). There exist economic factors that limit continuous use of chemical fertilizers as farm input; the rising cost of inorganic restricts the use of the commodity by most smallholders' farmers in sub Saharan countries. Combination of mineral fertilizers and organic manure is viewed by researchers as a technique that can reduce challenges inherent with mineral fertilizer yet increase yield out put on sustainable bases at low cost to the farmer.

The use of manure in crop farming provides reliable alternative to inorganic fertilizer. Several studies indicates that manure contributes to soil rehabilitation by addition of organic matter, improves soil structure, increase water holding capacity and buffers changes in soil pH (Antil and Singh, 2007; Fageria,2012; Jarvan et al., 2017). Following Government's initiative on pig production, many smallholder farmers have embraced pig farming, in which several tones of bio-slurry is been generated. There is little knowledge on the use of bio-slurry to enhance soil fertility as a consequence most farmers do not necessarily incorporate the slurry in crop

production. Therefore, this study was carried out to evaluate the influence of bio-slurry and phosphorus (SSP) fertilizer on the yield parameters of bambaranut in Southern Guinea savannah.

2.0 MATERIALS AND METHODS

2.1 Study location and description

The study was conducted on a farmer's field under rain-fed conditions in Gwer -West local Government. The town is located within the Southern Guinea Savanna Agro- Ecological Zone of Nigeria on the coordinates 7°37'55.60" N 8°12'59.62" E . The area has two distinct seasons; wet and dry with mean annual rainfall of 1250 mm and mean temperature of 32^0C. The area of land has been under continuous cultivation of sorghum and sesame.

2.2 Experimental Treatments and Design

The treatments were;

i. Control
ii. 2.5t/ha BS
iii. 5.0t/ha BS
iv. 7.0t/ha BS
v. 50kg/ha SSP
vi. 100kg/ha SSP
vii. 2.5t/ha BS + 50 kg/ha SSP
viii. 5.0t/ha BS + 50 kg/ha SSP
ix. 7.0t/ha BS + 50 kg/ha SSP

These treatments were laid in Randomized Complete Block Design (RCBD) in three replications.

2.3 land preparation

Land clearing was done manually using cutlass and hoe. The plot size was 3m by 3m with a distance of 1m between the plots

2.4 Chemical analysis of bio-slurry

The bio-slurry which was pig-slurry sample was obtained from oracle farms limited located in Makurdi. About 500g bio-slurry sample was taken to the laboratory for nutrient content analysis. The sample was air dried grounded and pass through 2 mm sieve The total nitrogen (N), available phosphorus (P), exchangeable bases (Ca, Mg, K and Na) soil pH, organic matter (OM) content were estimated according to the laboratory procedure outlined by IITA (1982).

2.5 Treatment application and sowing of crop

The bio-slurry and SSP fertilizer were applied in accordance to the treatments during seedbed preparation. This was proceeded by sowing after 7days of fertilizer application, on the 17th August, 2021. The spacing was 45cm by 45cm; two seeds were sown per hole and later thinned to one after crop emergence.

2.6 Data collection and statistical analysis

The data on dry seed yield (kg/ha), number of pods per plant and weight of seed per plant were determined at harvest. These crop data were subjected to analysis of variance (ANOVA) and the means that were statistically different were separated using Fisher's least significant difference (F-LSD) at 5% level of probability (Obi, 2001).

3.0 RESULTS

3.1 Chemical composition of bio-slurry

The chemical composition of bio-slurry is presented in Table 1. The soil pH was slightly alkaline 7.64, organic matter content was 16.01%, and the concentrations of nitrogen and phosphorus were 0. 62 % and 165.2 ppm respectively. The exchangeable cations were; K (10.15 cmol/kg), Ca (50.81 cmol/kg), Mg (1.53 cmol/kg), Na (0.78 cmol/kg). It could be deduced from the result of chemical analysis that bio-slurry had relative high concentrations of essential nutrient elements necessary for growth and yield of crop.

Table 1: Chemical composition of bio-slurry

Parameters	pH	OM (%)	N (%)	P (ppm)	Exchangeable cations (cmol/kg)			
					K	Ca	Mg	Na
Value	7.64	16.01	0.62	165.2	10.1	50.81	1.53	0.78

cmol/kg: cent mole of cation, ppm: parts per million

3.2 Effect of bio-slurry and mineral fertilizer on the yield parameters and seed weight of bambaranut

3.2.1 Number of pods per plant

Pods yield was significantly ($p<0.05$) affected by bio-slurry and mineral fertilizer application (Table 2). The highest number of pod yield per plant (45) was obtained from the mixture of bio-slurry at 7.0 t/ha plus 50 kg/ha of mineral fertilizer. The lowest number of pod yield (18) was obtained from non fertilizer treatments which suggest that bambaranut like other leguminous plant requires soil nutrients for optimal yield. There was no statistical difference between applying mineral fertilizer at 100kg/ha, and application of mineral fertilizer at 50 kg/ha plus bio-slurry at 7.0 t/ha. This suggests that addition of bio-slurry as a plant nutrient source could minimize the quantity of mineral fertilizer required by the plant. This result agrees with Shiyam et al. (2016) working in coastal rainforest zone of south eastern Nigeria reported that pod yield was significantly affected by fertilizer treatments at varying rates.

