Influence of composted sawdust and poultry manure on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench)

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ABSTRACT

Field and screen house studies were conducted in 2006 and 2007 at the University of Agriculture, Abeokuta, Ogun State, Nigeria to determine the optimum application rate of organo-mineral fertilizer (OMF) derived from composted sawdust and poultry manure and fortified with mineral fertilizer for the production of okra (*Abelmoschus esculentus*). Treatments used were: 0, 2.5, 5.0, 7.5, 10.0 t/ha OMF and 200kg/ha NPK 16-16-16 in the screen-house while the above with exception of 10.0 t/ha OMF were used on the field. Agronomic parameters evaluated were plant height, number of leaves, canopy spread, stem girth and fruit weight. Chemical characteristics of post – planting soil were also determined. Highest okra plant and fruit yield (34.83 cm and 138.31g/plant respectively) were observed on plants treated with 7.5 t/ha OMF in the screen house. The above fertilizer rate significantly increased the canopy spread and stem girth of okra above the control on the field.
Keywords – Organo-mineral Fertilizer, Sawdust, Poultry Manure

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INTRODUCTION

Okra is an important vegetable crop, it ranks first before other vegetable crops (Babatunde et. al., 2007). Okra fruits are used as soup thickeners, the leaves are used for human consumption in some regions. Mature dried seeds of okra are roasted, ground and added to coffee as an adubiant (Schippers, 2000; Njoku and Ebeniro, 2009). Eke *et. al.*, (2008) reported that okra yield is mostly limited by soil fertility and cultural management. Bush fallowing was reported by Ayoola and Adeniran (2006) to be an efficient system of soil fertility restoration and productivity in the tropics. This can no longer be practiced due to pressure on land and the need for increase in food production to meet the ever increasing human population.

The use of chemical fertilizers has been hindered by high cost, adulteration, yield reduction and irregularity in supply. Improvements in environmental conditions and fertilizer cost reduction have been highlighted as reasons for advocating the use of organic materials (Bayu et. al., 2006). The high rates requirement of organic fertilizers for high crop production has made its use not practicable among farmers. It is in view of the above that combined use of inorganic fertilizers and organic materials was reported by Lombin et. al., 1991to give higher crop yields than sole use of either animal manure or inorganic fertilizer. Saw dust which is considered as a source of environmental pollution due to its indiscriminate burning in virtually all saw mills in Nigeria could be composted with poultry manure and used as fertilizer. Organo-mineral fertilizer which is derived from composted saw dust and poultry manure fortified with chemical fertilizer is a cheap technology which could be used for higher crop production particularly for vegetable production which is usually regarded as minor crops. Research is therefore needed to determine the optimum application rate of organo-mineral fertilizer derived from composted saw dust and poultry manure for okra growth and yield.

MATERIALS AND METHODS

Screen house study: The experiment was conducted in 2006 at the screen house of the College of Plant Science and Crop Production of the University of Agriculture, Abeokuta, Nigeria, latitude 7° 17′ N and longitude 3º 26′ E, a transitional zone of the sub humid rain forest to the South and the derived savanna to the North West. Surface soil (0-15 cm) was collected from the experimental site, this was air dried and sieved with 2 mm and 0.5 mm sieves for pre-planting soil analysis. 10 kilograms of the soil was weighed into 11 liter perforated pots. Organo-mineral fertilizer derived from composted saw – dust and poultry manure at 3:1 and fortified with minerals were applied according to treatment levels by thorough mixing with the soil at two

weeks before planting okra seeds. Organo-mineral fertilizer used was obtained from birth road, University of Ibadan, Nigeria. The soil was adequately watered after okra seeds (var. V35) sourced from the Institute of Agricultural Research and Training (I. A. R. & T.), Moor Plantation, Ibadan, Oyo State Nigeria were planted at the rate of three seeds per pot, these were thinned to one plant per pot two weeks later. NPK 16-16-16 at the rate of 200 kg/ha was applied at two weeks after planting. Parameters assessed were: plant height by measuring from the soil level to the youngest leave at the top of the plant with the aid of a measuring tape, canopy spread by measuring the distance between matured leaf from one side of the plant and the other side of the plant with the aid of a measuring tape, number of leaves by physical counting, stem girth with the aid of a venier caliper, these measurements were taken at seven weeks after planting. Matured okra fruits were harvested at three days interval, these were weighed on a mettler weighing balance. At the end of the experiment, soil in each pot was pulverized, air dried and sampled for routine analysis.

