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The effect of organo-mineral and inorganic fertilizers on the growth, fruit yield, quality and chemical compositions of okra.

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Abelmoshus esculentus, organomineral fertilizer, inorganic fertilizer, okra quality, fruit yield.

1 SUMMARY

The field experiments were conducted at the Teaching and Research farm, Ladoke Akintola University of Technology, Ogbomoso in the 2005 and 2006 cropping seasons. The experiments were done to determine the effect of different levels of organo mineral and inorganic fertilizers on the growth, yield, quality and chemical compositions of okra. The treatments consisted of three levels of nitrogen, phosphorus and potassium (NPK) fertilizer (0, 150 and 200kg NPK ha^{-1}), and four levels of organo mineral fertilizer (0, 2, 3 and 4 t. ha^{-1}) used solely or in combination. This was a factorial experiment fitted into complete randomized block design with three replications. The data collected were number of leaves, plant height, number of fruits and fruit yield. The leaves and fruits nutritional contents and quality were also assessed.

The results showed that application of organomineral and inorganic fertilizers and their combinations significantly ($p \leq 0.05$) influenced the growth, yield, quality and nutritional contents of okra. Sole application of 150kgNPK ha^{-1} or 3 t. ha^{-1} organomineral fertilizer gave the highest growth, yield and quality of okra. However, there was no significant difference in the crop performance under these two fertilizer regimes. The combined application rates of 75kg NPK by 3 t. ha^{-1} organomineral fertilizer gave the best okra performance compared to other treatments. From the results, combined application of the two fertilizers type will reduce the farmer's budget for crop fertilization and inclusion of organic fertilizer in the combination will surely ensure production of crop under a less polluted environment.

2 INTRODUCTION

Okra is a flowering plant in the mallow family Malvaceae, originating from tropical and sub-tropical Africa and is natural to West Africa (Tindal, 1983). It was formerly considered a species of hibiscus, but is now classified in the genus *Abelmoschus*. The word okra is of Africa origin and means "Lady's fingers" in Igbo, a language spoken in Nigeria. Okra is mainly cultivated for its "pods" which are cooked and eaten in countries like Sudan, Egypt and Nigeria. It is also important in other tropical areas including Asia central and South America. In Nigeria, okra is grown in both the wet and dry season but attract a larger profit during the dry season when the demand is often in excess of the limited supplies. Fresh okra fruits are used as vegetable while the roots and stems are used for preparing "*gur*" or the brown sugar (Chauhan, 1972). Okra seeds are used for oil extraction.

Vegetables play a vital role in the improvement of the diet of mankind. Okra is a good source of vitamins, minerals, calories and amino acid found in seeds and compares favorably with those in poultry, eggs and soybean, (Thompson, 1949; Schipper, 2000). Fertilizer is a very essential input in crop production. The application of fertilizer is necessary for enhancing the soil nutrient status and increasing crop yield. Okra requires nutrients such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), sodium (Na) and Sulphur (S) for fertility maintenance and crop production. These nutrients are specific in function and must be supplied to plants at the right time and at the right quantity. Lack of sufficient amounts of these nutrients result in poor performance of the crop with growth been affected resulting to low yield (Shukla and Naik, 1993). The use of organic manure especially poultry dropping and ruminant dung for crop production has helped to improved agricultural practice in West Africa countries. Organic manure helps to improve the physical condition of soil and provide adequate amount of necessary nutrients for the soil productivity. Organic fertilizer play vital role as a major contributor of plant nutrients. It also acts as a store house for Cation exchange capacity and as a buffering agent against undesirable pH fluctuation (Adepetu and Corey, 1987).

Okra responds well to the dressing of organic and inorganic manure. Palm *et al* (1997) gave the importance of organic and inorganic fertilizer as essential tools in okra production. Okra can also be given combination of organic and inorganic fertilizers to improve the fruit yield and to supply balance nutrient to the crop (Mario *et al*, 1989). The objectives of this study is to determine the optimum level of organo mineral and inorganic fertilizer application for maximum growth, fruit yield, chemical compositions and quality of okra (*Abelmoschus esculentus*) fruits.

