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Response of different levels of N P K and FYM on growth and yield of okra (*Abelmoschus esculentus* L.) Var. Arka Anamika

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Abstract
A field experiment was conducted during *Kharif* (rainy) season of 2016 on Response of different levels of N P K and FYM on Growth and Yield of Okra (*Abelmoschus esculentus* L.) Var. Arka Anamika" on central research farm department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences Allahabad. The soil of experimental area falls in order *Inceptisol* and soil texture was sandy loam (sand % 62.25, silt % 24.52 and clay % 13.23). There were nine treatments combination replicated thrice in Randomized Block Design. The best application of T_8 – (100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}) has the observed resulted were found significantly maximum growth and yield attributes were recorded was the maximum plant height (113.67 cm), maximum number of leaves was (35.67), maximum number of branches was (5.87), maximum stem diameter was (2.97 cm), maximum average number of fruit per plant was (18.33), maximum average fresh weight of fruit was (20.07 g), maximum average length of fruit was (12.40 cm), maximum fruit yield per plant was (299.00 g), maximum average fruit yield per hectare was (149.50 q/ha), maximum cost benefit ratio 3.44, maximum gross return 224250.00, maximum net profit ₹ 159100 ha^{-1}, were produced by the treatment T_8 – (100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}) It was the best treatment for growth and yield of okra.

Keywords: Okra, *Abelmoschus esculantus* L., NPK, FYM, Growth attributes and yield attributes

Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] is known as *Bhindi* or lady's finger belonging to family *malvaceae*, having chromosome number (2n) = 130. Okra is most popular in India, total area under okra in India is reported to be 507.0 thousand hectare, production 5853.0 thousand tones and productivity 11.5 t ha-1. West Bengal is the leading state of area and production of okra, which has area 75.45 thousand hectare and production 882.39 thousand tonnes. Highest productivity is 17.08 t ha-1 of Jammu & Kashmir. Uttar Pradesh climate is good for okra that in total area 14.18 thousand hectare and production is 181.66 thousand tonnes NHB - Database (2015) [19].

Okra is most important vegetable crop grown during summer and rainy seasons. Okra (*Abelmoschus esculentus)* is one of the most widely known and utilized species of the family Malvaceae Naveed *et al.* (2009) [18], and an economically important vegetable crop grown in tropical and sub-tropical parts of the world Oyelade *et al.* (2003) [21]. Okra is recommended for consumption by World Health Organization due to its ability to fight diseases. Nutritive value varies in different cultivars and depending upon the agro-climate condition, Okra contains proteins, carbohydrates and vitamin C Gopalan *et al.* (2007) [11]. Consumption of young immature okra pods is important as fresh fruits, and it can be consumed in different forms. Fruits can be boiled, fried or cooked Akintoye *et al.* (2011) [2].

The okra plant requires warm temperatures and is unable to withstand low temperatures for long or tolerate any threat of frost. Optimum temperature is in the range of 21 to 30 degrees Celsius, with minimum temperatures of 18 degrees celsius respectively Abd El-Kader *et al.* (2010) [1].

Fertilizers and organic manures play an important role in increasing production, improving quality of vegetables and sustaining soil fertility. Organic manures contain all nutrients which are required for healthy growth of crop and help to improve physical, chemical and biological properties of soil Halkatti *et al.* (1997) [12].

Integrated nutrient supply system (INSS) approach involves the combine use of chemical fertilizers, organic manures and biofertilizers which ensures higher crop production, helps to restore and sustain the soil fertility, helps to overcome micronutrients deficiencies Kadrekar (1993) [14].

Organic manures like FYM provides plants both macro and micronutrients like N, P, K, Fe, S, Mo, Zn etc. in available from to the plants through biological decomposition and improves physical-chemical and biological properties of soil and thus resulting in enhanced crop growth and productivity along with maintaining the quality of crop produce.

Objectives

1. To find out the most suitable treatment for plant growth and yield.
2. To work out the economics of various treatments.

