Research Article

Response of Different Levels of N P K and FYM on Soil Health 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 Soil Health and Yield of Okra (*Abelmoschus esculentus* L.) Var. Arka Anamika" on central research farm department of Soil Science and Agricultural Chemistry, SHUATS, Allahabad. The soil of experimental area falls in order *Inceptisol* and soil texture was sandy loam. There were nine treatments combination replicated thrice in 3x3 factorial 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 effect on physical and chemical property of soil and yield of okra. The observed in post harvest soil resulted were significantly increased maximum values of water holding capacity (63.42%), % pore space (62.17%), organic carbon (0.74 %), nitrogen (304.90 kg ha^{-1}), phosphorus (33.58 kg ha^{-1}) and potassium (186.03 kg ha^{-1}) was with treatment T_8 – (100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}). The combination of T_8 – (100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}) showed slight decrease in pH (7.12), bulk density (1.30 Mg m^{-3}), and particle density (2.51 Mg m^{-3}), the same treatment EC (dS m^{-1}) was slightly increase 0.35 in post harvest soil. The maximum cost benefit ratio (C:B) 1:3.44, maximum gross return 224250.00, maximum net profit ₹ 159100 ha^{-1}, and highest yield 149.50 q ha^{-1} with T_8 – (100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}).

Keywords: Soil nutrients, yield attributes, FYM, NPK and Okra

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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, Nigeria, Sudan, Pakistan, Ghana, Egypt, Benin, Saudi Arabia, Mexico and Cameroon. Largest area and production is in India followed by Nigeria. 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 [1].

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 [2], and an economically important vegetable crop grown in tropical and sub-tropical parts of the world [3]. Okra is recommended for consumption by World Health Organization due to its ability to fight diseases. Its tender green fruits are used as a vegetable and are generally marketed in fresh state, but sometime in canned or dehydrated form. Nutritive value varies in different cultivars and depending upon the agro-climate condition, Okra contains proteins, carbohydrates and vitamin C [4]. 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 [5].

The composition of okra pods per 100 g edible portion, (81% of the product as purchased, ends trimmed) is: water 88.6 g, energy 144.00 kJ (36 kcal), protein 2.10 g, carbohydrate 8.20 g, fat 0.20 g, fibre 1.70 g, Ca 84.00 mg, P 90.00 mg, Fe 1.20 mg, β-carotene 185.00 µg, riboflavin 0.08 mg, thiamin 0.04 mg, niacin 0.60 mg, ascorbic acid 47.00 mg. [6]. 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 [7].

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 [8]. 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 [9].

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 such as aggregation, aeration, permeability, water holding capacity, slow release of nutrients, increasing in cation exchange capacity, stimulation of soil flora and fauna etc. and thus resulting in enhanced crop productivity along with maintaining the quality of crop produce. A well decomposed FYM contains 0.5% N, 0.2% P_2O_5 and 0.5% K_2O [10].

OBJECTIVES

1. To find out the most suitable treatment for soil health.
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 soil of experimental area falls in order *Inceptisol*, Alluvial in nature and soil texture was sandy loam (sand % 61.20, silt % 24.56 and clay % 14.24). **(**Bouyoucos 1927) **[**11**]**

The design applied for statistical analysis was carried out with 3x3 factorial randomized block design (Fisher R. A. 1958) [12], 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 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	$\mathbf{I_0+ F_0}$
T_1	0% RDF + 50% FYM @ 12.5 t ha^{-1}	$\mathbf{I_0+ F_1}$
T_2	0% RDF + 100% FYM @ 25 t ha^{-1}	$\mathbf{I_0+ F_2}$
T_3	50% RDF @ $N_{50}P_{30}K_{25}$ kg ha^{-1} + 0% FYM @ 0 t ha^{-1}	$\mathbf{I_1+ F_0}$
T_4	50% RDF @ $N_{50}P_{30}K_{25}$ kg ha^{-1} + 50% FYM @ 12.5 t ha^{-1}	$\mathbf{I_1+ F_1}$
T_5	50% RDF @ $N_{50}P_{30}K_{25}$ kg ha^{-1} + 100% FYM @ 25 t ha^{-1}	$\mathbf{I_1+ F_2}$
T_6	100% RDF @ $N_{100}P_{60}K_{50}$ kg ha^{-1} + 0% FYM @ 0 t ha^{-1}	$\mathbf{I_2+ F_0}$
T_7	100% RDF @ $N_{100}P_{60}K_{50}$ kg ha^{-1} + 50% FYM @ 12.5 t ha^{-1}	$\mathbf{I_2+ F_1}$
T_8	100% RDF @ $N_{100}P_{60}K_{50}$ kg ha^{-1} + 100% FYM @ 25 t ha^{-1}	$\mathbf{I_2+ F_2}$

The source of Nitrogen, Phosphorus, Potassium and FYM as Urea, SSP, MOP and FYM respectively. The fertilizer was applied a basal dose of 100 kg N, 60 kg P_2O_5 and 50 kg K_2O ha^{-1}. One third of nitrogen and entire quantity of P and K was applied prior to sowing remaining dose of nitrogen was applied in two splits at 30 and 60 Days after sowing. FYM was applied in the soil before one week from sowing according to the treatments.