3 MATERIALS AND METHODS

The experiments were conducted during 2005 and 2006 cropping seasons at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso (8^0 10'N and 4^0 10'E), Nigeria. The plot was made of sandy loam soil, moderately drained, previously under maize cultivation and left to fallow for one cropping season. The conventional tillage operations which include ploughing and preparation of beds were carried out to conserve the soil and its nutrient availability (Olaniyi, 2007). The land was ploughed two weeks before the bed making for planting of okra seeds. The area of land used was 0.012ha. This plot of land was divided into three replicates, each containing 12 beds to give a total of 36 experimental units. Each bed size was 1.2m x 1.2m with 0.5m spacing between beds and 1m apart in each block of rows for easy movement during cultural operations. The seeds were planted at a spacing of 0.5m x 0.5m to give a total of 40,000 plants ha^{-1}.

The treatments used include 3 levels of NPK (0, 150 and 200 kg NPKha^{-1}), 4 levels of organomineral (O.M) (0, 2, 3 and 4 t. O.M. ha^{-1}), and their combinations (75kgNPK + t. O.M. ha^{-1} , 75kg NPK +3 t. O.M. ha^{-1}, 75kg NPK + 4t. O.M. ha^{-1}, 100kg NPK + 4t.O.M. ha^{-1}).These 12 treatments were assigned to a randomized complete block design fitted into a factorial experiment with three replications. The various fertilizer treatments were applied three week after planting. Routine cultural operations such as weeding at three weeks intervals by hoeing and spraying of karate ® (10ml per 20 liters of water) at two weeks intervals against insects attack were carried out.

The growth and yield parameters collected were plant height, number of leaves, number of fruits and fruit yield. Dry matter yield was determined by placing the harvested plants in brown envelops, and dried in an oven at 65^0C till a constant weight was obtained. The dried plant and seed samples were separately ground with a Wiley mill, and passed through a 0.5mm sieve. Total N was determined by the macro-Kjeldahl procedure as described by I.I.T.A (1975). The P and K contents of the plants were determined by wet digestion with a mixture of nitric, sulphric, and perchloric acids. Phosphorus concentration was determined by the vanadomolybdate yellow colorimetry method (Jackson, 1962). Digested samples were diluted and used to determine the concentration of K using an atomic absorption spectrophotometer. Concentrations of nutrient were expressed on the basis of percentage dry plant material. All the data collected were subjected to analysis of variance and mean compared by the least significant difference at 0.05 probability level.

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4 RESULTS AND DISCUSSION

The mean plant height and number of leaves of okra increased gradually with the aged (Table 1).

Table 1: The mean plant height and number of leaves of okra as affected by organomineral and inorganic fertilizers application.

Treatments	Plant Height (cm)			Number of leaves		
	Weeks after Planting					
	2	4	6	2	4	6
0	3.60	13.73	32.24	3.49	7.98	8.55
150kgNPKha^{-1}	3.52	11.48	33.05	3.40	7.42	8.89
200kgNPKha^{-1}	3.81	11.73	46.05	4.00	5.88	8.66
2t.O.Mha^{-1}	2.94	10.55	28.03	2.68	6.10	8.22
3t.O.Mha^{-1}	3.41	11.05	32.18	3.73	6.97	10.00
4t.O.Mha^{-1}	4.42	10.66	56.77	3.88	6.77	10.89
75NPKkg x 2t.O.Mha^{-1}	3.94	12.21	31.78	4.00	5.77	9.33
75NPKkg x 3t.O.Mha^{-1}	3.64	12.50	38.38	3.83	7.09	11.78
75NPKkg x 4t0.Mha^{-1}	3.42	9.25	39.51	4.00	6.97	8.57
100NPKkg x 2t.O.Mha^{-1}	3.14	10.55	25.38	2.68	7.11	10.00
100NPKkg x 3t.O.Mha^{-1}	3.47	10.05	25.53	3.77	4.97	8.77
100NPKkg x 4t.O.Mha^{-1}	3.32	10.03	24.24	4.00	6.33	7.77
L.S.D $_{0.05}$						
NPK	0.43	4.31	1.37	1.04	0.33	1.45
Organo mineral (O.M)	0.45	4.53	1.44	1.09	0.35	1.50
NPK x O.M	0.48	4.83	1.54	1.16	0.37	1.60