Materials and methods

The experiment was conducted during kharif (rainy) season 2016 on crop research farm of department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute SHUATS Allahabad, (U.P.) India. The objective was to find put the best combination of N P K and FYM on growth and yield of okra for this region. The soil of experimental area falls in order *Inceptisol* and Alluvial in nature. The design applied for statistical analysis was carried out with 3x3 randomized block design having two factors with three levels of N: P: K @ 0, 50 and 100 % ha^{-1} and three levels of FYM 0, 50 and 100 % ha^{-1} respectively. The source of Nitrogen, Phosphorus, Potassium and FYM as Urea, SSP, MOP and FYM respectively. The plant distance R x R = 60 cm and P x P = 45cm, and seed rate 10 kg ha^{-1}**.**

Treatment details

Table 1: Treatment combination of different levels of N P K and FYM for okra trial.

Treatment	Treatment Combination	Symbol
T_0	Control	I_0+ F_0
T_1	@ 0% RDF + 50% FYM @ 12.5 t ha^{-1}	I_0+ F_1
T_2	@ 0% RDF + 100% FYM @ 25 t ha^{-1}	I_0+ F_2
T_3	@ 50% RDF @ $N_{50}P_{30}K_{25}$ kg ha^{-1} + 0% FYM @ 0 t ha^{-1}	I_1+ F_0
T_4	@ 50% RDF @ $N_{50}P_{30}K_{25}$ kg ha^{-1} + 50% FYM @ 12.5 t ha^{-1}	I_1+ F_1
T_5	@ 50% RDF @ $N_{50}P_{30}K_{25}$ kg ha^{-1} + 100% FYM @ 25 t ha^{-1}	I_1+ F_2
T_6	@ 100% RDF @ $N_{100}P_{60}K_{50}$ kg ha^{-1}+ 0% FYM @ 0 t ha_{-1}	I_2+ F_0
T_7	@ 100% RDF @ $N_{100}P_{60}K_{50}$ kg ha^{-1} + 50% FYM @ 12.5 t ha^{-1}	I_2+ F_1
T_8	@100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}	I_2+ F_2

Soil sample were collected from the 0-15 cm depth, after that dried and pass through sieve. Soil were analysis by using standard procedures as described following table 2.

Table 2: Physical and Chemical analysis of soil before sowing of Okra (*Abelmoschus esculentus* L.)

Parameters	Method employed	Result
Bulk density (Mg m^{-3})	Muthauval *et al*. (1992) [17]	1.38
Particle density (Mg m^{-3})	Muthuaval *et al*. (1992) [17]	2.65
Pore Space (%)	Muthuaval *et al*. (1992) [17]	48.40
Water holding capacity (%)	Black (1965) [4]	47.25
Soil pH (1:2)	Jackson (1958) [13]	7.32
Soil EC (dS m^{-1})	Wilcox (1950) [28]	0.21
Organic Carbon (%)	Walkley and Black's (1947) [27]	0.48
Available Nitrogen (Kg ha^{-1})	Subbaih and Asija (1956) [23]	268.08
Available Phosphorus (Kg ha^{-1})	Olsen *et al*. (1950)	20.11
Available Potassium (Kg ha^{-1})	Toth and Prince (1949) [25]	156.60

Results and discussions

Plant height (cm)

The statistically analyzed data presented in Table 3. The maximum plant height of okra after sowing at different days 30, 60 and 90 was 28.47, 89.20 and 113.67 cm found in T_8 - (100% RDF + 100% FYM ha^{-1}) followed by T_7 - (100% RDF + 50% FYM ha^{-1}) which was 27.30, 84.00 and 110.70 cm and minimum values of the result was found in T_0 - (control) which was 20.77, 71.23 and 92.77 cm respectively. The mean value of plant height of okra was found significant on different levels of NPK and FYM. It was also observed that the plant height were gradually increased with an increase in dose of NPK and FYM. It is generally beneficial for root and shoot growth of plants, increasing cell permeability and supply plant nutrients. Similar result were observed by Amran *et al.* (2014) [5] and Tyagi *et al.* (2016) [26].

No. of leaves plant^{-1}

The statistically analyzed data presented in Table 3. The result of the data depleted that the maximum number of leaves plant^{-1} of okra at different days 30, 60 and 90 after sowing was found in T_8 – (100% RDF + 100% FYM ha^{-1}) which was 13.67, 31.67 and 35.67 followed by T_7 - (100% RDF + 50% FYM ha^{-1}) was13.67, 29.67 and 34.00 and minimum values of the result was found in T_0 - (control) which was 7.67, 20.00, and 27.33 respectively. Similar result were observed by Amran *et al.* (2014) [5].