Field Experiment: This was conducted at the Teaching and Research Farm of the University of Agriculture, Abeokuta in 2007 planting season. The experimental site dominated by *imperata cylindrical* was manually cleared, six core soil samples were taken with the aid of a soil auger at 0-15 cm layer, these were bulked together and a truly representative soil sample was taken, this was used for routine analysis. Plots measuring 4 m x 3 m were demarcated with the aid of a measuring tape, a distance of 2 m was left between each replicate while plots were demarcated with a distance of 1 m. The treatments applied on the field were: control, N-P-K-16-16-16 at the rate of 200 kg/ha, organo-mineral fertilizer at the rate of 2.5, 5.0 and 7.5 t/ha. The treatments were replicated three times using Randomized Complete Block Design (RCBD). Organo-mineral fertilizer was applied immediately after plot demarcation by broadcasting and thorough mixing with the top soil (0-15 cm) layer. Okra seeds were planted on the 14th of May, 2007 at the rate of three seeds per hole, the spacing used was 60 cm x 30 cm, these were thinned to one seedling per stand at two weeks after planting. Chemical fertilizer was applied at two weeks after planting using row application method. The parameters assessed were as in the screen house experiment. At the end of the experiment, three core soil samples were collected from each plot, these were bulked together and used for routine analysis.

Routine Soil Analysis: Pre and post planting soil samples collected were sieved with 2 mm sieve size, some portion of the sieved soil was crushed in a porcelain mortar and passed through 0.5 mm sieve for organic carbon and total nitrogen determinations. Organic carbon was determined by Walkley Black method, pH was determined by glass electrode pH meter using 1:1 Soil: Water, particle size was determined by Bouyoucos hydrometer method (Bouyoucos, 1962), total nitrogen

by Kjeldahl method (Bremner, 1996), available phosphorus by Bray 1 method, available potassium was determined by extracting the soil with I M ammonium acetate (pH 7.0) and K read on flame photometer.

Statistical analysis

Data collected were subjected to a one-way Analysis of Variance (ANOVA) using SAS (SAS Institute 2000). Means were separated using Least Significant Difference (LSD) at $P \leq 0.05$.

RESULTS AND DISCUSSION

Results of the chemical properties of the soil used for the experiment showed that the soils were slightly acidic, low in total nitrogen, organic carbon, available P and exchangeable K. Therefore response to fertilizer applications by crops grown on them was expected. The organo-mineral fertilizer used for the experiment was rich in nitrogen, phosphorus, potassium and calcium and low in magnesium, boron, iron and zinc (Table 1).

The effect of chemical and organo-mineral fertilizers on okra height, canopy cover, stem girth and number of leaves is shown in Table 2. Okra height ranged between 27.00 and 34.84 cm at 7 WAP, the highest value (34.83 cm) was observed on plants treated with OMF at 7.5 t/ha, this value is significantly ($P \leq 0.05$) higher than plants treated with 10 t/ha organo-mineral fertilizer which had 27.00 cm as value (Table 2). Fertilizer application did not have any significant effect on the canopy cover, stem girth and number of leaves of okra. The highest okra yield value of 138.31g/plant in the screen house was recorded on plants treated with OMF at the rate of 7.5 t/ha, the value was significantly ($P \leq 0.05$) higher than other fertilizer treated plants with the exception of plants treated with chemical fertilizer with 113.90 g/plant as yield, The lowest yield (43.60 g/plant) was observed on 10 t/ha OMF treated plants (Figure 1), this could be due to excess nutrient application at this fertilizer rate which could have led to nutrient toxicity. It was as a result of this observation that organo-mineral fertilizer application on the field was limited to 7.5 t/ ha. Fertilizer application did not significantly affect the pH, Organic carbon, total nitrogen, phosphorus and potassium of post-planting soil (Table 4).

