International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 5, No. 5, p. 111-117, 2014

RESEARCH PAPER OPEN ACCESS

Effect of organic manure and sowing date on the growth and yield of okra (*Abelmoschus esculentus* Moench) in Samaru, Zaria, Nigeria

Mahmoud Babawuro Ali[1*], Hamma Idi Lakun[2], Saidu Mohammed Sani[3], Hayatudden Mohammed Adamu[4]

[1]*Federal College of Agriculture, Dadin Kowa Gombe State, Nigeria*

[2]*Samaru College of Agriculture ABU, Zaria, Nigeria*

[3]*Federal University Kashere, Gombe State, Nigeria*

[4]*Federal College of Education Technical, Gombe State, Nigeria*

Article published on November 23, 2014

Key words: Okra, organic manure, sowing date, growth, yield.

Abstract

A field trial was conducted to study the effect of organic manure and sowing date during the 2013 cropping season at the Teaching and Research Farm of Samaru College of Agriculture, Ahmadu Bello University, Zaria on the growth and yield of okra. Treatments consist; no manure (control), cow manure, sheep manure and poultry manure and sowing date of 8th May, 2013, 22nd May, 2013, 5th June, 2013 and 19th June, 2013 cropping season and laid out in a split plot design with organic manure assigned to the main plots; whereas sowing date to the sub plots with three replications. Data were collected on growth and yield parameters; Plant height, number of leaves plant^{-1}, number of branches plant^{-1}, leaf area plant^{-1}, number of pods plant^{-1}, pod length plant^{-1}, pod girth plant^{-1}, pod yield plot^{-1} and pod yield hectare^{-1}. Results obtained indicated that growth and yield of okra was lowest in control treatments which showed that the organic manure and sowing date used in the study especially poultry manure and sowing date of 5th June, 2013 positively influenced the performance and yield of okra. Poultry manure and sowing date 5th June, 2013 positively increased okra plant height and number of leaves plant^{-1}, number of branches plant^{-1}, number of pods plant^{-1}, pod yield plot^{-1} and pod yield hectare^{-1} compared to control treatments. There was no significant effect with respect to leaf area plant^{-1}, pod length plant^{-1} and pod girth plant^{-1}. Based on the findings of this experiment it could be deduced that poultry manure and sowing date of 5th June, 2013 promoted higher growth and yield of okra.

* **Corresponding Author:** Mahmoud Babawuro Ali ✉ Babawuroalikumo@gmail.com

Introduction

Okra (*Abelmoschus esculentus* (L.) Moench) is one of the most important vegetable grown in Nigeria (Tiamiyu *et al.*, 2012). It is an annual crop grown mainly as fruits and leafy vegetables in both green and dried state in the tropics (Tiamiyu *et al.*, 2012). The crop is used as soup thickener which may also be served with rice and other food types (Tiamiyu *et al.*, 2012). The fresh fruit is a good source of vitamins, minerals and plant protein (Eke *et al.*, 2012). Schippers (2000) stated that okra contains about 20% edible oil and protein, while its mucilage is utilized for medicinal purposes. The mature stem contains crude fibre which is used in paper industries and for making ropes (Schippers, 2000). Okra's flower can be very attractive and sometimes used in decorating the room (Schippers, 2000). Okra is cultivated under rain fed and in irrigated areas on a wide range of soils (Tiamiyu *et al.*, 2012). The production is seriously affected by the use of low yielding, sub-optimal and inappropriate manure doses as well as late sowing date (Tiamiyu *et al.*, 2012); Kol *et al.*, 2012; Ayoub and Afrah, 2014). The use of inorganic fertilizer has not been helpful under intensive agriculture because it is often associated with reduced crop yield, soil acidity and nutrients imbalance especially when okra is sown very late in the season (Tiamiyu *et al.*, 2012); Ojeniyi, 2000; Diruba *et al.*, 2009; Ekwu and Nwokwu, 2012). Furthermore, the extent to which farmers can depend on this input is constrained by unavailability of the right type of inorganic fertilizers at the right time, high cost, lack of technical know-how and lack of access to credit (Tiamiyu *et al.*, 2012; Eke *et al.*, 2012). This has encouraged scientists towards making use of organic materials both organic manures as well as organic wastes for improving the physical properties of soils that allow profitable crop production (Tiamiyu *et al.,* 2012). Currently, the utilization of these organic materials in soil fertility management in Africa and planting period of the crop is not encouraging when compared with the countries in Asia (Tiamiyu *et al.*, 2012; Kolo *et al.*, 2012; Eke *et al.*, 2012). According to Ojeniyi (2000); Ijoyah (2010); Ijoyah and Jimba (2011), published works on organic manure use and appropriate sowing period of okra in Nigeria is rather scanty. The need to use renewable forms of energy and reduce costs of fertilizing crops has revived the use of organic fertilizers worldwide (Tiamiyu *et al.*, 2012). Improvement of environmental conditions and public health are important reasons for advocating increased use of organic materials (Tiamiyu *et al.,* 2012; Omisore *et al.*, 2009; Sanwal *et al.*, 2007; Premsekhar and Rajashree, 2009). Farmers in the Northern part of Nigeria grow okra as rain fed and irrigated crop with a wide range of organic materials at sub-optimal levels thereby resulting in the reduction in crop yield (Tiamiyu *et al.*, 2012). In view of the above, this study was conducted to evaluate the effects of organic manure and sowing date on the growth and yield of okra viety Clemson spineless in Samaru, Zaria.