No. of branches plant^{-1}

The statistically analyzed data presented in Table 3. The result of the data depleted that the maximum no. of branch of okra at different days 50 and 75 after sowing was found in T_8 – (100% RDF + 100% FYM ha^{-1}**)** which was 4.67 and 5.87 followed by T_7 - **(**100% RDF + 50% FYM ha^{-1}) which was 4.33 and 5.57 and minimum values of the result was found in

T_0 - (control) which was 2.33 and 2.90 respectively. Combination of organic and inorganic fertilizers is generally beneficial for root and shoot growth of plants, increasing cell permeability and supply plant nutrients as Similar viewed by kuppusamy *et al.* (2013) [16].

Stem base diameter (cm)

The statistically analyzed data presented in table 3. The result of the data depleted that the maximum stem diameter of okra after sowing at different days 30, 60 and 90 was 1.30, 2.43 and 2.97 cm found in T_8 - (100% RDF + 100% FYM ha^{-1}) followed by T_7 - (100% RDF + 50% FYM ha^{-1}) was 1.23, 2.33 and 2.80 cm and minimum values of the stem diameter results was found in T_0 - (control) which was 0.77, 1.37 and 1.93 cm respectively. It was also observed that the stem diameter was gradually increased with an increase in dose of NPK and FYM. Similar result were observed by Tyagi *et al.* (2016) [26].

No. of fruits plant^{-1}

The statistically analyzed data presented in Table 3. The result of the data depleted that the maximum no. of fruits plant^{-1} of okra at different days 50 and 75 after sowing was found in T_8 - (100% RDF + 100% FYM ha^{-1}) which was 13.33 and 18.33 followed by T_7 - (100% RDF + 50% FYM ha^{-1}) which was 12.67 and 17.33 and minimum values of the result was found in T_0 - (control) which was 6.67 and 10.67 respectively. Availability of different nutrient by organic and inorganic fertilizer which resulted in increase growth and yield parameters of okra plant as Similar results were also reported by Amran *et al.* (2014) [5] and Kuppusamy *et al.* (2013) [16].

Fresh fruit weight (g) of okra

The statistically analyzed data presented in table 3. The maximum fresh fruit weight of okra was 20.07 g found in T_8 – (100% RDF + 100% FYM ha^{-1}) followed by 20.03 with T_7 - (100% RDF @ + 50% FYM ha^{-1}) and minimum fruit weight 10.23 g found in T_0 - (control). Application of organics with inorganic sources resulted in enhanced fruit length, fruit girth and ultimately increased the average fruit weight of *Abelmoschus esculentus* in agreement with findings of Similar results were also reported by Thirunavukkarasu *et al.* (2015) [24].

Length of fruit (cm) of okra

The statistically analyzed data presented in table 3. The data depleted that the maximum length of fruit of okra was 12.40 cm found in T_8 – (100% RDF + 100% FYM ha^{-1}) followed by 11.95 cm with T_7 - (100% RDF ha^{-1} + 50% FYM ha^{-1}) and minimum length of fruit 8.14 found in T_0 - (control). Application of organics with inorganic sources resulted in enhanced fruit length, fruit girth and ultimately increased the average fruit weight of *Abelmoschus esculentus* in agreement with findings of Similar results were also reported by Thirunavukkarasu *et al.* (2015) [24], Kumar *et al.* (2013) [15].

Yield plant^{-1} (g) of okra

The statistically analyzed data presented in table 3. The maximum yield plant^{-1} was 299.00 g found in T_8 – (100% RDF + 100% FYM ha^{-1}) followed by 287.00 g plant^{-1} with T_7 - (100% RDF + 50% FYM ha^{-1}) and minimum yield 208.67 g plant^{-1} found in T_0 - (control). These findings are in close conformity with the results reported by Tyagi *et al.* (2016) [26], Amran *et al.* (2014) [5] and kumar *et al.* (2013) [15].

