Growth, yield and nutritional values of okra varieties grown organically at Ogbomoso, Southwest Nigeria

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ABSTRACT

Field experiments were conducted at Ladoke Akintola university of Technology Teaching and Research farm, Ogbomoso Nigeria in the cropping seasons of 2009 and 2010 to determine the effect of organic nitrogen fertilizer on the growth, fruit yield, quality and chemical contents of okra varieties. Four okra varieties (Guanfranco Fuscello, Ogbomoso Local, LD 88 and NH 47-4) were subjected to four levels of organic nitrogen (N) fertilizer (0, 30, 45 and 60 kg. N $ha^{-1)}$. There were three replicates fitted into factorial experiment in a randomized complete block design. Data collected on the growth parameters, yield and quality attributes were analyzed using Analysis of Variance. The plant height and number of leaves of okra varieties increased with the increasing rates of applied organic N fertilizer, the highest values were obtained at maximum rate of 60 kg N ha^{-1}. There was significant effect on the plant height and number of leaves of okra among the okra varieties. The yield and yield components investigated increased as the organic N rate increases from 0 to 45 kg. N ha^{-1} significantly NH47-4 Ogbomoso local had the highest fruit yield, while LD88 had the least value. Although, all the okra varieties are very rich in protein, carbohydrate and other nutrient elements, NH47-4 had the highest nutritional contents. There were significant varietals differences on both fruit yield and quality attributes of okra. The combined nitrogen and varietals differences were significant for the grain yield in both years.

Keywords: *Abelmoschus esculentus,* varieties, organic fertilizer, growth, yield, quality.

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INTRODUCTION

Okra is an important leaf and fruit vegetable crop in Nigeria. It originates probably from East Africa and today is widely distributed in the tropics, subtropics and warmers portions of the temperate region. The plant is grown for its pods that are available in varying lengths and colours (white, red, green and purple) (ECHO, 2003).

Okra has many uses and is variable in nutrient composition (Tindall, 1986; Grubben and Denton, 2004). The immature pods can be used as fried or boiled vegetables in soups and stews. Okra is processed as a frozen pickled or canned product. Fresh fruit vegetable that can be consumed in different forms. In Nigeria, okra is usually boiled in water resulting in shiny soups and sauces, which are relished. The fruits also serve as soup thickeners (Schippers, 2000). Okra contains carbohydrate, proteins and vitamin C in large quantities (Adeboye and Oputa, 1996). The edible portions of the pod are good sources of protein as well as ascorbic acid content of 20g/100g (Keshinro and Ketiku, 1979) and high level of calcium, fibre, ash. Mature seeds contain about 21% of edible oil (Oyolu 1983; Grubben and Denton, (2004). It serves as an important source of dietary fibre and source of vitamin A, B and C as well as calcium, phosphorus, iron and iodine (Purseglove, 1991). The edible of the okra pod contains approximately water 86.1%, protein 2.2%, fat 0.2%, carbohydrate 9.7%, fibre 1.0% and ash 0.8%. (Fatokun, 1976; Okigbo, 1974). Okra seed is also a potential source of high quality protein due to its high lysine content. The crop can therefore serve as a supplement to cereal-based diets (Al-Wandawi, 1983). Well drained fertile soils with an adequate content of inorganic and organic fertilizers and reserve of the major elements are generally suitable for its growth. In Nigeria, various studies have been conducted on nutrients requirements of okra with inorganic fertilizers (Taylor, 1986) while very little have been reported on sole use of organic manure or in combination with inorganic fertilizers. There is scarcity information on the appropriate rate of organic fertilizer for the maximum yield and nutritional quality of okra in south western Nigeria. The objective of this study was to determine the optimum organic fertilizer rate for maximum yield and nutritional values, as well as the best okra variety for Ogbomoso, which falls within the guinea savannah zone of south west Nigeria.

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. Ogbomoso lies between longitude 4^0 10'E and latitude 8^0 10'N with mean annual rainfall of between 1,150 and 1,250mm of rain. The

temperature regime is high all year round. The mean minimum temperature is 28^0C and the maximum temperature is 33^0C with high humidity of about 74 all year round except in January when the dry wind blows from the North (Olaniyi, 2006). The plot of land used was made of sandy loam soil which was formerly under yam cultivation and left to fallow for almost two cropping seasons. The pre-treatment soil samples were collected for analysis before the field was manually cleared. The P^H was determined by means of the digital electronic P^H meter using 1:2 (soil: water) suspension. Ammonium Acetate (NH_4AC) was used to leach 10g of soil sample. The calcium content was determined through titration; the magnesium was determined by atomic absorption spectrophotometer while the potassium and sodium content were determined by flame photometry and total nitrogen by the micro-Kjeldahl method. The particle size analysis was done by hydrometer method (IITA, 1989).

