E3 Journal of Environmental Research and Management Vol. 4(3). pp. 0209-0213, April, 2013
Available online http://www.e3journals.org
ISSN 2141-7466 © E3 Journals 2012

Full Length Research Paper

Influence of nutrient amendments of soil quality on germination, growth and yield components of two varieties of okra (*Abelmoschus esculentus* (L.) Moench) sown at University of Uyo botanical garden, Uyo, Akwa Ibom State.

Okon, J. E.[1]*, Mbong, E. O.[1], Ebukanson, G. J.[1] and Uneh, O. H.[1]

[1]Department of Botany and Ecological Studies, University of Uyo, P. M. B. 1017, Uyo. Akwa Ibom State-Nigeria.

Accepted 24 March, 2013

The effects of organic and inorganic amendments of soil quality on germination, growth and fruit yield of two local cultivars of *Abelmoschus esculentus* (L.) Moench was studied under field conditions using perforated polythene bags. The results obtained revealed that both supplements improved the soil properties and caused significant ($P \leq 0.05$) stimulation in germination, growth and fruit yield (number of fruits 8 WAP) in the varieties studied but the stimulation was more with organic supplements. This study suggests the use of organic manure in this area.

Keywords: *Abelmoschus esculentus,* supplements, soil.

INTRODUCTION

Okra (*Abelmoschus esculentus* L. (Moench)) from the plant family Malvaceae, is an important soup condiment in Nigeria and it forms part of the Nigerian curry dishes. It is rich in vitamins, minerals and has several medicinal values as well (Seran *et al*., 2010).

Manure is any material obtained from plants, or animals or its remains, which may be added to the soil to improve its fertility. Manure contributes to the fertility of the soil by adding organic matter and nutrients such as nitrogen to the soil and tends to bind loose soil particles together thus increasing its water retention capacity (Anyanwu and Anyanwu, 1985). The word manure originates from a Greek word “manure” meaning “to cultivate land” and initially from a French word “mainoeuvre” which means “handwork”. There are two main types of manure namely: green manure and animal manure. The former is produced from fresh plant materials and the latter from the excrement/dropping of plant-eating mammals (herbivores) and poultry or from plant materials, which have been used as bedding for animals and so is heavily contaminated with feaces and urine. The process of spreading or incorporating manure is termed manuring (Goldstein, 1991).

Though manure could be used for several purposes, great care should be taken so as to reduce the risk of storing too large a pile of manure, which could also ignite. It should be kept away from insect vectors which may pick germs from manure and deposit them into human food or drinking water, thus contaminating it.Fertilizers are chemical compounds, which occur in pellets, crystals, jellies or less commonly fluids (liquid or gaseous), they are produced from non-living sources and contain specific mineral nutrients combined in a standard ratio, which may be added to the soil to improve its fertility. Based on the composition, fertilizers may be classified as nitrogenous (e.g. ammonium sulphate) or phosphate-based or combined nutrient fertilizer e.g. NPK-fertilizers (Lisk *et al*., 1992). Fertilizers could be very useful in increasing soil nutrient base and by extension, soil fertility but improper or excessive application could be detrimental to plants, pollute soil water bodies and deteriorate the soil structure (Dina *et al.,* 2003).

*Corresponding authors: E-mail: joesplendid@yahoo.com

Table 1: The physiochemical properties of experimental soil sample

Par Parameters	Unpolluted Garden soil	Organic manure (poultry droppings)	Inorganic manure NPK(15:15:15)
pH	6.15	6.81	6.60
Organic matter (%)	1.98	2.86	2.46
Total nitrogen (%)	0.06	0.08	0.09
Available P. (mg/kg)	39.99	41.88	40.10
Ex. Ca (cmol./kg)	3.25	2.82	2.66
Ex. Na (cmol./kg)	0.06	0.04	0.02
Ex. K. (cmol./kg)	0.09	0.18	0.15
Exchange acidity	2.62	2.10	2.30
ECEC (cmol/kg)	7.32	5/43	4.43
Base saturation (%)	64.81	47.02	46.07
Silt (%)	4.00	2.80	2.40
Clay (%)	4.20	3.60	3.20
Ex.Mg (cmol./kg)	1.30	0.89	0.60
Organic carbon	1.16	0.09	0.07
C/Nratio	91.67	98.89	94.69
Particle sizes sand (%)	91.80	94.00	93.80
E.C (Gs/m)	0.068	0.0467	0.0364

It is common knowledge that farmers in our locality use fertilizer and /or manure on gardens with the view of promoting growth in plants regardless of the soil types or the appropriate dose of application. With this in mind, this research seeks to investigate the effect of organic and inorganic amendments of soil properties on the growth and yield components of two varieties of okra.

MATERIALS AND METHODS

Collection of Seeds

Matured seeds of okra was collected from Akwa Ibom State Agricultural Development Project (AKADEP) and the viable seeds were used for the research.

