AGRONOMSKI GLASNIK 2-3/2012.
ISSN 0002-1954

Original scientific paper
Izvorni znanstveni članak

VEGETATIVE GROWTH OF OKRA (*Abelmoschus esculentus* (L) Moench) LOCAL VARIETY INFLUENCED BY POULTRY MANURE AND INORGANIC FERTILIZERS

VEGETATIVNI RAST LOKALNOG KULTIVARA OKRE (*Abelmoschus esculentus* (L) Moench) POD UTJECAJEM GNOJA PERADI I ANORGANSKOG UMJETNOG GNOJIVA

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ABSTRACT

A study to investigate the effects of organic and inorganic fertilizers on okra (*Abelmoschus esculentus*) (40 days local variety) was carried out at the biological garden of the University of Ilorin, Ilorin, Nigeria. Poultry manure was used as organic fertilizer while inorganic fertilizers consisted of single super phosphate, urea, and NPK 15:15:15. Results obtained revealed that application of poultry manure enhanced more vegetative growth, when compared with NPK 15:15:15, urea, single super phosphate and control experiment in terms of stem height, stem girth, leaf area, and number of leaves. Number of leaves was highest in plants treated with urea (10.3) compared with those treated with poultry dung (8.0), single super phosphate (3.0), NPK15:15:15 (6.7) and least in the control experiment with (2.7). The study clearly indicated the efficacy of poultry dung as a promising organic manure while urea was the best among the inorganic fertilizers followed by NPK 15:15:15, and single super phosphate being the least for *A.esculentus* growth.

Key words: NPK, organic fertilizer, SSP, Urea, 40-day variety

SAŽETAK

Istraživano je djelovanje organskog i anorganskog umjetnog gnojiva na okru (*Abelmoschus esculentus*) (lokalni kultivar od 40 dana) u biološkom vrtu Sveučilišta IIorin u IIorinu u Nigeriji. Upotrijebljen je gnoj peradi kao organsko umjetno gnojivo dok se anorgansko umjetno gnojivo sastojalo od jednostavnog superfosfata, ureje i NPK 15:15:15. Dobiveni rezultati pokazuju da je primjena gnoja peradi poboljšala vegetativni rast u usporedbi s NPK 15:15:15 i urejom, jednostavnim superfosfatom i kontrolnim pokusom u smislu rasta stabljike, obujma stabljike, područja listova i broja listova. Broj listova bio je najveći kod biljaka tretiranih urejom (10.3) u usporedbi s onima tretiranim gnojem peradi (8.0), jednostavnim superfosfatom (3.0), NPK 15:15:15 (6.7) i najmanji u kontrolnom pokusu (2.7). Istraživanje jasno upućuje na djelotvornost gnoja peradi kao obećavajućeg organskog gnojiva dok je urea bila najbolja među anorganskim gnojivima, a slijede NPK 15:15:15 i jednostavni superfosfat kao najslabiji za rast okre *A.esculentus.*

Ključne riječi: NPK, organsko gnojivo, SSP, urea kultivar od 40 dana

INTRODUCTION

Okro (*Abelmoschus esculentus)* L. Moench belongs to the family of plants called Malvaceae in the order Malvales. The okra plant was first placed in Hibiscus, the largest genus of the family distributed throughout the world (Gopalakrishnan 2007). It has different local names in Africa. For instance, in Nigeria, the Yorubas call it *Ila*, the Ibos call it *Okawale*, the Hausas call it *Kubewa*, while the Edos call it *Ikhiavbo*. Okra is a popular fast growing annual vegetable crop which is mostly cultivated in the southern part of Nigeria. Abeokuta, Oyo, Ogbomoso, Ondo and Ekiti are some of the major places where okra is grown in large quantities in the southern part of Nigeria. The fruit is a capsule 5-20 cm long containing numerous green or dark brown to black seeds (Schippers 2000). Soil high in organic matter and enough water tends to sustain the plant for longer growing period which in turn gives a good yield (NIHORT, 1985). Okra responds well to fertilizer application (Babatola, 2006). The quantity of N, P and K in one tonne of dry poultry manure has been estimated to be about twice the N, P, and K levels in a tonne of dry cow, sheep and goat manures. The nitrogen content of poultry manure has been reported to be about

30 kg/tonne, Phosphorus 4 kg/tonne and Potassium 24 kg/tonne (KARI, 2000). Poultry manure is widely recognized as a soil conditioner for raising soil pH and exchangeable bases levels. The effectiveness of rock phosphate as P source is enhanced by the solubilizing effect of poultry manure (Akande et al., 2005).

