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Effect of Different Types of Manure and Chemical Fertilizer on Growth and Development of Okra (*Abelmoschus esculentus L*)

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Abstract

The response of manures and chemical fertilizer toward the growth and development of crops was x-ray in this investigation. Poultry and compost manure not only feed many nutrients for crop production, but also they increase soil moisture content and lower soil bulk density on the other way. The pots experiment comprised 40 earthen pots with ten replications. The experiment was conducted at the net house area of tractor shed National Centre for Agriculture Mechanization in a complete randomized block design, to examine and compare growth parameters of okra seedlings in the treatments. The growth parameters of crops were statistically different from each other in the experimental design. In Poultry manure higher mean values for shoot length (27.50), crop yield weight (33.07) and leaf area (38.44) were recorded except at crop yield number which was overruled out at crop yield weight aggregate which captured at confidence Interval for Mean 26.58±4.17, 14.45±26.51 and 25.21±38.96 for poultry manure, compost manure and chemical fertilizer (NPK) respectively. Poultry manure application registered over 21% increases of N levels in the soil, from 0.12% to 2.57%. Exchangeable cations increased with the rate of manures application.

Keywords

Poultry Manure, Compost Manure, NPK, *Abelmoschus esculentus L*

1. Introduction

Consistence of Soil productivity maintenance is a major constraint of tropical agriculture system. Crop rotation is usually done for some years without use of fertilizers aim at enhance agricultural products. However, this cannot be sustained for long to meet increased demand of agricultural products due to increase population. Tropical soils are adversely affected by sub-optimal soil fertility and erosion, causing deterioration of the nutrient status and changes in soil organism populations [1].

Animal manure has been used as a source of local fertilizer in many countries across the globe. Proper use of manure and compost is essential for both a production and environmental standpoint. Applying rates that are too low and improper application can lead to nutrient deficiency and low yields. On the other hand, too high a rate can lead to nitrate leaching, phosphorus runoff, accelerated eutrophication of lakes, and excessive vegetative growth of some crops. Nutrients contained in manures are released more slowly and are stored for a longer time in the soil ensuring longer residual effects, improved root development and higher crop yields [2] and [3].

Manures are usually applied at higher rates, relative to inorganic fertilizers. When applied at higher rates, they give residual effects on the growth and yield of succeeding crops [4]. Improvements of environmental conditions as well as the

need to reduce cost of fertilizing crops are reasons for advocating use of organic materials [5]. Organic manures improve soil fertility by activating soil microbial biomass [6]. Application of manures sustains cropping system through better nutrient recycling [7]. Manures provide a source of all necessary macro- and micro nutrients in available forms, thereby improving the physical and biological properties of the soil [8].

Many workers have carried out experiments on the importance of organic manures in crop production. Reference [9] reported that the use of poultry, plant and sheep/goat manures improved all the growth parameters of the leafy vegetable they worked with. Other workers reported beneficial effects of organic manure on soil properties such as bulk density [10]. Soil moisture content [11] water-holding capacity and other soil physical properties [10].

The main objective of this work was chosen purposely to try application of poultry manure, compost manure and chemical fertilizer to check the growth parameters of vegetables and changes that taken place to physical and chemical properties of the soil in one side. Okra (*Abelmoschus esculentus* L) is an important protein source and is a low-value crop.

2. Materials and Methods

2.1. Experimental Site

Experiment was carried out in the net house area of tractor shed National Centre for Agriculture Mechanization {NCAM}. 40 earthen pots were used to test the vegetative growth parameters of *Abelmoschus esculantus L* vegetable. The size of each pot was 12 inches deep and 10 inches width and filled with 10kg sandy-loam texture soil checked by Land and Water Testing Laboratory (LWTL), having characteristics pH 8.6, Organic matter 0.56, organic C 1.52%, (particle size% sandy 68.7 & loamy 31.3), available total N% 0.12, P 10.1mg/kg, (Exchangeable cations cmol/kg; K 0.08, Ca 1.1, Mg 0.09, Na 0.04) and soil saturation 51% which was used for growth development in the pot. The seeds of species were collected from IITA, Ibadan. The design was a randomized complete block with 10 replications having the following treatments:

a. Poultry manure at the rate of 5-10kg/pot
b. Compost manure at the rate of 5-10kg/pot
c. Chemical fertilizer at the rate of 5-10kg/pot (designated as NPK)
d. Control: No addition of manure or chemical fertilizer

2.2. Source of Manure

Poultry manure was obtained from a layers house at NCAM Integrated Farm Project outside a laying house accommodating approximately 500 hens. The manure collected was not fresh and was not subjected to any treatment on the farm. It was then placed in clean plastic bag and transported to the experimental site.