Sources and Collection of Experimental Soil and Supplements

The soil sample used in this experiment was obtained from the Botany Dept. Postgraduate Res. Farm, Univ. of Uyo, Uyo.

The supplements used in this research were poultry droppings and NPK fertilizer (15:15:15). Inorganic supplement (NPK fertilizer) was obtained from Akwa Ibom State Agric. Development Project (AKADEP), Uyo Zone while the organic supplement was obtained from a poultry farm in Uyo Local Government Area of Akwa Ibom State.

Analysis of Soil Samples

The physiochemical properties of the experimental soil of both garden and the amended soil was determined using standard procedures, outlined by the Association of Official Analytical chemist (A.O.A.C. 2005).

Determination of Growth Parameters

The growth parameters such as plant height (shoot length), petiole length, leaf width and leaf length were measured using meter rule (in centimeter); internode number, and percentage germination were also determined when reading data. After harvesting, the plants were uprooted, carefully washed to remove the sand particles with the roots measured.

Determination of leaf area (LA)

Leaf area (LA) was determined by multiplying leaf length by leaf width with the correction co-efficient (r) which is 0.72 as proposed by Hoyt and Bradfield (1962). Leaf Area was calculated thus: $LA = L \times W \times r$.

Statistical Analysis

The data obtained were subjected to two-way analysis of variance (ANOVA) to determine the level of significant using standard methods of Sokal and Rohlf (1995).

RESULTS

Garden Soil

The physiochemical properties of the experimental soil indicated that (Table 1) the sandy loamy soil was rich in available phosphorus, effective cation exchange capacity

Table 2: The mean ± (SD.) effect of organic supplement on the growth of long fruit variety of okra (*Abelmoschus esculentus*) 8 WAP.

Parameters/ concentration (kg)	Plant Height (cm)	Petiole length (cm)	Internodes length	Root length (cm)	Leaf area (cm^2)	Seed germination (%)
0	27.35±0.55	4.52±0.58	2.34±0.79	13.95±1.75	33.64	50
0.5	85.12±6.46	5.92±2.19	6.63±2.85	20.55±1.87	46.04	100
1.0	65.25±2.69	8.96±4.89	5.46±1.78	13.82±10.02	58.80	100
1.5	74.75±0.51	7.46±3.60	6.87±1.76	16.77±8.89	41.13	100
2.0	77.75±4.54	8.6±2.57	5.4±0.69	16.42±3.26	43.62	100

Values represent mean ± standard deviation of three replicates, WAP (weeks after planting).

Table 3: The mean ± (SD.) effect of organic supplement on the growth of short fruit variety of okra (*Abelmoschus esculentus*) 8 WAP.

Parameters/ concentration (kg)	Plant Height (cm)	Petiole length (cm)	Internodes length	Root length (cm)	Leaf area (cm^2)	Seed germination (%)
0	19.5 ±2.00	4.92 ±1.01	3.68±0.86	4.5±0.5	14.35	50
0.5	51.33±1.17	12.16±5.10	4.39±1.53	16.1±1.68	136.00	75
1.0	55.13±1.86	8.01±0.98	5.98±2.88	15.9±2.70	53.58	75
1.5	55 ±18.70	17.19±0.94	4.61±1.28	15.33±.31	168.67	100
2.0	51.5±5.5	11.76±4.91	5.33±0.86	11.15±0.25	109.40	100

Values represent mean ± Standard deviation of three replicates. WAP (weeks after planting).

Table 4: The mean ± (SD.) effect of inorganic supplement on the growth of long fruit variety of okra (*Abelmoschus esculentus*) 8 WAP.

Parameters/ concentration (kg)	Plant Height (cm)	Petiole length (cm)	Internodes length	Root length (cm)	Leaf area (cm^2)	Seed germination (%)
0	28.05±4.05	4.53±0.06	4.18±1.10	11.4±0.00	34.72	75
0.5	65.37±12.00	7.51±1.66	4.41±1.39	10.35±1.33	45.35	100
1.0	69.03±9.46	7.86±1.00	6.94±3.07	9.23±2.39	63.97	100
1.5	78.06±3.59	7.90±2.22	5.40±1.68	14.76±140	77.08	100
2.0	52.66±2.01	7.31±1.66	3.75±1.16	13.6±0.69	70.13	100

Values represent mean ± Standard deviation of three replicates, WAP (weeks after planting).

and had a pH of 6.51, and the organic matter content, exchange capacity, silt, clay, exchange calcium, exchange acidity, exchange magnesium and organic carbon were low; while, total nitrogen, exchange sodium, exchange potassium and electrical conductivity were relatively low.

