EVALUATION OF THE EFFECT OF ORGANIC MANURE AND INORGANIC FERTILIZER ON THE GROWTH AND YEILD OF OKRA (*Abelmoschus esculentus L, moench*) IN LOKOJA, KOGI STATE, NIGERIA.

By

Okee, Joshua Ikabi

Corresponding Email: okeejoshua22@gmail.com

Abstract

This research evaluated the effect of organic and inorganic fertilizer on the growth and yield of okra (Abelmoschus esculentus) in Lokoja. Randomized Complete Block Design (RCBD) with three replications was used. Treatments consisted of 50kg/ha, 100kg/ha, and 150kg/ha of NPK 15:15:15 fertilizer; 5t/ha, 10t/ha and 15t/ha of poultry manure. Data collected were subjected to Analysis of Variance and means found to be statistically significant were separated using Fisher's Least Significant Difference (F-LSD) at 5% level of probability. Plot treated with 10tonnes per hectare of poultry manure significantly had highest vegetative growth especially plant height of (145.23cm) while the least plant was 69.53cm treated with 5t/ha of poultry manure. The plot with highest number of leaves (80.00) is from 10tonnes per hectare, while shortest plant of 37.67 from plot treated with 50kg/ha of NPK. The largest stem girth (5.20cm) was obtained from 50kg/ha NPK and the smallest stem girth of 3.72cm from 15t/ha of poultry manure. The highest number of branches (14.33) was obtained from 10t/ha of poultry manure and least number of branches (8.67) from plot treated with 50kg/ha NPK. The pod length, number of seeds and pod diameter shows no significant difference across all weeks of observation, while the pod weight showed significant difference, where the heaviest pod of 0.2333kg from plot treated with 150kg/ha NPK, while the lightest pod of 0.1100kg from plot treated with 5t/ha of poultry manure. However, the application of 10t/ha of poultry manure and 150kg/ha NPK for optimum yield of okra is recommended.

Keywords: Okra, Poultry Manure, NPK, Optimum, Yield

INTRODUCTION

Okra (*Abelmoschus esculentus L. Moench*) commonly known as "lady's finger" is a popular vegetable in tropical and sub-tropical countries of the world (Bisht and Bhat, 2006). It is now widely distributed in the tropics including Nigeria (National Research Council, 2006). It is an important vegetable crop occupying a land area of 277,000 hectares with a production of 731,000 metric tons worldwide and productivity of 2.63 t/ha (FAO 2006). In Nigeria, okra is grown in

both wet and dry season but attract a larger profit in the dry season when the demand is often in excess with limited supplies (Ayeni *et al.,* 2012).

Okra is mainly cultivated for its pods which are cooked and eaten in African countries like Nigeria, Egypt and Sudan. It ranked above other vegetable crops such as Amaranths, lettuce, Cabbage (Kolawole *et al*., 2008). Vegetables play a vital role in the improvement of the diet of mankind (Schippers, 2000). In Nigeria, Okra is produced and consumed all over the country for the mucilaginous or "draw" property of the fruit that aid easy consumption of the staple food products such as 'eba', amala, akpu, pounded yam. (Denton and Olufolaji, 2000). Okra is the rich source of carbohydrate, amino acids, vitamin which has multipurpose use like fresh or cooked consumption, as fodder to animal, medicinal and industrial use (Farinde *et al.,* 2007; Kumar *et al.,* 2017). However, the nutritional quality of okra can be influenced by the application of organic fertilizers, such as poultry manure and liquid seaweed with the following composition, according to Zodape *et al.,* (2008): carbohydrate, 7.39%; protein, 28.04%; and dietary fibre, 35.55%. Due to its multiple nutritional uses, it is hoped to be used to overcome nutritional and food security challenges in developing countries (Kumar *et al.*, 2017).

A lot of research have been conducted on the effect of poultry manure and NPK on the growth and yield of many different kinds of plants like maize, yam, cassava and others, a few of the researches are conducted in Nigeria (Abou-Magel *et al*., 2006, Surekha and Rao (2001) and Prakash *et al*., 2002). Some of the researches show that poultry manure causes greater growth and yield than NPK (Oiken and Asiegbu, 2003). Other research shows the superiority of NPK over poultry manure in their effects on the growth and yield of okra crop plant (Elmar and Wolfang 1990). Yet the result of some other researches shows no clear difference in the effectiveness of NPK and poultry manure in promoting the growth and yield of tropical crops (Oiken and Asiegbu (2003). The differences in results of the researches make it difficult to establish the effect of NPK and poultry droppings on growth and yield. Consequently, more research works are needed to establish the difference between NPK 15:15:15 and poultry dropping in their effects on the growth and yield of okra plants.

