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EFFECT OF POULTRY MANURE AND LIME ON THE GROWTH AND YIELD OF OKRA (*Abelmoschus esculentus* L. Moench)

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ABSTRACT

Field Experiments were conducted at the Teaching and research farm of the Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus in Oruk Anam, Nigeria, to examine the effects of lime and poultry manure on the growth and yield of okra. The treatments were three (3) varieties of Okra (Madison F1, Clemson spineless and Sahari F1) and Five (5) rates of soil amendment materials (10tons/ha poultry manure, 5tons/ha poultry manure, 2tons/ha lime, 5tons/ha poultry manure + 2tons/ha lime and the control). The experiment was a 3x4 factorial with three replications. Results indicated that all the three varieties of okra used in the experiment were similar in percentage establishment, leaf production and pods yields. However, there were significant differences in height and dry matter accumulation among the cultivars: Madison F1 were the tallest plants (47.38 cm in 2020, and 57.18cm in 2021) followed by Sahari F1 (42.59cm in 2020. and 54.32cm in 2021). Clemson spineless were the shortest plants (40.27cm in 2020), it also recorded the least dry matter weight (12.47g/plot) in 2021 The highest dry matter accumulation (17.57g/plot) was recorded in Madison F1 in 2020). The soil amendment materials /rates indicated significant differences in all the production and yield parameters considered in the experiment; 5tons/ha poultry manure + 2tons/ha lime consistently produced the tallest plants (47.65cm in 2020, and 56.49cm in 2021). The highest number of leaves were 14.16 and 13.89 in 2020 and 2021 respectively, and the highest total dry matter weight of 16.88g/plot in 2020 and 15 38g/plot in 2021were also recorded. The highest pods yield (4.31tons/ha) was obtained in 2020 also at application rate of 5tons/ha poultry manure + 2tons/ha lime. There were significant interaction effects between okra varieties and soil the amendment materials: Madison F1 treated with 5tons/ha poultry manure+2tons/ha lime produced the tallest plants (62.78cm in 2021). Safari F1 treated with the same rate of soil amendment materials also produced the highest yields (4.61tons/ha) and was therefore recommended for farmers in the study area.

Key words: Okra, poultry manure, lime.

INTRODUCTION

Okra is an important vegetable crop in the tropical and subtropical regions of the world. The crop is dicotyledonous, and belongs to the family Malvacea. It is known to have originated in tropical Africa (Akanbi *et al.*, 2010; Saifullah and Rabbani, 2009). But Grubben, (1977) traced the origin of okra to tropical Asia. However, the centres of genetic diversity include West Africa, India and Southern Asia (Hamon and Van Stolen, 1989). Okra is a warm season crop, requiring ample moisture for germination (Peet, 1992). It has high nutritional, medicinal and industrial value (Reddy *et al*., 2013). The edible part of okra is the immature pod, which is harvested when tender. The leaves, buds and flowers are also edible. In West Africa, okra is utilized mainly because of its high mucilage content which is used in the thickening of soup (Schippers, 2000). It is among the most frequently and popularly consumed traditional vegetable.

Poultry manure is organic manure, it consists of poultry droppings, wood shavings, feathers, remains of milled feeds and other organic substances. It is an efficient organic fertilizer. Poultry manure improves the physical and chemical properties of the soil (Reddy and Reddi, 1995) It also supplies the essential plant nutrients and makes a great improvement to soil texture and structure. Its average nutrient content is 3.03 % N, 2.63 % P_2O^5 and 1.4 % K_2O. It has been reported that 30% of nitrogen from poultry litter is in urea or ammonium form and hence, are made readily available (Sunassee, 2001). Poultry manure is used commonly in the tropics, due mainly, to its high nutrient content, lack of weed seeds, cheapness and availability (Aliyu, 2000). In developing economies, like Nigeria, high cost and scarcity of chemical fertilizers promote the use of poultry manure among small holder farmers. Udoh *et al.* (2005) stated that Okra responds positively to organic manure application.