Effects of amendments on Soil

The amended soil was rich in available phosphorus, and it showed slight stimulation of pH 6.81 with organic supplement and 6.60 with inorganic supplement. The organic matter content increased with both organic and inorganic supplement but exchange calcium, exchange acidity, silt and clay were low in the soil. Also, the total nitrogen content (%), sodium, exchange potassium and electrical conductivity were relatively low (Table 1).

Effects on germination, growth and fruit yield

Percentage germination was reduced (50-75%) in the unamended soil which served as the control but was 80-100% with supplemented soils. The data showed that in both varieties, there was stimulation in plant height, petiole length, internodes length and root length with both supplements when compared with the control (Table 2-5).

Both organic and inorganic amendments had clear influence on some agronomic traits of the two varieties. It is worthy to note that the long fruit variety yielded large fruits much earlier than the short variety. The number of fruits was more in this same variety under the same environmental and experimental conditions (Table 6).

DISCUSSION

Result obtained from this study point out the growth promoting potentials of inorganic, as well as organic manure in *Abelmoschus esculentus.* This indicates that these are factors, which could affect plant productivity. The results show that farmyard manure had the highest growth promoting influence on the yield components of *Abelmoschus esculentus,* while inorganic fertilizer (NPK, 15:15:15) had the least growth promoting influence on the plant. These results agree with the views of Anyanwu and Anyanwu (1985), in that farmyard manure can impact

Table 5: The mean ± (SD.) effect of organic supplement (NPK 15:15:15) on the growth of short fruit variety of okra (*Abelmoschus esculentus*)

Parameters/ concentration (kg)	Plant Height (cm)	Petiole length (cm)	Internodes length	Root length (cm)	Leaf area (cm^2)	Percentage germination (%)
0	16.83±3.47	2.34±0.63	1.87±0.65	6.93±1.06	10.05	50
0.5	36.25±1.25	7.33±3.15	2.88±0.37	7.10±1.90	60.07	75
1.0	50.00±0.00	9.88±6.50	3.78±0.37	10.9±0.00	155.30	75
1.5	33.50±3.50	7.45±2.23	3.16±0.68	11.3±0.60	115.39	75
2.0	45.00±0.00	7.07±1.90	9.73±1.52	14.6±0.00	55.78	75

Values represent mean ± Standard deviation of three replicates, WAP (weeks after planting).

Table 6: Effects of two nutrients application on the fruit number of two variety of okra (*Abelmoschus esculentus*) 8 WAP.

Conc. (kg)	Long variety: organic nutrient (poultry droppings)	Long variety: inorganic nutrient (NPK 15:15:15)	Short variety: organic nutrient (poultry droppings)	Short variety: inorganic nutrient (NPK 15:15:15)
0	-	-	-	-
0.5	2	1	-	-
1.0	3	2	1	-
1.5	4	2	1	-
2.0	5	3	2	1

WAP (weeks after planting).

nitrogen (as ammonium), phosphorus and micro-nutrient that can be used directly by plants. These nutrients have been implicated in the synthesis of chlorophyll and enhancement of foliage growth in plants (Ramlingam, 2003). It is not unlikely that the beddings in the manure could have contributed to its high nitrogen concentration since it absorbed feacal material rich in nitrogenous compounds and minimized loss of N_2 to the atmosphere (Anyanwu and Anyanwu, (1985). This observation indicates that nutrient amendments (especially organic-based) can be used to promote the growth of okra in nutrient limiting soils. This study is in-line with the works of Onuh *et al*. (2008) who reported that polluted and nutrient limiting soils supplemented with organic and inorganic nutrient materials reduced the adverse effect of crude oil to 10%. They therefore concluded that with poultry manure treatment, germination percentage was optimized in maize (100%). Ramligam (2003) endorsed this view, and equally believed that farmyard manure allows soil microorganism to decompose the organic matter available in the soil thus making N_2 to be available most readily to plants.

This study revealed that nutrient supplement significantly improved soil properties (especially organic supplement) and increased the yield and growth performance in both varieties of okra. This work confirms the reports of Haynes and Naidu (1998) that organic manure treatment led to higher growth rate in squash melon as compared to lime and fertilizer applications. This, they attributed to the increase in soil organic matter content, soil total nitrogen, porosity, bulk density, water holding capacity, infiltration capacity and aeration which often accompany the aggregating effect of organic manure on soil structure.

Recently, Odedina *et al*. (2011) while comparing the effects of different organic supplements stated that organic manures (especially that of poultry) contain high quantities of macro-nutrients, like N, K, Ca, P and Mg. Therefore, an organic supplement is expected to improve the availability of these nutrients in soils which are deficient. Its base elements content (K, Ca and Mg) also serve to reduce soil acidity. In their study, poultry manure had highest values of most nutrients. Going by the reports of Ojeniyi and Akanni (2008) which was confirmed by Agbede *et al.* (2008), it is worthy to note that Southern Nigerian soils are usually low in organic matter (OM), N and available P. Therefore, supplementing with inorganic or organic amendments is a good complement for these deficits.