The main objective of this study is to determine the response of growth and yield of Okra to NPK 15:15:15 and poultry manure application rates.

Specific objectives were to:

I. determine the rate of these fertilizers that gives optimum okra yield.
II. determine the level of each fertilizer that would result to best response of okra growth and yield.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted during the 2020 cropping season at a local farm in Lokoja, Kogi State, Nigeria of latitude 7° 49' and longitude 6° 45'E located in the Southern Guinea Savanna Agro-ecological.

Treatments and Experimental Design

The treatment consists of three levels each of NPK fertilizer 15:15:15 (N1, N2 and N3 at 50kg/ha, 100kg/ha and 150kg/ha respectively) and poultry manure (P1, P2 and P3 at 5t/ha, 10t/ha and 15t/ha respectively). The field experiment was laid out in Randomized Complete Block Design (RCBD) with treatments arranged in all possible factorial combinations giving a total of seven (7) treatments and replicated three times.

Plot Size

Each plot size was 2 m × 2 m and comprises of 3 ridges, with each plot giving an area of $4m^2$.

Alley within the replications and treatments are 0.5m and 1m respectively, While the total plot size measuring 8m x 17m resulting in a total area of $136m^2$.

Soil Analysis

Soil sample was randomly taken from the plot at 0 – 15cm. The soil was air-dried and sieved, using 2mm mesh sieve. Bulk soil samples were collected from the field to analyze for particle size distribution, pH, cation exchange capacity (CEC), organic matter content, total nitrogen and available phosphorus. Particle size analysis was determined by the textural triangle method. Soil pH was taken using pH electrode meter as described by (Rayment and Lyons, 2011). CEC (Cation Exchange Capacity) was determined using Carter summation method by summing the

total exchangeable bases together with total exchangeable acidity. Organic carbon was determined using the Walkey – Black Method (Wet Dichromate Oxidation Method). Kjeldahl method was used in the determination of Nitrogen content. Available phosphorus (P) was determined by Bray and Kurtz (1945) extraction method.

Soil Sampling

Composite soil samples were taken from five points on the experimental site at 0-15 and 0-30 cm depth prior to land preparation from the field to determine the physic-chemical properties of the soil.

Manure Sampling and Analysis

Poultry manure sample of broiler chicken was collected from God's Care Poultry Farm and analyzed using routine analysis in order to determine the chemical properties of the manure. Sample of poultry manure used was analyzed for its total nitrogen, phosphorus and potassium content to allow for the calculation of the required rates.

Land Preparation

The convectional tillage operations was carried out: the land was ploughed, harrowed and ridged at 75 cm apart before planting and preparation of ridges were carried out before seed sowing on the ridge.

Seed Source and Sowing

The seeds were obtained from the Kogi State Ministry of Agriculture, Lokoja.

Two okra seeds were sown per hole at intra row spacing of 40 cm on ridges at a depth of 3cm. The seedlings were thinned to one plant per stand at two weeks after sowing (WAS).

Manure Application

Poultry manure was applied 2 weeks before planting, by incorporating it into the soil along the ridges by making shallow groves about 5 cm as per varied treatments in the field trial.

Fertilizer Application

NPK fertilizer was applied by side dressing at 2 WAS as per treatments (50, 100 and 150kgha-1).

Weed Control

Force up at 1.4 kg ai ha-1 was used prior to land preparation to kill the emerged weeds before planting. Hoe weeding was carried out at 3 and 6 WAS in the field trial.

Pest and Disease Control

The okra plants were sprayed against beetles and caterpillars, by applying Cyper Force which has a systemic and contact action, at the rate of 0.5 litres per hectare (30 mls per 15litres of water) four times during plant growth, at five days intervals. Spraying starts from 3 weeks after seedling emergence, and stopped before the plant starts fruiting.

Harvesting

Harvesting was done by picking fresh tender pods. Pods were snapped off or cut with sharp knife.