Liming is the most effective managerial practice for reducing soil acidity and consequentially, improve crop production (Fageria and Baligar, 2008). Adding various types of liming materials could neutralize excessive hydrogen ions in soil solution (Bolan *et al*. 2003). Furthermore, liming can directly supply many cations that are important for crop production as part of the constituents included in liming materials e.g. Ca^{2+} and Mg^{2+} (Fageria and Nascente, 2014). Liming can also influence both the transformation and uptake of nutrients by plants through its indirect impact on the soil microbial community/activities (Cheng *et al*. 2013; Fageria, 2002). Additionally, previous reviews have extensively evaluated how liming could affect heavy metal concentration in soils (Bolan *et al*. 2003), nutrient use efficiency (Fageria and Baligar, 2008; Fageria and Nascente, 2014), and greenhouse gas emissions from acidic soils (Kunhikrishnan, 2016). A broad array of mechanisms have been described with which plant-soil-microbe interactions tremendously impact on nutrient acquisition, availability and crop productivity. However, unravelling such complex mechanisms can be difficult. Clear evidence has however been reported on how liming could be effectively used to enhance agronomic productivity, but the detailed information on the quantitative relationship between the liming management regime (i.e. both liming rate and material) and crop yield, remains limited.

In developing countries like Nigeria, the population growth rate is so high that improved technologies including rational use of fertilizers and other soil amendment materials, must be employed to meet the food requirements of the people. Declining soil fertility is a major production constraint in Africa, especially in Nigeria, and it is becoming increasingly critical to secure sustainable soil productivity (Oladotun, 2002). Organic manure helps to improve the physical condition of soil and provide adequate amount of necessary nutrients for soil productivity (Qhureshi, 2007). Liming acid soils provides a more favourable environment for plant growth by reducing toxic concentration of cations and increasing the microbial activities and availability of major plant nutrients. This study therefore was conducted to determine the effect of lime and Poultry manure/rates on the growth and yield of Okra.

MATERIALS AND METHODS:

The study was conducted at the Teaching and research farm of the Akwa Ibom State University, Obio Akpa Campus in the early cropping season of 2020 through 2021. Obioakpa is located on Latitude 4^0 $31^!$ to 5^0 $30^{!,}$ and Longitude 8^0 $30^!$ to 8, 00 $^!$ E (SLUS- AK, 1989). The area receives annual rainfall of about 2500mm in a bi-modal pattern, with a short dry spell in August (August break). The mean annual temperature varies between 22^0C and 32^0C. The relative humidity is about 85%.

The experiment consisted of three varieties of Okra (Madison F1, Sahari F1 and Clemson Spineless), and 5 levels of soil amendment materials, viz- 5tons/ha poultry manure, 10tons/ha poultry manure, 2 tons/ha lime, 5tons/ha poultry manure combined with 2tons/ha lime and the control. Each experimental unit measured 3.0m x 3.6m, the experimental units were separated from each other by a path measuring 0.5m, there were a total of 15 experimental units. The experiment was replicated three times. The replicates were separated from each other by a path measuring 1.0 m. The total land area covered by the experiment was 17.0m x 37.4m (635.8m^2).

Soil analysis:

Particle size distribution was determined by the Bouyoucos hydrometer method as described by Udo *et al.(*2009). Soil pH was measured electronically in 1:1.5 Soil – water suspension (Mclean, 1982). Soil organic carbon was determined by the Walkley – Black dichromate oxidation method (Black, 1965). Phosphorous was determined by the Bray P.1 method (Olsen and Sommers, 1982). Exchangeable cations (K, Ca, Mg) were extracted in 1M $NH_4OA_{C\ at}$ pH 7. K and Na were determined on the Flame photometer, while Ca and Mg were determined on the Atomic absorption spectrophotometer. Effective Cation exchange capacity (E C E C) was obtained by the summation of the exchangeable bases and the exchangeable acidity (Udo *et al.*, 2009). Percentage base saturation was calculated as follows:

$$\text{Percentage Base Saturation} = \frac{\text{Exchangeable Bases}}{\text{ECEC}} \times \frac{100}{1}$$

Data were collected on the following parameters; Plant height, Number of leaves, Days to 50% establishment, Total dry matter and Total pods yield (tons/ha). All the data collected were subjected to analysis of variance, and means that showed significant differences were compared at 5% probability level.