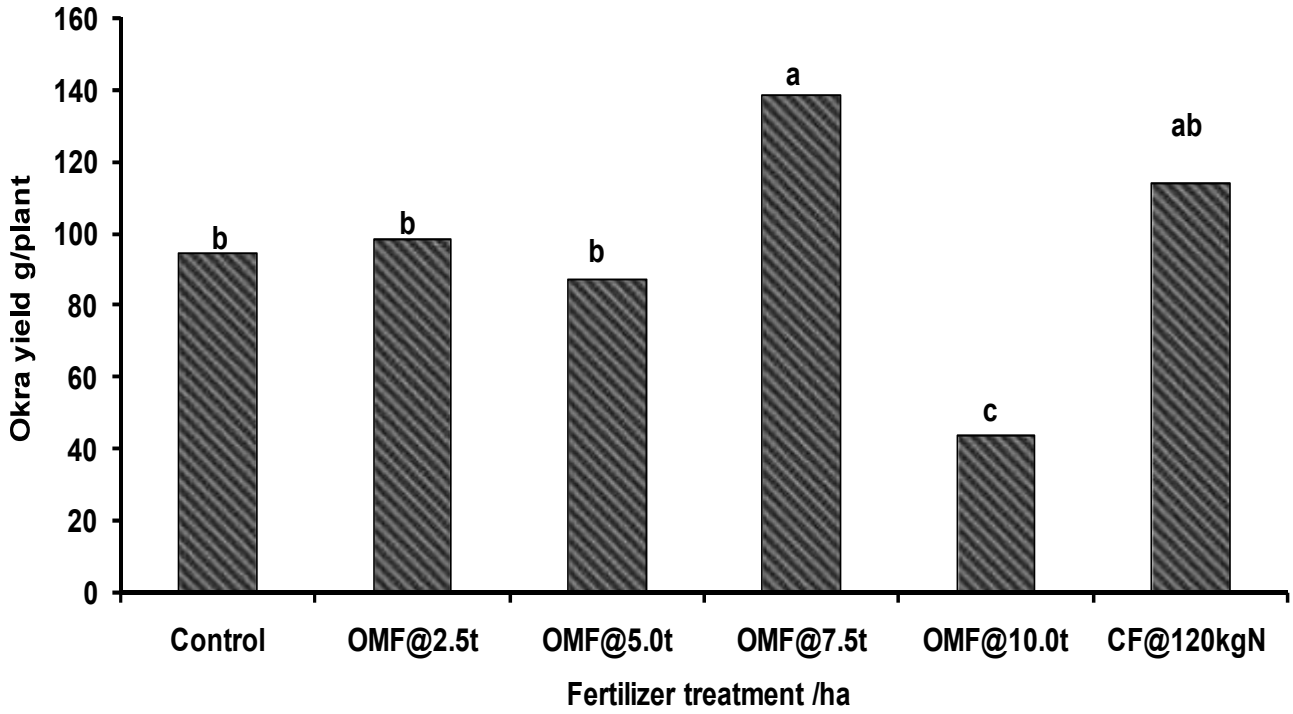

Figure 1. Effect of organic and inorganic fertilizers on okra yield in the screenhouse (n=3).