Yield ha^{-1} (q) of okra

The statistically analyzed data presented in table 3. The maximum yield ha^{-1} of okra was 149.50 q found in T_8 – (100% RDF + 100% FYM ha^{-1}) followed by 140.50 q with T_7 - (100% RDF + 50% FYM ha^{-1}) and minimum yield 104.33 q found in T_0 - (control). It was also observed that yield ha^{-1} were gradually increased with an increase in dose of NPK and FYM. The Interaction effect of NPK and FYM on yield ha^{-1} of okra was also found significant. These findings are in close conformity with the results reported by Amran *et al.* (2014) [5].

Cost of benifit ratio (C:B) of okra

The data presented in table 3. The maximum (B:C) ratio of okra was 1:3.44 found in T_8 – (100% RDF + 100% FYM ha^{-1}) followed by 1:3.44 with T_7 - (100% RDF ha^{-1} + 50% FYM ha^{-1}) and minimum (B:C) ratio of okra 1:2.98 found in T_0 - (control). Similar finding were observed by Tyagi *et al.* (2016) [26], Kuppusamy *et al.* (2013) [16] and Premsekhar and Rajashree (2009) [22].

Table 3: Response of different levels of N P K and FYM on plant growth and yield of okra at 90 days.

Treatment combination	Plant height (cm)	Leaves plant^{-1}	Branch plant^{-1}	Stem diameter	Fruit plant^{-1}	Fruit weight (g)	Fruit length (cm)	yield plant^{-1} (g)	Yield ha^{-1} (q)
T_0 (I_0+N_0)	92.77	27.33	2.90	1.93	10.67	10.23	8.14	208.67	104.33
T_1 (I_0+N_1)	96.77	30.67	4.00	2.30	13.67	13.28	9.55	234.00	117.00
T_2 (I_0+N_2)	98.40	31.00	4.27	2.33	14.00	14.71	9.93	241.33	120.67
T_3 (I_1+N0)	99.43	31.33	4.47	2.37	14.00	15.89	9.99	245.00	122.50
T_4 (I_1+N_1)	102.73	32.67	4.70	2.53	14.67	17.15	10.35	252.67	136.33
T_5 (I_1+N_2)	105.80	33.33	5.10	2.60	15.33	17.49	10.96	266.67	133.33
T_6 (I_2+N_0)	107.83	34.33	5.43	2.70	16.33	18.69	11.17	271.33	135.67
T_7 (I_2+N_1)	110.70	34.00	5.57	2.80	17.33	20.03	11.95	287.00	140.50
T_8 (I_2+N_2)	113.67	35.67	5.87	2.97	18.33	20.07	12.40	299.00	149.50
F- test	S	S	S	S	S	S	S	S	S
S. Em (±)	0.244	0.460	0.073	0.039	0.364	0.146	0.050	0.922	1.186
C. D. 5%	0.731	1.378	0.218	0.117	1.092	0.439	0.150	2.765	3.556

Conclusions

It was concluded from trial that the various level of N P K and FYM used from different sources in the experiment, the treatment combination T_8 - 100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1} was found to be the best treatment. The maximum cost benefit ratio 3.44, gross return (₹ ha^{-1}) 224250.00 and highest yield 149.50 q ha^{-1}, with application of T_8 - 100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}. This application of T_8 could be recommended for good growth, profitable production and responded better soil health for okra cultivation. The application of T_8 it is found that same treatment combination can be recommended to the

farmers with integrated nutrient management approach for Allahabad area.