Data collection

A two weekly data on plant height, stem diameter, number of leaves, number of primary branches per plant, pod length, pod diameter and pod yield was determined as means of sampling plants. Plant height and fruit length was measured by using a meter rule; stem diameter by using the thread and meter rule methods, while number of leaves, number of primary branches per plant and number of pods per plant were visibly counted. Pod weight was computed on fresh weight basis as sum of all harvest from net plot. Other parameters taken include days to first flowering.

Plant height

This was carried out by measuring the heights of the tagged plants with a meter rule from the top soil level to the tip of the terminal buds and the average recorded for each of the treatment.

Number of leaves per plant

This was taken by counting all fully expanded leaves on each of the tagged plants and the average value was recorded for each of the treatment.

Number of primary branches per plant

This was determined by counting all the developed primary lateral branches on each tagged plants and the mean value was recorded for each of the treatment.

Stem girth

This was determined using a thread to measure the plant stem diameter on each tagged plants. The measurement unit is in centimeter (cm).

Pod length

The length of six pods was taken from each plot, these were measured using meter rule and the average was recorded for each treatment.

Pods diameter

Six pods from the tagged plants in the plot was taken and their diameters measured, from, with Thread and the average was recorded for each treatment.

Pod weight

A weighing balance was used to weigh the sum of four harvests of fruits per plots.

Number of seeds per pod

The number of seeds was counted after drying the pod, the number of seeds of three pods from the tagged plants was counted.

Days to flowering

The day to flowering of the plant was determined after 42 days of sowing.

Statistical analysis

The growth and yield parameters collected were subjected to Analysis of Variance (ANOVA) to evaluate the effect of organic and inorganic manure on okra. Significantly different means were separated using Duncan Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Result of Soil Analysis

Table 1 shows the physical and chemical properties of soil at the experimental site at 0-15cm depth for 2020 cropping season. The results of the soil physical analysis showed that the textural class of the soil used for the field trial was clay loam. The analysis indicated that the soils used for the field trial was slightly acidic at 5.4, organic carbon of 0.78 and high in total nitrogen of 1.17. Available phosphorous was 11.25. Exchangeable bases in the field trial were high, where Ca , MG, CEC, K, and NA was 4.00, 3.26, 10.49, 0.33, and 0.50 respectively.

Table 1: Result of Soil Analysis

Soil properties	Soil sample (0 - 15cm) Values
Physical Properties.	
Sand %	36.9
Silt %.	31.4
Clay %.	31.7
Textural class	Clay Loam
Chemical Properties	
pH in H2O (1:2:5)	5.54
pH in CaCl2 (1:2:5)	5.29
Organic carbon%	0.78
Organic matter%	1.37
Total nitrogen%	1.17
Available	
Phosphorous mg/kg	11.25
Exchangeable bases	
(Cmol /kg/)	
Ca	4.00
Mg	3.26
K	0.33
Na	0.50
CEC	10.49

Result of Organic Manure Analysis

Table 2 shows the result of organic manures used in the experiment; poultry manure contained 2.86%N, 2.41%P and 1.46K.

Table 2: Result of Organic Manure Analysis

% Nitrogen (N)	% Phosphorus (P)	% Potassium (K)
2.86	2.41	1.46

Table 3: Effect of Organic Manure and Inorganic Fertilizer on Plant Height, Number of Leaves and Stem Girth of Okra in Lokoja, During 2020 Cropping Season.

	Plant height (cm)				Number of leaves				Stem girth (cm)			
Treatments	**2WAS**	**4WAS**	**6WAS**	**8WAS**	**2WAS**	**4WAS**	**6WAS**	**8WAS**	**2WAS**	**4WAS**	**6WAS**	**8WAS**
0t/ha	8.62	24.23	43.80	67.67^{b}	7.33	15.00	22.00	32.67^{b}	0.88	1.78	3.48	4.25
5t/ha	8.20	26.27	44.33	69.53^{b}	7.33	12.67	29.67	59.00^{ab}	0.73	1.98	3.10	4.12
10t/ha	12.53	31.43	76.33	145.23^{a}	8.67	15.33	56.67	80.00^{a}	0.82	1.98	3.85	4.45
15t/ha	11.47	26.67	51.20	78.87^{ab}	7.67	17.33	51.67	67.33^{ab}	0.87	1.72	3.10	3.72
50kh/ha	9.17	27.43	56.07	82.00^{ab}	7.33	13.00	35.00	37.67^{b}	0.83	2.12	4.12	5.20
100kg/ha	9.60	22.33	47.33	80.83^{ab}	7.67	11.33	37.33	69.33^{ab}	0.92	1.62	3.38	4.95
150kg/ha	9.67	26.27	44.33	74.93^{ab}	8.00	14.67	36.33	68.67^{ab}	0.85	1.88	3.33	4.33
LOS	**NS**	**NS**	**NS**	*****	**NS**	**NS**	**NS**	******	**NS**	**NS**	**NS**	**NS**
LSD	-	-	-	**74.88**	-	-	-	**41.90**	-	-	-	-

Source: Field Experiment, 2020

Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability.

