



RESEARCH PAPER

Liquid Poultry fertilizer (Manure Tea) for the Growth and Yield Enhancement of Okra Varieties in Southern Guinea Savanna, Nigeria

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ABSTRACT

Field experiment were conducted in 2018 and 2019 cropping season at Ibrahim Badamasi Babangida University, Teaching and Research Farm (Latitude 09 02" N and Longitude 06 34" E) to evaluate the method of liquid poultry manure application methods on the performance of okra varieties in Southern Guinea Savanna, Ecology of Nigeria. The experiments were arranged in Randomized Complete Block Design, consisting of three levels of liquid poultry manure application method (Control, foliar application and soil application) using two varieties of okra (NHAe 47-4 and Climpson spineless varieties). Data collected include okra height/plant, number of leaves/plants, and number of branches/plants were taken from three (3) randomly selected tagged plants from each plot at 4, 8 and 12 after planting (WAP) and yield parameter such as number of pods per plant and pod diameter, (cm), okra fruit weight/ plant (g) and cumulative yield of okra tones/ha. The result obtained indicated that foliar application of poultry tea (manure) significantly supported taller okra height, higher number of leaves and branches/plant, higher number of pods, longer pod diameter, okra weight/plant and higher cumulative yield at $P < 0.05$ in the Southern Guinea Savanna. Also, Climpson spineless variety of okra significantly supported better on all parameters evaluated when compared with NHAe 47-4 variety. Therefore, foliar application of liquid poultry manure with the use of Climpson variety of okra is recommended for the Southern Guinea Savanna Ecology of Nigeria.

Keywords: Application methods, Climpson spineless, Foliar, Liquid poultry manure, Okra

INTRODUCTION

Okra (*Abelmoschus esculentus*L) is an important vegetable in the tropic and subtropics. This is because of its nutritive values that are present in the leaves and fruits (Akintoye *et al.*, 2011). The fresh fruits are very rich in vitamin A and C, carbohydrate, calcium, potassium, iron, magnesium, zinc and other minerals which are often lacking in the diet of people. Medicinally okra plant is used for the treatment of pepticulcer, and a source of plasma replacement in man's body fluid. The seeds of Okra are normally sown at depths of 5–6 cm; Economic importance of okra cannot be overemphasized. Okra contains carbohydrates, protein and vitamin c in large quantities (Abou EL-Magd *et al.* 2006). Young immature okra fruit are important fruit vegetable that can be consumed in different forms. They could be boiled fry or cooked.

The intensive use of inorganic fertilizers have been reported to have negative impact on

environment, crops and depleted the soil health and fertility over the time (Adediran *et al.*, 2004; Nishio, 2012), in addition to the loss of farmers profitability because of its costs. In this regard, many researchers believe that chemical fertilizers could be substituted partially or totally by organic fertilizers, this is to reduce the dependence on hazardous agro-chemicals which can completely destroy the agro-ecosystems without serious impact on crop yields (Dauda *et al.*, 2008). Available evidences showed that application of organic fertilizers improves soil physical, chemical (Lakhdar *et al.*, 2008) and biological characteristics (Hawke and Summers, 2006; Alababan *et al.*, 2009) which positively enhanced plant growth and productivity as well as maintenance of soil fertility.

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Amongst the organic fertilizers, poultry manure is highly preferred due to its high organic matter content, concentration of plant macro and micro nutrients in available form easy to uptake by the plant as well as its availability throughout the year in significant amounts and cheaper than soil applied fertilizers. Poultry manure if applied with sufficient quantity could be covered the plant nutrient requirements (Amanullah *et al.*, 2007). Poultry manure could be applied as a solid organic fertilizer, mixed and incorporated into the soil directly or as a liquid organic fertilizer (manure tea and compost leachate), manure tea could be applied to the soil via irrigation system (fertigation) or as soil drench and/or to the plant foliage via foliar spraying (ROU, 2007).

Liquid manure (Manure tea) is the product of the livestock manure being steeped in a bag submerged in water. This tea is used for the fertilization of crops. This serves as an organic alternative to chemical fertilizers and is a more sustainable practice of fertilization (Wikipedia, 2019). It was also reported that plants absorbed liquid organic manure applied foliarily 20 times faster than the applied through the soil, in addition to the ability of liquid manure to help plants overcome temporary nutrient deficiencies (Jayasundara *et al.*, 2016). Foliar application of manure stimulates plant growth whenever the nutrient uptake through the roots is stopped as a result of any injury or root damages or infections (Smoleń 2012).

Crops varieties respond differently to a range of agronomic management practices (Makinde and Bello (2009) and Abdulmalik *et al.*, (2019). Several varieties of okra are available in Southern Guinea Savanna Ecology of Nigeria with different responses to environmental condition, agronomic practices and nutritional management and methods of its application adopted for their growth and yield. Thus, it is imperative to evaluate the response of okra varieties to different nutritional application methods.