OMF- Organo-mineral fertilizer
CF - Chemical fertilizer

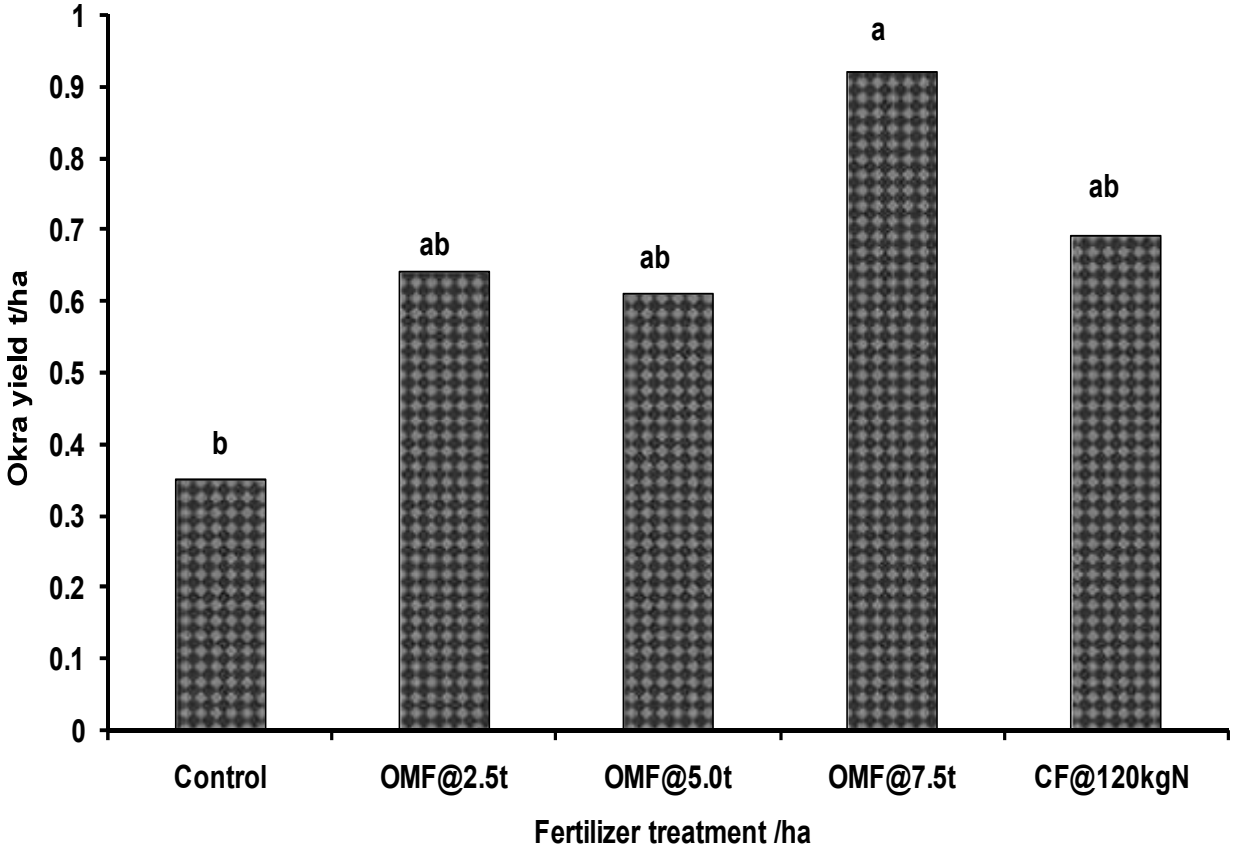

Figure 2. Effect of organic and inorganic fertilizers on okra yield in the field (n=3).

OMF-Organo-mineral fertilizer
CF- Chemical fertilizer

Table 1:Properties of the soils and organo-mineral fertilizer used for the experiment

Property	Soil		Organo-mineral Fertilizer	
	Greenhouse	Field	Property	Value
pH (H_2O)	6.27	6.10	Nitrogen (%)	5.69
Organic carbon (g/kg)	1.6	1.59	Phosphorus (%)	6.6
Available P (mg/kg)	3.42	3.42	Potassium (%)	2.8
Total nitrogen (g/kg)	1.1	1.2	Calcium (%)	6.4
K (cmol/kg)	0.1	0.1	Fe (mg/kg)	6.9
Sand (%)	90	85.8	Mg (mg/kg)	3.0
Silt (%)	6.0	6.80	Zn (mg/kg)	3.74
Clay (%)	4.0	7.40		
Textural class	Sand	Sand		

Table 2: Effect of chemical and organo-mineral fertilizers on the height, canopy cover, stem girth and number of leaves of okra in the screen house at 7 WAP (n = 3).

Treatment/ha	Height (cm)	Canopy cover (cm)	Stem girth (cm)	Number of leaves
Control	31.0	37.30	1.38	8.00
OMF@ 2.5 t	32.33	43.00	1.35	5.83
OMF@ 5.0 t	32.75	39.75	1.28	7.33
OMF@7.5 t	34.83	41.60	1.32	6.17
OMF@ 10 t	27.00	38.00	1.34	8.83
CF@ 120 kg N	30.58	41.50	1.35	7.00
LSD (P<0.05)	6.54	NS	NS	NS

WAP- Weeks After Planting
OMF – Organo-mineral Fertilizer
NS – Not Significant
CF – Chemical fertilizer

Table 3: Okra height, stem girth, number of leaves and canopy cover as affected by chemical and organo- mineral fertilizers in the field at 7 WAP (n = 3).