The plant height and number of leaves of okra were significantly ($p \leq 0.05$) increased as the applied NPK rate increased up to 200kgha^{-1} then declined thereafter. Similarly, the application of organomineral fertilizer significantly ($p<0.05$) increased the mean plant height with the optimum value recorded at 4t ha^{-1}. The values obtained differed significantly from one another. NPK and organo mineral combined effects significantly influenced the plant height and number of leaves with the highest value attained at 75kg NPK by 3t ha^{-1} as compared with the value obtained when no fertilizer was applied. These results are similar to the finding of Brown *et al.* (1995), who reported that the growth of okra plant was markedly influenced by the application of organomineral, NPK fertilizer and their combination as observed from the increased plant height and number of leaves compared to the control. The low response of okra to NPK fertilizer as compared to combined application of the two fertilizers is in agreement with the response patterns reported by other researchers on okra (Akanbi *et al.*, 2005) and on maize crop (Olaniyi *et al.*, 2005). This was largely due to the lower organic matter and total N in the soil as well as leaching and previous cropping history of the field. The effects of different levels of inorganic and organomineral fertilizer their combinations on the yield and yield components of *Abelmoschus esculentus* is presented in Table *2*.

The fruit development started at about five weeks after planting in all plots receiving NPK, organomineral and their combinations and it continued till the end of the data collection. NPK fertilizer application slightly increased the number of fruit and fruit yield of okra and the highest values were recorded with the application of sole NPK at 150kg ha^{-1} and 3t. ha^{-1} of organomineral fertilizers. There were significant differences in the effect of these two fertilizers on the okras number of fruit and fruit yield. The positive effect of NPK fertilizer on okra yield is in agreement with the work of Babatola & Olaniyi (1999) who reported better performance of okra when NPK fertilizer was applied.

Table 2:- The mean number of fruits and fruit yield of okra as affected by organo mineral and inorganic fertilizers application.

Treatments	**Number of fruit per plant**	**Fruit Yield(kgha^{-1})**
0	6.77	72.07
150kgNPKha^{-1}	7.44	83.82
200kgNPKha^{-1}	8.66	110.09
2t.O.Mha^{-1}	5.11	68.98
3t.O.Mha^{-1}	5.94	83.82
4t.O.Mha^{-1}	5.22	72.95
75NPKkg x 2t.O.Mha^{-1}	7.03	64.57
75NPKkg x 3t.O.Mha^{-1}	10.42	112.65
75NPKkg x 4t0.Mha^{-1}	5.81	64.86
100NPKkg x 2t.O.Mha^{-1}	6.55	91.88
100NPKkg x 3t.O.Mha^{-1}	7.61	106.17
100NPKkg x 4t.O.Mha^{-1}	8.51	100.74
L.S.D $_{0.05}$		
NPK	0.88	0.92
Organo mineral (O.M)	0.90	0.97
NPK x O.M	0.99	N.S

Organomineral fertilizer significantly ($p < 0.05$) increased the number of fruit and fruit yield with the optimum values recorded at 3t.ha^{-1}, then there after a slight declined. NPK and organomineral combinations gave the highest number of fruit and fruit yield. However, higher application rate of combined NPK and organomineral fertilizers beyond 75kg by 3t. ha^{-1} reduced the number of fruit and fruit yield of okra.

The 75kg NPK by 3t.ha^{-1} of organomineral proved most effective in ensuring good performance in terms of growth, and yield of okra. Also, this result is similar to those obtained by Akanbi *et al.* (2005), who observed a great increase in yield of okra when N fertilizer was combined with organomineral fertilizer.

The result of the nutrient composition of okra fruit and leaves as affected by the inorganic and organomineral fertilizer application and their combinations is presented in Table 3.

The result of the fruits (tissue) analysis of the okra showed the nutrients; %N, % Ca %Fe %Fiber and Vitamin C were significantly ($p \leq 0.05$) influenced by fertilizers application. These increased as NPK fertilizer levels increases up to the optimum rate of 150kgNPKha^{-1}, then decline there after. Likewise, the highest values were obtained when 3t.ha^{-1} of organomineral fertilizer was applied. NPK and organomineral combined effects significantly ($p \leq 0.05$) influenced nutrient compositions and quality of okra fruit and leaves with the highest value recorded at 75kgNPK by 3t.ha^{-1} of organomineral as compared with value obtained when no fertilizer was applied.