Varieties of okra have been evaluated for different agronomic practices; however, there is paucity of information on the effects of liquid fertilizer application methods on the growth and yield of okra in the Southern Guinea Savanna Ecology of Nigeria. Thus, the objective of this study is to evaluate the effect of liquid poultry manure liquid fertilizer (manure tea) for the

growth and yield enhancement of okra varieties in the Southern Guinea Savanna.

METHODOLOGY

The experiment was conducted at the Teaching and Research Farm, IBB University, Lapai on latitude 09 02" N and Longitude 06 34" E. The area is located in the Southern Guinea Savanna Agro ecological zone of Nigeria. It has an average rainfall of about 23-34.4mm and minimum rainfall of 107.3mm.

The experiments were laid in a 3 x 2 factorial in a Randomized Complete Block Design (RCBD), consisting of three levels of liquid poultry manure methods of application (soil application, foliar application and control) and two varieties of okra (Climpson spineless and NHAe 47- 4 varieties) replicated three times.

The organic fertilizer (poultry manure) used for the study was collected from Animal Research Farm of the University (IBBUL). The liquid poultry manure was prepared using modified method of Peiris and Weerakkody (2015) a week before application using 1:3 ratio of poultry manure to water, (weight/volume). A total of 20g partly dried poultry manure was weighed and packed in a permeable sack weekly. The tea-bag (the sac) was securely tightened and immersed in a 60 litre of water. The bucket was covered with the lid to discourage flies and other contaminants. The liquid was manually agitated twice a day to ensure proper mixture and filtration before application. The liquid poultry manure were applied one in a week from the second week to the end of the 10 week after planting at 20,000 litre/hactare. Okra seed planted were sauced from the vendors in Minna Niger State Capital.

Agronomy practices

The site selected for the experiment was cleared using tractor mounted plough and harrow and ridged a week later. Two (2) seeds were planted per hole at 40cm intra row spacing. Weeding was done twice at 3 and 6 weeks after planting (WAP) manually. Thereafter any emerged weed found were hand pulled. Pests and diseases were controlled using neem seed oil, emulsified using soap and water.

Parameters Evaluated:

Growth parameters such as okra height/plant, number of leaves/plant, and number of

branches/plant were taken from five (3) randomly selected tagged plants from each plot at 4, 8 and 12 after planting (WAP), also, yield parameters, number of pod/ plant and pod diameter/plant, (cm) and pod weight/plant (g) and cumulative pod yield/ha (tonnes) were also taken from the tagged plants.

Data collected were subjected to analysis of variance (ANOVA) and partitioned using least significant difference (LSD) at 5% probability level.

RESULTS AND DISCUSSION

The physico-chemical properties of the soil from the experimental sites, poultry manure and liquid poultry manure used in the 2018 and 2019 cropping seasons were hereby presented in Table 1. The soil was sandy loamy and slightly acidic. It also contained low organic carbon, low total nitrogen and low exchangeable Mg as compared to liquid poultry manure. With the exception of exchangeable K of the soil sample, the

exchangeable Ca, Mg and P of the two samples were adequate.

Table 2. showed the effect of liquid poultry manure (manure tea) methods of application on the okra plant height/plant at Lapai, Southern Guinea Savanna in 2018 and 2019 cropping seasons. The result indicated that at 4, 8 and 12 weeks after planting (WAP), the foliar application was significantly produced taller okra plant in the 2018 and 2019 cropping seasons WAP, which was significantly different from soil application and the control at $P \leq 0.05$ in the two cropping season. The least okra height was obtained from the control. The varieties effects on the okra height were significantly different. Climpson spineless variety of okra significantly produced taller okra when compared with NHAe 47-4 variety. The interaction of application methods and variety were not significantly different.

Table 1. Physico- chemical analysis of the Experimental Field Soil, poultry manure and Liquid Poultry manure

Sample Description	2018	2019	2018	2019	2018	2019
	Soil		Poultry Manure		Liquid manure	Poultry (Manure Tea)
pH (H ₂ O)	6.8	6.58	5.86	5.89	6.02	6.05
Organic Carbon (%)	0.77	0.77	1.32	1.45		
Organic Matter (%)	1.33	1.28	1.42	1.55		
Total N (%)	0.16	0.15	3.14	3.15	2.84	2.95
Available P (ppm)	25.98	20.95	16.54	17.55	23.23	24.85
Na (cmolKg ⁻¹)	0.15	0.8	0.36	0.45	0.21	0.25
Potassium (cmolKg ⁻¹)	0.05	0.08	1.36	1.52	0.33	0.35
Calcium (cmolKg ⁻¹)	2.8	2.75	2.32	2.85	3.28	3.45
Magnesium (cmolKg ⁻¹)	3.28	3.45	7.02	6.95	6.77	6.55
Exchangeable Acid (CmolKg ⁻¹)	0.44	0.43	0.53	0.58		
CEC (CmolKg ⁻¹)	6.72	6.5	6.25	7.15		
Sulphur (ppm)+					0.066	0.064
Zinc (ppm)			0.373	0.385		
Sand (%)	84.4	83.5				
Silt (%)	6.36	6.3				
Clay (%)	9.24	9.2				
Texture	Loamy Sandy	Loamy Sandy				