Use of organic manures to meet the nutrient requirement of crop would be an inevitable practice in the years to come for sustainable agriculture since, organic manures generally improve the soil physical, chemical and biological properties along with conserving the moisture holding capacity of soil and thus resulting in enhanced crop productivity along with maintaining the quality of crop produce (Eghball et.al.,2002).

Although the organic manures contain plant nutrients in small quantities as compared to the inorganic fertilizers, the presence of growth promoting principles like enzymes and hormones, besides plant nutrients make them essential for improvement of soil fertility and productivity (Dileep, 2005).

Despite the beneficial qualities of poultry manure, rates as high as 20 t/ha may be required to ensure adequate soil coverage especially in fields with low fertility and those that have been subjected to inorganic fertilization for many years. Under intensive agriculture, inorganic fertilization is often associated with reduced crop yield, soil acidity and nutrient imbalance (Kang & Juo, 1980; Ojeniyi, 2000). A lot of work has been done on okra and other related vegetables but not much has been reported on the influence of organic and inorganic fertilizers on the 40 days local variety of okra. It was therefore, the objective of this study to investigate the influence of both organic and inorganic fertilizers on 40days variety of okra grown in a large quantity in Ilorin and its adjoining towns and villages.

MATERIALS AND METHODS

Sandy loamy soil used for the experiment was obtained from a location within the biological garden of the University of Ilorin main campus. The soil was filled into a set of 45 plastic buckets which were perforated at the bottom to allow drainage of excess water. Poultry manure was dried, crushed and used as organic fertilizer. Inorganic fertilizers of N.P.K.(15:15:15), Single Super Phosphate (SSP) and Urea ($CO[NH_2]_2$) served as inorganic fertilizers. Okra seeds of a local variety (40-day variety) were obtained in an agrochemical shop

in Ilorin city. Five levels of organic fertilizers (15, 20, 25, 30 and 35g) and three levels of inorganic fertilizers (3, 5, 7g) were used. Both organic and inorganic fertilizers were mixed with the soil in the plastic pots before planting. Each of the fertilizer treatments was replicated three times while the control pots were without fertilizer. The pots were previously watered before planting and then arranged randomly in an open space in the biological garden. Watering was done regularly on a daily basis. Germination and growth parameters were taken at 2, 3, 4, 5, 6, 7 and 8 weeks after planting (WAP). Data were analyzed by analysis of variance (ANOVA) using SPSS package while means were separated by Duncan Multiple Range Test (DMRT).

RESULTS

Stem Height

Stem heights were greater in all the poultry manure concentrations than in the control except in 1WAP and 2WAP where concentrations were 20, 30 and 35g and stem heights were either at par with or shorter than in the control experiment (Table 1). In all, stem height was best in poultry manure of 15g concentration followed by 20 and 25g respectively (Table 1).

Table 1: Effect of Poultry Manure concentration on Okra stem height in (cm)

Tablica 1.: Djelovanje koncentracije gnoja peradi na visinu stabljike okre u (cm)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	13.01^{ab}	15.5^{b}	17.5^{b}	19.3^{c}	20.6^{c}	20.8^{c}	21.1^{c}
15	16.6^{a}	23.7^{a}	32.97^{a}	38.8^{a}	44.7^{a}	46.5^{a}	49.8^{a}
20	12.8^{ab}	19.3^{ab}	28.0^{ab}	35.0^{ab}	38.4^{ab}	41.5^{ab}	46.2^{ab}
25	16.3^{a}	21.5^{a}	30.8^{ab}	34.3^{ab}	39.7^{ab}	43.1^{ab}	50.2^{a}
30	10.9^{b}	15.7^{b}	25.8^{ab}	30.9^{b}	35.6^{b}	38.3^{b}	41.0^{b}
35	10.6^{b}	14.9^{b}	23.9^{bc}	29.7^{b}	35.0^{b}	38.0^{b}	41.5^{b}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Among the inorganic fertilizers used, single super phosphate (SSP) gave little support to early growth of okra stem height. Control experiment was better in stem height than concentrations of 3 and 5g of SSP from 1WAP to 5WAP, while 7g gave an improvement over lower concentrations as stem height increased generally with age of okra plant as also observed in all SSP concentrations (Table 2). Similar observation as in SSP was also recorded in Urea treated okra stem height and observation was throughout the growing period up to 7WAP except in the least concentration of 3g which gave the greatest stem heights (Table 3). Stem height were greater in the control

Table 2: Effect of single super phosphate concentration on Okra stem height in (cm^2).