Before sowing and after harvesting crop the soil samples were collected from 0-15 cm all the plot separately. The sample were dried under shade, crushed by mallet and pass through sieve, size of sieve depended on soil analysis. After the soil sample was preserved for the determination of the various physical and chemical parameters. The Physical and Chemical analysis of pre sowing soil and using standard procedures for soil analysis 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})	Muthuaval *et al.*(1992) [13]	1.38
Particle density (Mg m^{-3})	Muthuaval *et al.*(1992)	2.65
Pore Space (%);8	Muthuaval *et al.*(1992)	48.40
Water holding capacity (%)	Black (1965) [14]	47.25
Soil pH (1:2)	Jackson (1958) [15]	7.32
Soil EC (dS m^{-1})	Wilcox (1950) [16]	0.21
Organic Carbon (%)	Walkley and Black's (1947) [17]	0.48
Available Nitrogen (Kg ha^{-1})	Subbaih and Asija (1956) [18]	268.08
Available Phosphorus (Kg ha^{-1})	Olsen *et al* (1950) [19]	20.11
Available Potassium (Kg ha^{-1})	Toth and Prince (1949) [20]	156.60

Results and Discussion

Table 3 Response of different levels of N P K and FYM on *physico-chemical* properties and available macronutrients status in soil.

Treatment combination	Bd (Mg m^{-3})	Pd (Mg m^{-3})	Porocity (%)	WRC %	pH (1:2w/v)	EC (dS m^{-1})	O. C. (%)	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})
T_0 (I_0+N_0)	1.36	2.61	50.52	50.46	7.29	0.22	0.51	270.93	20.34	159.58
T_1 (I_0+N_1)	1.34	2.58	52.72	53.01	7.24	0.23	0.60	276.29	23.69	164.02
T_2 (I_0+N_2)	1.34	2.57	52.40	52.70	7.21	0.30	0.71	279.24	24.27	166.31
T_3 (I_1+N0)	1.33	2.55	54.27	54.59	7.24	0.28	0.56	286.44	26.80	170.59
T_4 (I_1+N_1)	1.32	2.54	57.33	55.29	7.19	0.29	0.63	289.19	28.08	174.02
T_5 (I_1+N_2)	1.33	2.54	58.48	55.92	7.14	0.29	0.69	292.28	29.27	176.06
T_6 (I_2+N_0)	1.32	2.52	59.08	58.26	7.15	0.28	0.58	298.18	30.87	181.41
T_7 (I_2+N_1)	1.31	2.53	59.31	61.26	7.14	0.31	0.72	300.42	32.35	183.18
T_8 (I_2+N_2)	1.30	2.51	62.17	63.42	7.12	0.35	0.74	304.90	33.58	186.03
F- test	NS	NS	S	S	NS	S	S	S	S	S
S. Em (±)	0.004	0.009	0.555	0.462	0.013	0.013	0.010	0.273	0.332	0.363
C. D. at 5%	0.013	0.028	1.663	1.386	0.039	0.039	0.030	0.819	0.997	1.089

Physical properties of post soil

The interaction effects of N P K and FYM on bulk density (Mg m^{-3}), and particle density (Mg m^{-3}) was non significant. Increasing doses of N P K and FYM slightly decrease bulk density and particle density of after crop harvest soil. The highest pore space % (62.17%) and water holding capacity (63.42%) was found significant with combination of T_8 – (100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}). Similar findings were reported by [21]. The presence of NPK and FYM in optimum amount increase pore space % of soil. It's contains higher amount of Salt, silt and clay particle. As these indicated an enrichment of fine fractions i.e. Silt and clay a part from the retention of dissolved O. M. leading to change in Physical properties of soil [22].

Chemical properties of post soil

During the course of study, Increasing doses of N P K, and FYM slightly decrease pH of the post harvest soil. It was observed that the highest pH was recorded in 7.29 with (T_0- control) and the lowest of 7.12 was recorded with the application of T_8 – (100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}). The decrease in pH might be due to growth and respiration rate is increase. Respiration evolves carbon dioxide and reacts with water to form carbonic acid in soil. Similar findings were reported by [23] and [24].

The chemical properties of soil was significantly affected by different treatment combination of N P K and FYM. The recorded significantly increased maximum values of electrical conductivity (0.35 dS m^{-1}), organic carbon (0.74%), Nitrogen (304.90 kg ha^{-1}), Phosphorus (33.58 kg ha^{-1}) and Potassium (186.03 kg ha^{-1}) was with treatment T_8- (100% RDF @ N_{100} P_{60} K_{50} kg ha^{-1} + 100% FYM @ 25 t ha^{-1}). Similar findings were reported by [25] and [24].