Table 2: Effect of liquid poultry manure application methods on the plant height of okra varieties in 2018 and 2019 cropping seasons

Methods of Application	Plant Height (cm)					
	4WAP		8WAP		12WAP	
	2018	2019	2018	2019	2018	2019
Control	8.68 ^a	8.52 ^a	17.75 ^c	17.65 ^c	30.20 ^c	28.56 ^c
Foliar Application	9.56 ^a	9.68 ^a	27.31 ^a	27.00 ^a	45.60 ^a	46.25 ^a
Soil Application	9.26 ^a	8.22 ^a	22.70 ^b	22.40 ^b	39.50 ^b	40.55 ^b
LSD _{0.05}	NS	2.232	4.4	4.555	5.55	5.825
Varieties						
Climpson Spineless	12.81 ^a	15.25 ^a	23.10 ^a	25.50 ^a	40.45 ^a	45.35 ^a
NHAe 47-4	10.20 ^b	11.15 ^b	18.74 ^b	19.26 ^b	35.60 ^b	38.20 ^b
LSD _{0.05}	0.8	0.855	4.27	4.555	5.155	5.25

Means followed with same letter(s) are not significantly different at 5% probability level using LS

Table 3. Effect of liquid poultry manure application methods on the Number of Leaves/plant of okra varieties in 2018 and 2019 cropping seasons

Methods of Application	Number of Leaves					
	4WAP		8WAP		12WAP	
	2018	2019	2018	2019	2018	2019
Control	5.25	5.5	13.75 ^c	13.90 ^c	17.20 ^c	20.55 ^c
Foliar Application	5.6	5.9	23.30 ^a	25.45 ^a	33.80 ^a	36.25 ^a
Soil Application	5.3	5.6	18.70 ^b	20.50 ^b	27.55 ^b	30.30 ^b
LSD _{0.05}	NS	NS	4.425	4.55	5.25	5.355
Varieties						
Climpson Spineless	5.96 ^a	5.45 ^a	21.10 ^a	22.50 ^a	32.55 ^a	34.20 ^a
NHAe 47-4	4.90 ^b	4.50 ^b	16.74 ^b	15.75 ^b	25.20 ^b	28.80 ^b
LSD _{0.05}	1	1	4.582	4.655	5.35	5.45

Means followed with same letter(s) are not significantly different at 5% probability level using LS

The effect of liquid poultry manure application on the number of okra leaves /plant were significantly differ at 8 and 12WAP. Foliar application of liquid poultry manure significantly supported higher number of leaves which was significantly different from soil application in the two cropping seasons. The least number of leaves was produced by the control treatment. In another vain the climpson spineless okra variety supported higher number of leaves throughout the experimental periods. The interactions between Liquid poultry manure and okra varieties were not significantly in the two cropping seasons as shown in Table 3.

The result of effect of liquid poultry manure application methods on number of branches of okra varieties indicated that the foliar application method produced higher number of branches of okra at 8 and 12 WAP when compared with soil application method. Control produced lesser number of branches of okra $P_{0.5}$ in the two cropping seasons. Also, climpson spineless variety okra produced higher number of branches when compare with NHAe 47-4 variety of okra. The interaction effect was not significant as shown in Table 4. The outcome of the foliar liquid poultry manure application methods was significantly better than soil

application method as well as the control. This increased growth attributes could be as a result of additional and adequate supply of N, P and K through foliar application which might have increased nutrient uptake and better translocation of nutrients. In addition nitrogen being chief constituent of protein and protoplasm has enhanced the synthesis of chlorophyll content of the leaves and cell division thus resulted in more number of leaves. These results are in confirmation with the findings of Anbumani *et al.* (2003)

Table 5 showed the result of effect of liquid poultry manure application methods on the yield and yield components of okra varieties in the Southern Guinea Savanna. The result indicated that the yield and yield components of okra varieties were significantly affected by the liquid poultry fertilizer application methods. Foliar application method of liquid poultry manure significantly produced higher number of okra pods/plant, longer okra pod/ plant (cm) wider diameter of pod/plant (cm), okra weight/plant (g) and higher cumulative yield/ ha (tonnes). These were significantly different from soil application method. The least were produced from the control.