Tablica 2.: Djelovanje koncenracije jednostavnog superfosfata na visinu stabljike okre u (cm^2)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	13.1^{ab}	15.5^{ab}	17.5^{ab}	19.3^{ab}	20.6^{ab}	21.0^{ab}	21.1^{a}
3	11.4^{ab}	13.2^{ab}	15.4^{ab}	18.1^{ab}	22.1^{ab}	24.4^{ab}	28.0^{a}
5	11.5^{ab}	13.1^{ab}	15.1^{ab}	17.3^{ab}	22.0^{ab}	29.0^{ab}	29.0^{a}
7	14.2^{a}	17.5^{a}	22.7^{a}	25.1^{a}	29.1^{a}	29.0^{ab}	32.5^{a}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Table 3: Effect of urea concentration on Okra stem height in (cm)

Tablica 3.: Djelovanje koncentracije ureje na visinu stabljike okre u (cm)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	13.1^{ab}	15.5^{ab}	17.5^{ab}	19.3^{ab}	21.0^{ab}	21.0^{ab}	21.1^{a}
3	8.9^{bc}	11.1^{bc}	14.8^{ab}	18.0^{ab}	24.0^{ab}	28.0^{ab}	32.0^{a}
5	5.2^{c}	6.4^{c}	9.2^{b}	11.7^{b}	16.0^{b}	18.0^{b}	20.2^{a}
7	5.7^{c}	7.1^{c}	9.2^{b}	12.8^{b}	15.0^{b}	21.0^{ab}	28.0^{a}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

experiment than all the urea concentrations at 23, 4, 5, and 6WAP except at 3g concentration (Table 3). Stem heights of okra plants treated with NPK inorganic fertilizers were greater than in the control experiments except at 7g concentration at 1-3WAP (Table 4). Okra plants treated with NPK fertilizers produced taller stems than both urea and single super phosphate fertilizers (Tables 2-4).

Table 4: Effect of NPK15.15.15 concentration on Okra stem height in (cm)

Tablica 4.: Djelovanje koncentracije NPK 15:15:15 na visinu stabljike okre u (cm)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	13.1^{ab}	15.5^{ab}	17.5^{ab}	19.3^{ab}	21.0^{ab}	21.0^{ab}	21.1^{a}
3	14.9^{a}	16.0^{ab}	19.6^{a}	25.3^{a}	29.2^{a}	32.0^{a}	36.3^{a}
5	13.8^{a}	16.2^{ab}	19.1^{a}	24.0^{a}	27.0^{ab}	32.5^{a}	34.3^{a}
7	12.7^{ab}	14.1^{ab}	17.4^{ab}	20.4^{ab}	26.0^{ab}	28.4^{ab}	32.5^{a}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Table 5: Effect of poultry manure concentration on Okra leaf numbers

Tablica 5.: Djelovanje koncentracije gnoja peradi na broj listova okre

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	4.0^{c}	5.0^{b}	4.7^{b}	4.3^{c}	3.3^{b}	3.3^{b}	2.7^{b}
15	5.7^{a}	7.0^{a}	6.3^{a}	5.7^{bc}	5.0^{bc}	6.3^{a}	7.0^{a}
20	5.3^{ab}	6.3^{a}	6.7^{a}	6.3^{ab}	5.7^{ab}	6.0^{a}	7.0^{a}
25	5.3^{ab}	6.3^{a}	7.3^{a}	7.0^{ab}	6.7^{ab}	7.0^{a}	8.0^{a}
30	4.7^{abc}	6.3^{a}	7.3^{a}	7.3^{a}	7.6^{a}	6.3^{a}	6.7^{a}
35	4.3^{bc}	6.0^{a}	8.0^{a}	7.6^{a}	7.3^{a}	6.0^{a}	5.3^{ab}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Table 6: Effect of single super phosphate concentration on Okra leaf numbers

Tablica 6.: Djelovanje koncentracije jednostavnog superfosfata na broj listova okre