Materials and methods

A field trial was conducted during the 2013 cropping season at the Teaching and Research Farm of Samaru College of Agriculture, Ahmadu Bello University, Zaria located on latitude 11°11'N and longitude 7°38'E and about 686m above sea level. Zaria falls under the Northern guinea Savannah agro ecological zone of north western Nigeria. The area has an annual rainfall range of 900 – 1,000 mm and mean annual temperature ranging from 25°C to 35°C (Tamiyu *et al.*, 2012); the soil of the area is sandy loam (Tamiyu *et al.*, 2012). The treatments consist of no manure (control), cow manure, sheep manure, poultry manure and sowing date of 8th May, 2013, 22nd May, 2013, 5th June, 2013 and 19th June, 2013 cropping season. The trial was laid out in a split plot design with organic manure in the main plots, whereas sowing date in the sub plots and three replications. After viability test, seeds were treated with Apron star at the rate of 10kg 3 kg^{-1} seeds before planting to protect the seeds against soil borne pathogens and pests (Tamiyu *et al.*, 2012). Planting was done at a spacing of 50 x 50cm. Four seeds of okra Clemson spineless were directly sown hole^{-1} at a depth of 2cm (Tamiyu *et al.*, 2012). After germination, seedlings were thinned to two plants stand^{-1} two weeks after

planting. Soil samples from (0–30cm) were collected from 8 different locations in the study area and were composited, air-dried and sieved through a 5mm sieve and their physical and chemical characteristics were determined before application of treatments (Tamiyu *et al.*, 2012). Organic manures were composted for two weeks and applied by broadcasting and thoroughly worked into the experimental plots a week to sowing. The trial beds measured 3 x 2m were watered and left for one week before planting okra seeds on them. This was to enable carbon-dioxide escape thus preventing burning and scorching of the tender seedlings (Tamiyu *et al.*, 2012). Cultural operations such as spraying, weeding were strictly observed as at when due. Five okra plants were sampled in the three inner rows of each treatment and used to record growth and yield attributes such as plant height, number of leaves plant^{-1}, number of branches plant^{-1}, leaf area plant^{-1}, number of pos plant^{-1}, pod length plant^{-1}, pod girth plant^{-1}, pod yield plot^{-1} and pod yield hectare^{-1}. Data collected were analyzed statistically using mixed model procedure of statistical analysis system software version 8. Means of treatments were compared using Duncan Multiple Range Test (DMRT) at 5% level of probability (Rangaswamy, 2010).

Results

Table 1 shows that the physical properties of the soil in 2013 cropping season was sandy-loam with high proportion of sand (82.51%), low silt (5.36%) and clay (12.12%). The chemical analysis revealed that the soil contains low amount of organic carbon (4.88%), pH in water (6.52), total nitrogen (3.50%), total phosphorus (2.10 mg kg^{-1}), potassium (1.88 mg kg^{-1}), magnesium (0.54 mg kg^{-1}), sodium (0.48 mg kg^{-1}) calcium (1.35 mg kg^{-1}) and cation exchange capacity (CEC) (5.20 mg kg^{-1}).

Table 1. Physical and chemical properties of the soil used for the experiment during the 2013 cropping season.