Table 1. Physico-Chemical properties of the soil of the study area at the commencement of the experiment

Parameter	Values
Sand (%)	74.90
Clay (%)	20.60
Silt (%)	4.50
Texture Class	Sandy Loam
pH	5.02
Organic matter	1.99
Total Nitrogen (%)	0.45
Available P (mg/kg)	32.22
Exchangeable Bases (cmol/kg)	
K	0.10
Ca	2.22
Mg	1.11
Na	0.05
Exchange Acidity (cmol/kg)	2.50
Effective Cation exchange capacity (cmol/kg)	6.20
Bases Saturation (%)	96.45

Table 2. Physical and chemical analysis of poultry manure.

Parameters	
(Chemical properties)	
Nitrogen (%)	3.81
Organic carbon (%)	30.23
Phosphorus (g/kg)	12.82
Calcium (g/kg)	28.60
Magnesium (g/kg)	0.87
Potassium (g/kg)	1.67
Sodium (g/kg)	2.45
Manganese (mg/kg)	18.01

RESULTS

Results of the physical and chemical analysis of the soil of the study area prior to commencement of the experiment showed that the soil was sandy loam, slightly acidic (pH 5.02) (Table 1) Organic matter contents was 1.99%. The total Nitrogen (0.45%) was far below 2.0% recommended by Udoh *et al.* 2005, as the critical value for optimum performance and yield of crops. The exchangeable bases; Potassium, Calcium, Magnesium and Sodium ions were 0.10, 2.22, 1.11, and 0.05 (cmol/kg) respectively.

Analysis of the poultry manure (Table 2.) indicated that it was alkaline (pH 8.12), very rich in Organic matter (83.12%) Nitrogen contents was 1.22%. Exchangeable bases were equally high; 1101.8mg/kg, 1674mg/kg, 472.6mg/kg, and 1036.7mg/kg, representing Phosphorous, Potassium, Calcium and Magnesium respectively.

Results also indicated that all the Okra varieties used in the experiment (Table 3.) were similar in percentage establishment, number of leaves and pods yield. Soil amendment materials on the other hand indicated significant differences in days to 50% establishment, plants height and number of leaves; Plants that received 5tons/ha poultry manure + 2tons/ha lime (Table 4.) were established in 46.11 days in 2020 and 45.73 days in 2021 . They were closely followed by plants that received 10 tons/ha poultry manure only (46.99 days in 2020, and 47.43 days in 2021). Plants in the control plot took longer days (52.74 in 2020, and 50.37 days in 2021) to establish and were significantly different from all the other plants that received any form of soil amendment material. Similarly, leaf production in okra was significantly influenced by the application of soil amendment materials; 5tons/ha poultry manure + 2tons/ha lime produced plants with the highest number of leaves (14.16 days in 2020, and 13.89 days in 2021), this was closely followed by 13.73 and 13.02 leaves produced in 2020 and 2021 respectively, on plots that received 10 tons/ha poultry manure only.

The soil amendment materials also influenced dry matter accumulation in okra when compared to plants in the control plot (Table 5) ; those plots that received 5tons/ha Poultry manure + 2ton/ha lime yielded the highest dry matter weight (16.88g/plant in 2020, and 15.38g/plant in 2021), this however, was not significantly different from 16.51g/plant produced by plants that received 10 tons/ha poultry manure only. Plants in the control plot had the least total dry matter weight (11.62g/plant in 2020, and 12.29g/plant in 2021).