The protein found in okra is very important in human diet; it helps to build muscle tissue and makes up enzymes which control all the hormones that control the organ. It is also responsible for the contraction of muscular fibers, protect against disease, clotting of blood and transport of oxygen in blood by hemoglobin. Vitamins are required for good vision, help bone growth, proper circulation, and aids digestion. Okra is a good source of calcium, which helps to keep bone strong and lessen the chance of fractures. (Grubben and Denton, 2004). The response of okra to the two fertilizers varied slightly, with significant effects recorded for the growth parameters, nutritive values, and yield attributes. However, the sole application of 150kg NPK ha^{-1} and 3tha^{-1} organomineral fertilizer and their combination at 75kg NPK by 3t.ha^{-1} organomineral performed favorably well in terms of growth and fruit yield of okra. . Despite the environmental and other yield constraints encountered by the crop during the growth and fruit production periods, the overall assessment showed that it is essential to considered the main commercial fraction like the fruit yield performance of okra in choosing the level of organomineral and inorganic fertilizers and their combination suitable for use in okra production.

Table 3: nutritive values of okra leaves and fruits as affected by organomineral and inorganic fertilizers

NUTRITIONAL VALUES											
	%Nitrogen		%P	%Protein	%K	%Ca	%Fe	%Fibre		Vitamin C mg/100g	
Treatments	Leaf Fruit		Leaf Fruit	Leaf Fruit	Leaf Fruit	Leaf Fruit	Leaf Fruit	Leaf	Fruit	Leaf	Fruit
0	0.31	0.04	0.01	1.93	0.36	0.91	730.39	17.56	32.55	21.48	1.38
			0.10	0.25	0.38	0.86	788.99				
150kgNPK ha^{-1}	1.17	0.85	0.09	7.32	0.44	0.95	672.16	19.33	32.55	25.51	1.58
200 kgNPK ha-1			0.22	5.30	0.50	0.88	994.69				
2t.O.Mha-1	3.43	1.79	0.09	21.43	0.48	1.12	979.58	20.20	25.67	26.22	1.66
			0.27	11.18	0.52	1.02	1,093.26				
	0.36	0.25	0.07	2.25	0.48	1.00	617.42	18.88	33.40	24.67	1.46
			0.13	1.56	0.45	0.68	825.18				
3t.O.M ha-1	2.95	1.25	0.09	0.18	0.49	1.10	988.96	20.45	35.75	28.33	1.72
			0.33	7.8	0.56	0.90	1,160.26				
4t.O.Mha^{-1}	2.25	0.57	0.05	14.00	0.47	1.06	872.88	19.58	35.46	28.35	1.63
			0.29	3.56	0.52	0.10	916.26				
75kgx2tha^{-}	1.60	1.56	0.10	10.00	0.48	1.18	843.33	22.07	35.86	28.85	1.56
^{1}75kgx3tha^{-1}			0.35	9.75	0.55	0.91	902.18				
	4.12	2.02	0.15	25.70	0.51	1.35	1,015.25	25.10	38.75	30.52	1.88
			0.51	12.63	0.59	1.13	1,521.03				
75kgx4 tha^{-1}	2.65	0.32	0.06	16.50	0.38	0.58	860.75	20.65	36.00	29.18	1.69
100kgx2tha^{-1}			0.28	2.00	0.49	0.73	995.06				
	2.86	1.53	0.09	17.80	0.48	1.00	977.14	21.25	36.45	28.46	1.60
			0.36	9.57	0.55	0.86	1,000.95				
100kgx3tha^{--1}	3.01	0.55	0.10	18.90	0.49	1.23	995.15	23.35	37.05	29.05	1.73
			0.43	3.44	0.57	0.95	1,305.25				
100kgx4tha^{-1}	0.60	0.35	0.04	3.75	0.24	0.93	7540.1	18.36	35.53	27.65	1.56
			0.25	2.18	0.48	0.68	856.15				
L.S.D $_{0..05}$											
NPK	0.36	0.32	0.015	1.81	20.59	0.20	0	0.44	0	0.57	0.10
			29.27	12.10	0.057	0.16	36.04				
Organomineral	0.37	0.33	15.59	1.90	21.65	0.20	0	0.46	0	0.59	0.10
(O.M)			28.67	12.72	0.058	0.17	37.88				
NPK X O.M	0.40	0.35	16.97	2.03	23.12	0.22	0	0.50	0	0.63	0.11
			30.60	13.56	0.062	0.18	40.46				

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