Mechanical composition	Soil depth 0-30cm
Sand %	82.51
Silt%	5.36
Clay%	12.12
Organic carbon%	4.88
pH in H_2O	6.52
Total nitrogen %	3.50
Available phosphorus mg kg^{-1}	2.10
Available potassium mg kg $^{-1}$	1.88
Available calcium mg kg $^{-1}$	0.54
Available sodium mg kg $^{-1}$	0.48
Available magnesium mg kg $^{-1}$	1.35
Cation exchange capacity (CEC) mg kg $^{-1}$	5.20

Plant height (cm)

Table 2 shows a significant difference at P≤0.05 between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 cropping season. The control of no manure applied, significantly produced the lowest means of 6.56, 8.34, and 12.00 on plant height; whereas poultry manure significantly produced the highest means of 9.20, 12.28 and 14.15 throughout the sampling periods on plant height. Table 2 also shows that there was a significant difference at P≤0.05 between means due to sowing date at 3WAS, 6WAS and 9WAS during the 2013 cropping season. Sowing okra on 8th May, 2013 significantly produced the lowest means of 6.34, 8.25, and 10.80 on plant height; whereas sowing okra on 5th June, 2013 significantly produced the highest means of 9.10, 12.21 and 14.10 throughout the sampling periods on plant height.

Number of leaves plant^{-1}

Table 2 shows a significant difference at P≤0.05 between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 cropping season. The control of no manure applied; significantly produced the lowest means of 3.80, 4.26, and 8.30 on number of leaves plant^{-1}; whereas poultry manure significantly produced the highest means of 5.25, 6.67 and 10.21 throughout the sampling periods on number of leaves plant^{-1}. Table 2 also shows a significant difference at P≤0.05 between means due to sowing date at 3WAS, 6WAS and 9WAS during the 2013 cropping season. Sowing okra on 8th May, 2013 significantly produced the lowest means of 3.76, 4.21, and 8.31 on number of leaves plant^{-1}; whereas sowing okra on 5th June, 2013 significantly produced the highest means of 5.16, 6.62 and 10.11 throughout the sampling periods on number of leaves plant^{-1}.

Table 2. Growth parameters of okra as influenced by organic manure and sowing date in 2013 cropping season at Samaru, Zaria.

	Plant height (cm) plant^{-1}			Number of leaves plant^{-1}			Number of branches plant^{-1}			Leaf area (cm^2) plant^{-1}		
Organic manure	3WAS	6WAS	9WAS	3WAS	6WAS	9WAS	3WAS	6WAS	9WAS	3WAS	6WAS	9WAS
No manure (control)	6.56c	8.34c	12.00c	3.80c	4.26c	8.30b	3.14d	3.88d	4.42c	25.32b	26.72b	29.61d
Sheep manure	7.81b	10.43b	13.35b	4.32b	5.48b	8.33b	4.12b	4.36b	5.38b	25.68ab	26.92ab	31.83b
Poultry manure	9.20a	12.28a	14.15a	5.25a	6.67a	10.21a	5.22a	5.36a	6.16a	26.37a	27.48a	33.10a
Cow manure	7.33b	9.76bc	12.23bc	3.63bc	5.58b	9.99ab	3.87c	4.20c	5.32b	25.51b	26.33b	30.43c
SE±	0.24	0.42	0.53	0.22	0.24	0.38	0.09	0.15	0.18	0.23	0.26	0.28
Sowing date												
8th May, 2013	6.34d	8.25d	11.80c	3.76c	4.21c	8.31bc	3.12d	3.82d	4.41c	25.30d	26.68d	29.41d
22nd May, 2013	7.41b	10.22b	12.65b	4.28b	5.43b	8.26c	4.10b	4.32b	5.34b	25.65b	26.82ab	31.57b
5th June, 2013	9.10a	12.21a	14.10a	5.16a	6.62a	10.11a	5.20a	5.32a	6.12a	26.31a	27.38a	33.00a
19th June, 2013	7.23c	9.68c	12.21bc	3.54d	5.54b	9.84b	3.83c	4.23c	5.30b	25.48c	26.23c	30.34c
SE±	0.14	0.22	0.32	0.10	0.14	0.18	0.05	0.08	0.09	0.12	0.14	0.15
OM x SD	*	*	*	*	*	*	*	*	*	NS	NS	NS

Key: - OM = Organic manure, SD = Sowing date, NS = Not significant, * = Significant at 5% level of probability.