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	4.0^{ab}	5.0^{ab}	5.0^{ab}	4.3^{bc}	3.3^{b}	3.3^{cd}	2.7^{c}
3	4.0^{ab}	3.7^{ab}	4.3^{b}	4.3^{bc}	3.3^{b}	2.7^{d}	2.3^{c}
5	4.0^{ab}	4.7^{ab}	5.0^{ab}	4.3^{bc}	3.3^{b}	3.3^{cd}	2.0^{c}
7	4.7^{ab}	6.0^{a}	4.3^{b}	4.0^{c}	4.0^{b}	3.7^{cd}	3.0^{c}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz p<0,05
WAP= tjedan nakon sadnje

Table 7: Effect of urea concentration on Okra leaf numbers

Tablica 7.: Djelovanje koncentracije ureje na broj listova okre

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	4.0^{ab}	5.0^{ab}	5.0^{ab}	4.3^{bc}	3.3^{b}	3.3^{cd}	2.7^{c}
3	4.7^{a}	6.0^{a}	7.0^{ab}	7.3^{ab}	8.3^{a}	9.0^{a}	9.3^{ab}
5	2.3^{b}	3.0^{b}	4.3^{b}	4.0^{c}	4.0^{b}	5.0^{bcd}	5.7^{bc}
7	2.7^{b}	3.7^{ab}	5.0^{ab}	7.0^{abc}	9.0^{a}	10.0^{a}	10.3^{a}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz p<0,05
WAP= tjedan nakon sadnje

Number of leaves

More leaves were observed in poultry treated okra plants than in those of control experiments (Table 5). Leaf number increased with age of the okra plants and even beyond vegetative stage to reproductive stage (Table 5). Number of leaves in okra treated with inorganic fertilizer of SSP was at par with the control experiments and there was a decrease as the fruiting stage set in (Table 6). Urea fertilizer enhanced higher and continuous increase from vegetative to reproductive stage. Concentrations of control experiments of 3 and 7g were better than 5g as well (Table 7). All the concentrations of NPK inorganic fertilizer enhanced good leaf production which, however, dropped sharply at 8WAP, which was at the peak of reproductive stage (Table 8).

Table 8: Effect of NPK 15:15:15 concentration on Okra leaf numbers

Tablica 8.: Djelovanje koncentracije NPK 15:15:15 na broj listova okre

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	4.0^{ab}	5.0^{ab}	5.0^{ab}	4.3^{bc}	3.3^{b}	3.3^{cd}	2.6^{abc}
3	5.0^{a}	6.0^{a}	8.0^{a}	8.0^{a}	8.0^{a}	6.7^{abc}	5.7^{abc}
5	5.0^{a}	5.7^{ab}	8.0^{a}	7.7^{a}	8.0^{a}	8.7^{a}	6.0^{abc}
7	5.0^{a}	6.0^{a}	6.3^{ab}	7.3^{ab}	8.3^{a}	8.0^{ab}	6.7^{abc}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Stem Girth

Thicker stem girths of okra plants were recorded in all the poultry manure concentrations than in the control experiments (Table 9). Higher concentrations of 5 and 7g of SSP produced thicker okra stem girths than the control experiments (Table 10). Urea fertilizer enhanced thicker okra stem girth in all its concentrations than the control experiments but less thicker in poultry, NPK and urea treated okra plants (Tables 11, 9, 10 and 12).

Table 9: Effect of poultry manure concentration on Okra stem girth in (cm)

Tablica 9.: Djelovanje koncentracije gnoja peradi na obujam stabljike okre (cm)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	0.2^{c}	0.5^{d}	0.8^{b}	0.8^{a}	0.8^{d}	0.9^{b}	0.9^{b}
15	0.9^{a}	1.3^{a}	1.6^{a}	1.7^{a}	1.6^{c}	1.7^{a}	1.8^{a}
20	0.8^{a}	1.2^{ab}	1.5^{a}	1.5^{a}	1.7^{bc}	1.9^{a}	2.1^{a}
25	0.6^{b}	1.1^{abc}	1.5^{a}	1.6^{a}	1.8^{abc}	2.1^{a}	2.3^{a}
30	0.4^{bc}	0.9^{c}	1.6^{a}	1.7^{a}	2.0^{a}	2.1^{a}	2.2^{a}
35	0.3^{c}	1.0^{bc}	1.6^{a}	1.7^{a}	1.9^{ab}	2.2^{a}	2.3^{a}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Table10: Effect of single super phosphate concentration on Okra stem girth in (cm)