Compost manure, this is the component of cow and goat dung, dry legume plants, weeds and remnant foods were missed together and put in an already dug land which was then covered and left for 2 months and 4 days, to serve as compost bin.

2.3. Rising of Seedlings

At the time of sowing 4 seeds were planted in each pot. After germination only 2 healthy seedlings were selected for further examination, while remaining plants were thinned out. This research was conducted between the month of July-October 2017.

2.4. Applications of Treatment

Application of manures was done 3 weeks prior to the time of sowing to allow decomposition of the applied manures before seed germination. After 3 weeks of planting, the treatments were added with manures and chemical fertilizer at different rate to the replicates.

The first harvest was made after 34 days of germination among the poultry manure{PM}while a week after harvest was also made among the compost manure{CM} and NPK. Thereafter. Time interval for harvesting was finally fixed for 5days. At the end of harvesting the plants were carefully dug out with roots from the pots kept into paper envelopes, labeled separately then taken into laboratory for different growth parameters.

2.5. Measurements of Growth Parameters

At each harvest, the following parameters were recorded; Shoot length (cm), Root length (cm), Number of leaves, Leaf area (mm), Number of crop yield, crop yield weight, Shoot fresh weight (g), Root fresh weight (g), Shoot Dry weight (g) and Root Dry weight (g).

2.6. Statistical Analysis

One-way ANOVA was carried out to determine the differences among treatment groups of growth and development variables of Okra.

3. Results

Table 1. *ANOVA table for the effect of different manure and chemical fertilizer on Abelmoschus esculantus L.*

Parameters	Treatments	Mean	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
Shoot length	Poultry	27.50	24.10	30.89
	Compost	23.61	21.07	26.16
	NPK	26.3	22.9	28.7

Parameters	Treatments	Mean	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
Root length	control	20.21	18.65	21.76
	Poultry	17.47	15.86	19.08
	Compost	12.18	9.98	14.38
	NPK	16.9	14.6	18.2
Shoot fresh weight	control	8.86	8.08	9.64
	Poultry	30.45	27.44	33.47
	Compost	24.65	21.97	27.33
	NPK	28.6	25.4	31.2
Root fresh weight	control	20.21	16.66	21.26
	Poultry	2.80	2.34	3.26
	Compost	2.21	1.84	2.58
	NPK	2.7	2.11	3.13
Shoot dry weight	control	1.72	1.51	1.93
	Poultry	12.79	11.15	14.43
	Compost	10.44	9.02	11.86
	NPK	11.6	10.8	13.61
Root dry weight	control	8.19	7.27	9.10
	Poultry	0.48	.35	.63
	Compost	0.56	.46	.66
	NPK	0.51	.38	.65
Crop yield number	control	0.44	.39	.49
	Poultry	5.0	4.17	5.84
	Compost	4.00	3.25	4.75
	NPK	4.6	4.60	5.97
Crop yield weight	control	3.30	2.54	4.06
	Poultry	33.07	26.58	39.56
	Compost	20.48	14.45	26.51
	NPK	32.8	25.21	38.96
Leaf area	control	13.63	8.99	18.27
	Poultry	38.44	34.48	42.39
	Compost	31.23	29.37	33.09
	NPK	37.75	34.23	42.10
Number of leaves	control	23.30	21.44	25.16
	Poultry	8.20	7.39	9.01
	Compost	6.40	5.90	6.90
	NPK	8.22	7.41	9.12
	control	5.60	5.10	6.10