Table 2: Effect of treatment on number of pods yield per plant

Treatment	Value
Control	*17a*
2.5t/ha BS	17a
5.0 t/ha BS	23ab
7.0 t/ha BS	27b
50 kg/ha SSP	38bc
100 kg/ha SSP	42c
2.5 t/ha BS + 50 kg/ha SSP	*38bc*
5.0 t/ha BS + 50 kg/ha SSP	38bc
7.0 t/ha BS + 50kg/ha SSP	42c
LSD ($p<0.05$)	6.1

BS-bio-slurry, SSP-single supper phosphate, mean bearing the same alphabet are statistically the same

3.2.2 Seed weight per plant

The weight of seeds per plant was significantly influenced by fertilizer application (Table 3). The mixture of bio-slurry and mineral fertilizer gave the highest seed weight at all levels of the mixture compared to sole application of mineral fertilizer even though there was no significant difference between seed weight obtained from sole application of mineral fertilizer and seed weight of plants obtained from bio-slurry plus mineral fertilizer at all levels of mixture . The highest seed weight (52.5kg/ha) was obtained at the mixture of bio-slurry at 7.0 t/ha plus 50kg/ha of mineral fertilizer. Non fertilizer (control) treatment gave the lowest seed weight (32 kg/ha) per plant, which was statistically the same with seed weight obtained from manure at 2.5, 5.0 and 7.0 t/ha. Sole application of mineral fertilizer at 100kg/ha gave seed weight statistically the same with bio-slurry plus mineral fertilizer at all levels. This result agrees with Berchie et al. (2010) and Shiyam et al. (2016) who reported that seed weight of bambaranut was significantly affected by oganomineral fertilizer.

Table 3: Effect of treatment on seed weight per plant

Treatment	Value (g)
Control	*32a*
2.5t/ha BS	32a
5.0 t/ha BS	32.7a
7.0 t/ha BS	35.1a
50 kg/ha SSP	48b
100 kg/ha SSP	52.1c
2.5 t/ha BS + 50 kg/ha SSP	*49.7bc*
5.0 t/ha BS + 50 kg/ha SSP	52c
7.0 t/ha BS + 50kg/ha SSP	52.5c
LSD ($p<0.05$)	3.10

LSD -BS-bio-slurry, SSP-single supper phosphate, mean bearing the same alphabet are statistically the same

3.2.3 Seed yield per hectare

The seed yield of bambaranut was influenced by bio-slurry and mineral fertilizer as can be observed in Table 4. Control treatment had the lowest seed yield per hectare (617.9 kg/ha). Even though higher seed yield per hectare were obtained from sole manure treatments compared to control, there was no statistical difference ($p>0.05$) between seed yield obtained from control treatment and sole application of manure at all level. The highest seed yield per hectare was obtained from sole application of mineral fertilizer at 100kg/ha (712.1kg/ha) but was statistical the same with yield obtained from application of bio-slurry at 5.0t/ha plus mineral fertilizer at 50kg

and yield obtained from bio-slurry application plus mineral fertilizer at 7.0 t/ha and 50 kg/ha. This result agrees with Wamba et al.2012 who reported that seed yield of bambaranut was significantly improved by fertilizer application. The influence of manure and mineral fertilizer on crop yield has been widely reported (Nweke and Emeh,2013; Anetor and Emueti,2014).

Table: 4 Effect of treatment on seed weight per hectare

Treatment	Value (kg/ha)
Control	*617.9a*
2.5t/ha BS	619.3ab
5.0 t/ha BS	622.7abc
7.0 t/ha BS	635.1bc
50 kg/ha SSP	638c
100 kg/ha SSP	712.1e
2.5 t/ha BS + 50 kg/ha SSP	*679.7d*
5.0 t/ha BS + 50 kg/ha SSP	688.3d
7.0 t/ha BS + 50kg/ha SSP	702.5e
LSD (p<0.05)	17.03

LSD -BS-bio-slurry, SSP-single supper phosphate, mean bearing the same alphabet are statistically the same

4.0 Conclusion

The application of bio-slurry and a nutrient source significantly influence crop yield either as sole nutrient source or plus mineral fertilizer. Also, the quantities of mineral fertilizer necessary for optimal crop yield could be minimized with the addition of bio-slurry as fertilizer. Therefore, bio-slurry plus mineral fertilizer is recommended for cultivation of bambaranut in the study area.

References

Adediran JA, Taiwo IB, Sobulo RA (2014) Comparative Nutrients Level of Some Solid Organic Wastes and their Effect on Tomato (Lycopersicum esculentus) Yield. African Soils. 33: 100-113).

Anetor, MO & Omueti, JAI (2014). Organomineral fertilizer in some Phosphorus-unresponsive soils of southwestern Nigeria : 1. Effects on maize growth response and soil properties. Agriculture and Biology Journal of North America, 5 (6): 265 – 280

Antil SR, Singh M (2007). Effects of organic manures and fertilizers on organic matter and nutrients status of the soil. Archives of Agronomy Soil Science. 53(5):519-528.