Tablica 10.: Djelovanje koncentgracije jednostavnog superfosfata na obujam stabljike okre (cm)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	0.2^{c}	0.5^{d}	0.8^{b}	0.8^{a}	0.8^{d}	0.9^{b}	0.9^{b}
15	0.9^{a}	1.3^{a}	1.6^{a}	1.7^{a}	1.6^{c}	1.7^{a}	1.8^{a}
20	0.8^{a}	1.2^{ab}	1.5^{a}	1.5^{a}	1.7^{bc}	1.9^{a}	2.1^{a}
25	0.6^{b}	1.1^{abc}	1.5^{a}	1.6^{a}	1.8^{abc}	2.1^{a}	2.3^{a}
30	0.4^{bc}	0.9^{c}	1.6^{a}	1.7^{a}	2.0^{a}	2.1^{a}	2.2^{a}
35	0.3^{c}	1.0^{bc}	1.6^{a}	1.7^{a}	1.9^{ab}	2.2^{a}	2.3^{a}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Table11: Effect of urea concentration on Okra stem girth in (cm)

Tablica 11.: Djelovanje koncentracije ureje na obujam stabljike okre (cm)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	0.2^{d}	0.5^{c}	0.8^{c}	0.8^{de}	0.8^{c}	0.9^{d}	0.9^{de}
3	0.3^{bcd}	0.7^{abc}	1.0^{bc}	1.0^{cd}	1.2^{bc}	1.7^{bc}	2.0^{abc}
5	0.3^{cd}	0.4^{c}	0.6^{c}	0.6^{de}	1.0^{bc}	1.1^{cd}	1.2^{cde}
7	0.2^{d}	0.6^{c}	0.8^{c}	1.4^{bc}	2.0^{a}	2.2^{ab}	2.4^{ab}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Table12: Effect of NPK 15:15:15 concentrations on Okra stem girth in (cm)

Tablica 12.: Djelovanje koncentracije NPK 15:15 :15 na obujam stabljike okre (cm)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	0.2^{d}	0.5^{c}	0.8^{c}	0.8^{de}	0.8^{c}	0.9^{d}	0.9^{de}
3	0.7^{a}	1.0^{ab}	1.7^{a}	1.8^{a}	1.9^{a}	2.1^{ab}	2.3^{ab}
5	0.4^{bcd}	1.0^{ab}	1.5^{ab}	1.5^{ab}	1.6^{ab}	1.6^{bc}	1.7^{bcd}
7	0.5^{abc}	0.8^{abc}	1.8^{a}	1.9^{a}	2.1^{a}	2.4^{a}	2.6^{a}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Leaf Area

All the concentrations of poultry manure enhanced larger leaf areas in okra plants than those of the control. Leaf areas increased with age of the plants even up to the fruiting stage (Table 13). Okra plants treated with SSP enhanced larger leaf area than the control but smaller in lower concentration of 3g when at fruiting stage of 6-8WAP (Table14). Leaf area increased with the age of okra plants. Leaf areas in urea treated plants were smaller than in the control

Table 13: Effect of poultry manure concentration on Okra leaf area in (cm^2)

Tablica 13.: Djelovanje koncentracije gnoja na područje lista okre (cm^2)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	5.0^{c}	15.0^{c}	17.7^{b}	18.3^{b}	20.1^{b}	20.1^{b}	21.2^{b}
15	18.6^{a}	26.9^{bc}	90.7^{a}	85.4^{a}	83.9^{ab}	83.9^{ab}	84.1^{ab}
20	11.6^{b}	34.9^{abc}	84.5^{a}	84.5^{a}	95.1^{ab}	65.0^{ab}	94.2^{a}
25	12.01^{b}	43.9^{ab}	74.6^{a}	81.9^{a}	87.9^{ab}	89.1^{b}	95.3^{a}
30	8.7^{bc}	37.4^{abc}	77.1^{a}	104.5^{a}	127.0^{a}	127.0^{b}	110.1^{c}
35	6.9^{bc}	26.9^{bc}	61.3^{a}	87.8^{a}	98.5^{ab}	98.5^{ab}	84.9^{ab}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Table 14: Effect of single super phosphate concentration on Okra leaf area in (cm^2)

Tablica 14.: Djelovanje koncentracije jednostavnog superfosfata na područje lista okre (cm^2)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	5.0^{bc}	15.0^{abc}	18.0^{a}	18.3^{b}	20.1^{b}	20.1^{e}	21.2^{de}
3	4.0^{bc}	17.3^{abc}	22.9^{a}	23.0^{b}	18.0^{b}	6.9^{e}	7.1^{e}
5	5.2^{bc}	12.1^{abc}	22.8^{a}	23.0^{b}	31.0^{b}	23.0^{e}	23.1^{de}
7	9.9^{a}	26.9^{a}	42.7^{a}	43.0^{ab}	45.0^{b}	36.0^{de}	36.1^{cde}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Table15: Effect of Urea concentration on Okra leaf area in (cm^2)