When 5tons/ha poultry manure + 2tons/ha lime were added to the soil, pod yields were significantly increased (4.31tons/ha in 2020 and 3.92 tons/ha in 2021), this was not significantly different though, from plots which received 10tons/ha poultry manure only (3.94 tons/ha in 2020, and 3.54 tons/ha in 2021). Okra yields in plots that received 5tons/ha poultry manure only were similar to those that received 2tons/ha liming materials only, but they generally performed better than those in the control plot.

Interactive effect of okra varieties and soil amendment materials on plants height and number of leaves were significant (Table 6.); the tallest plants (62.78cm in 2021, and 52.13cm in 2020) were Madison F1 treated to 5 tons/ha poultry manure+ 2tons/ha lime. The same treatment combinations also yielded the highest number of leaves (15.10 in 2020). In 2021 the highest number of leaves (14.23) were however produced on Clemson spineless treated to the same level of the soil amendment materials. Interactive effect of okra varieties and soil amendment materials on Dry matter weight and Pods yield of Okra were significant. The treatment combinations showed significant differences ($p<0.05$) on Dry matter weight and Pods yield of Okra. The highest total dry matter weight (20.66g/plot) was obtained in 2020 when Madison F1 was treated with 5tons/ha poultry manure + 2tons/ha lime. In 2021, the highest yields (4.31tons/ha) was however obtained when Madison F1 received the same treatment. Similarly, the yield of okra varieties were significantly enhanced when 5tons/ha poultry manure was combined with 2tons/ha lime. When Sahari F1 was treated to 5tons/ha poultry + 2tons/ha lime the yield increased to 4.61 tons/ha in 2020, this was followed by 4.24 tons/ha in 2020 obtained when Madison F1 was given the same dosage of soil amendment materials. Clemson spineless however, yielded the lowest (4.10 tons/ha).

Table 3. Effect of okra varieties on establishment percentage, plants height and number of leaves per plant in 2020.

Treatment	Days to 50% Establishment	Plant height (cm)			Number of leaves
		3WAS	6WAS	9WAS	
Okra Varieties					
					2020
Madison F1	49.76^{a}	18.22^{a}	33.02^{a}	47.38^{a}	12.88^{a}
Clemson Spineless	47.68^{a}	15.28^{b}	26.77^{b}	40.27^{b}	11.84^{a}
Sahari F1	49.74^{a}	13.40^{b}	28.04^{b}	42.59^{ab}	12.12^{a}
					2021
Madison F1	46.93^{ab}	23.99^{a}	43.30^{a}	57.18^{a}	12.25^{a}
Clemson Spineless	48.59^{ab}	21.22^{ab}	36.54^{b}	53.49^{b}	11.60^{a}
Sahari F1	50.21^{a}	20.26^{b}	38.91^{ab}	54.32^{b}	12.33^{a}

Means with the same superscript along the columns are not significantly different from each other (p>0.05)

Table 4. Effect Soil amendment materials on Establishment percentage, Plants height and Number of leaves per plant in 2020 and 2021.

Treatment	Days to 50% Establishment	Plant height (cm)			Number of eaves
		3WAS	6WAS	9WAS	
Soil Amendment Materials					
					2020
Control	52.74^{a}	14.61^{b}	26.95^{a}	38.99^{b}	10.13^{a}
5 tons/ha Poultry Manure	49.48^{ab}	15.42^{ab}	29.92^{a}	44.51^{ab}	11.60^{b}
10 tons/ha Poultry Manure	46.99^{b}	14.61^{b}	28.54^{a}	43.25^{ab}	13.73^{a}
2 tons/ha Lime	49.97^{ab}	15.22^{ab}	28.76^{a}	42.65^{ab}	11.78^{b}
5tons/ha Poultry Manure+ 2 tons/ha lime	46.11^{b}	18.31^{a}	32.21^{a}	47.65^{a}	14.16^{a}
					2021
Control	50.37^{a}	20.56^{a}	34.97^{b}	52.67^{b}	10.20^{c}
5tons/ha Poultry Manure	48.92^{ab}	22.14^{a}	39.86^{ab}	55.02^{ab}	11.46^{bc}
10 tons/ha Poultry Manure	47.43^{ab}	20.80^{a}	40.68^{ab}	55.70^{ab}	13.02^{a}
2 tons/ha Lime	50.44^{a}	21.68^{a}	39.04^{ab}	55.08^{ab}	11.72^{b}
5 tons/ha PoultryManure + 2tons/ha lime	45.73^{b}	23.93^{a}	43.36^{b}	56.49^{a}	13.89^{a}