Number of branches plant^{-1}

Table 2 shows a significant difference at P≤0.05 between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 cropping season. The control of no manure applied; significantly produced the lowest means of 3.14, 3.88, and 4.42 on number of branches plant^{-1}; whereas poultry manure significantly produced the highest means of 5.22, 5.36 and 6.16 throughout the sampling periods on number of branches plant^{-1}. Table 2 also shows a significant difference at P≤0.05 between means due to sowing date at 3WAS, 6WAS and 9WAS during the 2013 cropping season. Sowing okra on 8th May, 2013 significantly produced the lowest means of 3.12, 3.82, and 6.16 on number of branches plant^{-1}; whereas sowing okra on 5th June, 2013 significantly produced the highest means of 5.20, 5.32 and 6.12 throughout the sampling periods on number of branches plant^{-1}.

Leaf area (cm^2) plant^{-1}

Table 2 shows a significant difference at P≤0.05 between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 cropping season. The control of no manure applied; significantly produced the lowest means of 25.32, 26.72, and 29.61 on leaf area plant^{-1}; whereas poultry manure significantly produced the highest means of 26.37, 27.48 and 33.10 throughout the sampling periods on leaf area plant^{-1}. Table 2 also shows a significant difference at P≤0.05 between means due to sowing date at 3WAS, 6WAS and 9WAS during the 2013 cropping season. Sowing okra on 8th May, 2013 significantly produced the lowest means of 25.30, 26.65, and 29.41 on leaf area plant^{-1}; whereas sowing okra on 5th June, 2013 significantly produced the highest means of 26.31, 27.38 and 33.00 throughout the sampling periods on leaf area plant^{-1}.

Number of pods plant^{-1}

Table 3 shows a significant difference at P≤0.05

between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 cropping season. The control of no manure applied; significantly produced the lowest means of 2.22, 2.56, and 3.10 on number of pods plant^{-1}; whereas poultry manure significantly produced the highest means of 4.26, 4.53 and 5.35 throughout the sampling periods on number of pods plant^{-1}. Table 2 also shows a significant difference at P≤0.05 between means due to sowing date at 3WAS, 6WAS and 9WAS during the 2013 cropping season. Sowing okra on 8th May, 2013 significantly produced the lowest means of 2.20, 2.52, and 3.08 on number of pods plant^{-1}; whereas sowing okra on 5th June, 2013 significantly produced the highest means of 4.22, 4.48 and 5.32 throughout the sampling periods on number of pods plant^{-1}.

Table 3. Yield parameters of okra as influenced by organic manure and sowing date in 2013 cropping season at Samaru, Zaria.

Organic manure	Number of pods plant^{-1}			Pod length (cm) plant^{-1}			Pod girth (cm) plant^{-1}			Pod yield plot^{-1} (kg)	Pod yield hectare^{-1} (tons)
Organic manure	8WAS	10WAS	12WAS	8WAS	10WAS	12WAS	8WAS	10WAS	12WAS	2.53d	
No manure (control)	2.22c	2.56d	3.10c	3.41a	4.11a	4.34a	2.10a	2.11a	2.12a	2.73c	2.78b
Sheep manure	3.35b	3.48b	4.38b	3.52a	4.16a	4.47a	2.10a	2.12a	2.16a	3.83a	2.86b
Poultry manure	4.26a	4.53a	5.35a	3.53a	4.35a	4.56a	2.11a	2.15a	2.17a	2.82b	3.23a
Cow manure	2.45c	2.88c	4.22b	3.43a	4.10a	4.44a	2.12a	2.11a	2.13a	0.22	2.90ab
SE±	0.23	0.24	0.26	NS	NS	NS	NS	NS	NS		0.24
Sowing date											
8th May, 2013	2.20c	2.52d	3.08c	3.38a	4.10a	4.33a	2.09a	2.10a	2.11a	2.48d	2.64c
22nd May, 2013	3.32b	3.44b	4.32b	3.48a	4.12a	4.45a	2.11a	2.11a	2.12a	2.68c	2.66c
5th June, 2013	4.22a	4.48a	5.32a	3.48a	4.32a	4.54a	2.12a	2.13a	2.14a	3.13a	3.11a
19th June, 2013	2.42c	2.78c	4.20c	3.40a	4.08a	4.43a	2.13a	2.11a	2.13a	2.78b	2.83b
SE±	0.12	0.13	0.14	NS	NS	NS	NS	NS	NS	0.12	0.13
OM x SD	*	*	*	NS	NS	NS	NS	NS	NS	*	*

Key: - OM = Organic manure, SD = Sowing date, NS = Not significant, * = Significant at 5% level of probability.