Tablica 15.: Djelovanje koncengracije ureje na područje lista okre (cm^2)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	5.0^{bc}	15.0^{abc}	18.0^{a}	18.3^{b}	20.1^{b}	20.1^{e}	21.2^{de}
3	4.4^{bc}	12.6^{abc}	28.0^{a}	72.1^{ab}	87.0^{ab}	115.1^{ab}	117.0^{ab}
5	2.0^{c}	9.1^{bc}	21.0^{a}	37.0^{b}	58.0^{ab}	56.0^{cde}	60.5^{bcde}
7	2.0^{c}	6.9^{c}	18.0^{a}	63.0^{ab}	85.0^{ab}	160.4^{a}	164.5^{a}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

experiment in all its concentrations at 2 and 3WAP but were better than the control experiment as from 4-8WAP (Table 15). Urea treated okra plants increased in leaf area more at the flowering and fruiting time than in the vegetative stage (Table 15). Similar trends as in Urea treated okro plants were also observed in NPK treated okra plants. The leaf areas were smaller at 2 and 3WAP than the control experiment but were higher as from 4-8WAP (Table 16).

Table16: Effect of NPK 15:15:15 concentration on Okra leaf area in (cm^2)

Tablica 16.: Djelovanje koncentracije NPK 15:15:15 na područje lista okre (cm^2)

Conc.(g)	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
0	5.0^{bc}	15.0^{abc}	18.0^{a}	18.3^{b}	20.1^{b}	20.1^{e}	21.2^{de}
3	7.7^{ab}	23.3^{ab}	52.5^{a}	101.0^{a}	124.0^{a}	105.2^{abc}	108.0^{abc}
5	6.8^{ab}	17.3^{abc}	37.4^{a}	60.0^{ab}	80.0^{ab}	83.6^{bcd}	113.0^{abc}
7	5.2^{bc}	26.0^{a}	46.2^{a}	78.3^{ab}	95.0^{ab}	93.0^{ab}	93.3^{abcd}

Means followed by the same letter (s) along the same column are not significantly different at $p < 0.05$.
WAP=Weeks after planting

Prosjeci uz isto slovo i u istom stupcu značajno se ne razlikuju uz $p<0,05$
WAP= tjedan nakon sadnje

Discussions

Although okra can be cultivated without the application of fertilizer or manures as seen in the control experiment (without manure) but for increase in the vegetative fruit yield, application of organic manure (poultry dung) or inorganic manure (N.P.K and urea) will be very relevant and necessary. This observation also agreed with that of Adepoju (1995) who also observed better growth performance of maize with inorganic fertilizers of locally compounded NPK. Leaf number increased with age of the okra plants and even beyond vegetative stage to reproductive stage. All the concentrations of NPK inorganic fertilizer enhanced good leaf production which, however, dropped sharply at 8WAP which is at the peak of reproductive stage. This drop in leaves number may be due to the shift from vegetative growth to reproductive stage with an imminent approach of senescence since okra is a monocarpic plant. Numbers of leaves in okra treated with inorganic fertilizer of SSP were at par with the control experiments and there was a decrease as the fruiting stage set in.

Number of leaves under the effect of inorganic fertilizers revealed that urea in concentrations of 3g and 7g produced the highest number of leaf at 8 WAP (9.3 and 10.3) an indication that urea can prolong the vegetative growth of okra.

It is observed from this study that plant treated with poultry dung responded better with increased growth and development. The increase in vegetative growth parameters such as plant height, stem girth and others resulted from improved soil nutrient, as a result of organic manure (poultry dung) as well as inorganic fertilizers application. This agreed with the observations of early workers who variously reported that plant responded to the improved soil conditions under manure with an increased yield (Bhangou. et.al; 1998, Hward and Albregts, 2003).

CONCLUSION

From the results of this study it has been observed that okra which is normally planted without fertilizer application by local farmers could do better with the application of fertilizer. It was also observed from the study that poultry manure proved to be efficacious as a good source of organic fertilizer that supported good vegetative growth in okra. This is promising as emphasis is

being shifted to organic farming worldwide. Poultry manure where available can be cheaper than inorganic fertilizers.

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Received – Primljeno:
20.03.2012.