These significant response of yield of foliar application method against the soil application method and the control can be attributed to the

ability of plants to absorb nutrients through the cuticle of the plant leaves or the stomata and then enter the cells facilitating easy and rapid utilization of nutrients. Hence, the crop response occurs in a short time in foliar application compared to soil application. This result is in line with Smoleń, (2012) who observed that foliar application of fertilizers could be considered as one of the most efficient methods of fertilizers application, which used to deliver the needed nutrients to plants in adequate concentrations and improve plant nutritional status as well as increase the crop yield and its quality. It also concurs with Oosterhuis, (1999) who reported that the foliar fertilization has the ability to improve the efficiency and rapidity of utilization of a nutrient urgently required by the plant for maximum growth and yield.

The effects of okra varieties on yield and yield components showed that the climpson varieties produced significantly higher number of okra pods/plant, longer okra pod/ plant (cm) wider diameter of pod/plant (cm), okra weight/plant (g) and higher cumulative yield/ ha (tonnes) when compared with NHAe 47-4 variety $P < 0.05$ in the 2018 and 2019 cropping seasons in the Southern Guinea Savanna Ecological zone. This could be as a result of the fact that climpson spineless variety is an hybrid okra variety newly introduced.

Table 4: Effect of liquid poultry manure application methods on the Number of branches/plant of okra varieties in 2018 and 2019 cropping season

Methods of Application	Number of Branches/plant					
	4WAP		8WAP		12WAP	
	2018	2019	2018	2019	2018	2019
Control	5.25	5.20	10.45 ^b	9.95 ^b	15.50 ^c	16.80 ^c
Foliar Application	5.80	5.60	15.75 ^a	15.80 ^a	25.25 ^a	27.50 ^a
Soil Application	5.60	5.30	11.65 ^b	10.85 ^b	20.20 ^b	21.60 ^b
LSD _{0.05}	NS	NS	3.550	3.755	4.550	4.855
Varieties						
Climpson Spineless	5.45 ^a	5.60 ^a	15.15 ^a	16.25 ^a	25.20 ^a	27.30 ^a
NHAe 47-4	4.35 ^b	4.85 ^b	12.45 ^b	14.20 ^b	20.50 ^b	23.50 ^b
LSD _{0.05}	0.555	0.70	2.030	2.255	4.200	4.800

Means followed with same letter(s) are not significantly different at 5% probability level using LS

Table 5: Effect of Liquid Poultry Manure Application Methods on Fruit Yield Characteristic Okra Varieties.

Methods of Application	Fruit Length (cm)		Fruit Diameter (cm)		Number of Fruit/ Plot		Fruit Weight/Plot (kg)		Cumulative Yield (Tonnes/Ha)	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Control	5.48 ^c	6.30 ^c	3.98 ^c	3.55 ^c	20.50 ^c	21.25 ^c	9.66 ^c	8.65 ^c	0.85 ^b	0.90 ^b
Foliar Application	10.72 ^a	10.55 ^a	7.45 ^a	7.20 ^a	35.00 ^a	32.50 ^a	15.45 ^a	15.20 ^a	1.65 ^a	1.82 ^a
Soil Application	6.65 ^b	8.60 ^b	5.25 ^b	5.30 ^b	25.50 ^b	26.20 ^b	11.88 ^b	12.20 ^a	0.95 ^b	1.15 ^b
LSD _{0.05}	2.15	2.25	1.04	1.1	4.2	4.5	2.58	2.65	0.45	0.55
Varieties										
Climpson	12.97 ^a	11.40 ^a	5.14 ^a	5.20 ^a	29.62 ^a	30.5	9.60 ^a	10.85	1.80 ^a	1.60 ^a
Spineless										
NHae 47-4	7.60 ^b	7.25 ^b	3.32 ^b	3.30 ^b	21.67 ^a	20.46	4.39 ^b	4.5	0.85 ^a	0.75 ^b
LSD _{0.05}	2.18	2.4	1.76	1.4	5.22	5.6	2.78	2.75	0.5	0.55

Means with the same letter(s) are not significantly different at $p < 0.05$ using LSD

Conclusion and Recommendations

Different review studies suggest that liquid organic manures has beneficial effect on growth, yield of crops. Studies have also proved that the foliar application of fertilizer significantly supported better growth and high yield of crops. Therefore, it is advisable to promote the use of liquid fertilizer and be foliarly applied. The practice will not only increase the yield of organic okra only but can also improve growth and yield of other crops with improved soil health. It will make the vegetable crop production system more sustainable in long run. Home scale preparation of different liquid manure and their application should be promoted among the organic growers for large scale adoption of organic crops production.

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