WAS = weeks after sowing, LOS = level of significance, NS = non-significant,
LSD =least significant difference, * = significant, ** = highly significant.

Table 3 shows the effect of organic manure (poultry manure) and inorganic fertilizer (NPK 15:15:15) on plant height, number of leaves and stem girth of okra plant which was significant

($p \leq 0.05$) at 8 weeks after sowing (WAS) for plant height and number of leaves. No significant difference was observed for stem girth across the treatments. Plot treated with poultry manure at 10t/ha had the tallest okra plant (145.23cm) at 8WAS while the shortest okra plant (69.53cm) was obtained from plot treated with 5t/ha of poultry manure. For NPK fertilizer, the tallest plant (82.00cm) was observed from plot treated with 50kg/ha while the shortest plant height (74.93cm) was observed from plot treated with 150kg/ha at 8WAS. There was significant increase in okra plant height on the plot treated with 10t/ha of poultry manure, this progression conforms with findings of Aniefiok (2013) who reported that poultry manure increases plant height. This is also in line with Alasiri and Ogunlela (1999) who also reported that application of poultry manure at the rate 10t ha-1 gave an optimum growth and yield of okra at Owu Southwest Nigeria.

The highest number of leaves (80.00) was obtained from plot treated with 10t/ha of poultry manure, while the least number of leaves (59.00) was observed in plot treated with poultry manure. For NKP 15:15:15, the highest number of leaves (69.33) was derived from plot treated with 100kg/ha. Poultry manure at 10t/ha which gave the highest number of leaves is in agreement with the findings of Ajari *et al*., (2003) in okra production who reported that organic manure especially poultry manure could increase plant height and number of leaves in crops. Thus, indicating the importance of poultry manure on the vegetative growth of okra. The largest stem girth (5.20cm) was obtained from plot treated with 50kg/ha of NPK while the smallest girth (3.72) was obtained from plot treated with 15t/ha of poultry manure.

Table 4: Effect of Organic Manure and Inorganic Fertilizer on Number of Branches, Pod Length and Pod Diameter of Okra Plant in Lokoja, During 2020 Cropping Season.

	Number of branches			Pod length (cm)			Pod diameter (cm)		
Treatment	**4WAS**	**6WAS**	**8WAS**	6WAS	8WAS	10WAS	**6WAS**	**8WAS**	**10WAS**
0t/ha	6.00	9.67	13.33	8.10	8.80	10.20	4.88	5.27	4.62
5t/ha	4.67	7.00	10.33	8.97	9.73	10.60	4.92	5.43	5.70
10t/ha	6.00	10.00	14.33	9.07	9.70	9.20	5.10	5.13	4.93
15t/ha	4.67	6.67	9.33	8.83	9.63	10.17	4.90	4.90	4.97
50kh/ha	3.67	7.67	8.67	9.73	11.30	10.90	4.63	5.03	5.00
100kg/ha	5.00	7.33	12.67	8.70	9.63	10.03	4.75	4.77	5.52
150kg/ha	4.33	6.33	13.67	8.47	11.30	11.87	5.37	4.77	4.92
LOS	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
LSD	-	-	-	-	-	-	-	-	-

Source: Field Experiment, 2020

Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability.

WAS = weeks after sowing, LOS = level of significance, NS = non-significant, LSD =least significant difference.