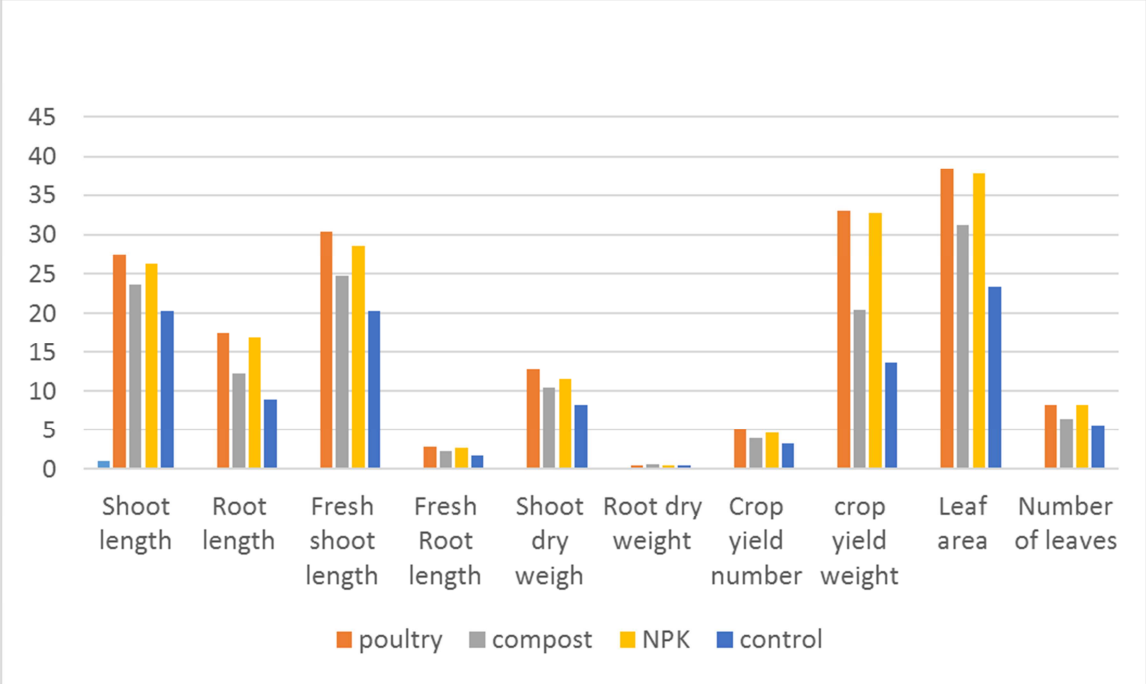

Figure 1. *Graphic representation of parameters.*

Table 2. *Physical and chemical properties of the soil at the end of the experiment.*

Parameters	Poultry manure	Compost manure	Control
Organic carbon%	36.7	23.8	1.50
pH	7.40	8.10	7.90
Total N%	2.57	2.38	0.09
P mg/kg	11.33	10.6	9.61
Exchangeable cations measure in centimoles per kg (cmol/kg)			
K	1.7	1.09	0.07
Ca	4.25	3.72	1.04
Mg	2.53	2.61	0.07
Na	0.11	0.13	0.04

All values were from bulked of treatments.

Table 3. *Effect of organic manures and inorganic fertilizer on moisture content and bulk density of the soil.*

Treatments	Moisture content %	Bulk density (Mg/m^3)
PM -5kg/pot	10.91	1.54
PM-10kg/pot	11.41	1.52
CM-5kg/pot	10.74	1.55
CM-10kg/pot	10.96	1.54
NPK-5kg/pot	10.86	1.56
NPK-5kg/pot	10.86	1.56
Control	9.87 (9.8)*	1.62 (1.6)*

*Values at the beginning of experiment are shown in brackets. All values were from bulked of treatments.

4. Discussion

4.1. Effect at Crop Yield Number/Crop Yield Weight

The result from the above ANOVA table (Randomized Complete Block Design) tested at 5% level of Significant for Growth and Development of Okra with different manure and chemical fertilizer designated as NPK. The results show that growth and development of okra with respect to crop yield number is independent or has no correlation with neither poultry nor compost manure but can only be determined by the aggregate of crop yield weight. There was no significant difference at crop yield number while highly significant at crop yield weight as shown in the Table-1 which states the explicitly confidence interval for all treatments at crop yield number and crop yield weight.

4.2. Effects at Number of Leaves/ Plant and Leaf Area/Plant

Numbers of leaves per plant were significantly increased due to nutrients availability per pots and the wideness of the leaves was also significantly enhanced. Thus the leaf area/plant and number of leaves/ plant were significantly greater in the other poultry manure > compost manure> NPK >control.

4.3. Effects at Shoot /Root Length Weight Respectively

The results therefore indicate that the observed response was largely due to increased availability of Nitrogen, Phosphorus and Potassium which aligned with the increase chemical properties of the soil (Table-2) tested at the end of experiment and consequently enhanced shoot/ root growth and dry weight. This is also corroborated by the confidence Interval for Mean whereby all the replicates in poultry manure were highly and positively correlated to the increment soil availability levels of Nitrogen, Phosphorus and Potassium after manure had being added. The results are in agreement with those reported by [12]. Who observed significant effects on yield of common beans following application of poultry manure.