Means with the same superscript along the columns are not significantly different from each other (p>0.05

Table 5. Total dry matter weight and Pods yield of Okra as Influenced by Okra varieties and Soil amendment materials.

Treatment	2020 Total Dry matter Weight (g/plot)	2020 Pods yield (tons/ha)	2021 Total Dry matter Weight (g/plot)	2021 Pods yield (tons/ha)
Okra varieties				
Madison F1	17.57^{a}	3.28^{a}	14.98^{a}	3.18^{a}
Clemson Spineless	12.92^{b}	3.22^{a}	14.17^{a}	2.97^{a}
Sahari F1	13.76^{b}	3.32^{a}	12.47^{b}	3.31^{a}
Soil Amendment Materials				
Control	11.62^{b}	2.15^{c}	12.29^{b}	2.32^{c}
5tons/ha PoultryManure	14.61^{a}	3.03^{b}	13.52^{ab}	3.02^{b}
10 tons/ha Poultry Manure	16.51^{a}	3.94^{a}	15.20^{a}	3.54^{a}
2 tons/ha Lime	14.14^{ab}	2.94^{b}	12.97^{b}	2.96^{b}
5 tons/ha Poultry Manure + 2 tons/ha Lime	16.88^{a}	4.31^{a}	15.38^{a}	3.92^{a}

Means with the same superscript along the columns are not significantly different from each other (p>0.05)

Table 6. Interactive effect of Okra varieties and soil amendment materials on Establishment percentage, Plants height and Number of leaves per plant.

Treatment	Days to 50% Establishment	Plant height (cm) 3WAS	6WAS	9WAS	Number of leaves
			2020		
Madison F1 + control	52.11^{ab}	18.42^{ab}	33.0^{ab}	41.29^{ab}	10.53^{g}
Madison F1 + 5tons/ha PM	50.76^{ab}	17.92^{abc}	33.25^{ab}	48.17^{ab}	12.20^{cde}
Madison F1 +10 tons/ha PM	45.42^{bc}	16.50^{ab}	30.33^{ab}	49.88^{ab}	14.84^{ab}
Madison F1 + 2tons/ha lime	51.10^{ab}	17.58^{ab}	31.79^{ab}	45.42^{ab}	11.76^{def}
Madison F1 + (5 tons/ha PM + 2 tons/ha lime)	49.39^{ab}	20.67^{a}	36.71^{a}	52.13^{a}	15.10^{a}
Clemson Spineless + Control	50.18^{ab}	13.83^{bc}	23.37^{b}	39.88^{ab}	9.74^{fg}
Clemson Spineless + 5 tons/ha PM	47.80^{bc}	14.75^{bc}	26.92^{ab}	39.38^{ab} 1	1.19^{ef}
Clemson Spineless +10 tons/ha PM	46.06^{bc}	14.75^{bc}	27.42^{ab}	39.79^{ab}	13.04^{cd}
Clemson Spineless + 2 tons/ha lime	47.83^{bc}	15.0^{bc}	25.29^{ab}	38.21^{ab}	11.35^{ef}
Clemson Spineless + (5 tons/ha PM 2 tons/ha lime)	46.51^{bc}	18.08^{ab}	30.83^{ab}	44.08^{ab}	13.89^{ab}
Sahari F1 + Control	55.92^{a}	11.58^{cd}	24.46^{b}	35.79^{b}	10.14^{g}
Sahari F1 + 5 tons/ha PM	49.88^{ab}	13.58^{bc}	29.59^{ab}	46.0^{ab}	11.42^{ef}
Sahari F1 + 10 tons/ha PM	49.50^{ab}	12.58^{d}	27.88^{ab}	40.09^{ab}	13.31^{abc}
Sahari F1 + 2 tons/ha lime	50.98^{ab}	13.08^{cd}	29.19^{ab}	44.34^{ab}	12.24cde
Sahari F1 + (5 tons/ha PM + 2tons/ha lime)	42.43^{c}	16.17^{ab}	29.09^{ab}	46.75^{ab}	13.49^{ab}