Table 4 shows the effect of organic manure and inorganic fertilizer on the number of branches, pod length and pod diameter of okra plant. No significant difference ($P \geq 0.05$) was observed for the three parameters at 4 to 10^{th} weeks after sowing. Nevertheless, 10t/ha of poultry manure gave the largest number of branches (14.33) while 50kg/ha of NPK gave the least number of branches (8.67) at 8WAS. Plot treated with 150kg/ha of NPK gave the best pod length of 8.47, 11.30 and 11.87cm across all weeks observed, while the control plot was observed to give the shortest pod length of okra plant. The result obtained is in agreement with Babatola (2006) who reported an increased in okra yield due to NPK fertilizer application. This indicates that the application of

fertilizer is necessary in enhancing the soil nutrient status and increasing crop yield. At 10th WAS, the largest okra pod diameter (5.70cm) was observed in plot treated with 5t/ha of poultry manure, while the lowest okra pod diameter (4.60cm) was observed in control plot.

Table 5: Effect of Organic Manure and Inorganic Fertilizer on the Number of Seeds and Pod Weight of Okra in Lokoja, During the 2020 Cropping Season.

	Number of seeds			Pod weight (kg)
Treatment	**6WAS**	**8WAS**	**10WAS**	**10WAS**
0t/ha	39.67	105.67	103.67	0.127
5t/ha	86.00	95.67	116.33	0.110
10t/ha	97.67	101.33	100.00	0.117
15t/ha	77.33	83.00	94.67	0.113
50kh/ha	93.33	99.00	97.33	0.137
100kg/ha	81.33	107.33	116.67	0.113
150kg/ha	90.33	95.33	94.00	0.233
LOS	**NS**	**NS**	**NS**	****
LSD	**-**	**-**	**-**	**0.10**

Source: Field Experiment, 2020

Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability.

WAS = weeks after sowing, LOS = level of significance, NS = non-significant, LSD =least significant difference.

Table 5 shows the effect of organic and inorganic manure on the number of seeds in okra pods and the pod weight. The result shows no significant difference (at P≥0.05) between treatments for number of seeds but showed significant difference (P≥0.05) in pod weight at 10th WAS. However, plot treated with 100kg/ha of NPK was observed to produce the highest number of seeds (116.67) at 10th WAS while 150kg/ha produced the least number of seeds (94.00).

The pod weight with the heaviest pod was obtained from 150kg/ha of NPK producing a mean weight of 0.233kg, while the lightest pod with mean weight of 0.110kg was obtained from plot treated with 5t/ha poultry manure. From the results obtained, higher yields were observed from plot treated with inorganic fertilizers. Highly yield performance (pod length, number of seeds and pod weight) were observed from plots treated with inorganic fertilizer particularly 150kg/ha NPK, this could be due to quick mineralization and availability of nutrient embedded in inorganic fertilizer which is resourceful for subsequent utilization for reproductive development. This observation is in line with Akande *et al*., 2010 who reported that inorganic fertilizer can improve nutrient availability and increase crop yield. The result obtained is also in agreement with Omotosho and Shittu (2007) who reported that NPK fertilizer application significantly increased yield and yield components with optimum yield of okra at 150 NPK kg/ha in South Western Nigeria.

CONCLUSION AND RECOMMENDATIONS

From the experiment, it was discovered that higher vegetative growth [plant height (145.23cm) and number of leaves (80.00)] was obtained in plots treated with organic fertilizer (poultry manure), whereas optimum yield was obtained from plots treated with inorganic fertilizer (NPK 15:15:15). For effective growth of okra plant, the application of 10t/ha of poultry manure and 150kg/ha of NPK to improve okra yield is recommended. A combined treatment of poultry manure at 10t/ha and 150kg/ha of NPK is also recommended.

The study also suggests that further experiment should be carried out such as; different treatment combination of organic and inorganic fertilizers should be tried to see the possible results.

REFERENCES

Abou-Magel E.I., El-Bassiony M.A., and Fawzy Z.F. (2006) Effect of organic manure with or without chemical fertilizer on growth, yield and quality of some varieties of Broccoli plants. J. of *Applied Science Res*., 2(10) ,791-798.

Ajari, O Tsado, L. E. K., Oladiran, J. A. and Salako,E. A. (2003). Plant height and fruit yield of okra as affected by field application of fertilizer and organic matter in Bida, Nigeria. *The Nigerian Agricultural Journal*, 34: 74-80.

Akande, M. O., Oluwatoyinbo, F. I., Adediran, J. A. and Buari, K. (2003). Soil amendments affect the release of P from rock phosphate and the development and yield of Okra. *Journal of Vegetable Crop Production*, 9(2): 3-9, https://doi.org/10.1300/J068v09n02_02.

