International Journal of Agriculture and Plant Science
www.agriculturejournal.in
Online ISSN: 2664-7664, Print ISSN: 2664-7656
Received: 05-03-2022, Accepted: 21-03-2022, Published: 06-04-2022
Volume 4, Issue 1, 2022, Page No. 30-34

Effect of nutrient management on yield parameters of okra

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Abstract
A field experiment was conducted at the Instructional Farm of Sardar Patel University, Balaghat (M.P.), during *kharif* season of 2020-21, to evaluate the influence of **"**Integrated Nutrient Management for Okra (*Abelmoschus Esculentus* L.) Cv. 'Super Green' Under Condition of Madhya Pradesh" Totally 07 different treatments consisting of different organic and inorganic and fertilizers, alone and in both combination have been tried. Among the different integrated nutrient management practices, The application of integrated nutrient management significantly enhanced yield or productivity parameters *viz.* Number of fruit per plant, Diameter of fruit (cm), Length of fruit (cm), Weight of fruit (g), Fruit yield per hectare (q) were also significantly superior in the T_2 (100:60:50 kg NPK ha^{-1} through Urea, SSP and MOP) followed by treatment T_3 (5.0 MT Vermicompost ha^{-1}). On the basis of above findings, treatment T_2 (100:60:50 kg NPK ha^{-1} through Urea, SSP and MOP) stand first in position and T_3 (5.0 MT Vermicompost ha^{-1}) stand in second order of preference. However, treatment T_4 (10.0 MT FYM $ha^{-1)}$ comes in next in order. There for it may be concluded that treatment T_5 (50:30:25 kg NPK ha^{-1} through Urea, SSP and MOP + 2.5 MT Vermicompost ha^{-1}) may be prefer for integrated nutrient management in okra.

Keywords: nutrient management, parameters, Okra

Introduction
Okra (Abelmoschus esculentus (L). Moench) is one of the most well-known, adaptive and widely utilized species of the family Malvaceae. It is native to Ethiopia (Rubatzky and Yamaguchi, 1999) [12]. Okra is widely cultivated in plans of the India. Total area covered in India by vegetable crops is 10106 thousand hectares and total production 169064 thousand metric tonnes with okra crop occupying nearly 511 thousand hectares area, production 5848.6 thousand metric tonnes and productivity of 11.40 metric tonnes / ha (Anonymous 2019b) [2]. Okra crop covered 5.05% of total area and 3.46% of total vegetable production.
In Madhya Pradesh total area under vegetable crops is 757.67 thousand hectares with production of about 15568.26 thousand metric tonnes and okra crop occupies area 27.11 thousand hectares with production 342.05 thousand metric tonnes and productivity 12.62 metric tones / ha (Anonymous 2019c) [3]. Chhindwara, Jabalpur, Sagar, Hoshangabad, Tikamgarh, Ratlam, Dewas, Katni, Barwani, Balaghat, Gwalior, Datia, Alirajpur, Bhind, Dhar, Shivpuri and Chhatarpur are major okra producing districts in Madhya Pradesh (Anonymous 2019d) [4].
It is also a chief vegetable crop grown for its immature pods that can be consumed as a fried or boiled vegetable or may be added to salads, soups and stews (Kashif *et al*., 2008) [7]. Okra plays a significant role in human nutrition by providing carbohydrates, protein, fat, minerals and vitamins that are generally deficient in basic foods. This is the vegetable, valued for many of its properties. The fruits are used in making soup, salad and for flavouring when dried and powdered. The tender fruits contain minerals especially calcium, magnesium, iron and phosphorus, protein, vitamin A and C including riboflavin as well as high mucilage (Ndaeyo *et al*., 2005) [11]. Vegetables and vegetables based cropping systems show that vegetable crops are well responsive to nutrient supply through organic manures and chemical fertilizers (Kale *et al*., 1991) [8]. Okra produces fruits for a long time and needs balanced and sufficient supply of nutrients for higher yield and better quality. Indiscriminate use of inorganic fertilizers has resulted in decreased nutrient uptake, poor quality of vegetables and deterioration of soil health (Agrawal, 2003) [1]. The country is now facing various problems like inadequate and imbalanced fertilizer use, distorted NPK consumption ratio and nutrient mining, leading to multi nutrient deficiency.
Potassium is one of the three major nutrient elements required by plants. Potassium imparts vigour and disease resistance to the plant and plays an important role in crop productivity. It is always involved in the movement of carbohydrates, therefore, accumulation of carbohydrates and soluble nitrogen compound points to diminish protein synthesis in case of potassium deficiency. It also regulates the transpiration process through opening and closing of the stomata by affecting the activities of guard cells. In these organelles potassium activates the fat producing enzyme and enhances the oil content (Mandal and Chatterjee, 1973) [9].