Results of the pot experiment indicated that applications of the poultry manure significantly increased the chemical soil properties evaluated irrespective of the replicates, soil available levels of Nitrogen, Phosphorus and Potassium and other soil chemicals increased with increasing rates of application (Table-2.) Similar trends were observed for other growth parameters; namely, shoot /root length, shoot/root fresh and dry weight, crop yield weight and leave area. Generally, results of the pot experiment confirmed increment in the mineralization of Nitrogen, Phosphorus irrespective of manure types which might have been significantly improved soil organic matter and chlorophyll content in the leaves. Applications of the manures could therefore immensely improve fertility of the soil. Given its superior responses, poultry manure could be a very attractive fertilizer alternative particularly for annual crops with short growth cycle such as Okra, maize, beans etcetera. Results of this study was confirmed the other research done under different field conditions and for longer experimental duration by [13]. Animal manure was frequently used by the farmers in most of the developing countries such as Pakistan for obtaining good quality and quantity yields of the crops, vegetables and fruits. The results of Okra in poultry and compost manure in this paper were also supporting documents of the research area across the globe.

4.4. Effect of Poultry and Compost Manure on the Chemical Properties of the Soil

The pH levels were expected to rise with the addition of the organic manure due to release of ammonia from the decomposing manure [14] and the Ca level of the poultry manure. The pH of the soil in poultry manure moves toward acidic compared to its initial level from 8.6 to 7.4. However,

in compost manure the neutrality of the soil was maintained from 8.6 to 8.1

(Table 2). Nitrogen level increased from 0.12% to 2.57% in poultry manure treatment probably it might be due to raw poultry manure, addition of the poultry manure to give an increase of 21% over the control showed positive signs of applying poultry manure to the soil. However, only slight increase from 0.12% to 2.38% was observed in compost manure. On the other hand similar trend were observed for other chemical properties of the soil.

4.5. Effect of Poultry Manure on Physical Properties of the Soil

Moisture content (plant available water) and bulk density (Table 3). Application of poultry manure increased moisture content of the soil with 10kg/pot having a little edge over 5kg/pot; both doing better than the compost manure and chemical fertilizer. Poultry manure, with its high organic carbon content, adds organic matter to the soil, this shows the more quantity of poultry manure applied the more soil moisture content. Organic matter has the ability to retain appreciable amounts of soil moisture, hence, probably the rise in level of moisture content of soil was due to its high organic matter. This positive change or reaction in soil moisture content due to poultry manure addition has been reported by [15].

On the other way, bulk density values were slightly lowered by the addition of manures when compared with the initial bulk density value of the soil, especially poultry manure (from 1.60 to 1.54–1.52 Mg m^{-3}). Although the drop was not much, it gave a positive sign of what poultry manure could do to soils with low bulk densities. Reference [16] reported that addition of poultry manure to the soil significantly decreased soil bulk density. Thus, it can be concluded that poultry manure has favourable effects on the moisture content and bulk densities of the site located for the experiment in NCAM. High moisture contents and lower bulk densities are good soil characteristics for good plant growth.

4.6. Problems Encountered During the Investigation

One of the problems observed during investigation was that the treatments in compost were contained number of weed seeds which were not digested by the animals and weed seeds which were also component of the manure. So with the application of compost manure in the field the seeds were propagated and competed with the vegetables for the available nutrients. On the other hand, compost is considered cool, and has a more balanced pH and less salt tested at the end of experiment. It is particularly odorless and does not seem to attract maggots and flies unlike its counterpart.

5. Conclusion and Recommendation

The investigation showed that the yield components of Okra were enhanced by the application of manures. Application of organic fertilizers improved the chemical properties of the soil when compared to the control but the response okra in poultry manure far better than compost manure and chemical fertilizer. The objective of this study was to comparatively evaluate the effects of poultry manure, compost manure and chemical fertilizer on soil chemical properties and Okra at different vegetative growth levels. It is recommended that this experiment be repeated for another planting season in other to validate the reliability of the results. Thus due to application of this local manure, farmers could obtain good quality and quantity of yields of theirs crops, vegetables and fruits because the study shows that it is a valuable fertilizer whose use needs to be encouraged.

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