The plot was marked using the field tape and pegs. The site was manually cleared and forty eight raised beds were made to conserve the soil and its nutrients availability. The area of land used was 0.18ha. The plot of land was divided into three blocks, each containing 16 beds to give a total of 48 beds. Each bed size was 2.2m x 1.2m with a spacing of 0.5cm within the bed in each block and 1m spacing between blocks, to ease movement during cultural operations.

Table 1: Effect of organic fertilizer rates and varieties on the growth parameters of okra

	Fertilizer	PLANT HEIGHT		NUMBER OF LEAVES	
Variety	Rate	3WAS	6WAS	3WAS	6WAS
Guanfranco	0	7.4	16.3	5.5	10.6
Fuscello	30	8.0	16.8	5.6	11.0
	45	9.9	21.8	6.2	11.0
	60	11.1	22.2	6.3	12.0
Ogbomoso local	0	9.0	18.6	5.6	7.5
	30	10.7	19.2	6.0	8.6
	45	12.7	21.0	6.3	8.8
	60	10.1	22.5	5.7	9.1
LD 88	0	7.7	14.4	5.8	8.4
	30	8.1	15.0	5.8	9.0
	45	9.7	18.0	5.9	9.1
	60	8.2	18.2	6.0	9.3
NH47-4	0	9.5	17.8	5.6	7.8
	30	10.8	18.4	5.6	8.0
	45	11.5	18.8	6.1	8.2
	60	11.1	21.	5.6	8.4
LSD (0.05)					
Fertilizer(F)		Ns	Ns	Ns	Ns
Variety (V)		1.67	Ns	Ns	1.00
F X V		Ns	Ns	Ns	Ns

Table 2: Yield and Yield components of Okra as affected by organic fertilizer rates and varieties

Variety	Fertilizer rate	Number of fruits	Fruit diameter	Fruit length	Fruit weight	Yield (t/ha)
Guanfranco	0	8.7	5.5	9.9	60.7	2.4
Fuscello	30	8.7	5.5	11.0	72.8	2.9
	45	11.8	5.6	11.2	78.0	3.1
	60	8.0	5.8	11.3	59.2	2.4
Ogbomoso local	0	4.4	7.2	6.7	53.1	2.1
	30	8.1	7.4	5.3	72.5	2.9
	45	8.6	8.4	5.7	75.6	3.0
	60	5.7	8.3	5.5	58.7	2.3
LD 88	0	4.8	5.8	5.1	39.8	1.6
	30	7.8	6.8	5.3	91.5	3.7
	45	8.1	7.7	5.6	94.7	3.8
	60	7.0	7.0	6.3	71.8	2.0
NH47-4	0	8.3	8.1	4.5	90.8	3.6
	30	6.8	9.1	4.8	94.8	3.8
	45	8.4	9.7	5.9	118.8	4.8
	60	6.3	10.3	5.1	104.9	4.2
LSD (0.05)						
Fertilizer(F)		Ns	0.46	0.32	ns	ns
Variety (V)		1.84	0.46	0.32	17.93	17.93
F X V		ns	0.21	0.10	ns	ns

Table 3: Nutrient contents of Okra varieties as affected by organic fertilizer rates.

Variety	Fertilizer rate (kg)	%Ca	%Mg	%K	%P	%N	Mg Fe
Guanfranco	0	0.48	0.42	2.45	0.08	1.14	183.21
Fuscello	30	0.50	0.43	2.36	0.04	1.16	218.84
	45	0.50	0.41	2.69	0.14	1.71	292.83
	60	0.41	0.40	2.48	0.08	1.32	200.29
Ogbomoso local	0	0.41	0.38	2.31	0.06	1.01	177.83
	30	0.52	0.40	2.28	0.05	1.06	221.63
	45	0.34	0.38	2.43	0.09	1.26	348.00
	60	0.32	0.38	2.08	0.02	1.22	345.00
LD 88	0	0.30	0.39	2.24	0.04	1.01	228.26
	30	0.45	0.41	2.32	0.05	1.03	240.59
	45	0.28	0.38	2.43	0.08	1.64	259.58
	60	0.44	0.41	2.45	0.06	1.24	155.91
NH47-4	0	0.25	0.38	2.42	0.11	1.06	193.64
	30	0.35	0.40	2.33	0.07	1.18	250.48
	45	0.28	0.40	2.48	0.15	1.33	379.44
	60	0.20	0.35	2.38	0.04	1.29	363.07
LSD (0.05)							
Variety		0.01	0.01	0.04	0.002	ns	1.10
Fertilizer		0.01	0.01	0.04	0.002	0.21	1.10
V X F		0.0001		0.0016	0.000004	ns	1.21