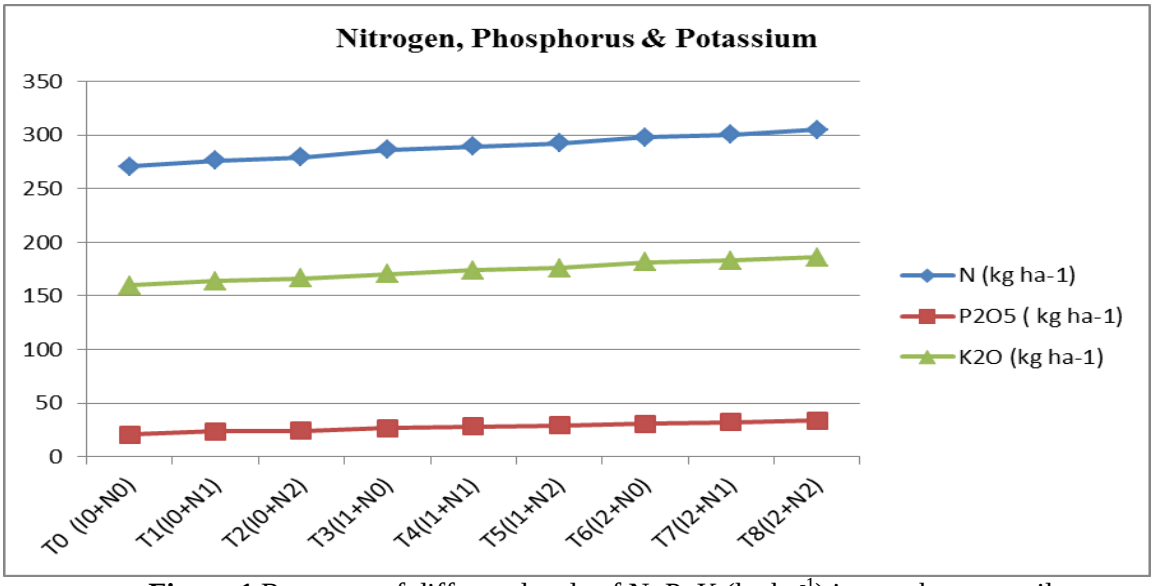

Figure 1 Response of different levels of N: P: K (kg ha^{-1}) in post harvest soil

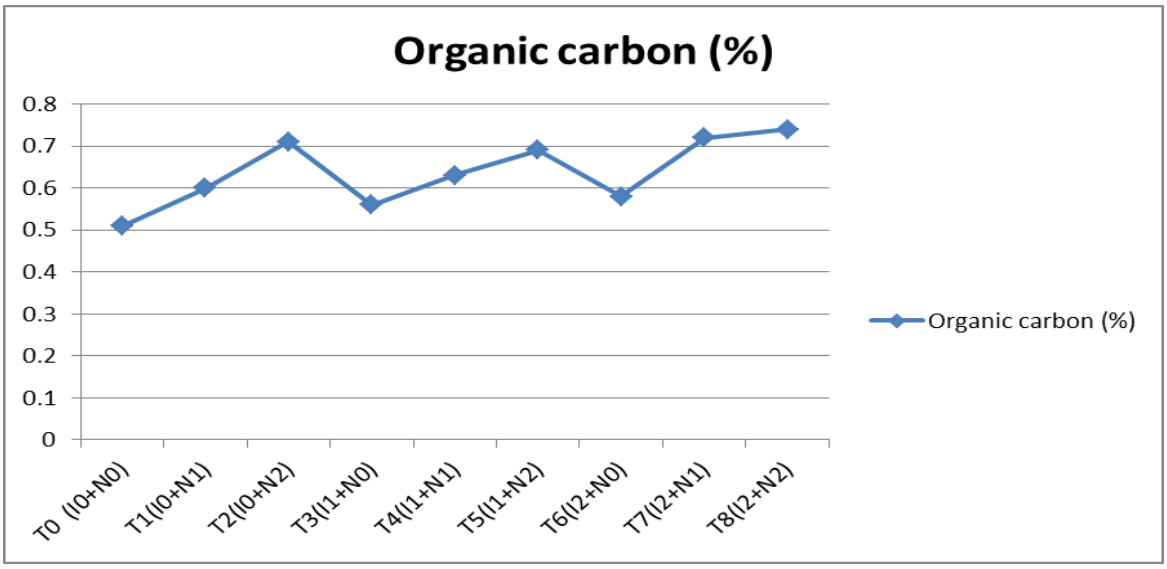

Figure 2 Response of Different levels of N:P:K and FYM on Organic carbon (%) in post harvest soil

Conclusions

It was concluded from trial that the different levels of N P K and FYM used for okra, the treatment combination T_8 – [100% N P K @ $N_{100}P_{60}K_{50}$ kg ha^{-1} + 100% FYM @ 25 t ha^{-1}] was found to be the best treatment for soil health and yield of okra. It gave highest cost benefit ratio (C:B) of 1:3.44 for okra var. Arka Anamika. Thus, treatment T_8 could be recommended for profitable production of Okra (*Abelmoschus esculentus* L.) and sustainable good soil health. Therefore, it is found that same treatment combination can be recommended to the farmers with integrated nutrient management approach for Allahabad area.

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