Pod length (cm) plant^{-1}

Table 3 shows that there was no significant difference at P≥0.05 between means due to organic manure and sowing date at 3WAS, 6WAS and 9WAS during the 2013 cropping season.

Pod girth (cm) plant^{-1}

Table 3 shows that there was no significant difference at P≥0.05 between means due to organic manure and sowing date at 3WAS, 6WAS and 9WAS during the 2013 cropping season.

Pod yield (kg) plot^{-1}

Table 3 shows a significant difference at P≤0.05 between means due to organic manure during the 2013 cropping season on pod yield plot^{-1}. The control of no manure applied; significantly produced the lowest mean of 2.53 on pod yield plot^{-1}; whereas sowing okra on 5th June, 2013 significantly produced the highest mean of 3.78 during the sampling period on pod yield plot^{-1}. Table 3 also shows a significant difference at P≤0.05 between means due to sowing date during the 2013 cropping season on pod yield plot^{-1}. Sowing okra on 8th May, 2013 significantly produced the lowest mean a of 2.48 on pod yield plot^{-1}; whereas sowing okra sowing date of 5th June, 2013 significantly produced the highest mean of 2.78 during the sampling period on pod yield plot^{-1}.

Pod yield (tons) hactare^{-1}

Table 3 shows a significant difference at P≤0.05 between means due to organic manure during the 2013 cropping season on pod yield hectare^{-1}. The control of no manure applied; significantly produced the lowest mean of 2.78 on pod yield hectare^{-1}; whereas sowing okra on 5th June, 2013 significantly produced the highest mean of 2.90 during the sampling period on pod yield hectare^{-1}. Table 3 shows

that there was a significant difference at P≤0.05 between means due to sowing date during the 2013 cropping season on pod yield hectare^{-1}. Sowing okra on 8th May, 2013 significantly produced the lowest mean of 2.64 on pod yield hectare^{-1}; whereas sowing okra at 6th June, 2013 significantly produced the highest mean of 2.88 during the sampling period on pod yield hectare^{-1}.

Discussion

The increased in plant height of okra due to organic manure and sowing date could be due to the contribution made by manure to increased in fertility status of the soil and adequate moisture; as there was low moisture in it (Tiamiyu *et al.*, 2012; Dilruba *et al.*, 2009; Ijoyah, 2010). Manure when decomposed increases both macro and micro nutrients as well as enhances the physical and chemical properties of the soil (Tiamiyu *et al.*, 2012). This could have led to its high vegetative growth (Eke *et al.*, 2012; Tiamiyu *et al.*, 2012). The non-significant difference observed in the treatments supplied with sheep and cow manure with control treatment could either be there were some nutrients already present in the soil or the plants need were satisfied with the quantity of nutrients present in the soil (Tiamiyu *et al.*, 2012). Okra grown on poultry manure and sown at the right time performed better in terms of the height of the plant than other two sources of organic manure and sowing date (Tiamiyu *et al.*, 2012; Ijoyah and Jimba, 2011). This shows that poultry manure was readily available and in the best form for easy absorption by the plant roots, hence there was a boost in the morphological growth of the plant (Tiamiyu *et al.*, 2012). The obtained results corroborated the finding of (Tiamiyu *et al.*, 2012; Ayoub and Afrah, 2014) in okra production in which they reported that organic manure, especially poultry manure could increase plant height of crops when compared with other sources of manures and sowing date. The increase in number of leaves plant^{-1} with organic fertilizer application and sowing date stressed its importance during the vegetative growth of plants (Tiamiyu *et al.*, 2012; Kolo *et al.,* 2012). The non-significant effect of manure sources on pod length may be due to the effect of these sources of organic manure on enhancing vegetative growth. All the nutrients supplied by the different manure sources might have been diverted to vegetative growth (Tiamiyu *et al.*, 2012). This may be due to their bulkiness and higher amount of nutrients already present in the soil may contribute to this phenomenon (Tiamiyu *et al.*, 2012). The increase in fresh pod weight of okra due to poultry manure and sowing date could be attributed to easy solubilization effect and sowing okra at the right time when moisture in the soil was adequate which enhanced the released of plant nutrients leading to improved nutrient status and water holding capacity of the soil. The results obtained were in agreement with the findings of (Tiamiyu *et al.*, 2012; Sanwal *et al.*, 2007; Premsekar and Rajashree, 2009; Ekwu and Nwokwu, 2012) in which they reported that higher yield response of crops due to organic manure application could be attributed to improved physical and biological properties of the soil resulting in better supply of nutrients to the plants.