Means with the same superscript along the columns are not significantly different from each other (p>0.05

Table 6 cont. Interactive effect of Okra varieties and soil amendment materials on Establishment percentage, Plants height and Number of leaves per plant.

Treatment	Days to 50% Establishment	Plant height (cm) 3WAS	6WAS	9WAS	Number of leaves
2021 Madison F1 + control	47.75^{ab}	22.93^{ab}	41.46^{ab}	52.39^{ef}	10.41^{bc}
Madison F1 + 5tons/ha PM	46.72^{ab}	24.59^{ab}	42.88^{ab}	56.85^{ab}	11.95^{ab}
Madison F1 +10 tons/ha PM	45.86^{b}	21.59^{ab}	44.79^{ab}	57.81^{bc}	13.30^{abc}
Madison F1 + 2tons/ha lime	48.57^{ab}	23.25^{ab}	42.50^{ab}	$56{,}05^{bc}$	11.94^{ab}
Madison F1 + (5 tons/ha PM + 2 tons/ha lime)	45.76^{b}	27.59^{a}	44.88^{a}	62.78^{a}	13.65^{ab}
Clemson Spineless + Control	50.13^{ab}	20.13^{ab}	33.96^{ab}	51.60^{f}	9.76^{c}
Clemson Spineless + 5 tons/ha PM	49.07^{ab}	21.46^{ab}	35.34^{ab}	53.54^{cde}	10.77^{ab}
Clemson Spineless +10 tons/ha PM	47.05^{ab}	21.88^{ab}	35.33^{ab}	54.26^{bc}	12.14^{ab}
Clemson Spineless + 2 tons/ha lime	49.92^{ab}	21.67^{ab}	35.75^{ab}	56.38^{bc}	11.10^{abc}
Clemson Spineless + (5 tons/ha PM 2 tons/ha lime)	46.75^{ab}	20.96^{ab}	42.34^{ab}	51.65^{f}	14.23^{a}
Sahari F1 + Control	53.23^{a}	18.63^{b}	29.50^{a}	54.04^{bc}	10.44^{ab}
Sahari F1 + 5 tons/ha PM	50.96^{ab}	20.38^{ab}	41.38^{ab}	54.66^{bc}	11.67^{ab}
Sahari F1 + 10 tons/ha PM	49.37^{ab}	18.92^{ab}	41.92^{ab}	55.04^{bc}	13.63^{ab}
Sahari F1 + 2 tons/ha lime	52.81^{a}	20.13^{ab}	$38.\ 88^{ab}$	52.81^{de}	12.12^{ab}
Sahari F1 + (5 tons/ha PM + 2tons/ha lime)	44.66^{b}	23.25^{ab}	42.88^{ab}	55.04^{bc}	13.78^{ab}

Means with the same superscript along the columns are not significantly different from each other (p>0.05

DISCUSSION

Yields of arable crops depend largely on stand establishment, juvenile growth and productivity, usually influenced by environmental and cultural practices, including manural practices (Ibeawuchi *et al.*, 2005). The application of soil amendment materials therefore is crucial for crop growth and development (Alagba, 2010).