Alasiri, K. O. and Ogunkeye, O. O. (1999). Effect of different levels of poultry manure on seed yield of Okra. Proceedings 25th Annual conference of Soil Science Society of Nigeria, 21st – 25th November, 1999. Benin, Nigeria.

Aniefiok, I. A. (2013). Effects of Poultry Manure and Plant Spacing on the Growth and Yield of Waterleaf (*Talinum fructicosum* L. Juss). *Journal of Agronomy*, 12(3): 146-152.

Ayeni, L. S., Adeleye, E, O. and Adejumo, J. O. (2012). Comparative effect of organic,organo mineral and mineral fertilizers on soil properties, nutrient uptake, growth and yield of Maize (*Zea mays*). *International Research Journal of Agricultural Science and Soil Science*,2(11):493-497.

Babatola L. A, Ojo D. O, Adewoyin O. B (2002). Effect of NPK 20:10:10 fertilizer levels on the yield of okra-sweetcorn intercrop and post-harvest quality of okra. Proc. Hortic. Soc. Nig. Conf. pp 74-78.

Bisht, I. S and Bhat, K. V. (2006). Okra (*Abelmoschus spp*.). In: Ram, J. Singh (Editors), CRC Press. Genetic Resources, chromosome engineering, and crop improvement, vegetable crops, 3: 147-183.

Bray, R.H. and Kurtz, L.T. (1945) Determination of Total Organic and Available Forms of Phosphorus in Soils. *Soil Science*, 59, 39-45.

Denton and Olufolaji. Comparative effect of poultry manure, piggery manure and NPK fertilizers on the growth, yield and nutrient content of Okra (Abelmuschus esculentus). *International journal of current research and review* 7 (12) 1, 2015

FAO. The state of food and agriculture (Food and Agriculture Organization of the United Nations. 2006).

Farinde, A.J Owolarafe, O.I., and Ogungbemi, O.I. (2007). An overview of production, processing, marketing and Utilisation of Okra in Egbedore Local Government Area of Osun State, Nigeria. *Agricultural Engineering International: the CIGR Ejournal*. 9: 1-10.

Kolawole G. O Olapede A. O, Alade C. R, Olaniyi J. O (2008). Response of okra (*Abelmoschus esculentus*) varieties to NPK fertilizer in the South Guinea Savanna of Nigeria. Niger. *J. Horticult. Sci*. 13: 99-108.

Kumar Olapede A. O, Alade C.bR, Olaniyi J. O (2017). Irrigating okra with secondary treated municipal wastewater: Observations regarding plant growth and soil characteristics. *International Journal of Phytoremediation*,19 (5): 490 -499, https:// doi.o rg/10.1080/15226514.2016.1244169.

National Research Council. Okra lost crops of Africa. Vol. II Vegetables, 2006.

Oiken and Asiegbu (2003). The effect of NPK 15:15:15 fertilizers and poultry droppings on Tomato yield in Akpa, Ankpa Local Government in Kogi State. *Rosemary Laruba Akagwu.* 1(2) 84-87.

Omotosho S. O and Shittu O. S. (2007). Effect of NPK fertilizer rates and method of application on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench). *Res.J. Agron*. 1(2) 84-87.

Prakash Y.S., Bhadoria P.B.S. and Amitava R. (2002). Relative efficiency of organic manure in improving resistance and pest tolerance of Okra, *Ann. Agr Res.* 23, 525-531

Qhureshi, Z. (2007). Breeding Investigation in Bhendi (*Abelmoschus esculentus* (L.) Moench). Master Thesis, University of Agriculture Sciences, GKVK, Bangalore.

Rayment, G.E. & Lyons, D.J. 2011. *Soil Chemical Methods–Australasia.* CSIRO Publishing, Melbourne.

Schippers, R. R. (2000). African indigenous Vegetables, An overview of the cultivated species. DFID, CTA 118 pp. National Resources Institute (NRIU) University of Greenwich London, United Kingdom 214pp.

Surekha J. and Rao P.A., (2001). Management of aphids on bhendi with organic sources of NPK and certain insecticides. *Andhra Agricultural Journal*, 48, 56-60.

Zodape, S. T, Kawarkhe, V. J., Patolia, J. S., Warade A. D. (2008). "Effect of liquid seaweed fertilizer on yield and quality of okra (*Abelmoschus esculentus* L.). *Journal of Scientific & Industrial Research* 67, 1115-1117.