References

1. Abd El-Kader AA, Shaaban SM, Abd El-Fattah MS. Effect of irrigation levels and organic compost on okra plants (*Abelmoschus esculentus* L.) grown in sandy calcareous soil. Agric. Bio. J N. Am. 2010; 1(3):225-231.
2. Akintoye HA, Adebayo AG, Aina OO. Growth and yield response of okra intercropped with live mulches. Asian J. Agric. Res. 2011; 5:146-153.
3. Anonymous. Official method of analysis. Association of Official Analytical Chemists, Verginia, USA, 1990.
4. Black CA. Methods of soil analysis, Am. Soc, Agron. madison, Wisconsin, U.S. Am 1965, 2.
5. Amran Hisham, Aziz, Prasad VM, Saravanan S. Effect of FYM on Growth, Yield and Fruits Quality of Okra) Abelmoschus *esculentus* L Moench). Journal of Agriculture and Veterinary Science. 2014; 7(3):07-12.
6. Bouyoucos GJ. The hydrometer as a new method for the mechanical analysis of soils. Soil Sci. 1927; 23:393-395.
7. Buoyoucos GJ. A recalibration of the hydrometer method for making mechanical analysis of soil. 1952; 43:434.
8. Fao Stat. Online Interactive Database on Agriculture. Fao Stat. 2014. www.fao.org.
9. Fisher RA. Statistical methods for research workers. 13th edn, Hafner, New York, 1958.
10. GOI. Data base on Indian Agriculture, Department of Agriculture and Cooperation, 2014. http:// dacnet.nic.in.
11. Gopalan C, Sastri SBV, Balasubramanian S. Nutritive value of Indian foods, National Institute of Nutrition (NIN), ICMR, India, 2007.
12. Halkatti SV, Doddamani, Nagnur SV. Importance of organic manure in agriculture. Farmers & Parliament. 1997; 33(2):17-18.
13. Jackson ML. Soil chemical analysis, Prentice Hall, Inc, Englewood Cliffe, N.J, 1958.
14. Kadrekar SB. Nutrient finite land resources to nourish teeming millions. J Indian Soc. Soil Sci. 1993; 41(4):611-612.
15. Kumar Tarun, Kumar Mukesh, Singh Manoj, Kumar, Kumar Vipin, Kumar Arvind *et al*. Impact of Integrated Nutrient Management (INM) on growth and Economic Yield of Okra. Annals of Horticulture. 2013; 6(1):107-114.
16. Kuppusamy M, Sankar R, Sundaram V. Effect of organic sources of nitrogen on growth and yield of bhendi [*Abelmoschus esculentus* (L.) Moench.]. The asian journal of horticulture. 2013; 8(1):154-157.
17. Muthuvel P, Udayasoorian C. Soil, plant, water and agrochemical analysis, Tamil Nadu Agricultural University, Coimbatore, India, 1992.
18. Naveed A, Khan AA, Khan IA. Generation mean analysis of water stress tolerance in okra (*Abelmoschus esculentus* L.). Pak. J Bot. 2009; 41:195-205.
19. NHB. Database, 2015. www.nhb.gov.in
20. Olsen SR, Cole CV, Watnahe FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate U.S. Deptt. Agr. Circ. 1954, 939.
21. Oyelade OJ, Ade-Omowaye BIO, Adeomi VF. Influence of variety on protein, fat contents and some physical characteristics of okra seeds. J Food Eng. 2003; 57:111-114.
22. Premsekhar M, Rajashree V. Influence of Organic Manures on Growth, Yield and Quality of Okra. Tamil Nadu Agricultural University, Coimbatore- 641 003 – India. American-Eurasian Journal of Sustainable Agriculture. 2009; 3(1):6-8.
23. Subbiah BV, Asija GL. a rapid procedure for the estimate of Available nitrogen in soil current sciences. 1956; 25:259-260.
24. Thirunavukkarasu M, Balaji T. Effect of Integrated nutrient management (INM) on growth attributes, biomass yield, secondary nutrient uptake and quality parameters of bhendi (*Abelmoschus esculentus* L.). INDIA Journal of Applied and Natural Science. 2015; 7(1):165-169.
25. Toth SJ, Prince AL. Estimation of Cation Exchange Capacity and exchangeable Ca, K and Na content of Soil by Flame Photometer technique. Soil Sci. 1949; 67:439-445.
26. Tyagi SK, Shukla Anita, Mittoliya VK, Sharma ML, Khire AR, Jain YK. Effect of Integrated Nutrient Management on Growth, Yield and Economics of Okra (*Abelmoschus Esculentus* (L). Moench). National Academy of Agricultural Science. 2016; 34(2).
27. Walkley A, Black IA. Critical examination of rapid method for determining organic carbon in soils, effect of variance in digestion conditions and of inorganic soil constituents. Soil sci. 1947; 632:251.
28. Wilcox LV. Electrical conductivity, Amer. Water kworks Assoc. J. 1950; 42:775-776.