Four varieties of okra; Clemson spineless obtained from the Seed Project Company, Kano, Ogbomoso local, NH 47-4 and LD88 gotten from Agronomy department, LAUTECH, Ogbomoso were subjected to four rate of organic fertilizer. The organic fertilizer used was unfortified sunshine fertilizer, applied as a Nitrogen source at 0, 30, 45 and 60kg N ha^{-1} rates. The 16 treatment combinations were laid out in a factorial experiment and fitted into a randomized complete block design, replicated thrice.

The 4 varieties were randomly assigned to plots within each replicate and seeds were planted by direct seeding at a spacing of 0.5 x $0.5m^2$. The plants were thinned to one plant per stand just before fertilizer application. Unfortified sunshine organic fertilizer was applied at 0, 30, 45 and 60 kg. N ha^{-1} to each variety randomly in each replicate, 3 weeks after sowing (WAS). Crop protection practices were carried out with spraying of neem seed extract at 2, 4 and 6 WAS against defoliating pests and weeding was done manually thrice at 3, 6 and 9 WAS.

Data collection on growth and yield of okra varieties began 3 WAS at 2-weekly intervals from six tagged plants per plot. Plant height was measured with a meter ruler from the base to the tip of the main shoots. Number of leaves was recorded by counting and recorded. The yield attributes included number of flowers, number of fruits, fruit length (cm), fruit diameter (cm), fruit weight/plant (g) and fruit yield/hectare (t./ha). Flowers on each bed were counted every five days interval for two weeks

After the okra plants have developed fruit and have reached maturity, the fruits were harvested from the six tagged plants on each bed at every five days interval. The harvested fruits were measured with measuring rule and venial calliper to know the length and diameter respectively, of each fruit. The number of fruits was determined by counting while the fresh weight of okra fruits was measured using an electric weighing balances.

After determination of fruit yield, fruits were dried in an oven at 60^0C for 48 h. Dried samples were milled and ground for tissue analysis. Total P was determined by the Vanadomolybdate method, K and Ca were determined by flame photometry and Mg and Fe were determined by atomic absorption spectrophotometer. Total N was analyzed by the micro-Kjeldahl procedure and crude protein was obtained by multiplying the total N by a factor of 6.25 (IITA, 1982). Since data recorded from the two year trials were similar, their average were determined, analysed and presented in this study. Data collected were subjected to analysis of variance in SAS (SAS, 1989) and the means were separated by the least significant difference at 5%probability level.

RESULTS AND DISCUSSION

Growth parameters: The growth parameters of okra varieties measured are presented in Table 1. The plant height and number of leaves of different okra varieties increased as plant aged. Also, these growth characters increased with increasing rate of applied organic fertilizer from 0 up to the maximum rate of 60kg/ha. . Although, the highest values were obtained from plants that received 60kg/ha, there was no significant different from the values recorded at 45kg and 60kg/ha of applied fertilizer. There are significant ($P<0.05$) varietals effects on the plant height and number of leaves of okra at 3 and 6 WAS, respectively. Ogbomoso local closely followed by NH47-4 gave the highest plant height while LD88 recorded the least values when no fertilizer was applied. Likewise, Guafranco fuscello closely followed by LD88 recorded the highest number of leaves while Ogbomoso local gave the least value, with and without fertilizer application. There is no significant varietal and fertilizer combined effect on both the plant height and number of leaves of okra at all the sampling periods under this study.

The increased in the growth parameters (plant height and number of leaves) with applied fertilizer rates revealed that the applied organic fertilizer contained and supplied adequate amount of essential nutrients especially N needed for the rapid growth and development of okra plants. This is in accordance with the work of Olaniyi and Akanbi

(2007), which stated that organic fertilizers are capable of supplying the essential nutrient elements needed for plant growth and optimum productivity.