Moyin-Jesu (2007, 2008) also found that poultry manure had the highest concentrations of N, P, K, Ca, Mg, Fe and Cu when compared with turkey and duck manures. Nutrients contained in the organic sources are readily available to crop uptake after they are mineralized and released in the soil (Odedina *et al*. 2011). It is possible that the manure stimulated Okra growth as a result of increased nutrient availability.

This study also showed that okra in soil supplemented with organic manure (poultry droppings) produced better fruits than those in soil with inorganic fertilizer (NPK 15:15:15) Table 6. The slight reduction in growth parameters obtained with inorganic fertilizer (NPK) could be attributed to the leaching and loosening effect, which an inorganic fertilizer leaves on the soil structure. It could equally be linked with a reduction in soil pH that happens to be the major pitfall in sustained use of these fertilizers. This low pH according to Akoroda (1990) can be detrimental to the thriving potentials of plants. Agyenim

et al. (2006) confirmed that poultry manure treatments produce high values for plant heights, leaf area index and biomass. Poultry manure application registered over 58% increase of nitrogen level in the soil, from 0.09%-0.18%, and exchangeable cations increase with increase in manure application. The varieties of Okra used in the study showed stimulation in both growth performance and yield (fruits) above the control.

Conclusion and Recommendation

Generally, high growth parameter values as well as improved soil indices were obtained in the study through the use of both nutrient amendments but specifically, the use of organic manure proved optimal in improving soil status of this area, growth and yield of these varieties of Okra. Under uniform experimental conditions, the long fruit variety proved a better alternative in terms of time of yield, size and number of fruits. From the foregoing, the use of organic manure in this area is recommended.

REFERENCES

Agbede TM, Ojeniyi SO and Adeyemo AJ (2008). Effect of poultry manure on soil physical and chemical properties, growth and grain yield of sorghum in southwest Nigeria. American-Eurasian J. of Sustainable Agriculture 2:72-77.

Agyenim SB, Zickerman J and Kornahrens M (2006). Poultry manure effect on growth and yield of Maize. West African J. Applied Ecology 9:1-11.

Akoroda MO (1990). Ethnobotany of *Abelmoschus Esculentus.* Among Igbos of Nigeria. Economic Botany 44 (1): 21-39.

Anyanwu AC And Anyanwu VA (1985). Introduction to Agricultural Science in Post-Primary Schools. Afrian Educational Pub. Ibadan. p. 205.

AOAC (2005). Official Methods of Analysis of the Association of Official's Analytical Chemists, (17th edn.) Arlington, Virginia. pp. 96-105.

Dina OA, Adedapo A, Oyinloye OP and Saba AB (2003). Effects of *Telfairia occidentalis* extracts on rabbits. African J. of Biomedical Research 3(3): 181-183.

Goldstein N (1991). Composting of organic materials. Bio. Cyc. 2:31-34.

Haynes RJ and Naidu R (1998). Influence of lime, fertilizer and manure applications on soil organic matter content and soil physical conditions. Soil and tillage Res. 19: 77-87.

Hoyt P and Bradfield R (1962). "Effect of varying leaf area by defoliation and plant density on dry matter production on corn. Agronomy J. 54: 523-525.

Lisk DJ, Gutenmann WH, Rutzke M, Kuntz, HT and Chu G (1992). Toxic materials in the soil. Arch. Environ. Contam. Toxicol. 22:190-194.

Moyin-Jesu EI (2007). Effect of some organic fertilizers on soil and coffee leaf chemical composition and growth. University of Khartoum J. of Agric. Sci. 15(1):52-70.

Moyin-Jesu EI (2008). Comparative evaluation of different organic fertilizers on soil fertility, leaf minerals composition and growth performance of dikanut seedlings (*Irvingia gabonensis,* L.*)*. Emirate J. of Food and Agric. 20(2):1-9.

Ojeniyi SO and Akanni DI (2008). Effect of animal manures on soil properties, leaf nutrient composition, growth and yield of pepper *(Capsicum annum).* J. of Res. in Agric. 5(4):86-90.

Onuh MO, Madueke OK and Ohia GU (2008). Effect of poultry Manure and cow dung on physical and chemical properties of crude oil polluted soil. J. Environ. Sci. 18(26):228-236.

Ramlingam RS (2003). Modern Biology For Senior Secondary Schools. Tyndall Publishers, Ibadan: pp. 167-198.

Seran TH, Srikrishnah S and Ahamed MMZ (2010). Effect of different levels of inorganic fertilizers and compost as basal application on the growth and yield of some food crops. The J. of Agric. Sci. 5(2):64-70.

Sokal RR and Rohlf FJ (1995). Biometry, New York: Colt Freeman Company. p. 887.