Arise AK, Akintayo OO, Dauda AO Adeleke BA (2019) Chemical, functional and sensory qualities of Abari (Maize-Based Pudding). Nutritionally Improved with Bambara Groundnut (Vigna subterranea). Ife Journal of Science 21(1)

Berchie, JN., Opoku,M., Adu-Dapaah,H., Agyemang, A., Asare, E., Sarcodie-Addo, SA & Addo, JK (2012). Evaluation of five Bambara groundnut (*Vigna subterranea* (L.) Verdc.) landraces to heat and drought stress at Tono-Navrongo, Upper East Region of Ghana. African Journal of Agricultural Research 7(2): 250-256.

Chibueze, U. Dickson, O & Chinwendu, S (2013). Heavy metal contents of inorganic and organic fertilizers commonly used in Southeast Nigeria. An Open Agriculture, Science, Technology, 1, 1-9.

Fageria NK (2012) Role of soil organic matter in maintaining sustainability of cropping systems. Communications in Soil Science and Plant Analysis, 43: 2063–2113. https://doi.org/10.1080/00103624.2012.697234

Faheed, F., and Abd-El Fattah, Z. (2008) Effect of Chlorella vulgaris as Bio-fertilizer on Growth Parameters and Metabolic Aspects of Lettuce Plant. Journal of Agriculture Soc. Science. 4: 165-169.

Gulzar M, Minnaar A (2016) Underutilized protein resources from African legumes. In: Nadathur SR, Wanasundara JPD, Scanlin L (eds) Sustainable protein sources. Academic, London, pp 197–205. https://doi.org/10.1016/B978- 0- 12- 802778- 3.00012- 3

Havlin, JL., Tisdale, SL., Nelson WL and Beaton, JD (2014). Soil Fertility and Fertilizers: An Introduction to Nutrient Management. 8thEd. Pearson Prentice Hall. New Jersey.JumakPublishers, Ringroad, Ibadan

IITA (International Institute for Tropical Agriculture) (1982). Automated and semi-automated methods for soil and plant analysis. Manual Series No.7. IITA, Ibadan, Nigeria

Järvan M., Vettik R., Adamson A. (2017). Assessment of plant nutrients' dynamics in organically and conventionally managed soils by means of different extraction methods. Acta Agriculturae Scandinavica, Section B: Soil and Plant Science, 67 (3): 191–201

Nweke, IA & Emeh,H.O (2013). The response of Bambara groundnut (*Vigna subterranea* (L.)Verdc.) to

phosphate fertilizer levels in Igbariam South East Nigeria. IOSR Journal of Agriculture & Veterinary Science. 2(1): 28-34.

Obi, UI (2001). Introduction to Factorial Experiment for Agricultural, Biological and Social Science Research. 2nd ed. Optimal Computer solution Ltd. Enugu, Nigeria 63-75

Olanipekun, BF., Otunola, ET., Adejuyitan, JA & Adeyanju, JA (2012) Proximate and fatty composition of bambara groundnut (Voandzeia subterranean (L.) Thouars) as influenced by fermentation with a combination of Rhizopus oligosporus and R. nigricans. Transnational Journal of Science and Technology, 2 (9): 77 – 87

Olatunde,SJ., Opeolu,M.,Ogundele,J., Chiemela EC, Taofik AS & Onoja,V (2020). Traditional Food Uses of Bambara Groundnut. In Oyeyinka, SA.,Ade-Omowaye, BIO (eds.), Food and Potential Industrial Applications of Bambara Groundnut, https://doi.org/10.1007/978-3-030-73920-1_9

Oyeyinka SA, Tijani TS, Oyeyinka AT, Arise AK, Balogun MA, Kolawole FL, Joseph JK (2018) Value added snacks produced from Bambara groundnut (Vigna subterranea) paste or flour. LWT-Food Science Technology 88:126–131

Reddy, RS (2016).Principles of Agronomy.5th Edition.Kalyani Publishers, New Delhi, India

Shiyam, JO., Nkor, NN., Binang, WB & Effa, EB (2016) Yield Response of Bambara Groundnut(Voandzeia subterrenea (L) Thours.) Varieties to Organomineral Fertilizer in the Coastal Forest of Southeastern Nigeria. SCIREA Journal of Agriculture. Vol.1:1. pg91-106 http://www.scirea.org/journal/Agriculture

Temegne, NC., Gouertoumbo,WT., Wakem,GA.,. Nkou, FTD., Youmbi,E., Ntsomboh,G (2018a). Origin and Ecology of Bambara Groundnut (*Vigna subterranea* (L.)Verdc: A Review. Journal of Ecology Natural Resource 2(4):000140

Wamba, OF., Taffouo,VD.,Youmbi, E., Ngwene,B & Amougou, A (2012). Effects of organic and inorganic nutrient source on growth, total and yield of three bambara groundnut (*Vigna subterranea* (L.) Verdc.) Landraces in the coastal region of Cameroon. Journal of Agronomy. 11(2): 31-42.