Conclusion

Application of organic manure and sowing date had a significant effect on plant height, number of leaves plant^{-1}, number of branches plant^{-1}, leaf area plant^{-1}, number of pods plant^{-1} and pod yield plot^{-1}of okra grown during 2013 cropping season at Samaru, Zaria. The results obtained revealed that okra responded well to the application of poultry manure and sowing date of 5th June, 2013 compared to other sources of organic manures and other sowing date in the study. Based on the finding of this study, it could be recommended that applying poultry and sowing okra first week of June of every year would be good for greater pod yield of okra production.

References

Ayoub ZE Afrah AA. 2014. Effect of cultivar and sowing date on okra seed yield. Universal Journal of Applied Science **2(3),** 64 -67.

Dilruba S, Mizra H, Karim R, Kamrun N. 2009. Yield response of okra to different sowing time and application of growth hormones. Journal of

Horticultural Sciences and Ornamental Plants **1(1),** 10 -14.

Eke KA, Essien BA, Ogbu JU. 2008. Determination of optimum planting time of okra in the derived savannah. *Proc. of the 42nd Conf. of ASN at Abakaliki* 17th–23rd Oct. 2008. 242 – 245 p.

Ekwu LG, Nwokwu GN. 2012. Effect of plant spacing and planting date on the growth and yield of okra. International Journal of Agriculture and Rural Development **15(2),** 1041 -1048.

Ijoyah MO. 2010. Productivity of okra to varying sowing date in Makurdi, Nigeria. Journal of Applied Biosciences **32,** 2015-2019.

Ijoyah MO, Jimba J. 2011. Effects of planting methods, planting date and intercropping systems on sweet potato-okra yields in Makurdi, Nigeria. Agricultural Science Research Journal **1(8),** 184 -190.

Kolo E, Takim FO, Fadayomi O. 2012. Influence of planting date and weed management practice on weed emergence, growth and yield of maize in southern guinea savanna of Nigeria. Journal of Agriculture and Biodiversity Research **1 (3),** 33-42.

Ojeniyi SO. 2000. Effect of goat manure on soil nutrient and okra yield in a rain forest area of Nigeria. Applied Tropical Agriculture **5,** 20-23.

Omisore JK, Kasali MY, Chuckwu UC. 2000. Determination of optimum poultry manure rate for maize production. Proceedings of the 43rd Annual Conference of the Agricultural society of Nigeria (ASN) October 20 -23 Held at the National Universities Commission and Raw Materials Research and Development Council, Abuja Nigeria, 260 – 263.

Premsekhar M, Rajashree V. 2009. Influence of organic manure on growth, yield and quality of okra. American Eurasian Journal of Sustainable Agriculture **3(1),** 6 – 8.

Rangaswamy R. 2010. A Text Book of Agricultural Statistics, *S*econd Edition, New Age International Publishers, New-Delhi, India, 234-458.

Sanwal SK, Lakminarayana K, Yadav RK, Rai N, Yaldav DS, Mousumi B. 2007. Effect of organic manures on soil fertility, growth, physiology, yield and quality of turmeric. Indian Journal of Horticulture **64(4),** 444 – 449.

Schippers RR. 2000. African Indigenous Vegetable: an overview of the Cultivated Species. Chaltham U.K. National Resources Institute A.C.D.E.U. Technical Centre for Agro-culture and Rural Cooperation. 105 – 117 p.

Tiamiyu RA, Ahmed HG, Muhammad AS. 2012. Effect of sources of organic manure on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench) in Sokoto, Nigeria. Nigerian Journal of Basic and Applied Science **20(3),** 213 -216.