The optimum fertilizer rate of 45kg N/ha and a declined thereafter obtained in this study revealed that normal rate should be supplied and over application must be avoided (Olaniyi and Ajibola, 2008)..Application of nitrogen has been reported to significantly improve okra growth (Sharma *et al*; 1996, Katung, *et al,* 1996), and the variation among the varieties reconfirmed the work of Olaniyi *et al*. (2009) for amaranths. The result obtained in this study reconfirmed the work of Akanbi *et al*. (2004) who reported that application of organic manure significantly increased the growth of okra.

Marketable Yield: The yield and yield components of okra varieties as influenced by organic fertilizer rates are shown in Table 2. The number of flowers, fruit diameter, fruit length, number of fruits, fruit yield per plant and per hectare increased with an increase in organic fertilizer rate. The highest values were obtained at the optimum rate of 45 kg N/ha, then thereafter a declined or remained stable for all the varieties. NH47-4 followed by LD88 gave the highest fruit yield, while Ogbomoso local recorded the least value at 45kg N/ha. The applied organic fertilizer rates significantly improved fruit diameter and fruit length of okra varieties. The yield and yield components measured were significantly ($P<0.05$) influenced by the varietals effect with NH47-4 followed by Ogbomoso local had the highest fruit yield, while LD88 recorded the least value, when no fertilizer was applied. There are significant ($P<0.05$) interactive effects of variety and fertilizer rate on the fruit diameter and length, of okra

The great increased in the yield and yield components of okra with fertilizer application was in accordance with other researchers (Fatokun and Chelda, 1983; NIHORT, 1983), who reported a significantly improvement in okra fruit yield. Ayodele, (1993) noted that the use of fertilizers was responsible for over 50% yield increase in crops. Fatokun and Chelda (1983) reported that application of nitrogen increased fresh pod yield of okra plants. The use of organic fertilizers in okra production has been reported by various researchers (Akanbi *et al*., 2004 ; Olaniyi and Akanbi, 2007) as a fruit yield enhancement. This is in agreement with the findings of Akanbi *et al*. (2010) who reported that application of organic manure significantly increased the fruit yield of okra. The significant differences in the entire yield components among varieties meant that okra varieties responded differently to the applied treatment which may be due to differences in genetic constitutions.

Nutrient contents of okra fruits: The percentage compositions of Ca, Mg, K, P, Fe and N of okra fruits are presented in Table 3. The nutrient contents of okra fruits were significantly ($P<0.05$) influenced by fertilizer rate, variety and fertilizer rate by variety combined effects, except for N content which was only significantly ($P<0.05$) improved by fertilizer application. The nutrient compositions of okra fruits increased as the fertilizer level increases from 0 up till 45kg N/ha, thereafter a slight declined or remained stable at 60kg N/ha. There were significant differences in %Ca, %Mg, %K, %P and %Fe among the varieties except N that shows no significance effect among varieties. The highest nutrient compositions were found in Guafranco fuscello except P and Fe which were obtained in large quantity from NH47-4 and LD 88 respectively, when no fertilizer was applied. The local variety used (Ogbomoso local) had low fruits nutrient compositions among the varieties used. The nutrient compositions of okra fruits were significantly influenced by the combined effects of variety and fertilizer application, except on N content.

One of the factors limiting okra production is soil nutrient content especially nitrogen. Nitrogen fertilizer makes up 50% of all the nutrients inputs, and its availability play important role in determining farmers crop yield. This has been attributed to the fact that its role in the plant can not be easily substituted. Application of nitrogen has been reported to significantly improve okra dry matter partitioning (Akanbi *et al*, 2010) and chemical compositions of okra fruits (Fatokun and Chelda, 1983 ; Al- Wandawi, 1983).

CONCLUSION

Different rates of unfortified sunshine organic fertilizer were applied to the four varieties of okra, to determine their effect on growth, yield and nutritional values of okra. The application of organic fertilizer significantly increased the growth, yield and nutritional values of okra varieties. The optimum growth, fruit yield and better nutritional values were obtained at 45kg/ha for all the varieties. The response of each of the variety to fertilizer level varied slightly with NH47-4 recorded better performance with and without fertilizer application. Therefore, the recommended rate for optimum growth, yield and nutritional values of okra in this agro ecological zone is 45kgN/ha, while NH47-4 performed better among the tested varieties.

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