Treatment/ha	Height (cm)	Stem girth (cm)	Number of leaves	Canopy cover (cm)
Control	14.20	0.75	8.00	39.00
OMF@ 2.5 t	24.60	1.16	10.00	58.30
OMF@ 5.0 t	27.00	1.34	11.30	64.00
OMF@7.5 t	26.20	1.49	16.00	68.70
CF@ 120 kg N	28.80	1.48	16.70	67.80
LSD ($P<0.05$)	11.65	0.52	6.13	21.17

WAP- Weeks After Planting
OMF – Organo-mineral Fertilizer
CF- Chemical fertilizer

Table 4: Post-planting Soil Properties as affected by chemical and organo-mineral fertilizers

Treatment/ha	Screenhouse						Field				
	pH (H_2O)	O.C. (%)	Total N (%)	Available P (mg/kg)	K (cmol/kg)		pH (H_2O)	O.C. (%)	Total N (%)	Available P (mg/kg)	K (cmol/kg)
Control	6.26	0.72	0.14	20.04	0.16	Control	5.96	0.55	0.09	27.12	0.13
OMF@2.5t	6.40	0.61	0.14	22.09	0.13	OMF@2.5t	6.09	0.46	0.26	21.40	0.17
OMF@5.0t	6.52	0.65	0.18	24.12	0.11	OMF@5.0t	6.07	0.32	0.12	41.54	0.15
OMF@7.5t	6.45	0.70	0.21	31.68	0.09	OMF@7.5t	6.18	0.53	0.14	41.80	0.19
OMF@10t	6.45	0.61	0.11	19.73	0.13	CF@120kgN	-	-	-	-	-
CF@120kgN	6.35	0.53	0.18	31.49	0.13		5.98	0.42	0.14	51.43	0.21
LSD (P<0.05)	NS	NS	NS	NS	NS	LSD (P<0.05)	NS	NS	NS	NS	NS

OMF-Organo-mineral Fertilizer CF- Chemical Fertilizer NS – Not Significant

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Table 3 shows the effect of chemical and organo-mineral fertilizers on the height, stem girth, number of leaves and canopy cover of okra in the field. The highest plant height of 28.80 cm was given by plants treated with chemical fertilizer, the value is significantly ($P \leq 0.05$) higher than the one for control but are not significantly different from the values of other fertilizer treated plants. The stem size of fertilized okra plants were significantly increased above the unfertilized plants, highest value (1.49 cm) which is not significantly different from other fertilizer treated plants were observed on 7.5 t/ha OMF treated plants. Chemical fertilizer application resulted into significantly ($P<0.05$) higher number of okra leaves (16.70) when compared with the control, this value is however not significantly different from other fertilizer treated plants with the exception of plants treated with 2.5 t/ha OMF. Canopy spread of okra plants was influenced by fertilizer application, values ranged from 21.17 cm to 68.70 cm, highest value (68.70 cm) was given by plants treated with 7.5 t/ha OMF and is significantly ($P \leq 0.05$) higher than control value but not significantly different from other fertilizer treated plants.

Figure 2 shows the effect of fertilizer application on the weights of okra fruits in the field, the highest fruit weight (1.10 t/ha) which is significantly ($P \leq 0.05$) higher than the control was given by plants treated with 7.5 t/ha OMF, Ayoola and Makinde (2007) reported that complementary use of organic and inorganic fertilizers improved maize yield. This value is however not significantly different from the values given by plants treated with other fertilizer types. Okra yield followed this order of fertilizer treatment: 7.5 t/ha OMF > NPK > 2.5 t/ha OMF > 5.0 t/ha OMF > control. The rates of organo-mineral fertilizer which brought about significant increases in okra growth and yield were between 2.5 and 7.5 t/ha, Omueti et. al. (2000) reported that OMF could be used at the rate of 2.5- 7.5t/ha for vegetable production. Fertilizer application had no significant effect on the pH, organic carbon, total nitrogen, available phosphorus and potassium contents of post planting soil (Table 4).

Fertilizer application did not improve the nitrogen, phosphorus, potassium and organic carbon contents of post-planting soil both in the field and the screen house, this may be as a result of the low concentrations of the

above nutrients in the soils used for the experiment. Okra could be grown with organo-mineral fertilizer at the rate of 2.5 -7.5t/ha for maximum agronomic and fruit yield.

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