The soil amendment materials used in this experiment were significant for all the growth and yield parameters considered; with 5tons/ha poultry manure + 2tons/ha lime consistently giving the best results. However, for most growth and yield parameters considered, there were no significant differences in performance between 5tons/ha poultry manure+2tons/ha lime, and 10tons/ha poultry manure applied alone. Reddy and Reddi (1995) stated that poultry manure is an excellent organic fertilizer, and that its addition improves the physical and chemical properties of the soil. It has a fairly high nutrient composition when compared with other sources of animal manure. Cheng *et al*.(2013) stated that liming can influence both the transformation and uptake of nutrients by plants through its indirect impact on the soil microbial community / activities. Fageria and Baligar (2008) also stated that Plant-soil-microbe interactions tremendously impacted on nutrient availability, acquisition, and crop productivity. Interactive effects of okra varieties and the soil amendment materials were significant for dry matter accumulation and pods yield of okra; Sahari F1 treated to 5tons/ha poultry manure mixed with 2tons/ha lime consistently yielded the best results, suggesting that the benefits of poultry manure application to okra can be further enhanced if lime at the recommended rate is also added to it.

Table 7. Interactive effects of okra varieties and soil amendment materials on dry matter weight and pods yield of okra

Treatment	2020 Total Dry matter Weight(g/plant)	2020 Pods yield tons/ha)	2021 Total Dry matter Weight(g/plant)	2021 Pods yield (tons/ha)
Madison F1 + control	12.46[fg]	2.38[fg]	12.48[cd]	2.43[fg]
Madison F1 + 5tons/ha PM	16.84[bc]	2.74[bc]	15.41[ab]	3.18[bcd]
Madison F1 +10 tons/ha PM	19.84[ab]	4.07[bc]	17.22[a]	3.23[bc]
Madison F1 + 2tons/ha lime	18.05[ab]	2.96[cd]	13.12[cd]	2.77[cd]
Madison F1 + (5 tons/ha PM + 2 tons/ha lime)	20.66[a]	4.24[ab]	16.67[ab]	4.31[a]
Clemson Spineless + Control	11.56[g]	2.14[ef]	13.38[cd]	2.02[g]
Clemson Spineless + 5 tons/ha PM	12.83[ef]	2.70[g]	13.59[d]	2.65[de]
Clemson Spineless +10 tons/ha PM	13.39[ef]	4.06[ab]	14.95[ab]	3.53[abc]
Clemson Spineless + 2 tons/ha lime	12.37[fg]	3.09[de]	13.92[bc]	2.90[bc]
Clemson Spineless + (5 tons/ha PM 2 tons/ha lime)	14.46[de]	4.10[ab]	15.03[ab]	3.75[ab]
Sahari F1 + Control	10.84[g]	1.92[cd]	11.03[e]	2.50[ef]
Sahari F1 + 5 tons/ha PM	14.16[de]	3.64[ab]	11.55[de]	3.24[bc]
Sahari F1 + 10 tons/ha PM	16.30[bc]	3.68[ab]	13.43[cd]	3.88[ab]
Sahari F1 + 2 tons/ha lime	11.99[fg]	2.77[bc]	11. 88[de]	3.22[bc]
Sahari F1 + (5 tons/ha PM + 2tons/ha lime)	15.51[cd]	4.61[a]	14.44[ab]	3.70[ab]

Means with the same superscript along the columns are not significantly different from each other (p>0.05)

CONCLUSION AND RECOMMENDATION

All the okra varieties used in this experiment were similar in percentage establishment, number of leaves produced and pods yield (tons/ha). There were however, significant differences in total dry matter weight and plant height.

The soil amendment materials, at all levels, indicated significant beneficial influence on the growth and yield of okra, irrespective of the variety, Such beneficial effects were even more pronounced when lime, at the rate of 2.0 tons/ha was added to the poultry manure. The best yields (4.61 tons/ha) was obtained when Sahari F1 was treated to 5tons/ha poultry manure mixed with 2tons/ha lime and was therefore recommended for okra farmers in the study area.

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