Materials and Methods
A field experiment was conducted at the Instructional Farm of Sardar Patel University, Balaghat (M.P.). Balaghat District is located in the southern part of Jabalpur Division. It occupies the south eastern portion of the

Satpura Range and the upper valley of the Wainganga River. The district extends from 21°19' to 22°24' north latitude and 79°31' to 81°3' east longitude. The total area of the district is 9,245 km2. Climatologically Balaghat is characterized as slightly moist hot and humid subtropical climate zone. An average annual rainfall of 1100.6 mm is generally appeared and mostly concentrated during the period from June to September. The major portion of the rainfall is received by South-Western monsoon. The May and December is the hottest and coolest month of the year respectively. In general, weekly maximum temperature goes upto 47 °C during the summer season and minimum temperature falls upto 10 °C during the winter season.

The experiment consisted of 7 treatments *viz*. T_1: Control (No NPK), T_2: 100:60:50 kg NPK ha-1 through Urea, SSP and MOP, T_3: 5.0 MT Vermicompost ha-1, T_4: 10.0 MT FYM ha-1, T_5: 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 2.5 MT Vermicompost ha-1, T_6: 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 5 MT FYM ha-1, T_7: 25:15:12.5 kg NPK ha-1 through Urea, SSP and MOP + 1.875 MT Vermicompost ha-1 + 3.75 MT FYM ha-1 which was arranged in Randomized Block Design with three replications. The recommended fertilizer dose of 100:60:50 kg NPK ha-1 was applied to the okra crop. The full dose of FYM, Vermicompost, P, K and half dose of N at the time of Sowing and the remaining half dose of N according to the treatments. Nitrogen was supplied through urea containing 46 per cent nitrogen, while phosphorus and potash were supplied through single super phosphate and murate of potash containing 16 per cent P2O5 and 60 per cent K2O, respectively. Two healthy seeds were dibbled 1-2 cm deep maintaining uniform distance 50 x 30 cm in flat beds. The seed rate of okra in rainy season was 12-15 kg ha-1. An effort was made to maintain a uniform population per bed. First weeding and hoeing was done after 25 days of sowing and subsequent two weeding and hoeing were done after 35 and 45 days of sowing.

Results and Discussion

Yield attributes

Number of fruit per plant, Length of fruit (cm) and Diameter of fruit (cm)

The data on various yield attributes *viz*. number of fruits per plant, length of fruit (cm) and diameter of fruit as influenced by the nutrient management practices were recorded and presented in Table 1and figure 1 and 2. Significantly higher fruits was observed in treatment T2 100:60:50 kg NPK ha-1 through Urea, SSP and MOP (20.53) followed by treatment T3 5.0 MT Vermicompost ha-1 (19.33), T4 10.0 MT FYM ha-1 (18.75), T5 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 2.5 MT Vermicompost ha-1 (17.20), T6 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 5 MT FYM ha-1(16.90), T7 25:15:12.5 kg NPK ha-1 through Urea, SSP and MOP + 1.875 MT Vermicompost ha-1 + 3.75 MT FYM ha-1 (16.20). And significantly less fruits was recorded in treatment T8 (Control Plot) (14.20).

Significantly higher fruits length was observed in treatment T2 100:60:50 kg NPK ha-1 through Urea, SSP and MOP (10.90 cm) followed by treatment T3 5.0 MT Vermicompost ha-1 (10.23 cm), T4 10.0 MT FYM ha-1 (9.99 cm), T5 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 2.5 MT Vermicompost ha-1 (9.63 cm), T6 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 5 MT FYM ha-1(9.43 cm), T7 25:15:12.5 kg NPK ha-1 through Urea, SSP and MOP + 1.875 MT Vermicompost ha-1 + 3.75 MT FYM ha-1 (9.19 cm). and significantly less fruits length was recorded in treatment T8 (Control Plot) (7.83 cm).

More or less the present findings are agreement with the findings of Dademal and Dongale (2004) who studied the response of okra (var. Arka Anamika) to the application of organic manures and varied levels of chemical fertilizers and reported that the growth characters (plant height and dry matter production), yield contributing characters (number of fruits/ plant, fruit weight/ plant, fruit length) and fruit yield of okra significantly increased with 7.5 t/ha FYM application as compared to no manure or application of 1.5 t/ha vermicompost only.

Significantly higher fruits diameter was observed in treatment T2 100:60:50 kg NPK ha-1 through Urea, SSP and MOP (1.75 cm) followed by treatment T3 5.0 MT Vermicompost ha-1 (1.60 cm), T4 10.0 MT FYM ha-1 (1.59 cm), T5 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 2.5 MT Vermicompost ha-1 (1.53 cm), T6 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 5 MT FYM ha-1(1.49 cm), T7 25:15:12.5 kg NPK ha-1 through Urea, SSP and MOP + 1.875 MT Vermicompost ha-1 + 3.75 MT FYM ha-1 (1.38 cm). And significantly less diameter length was recorded in treatment T8 (Control Plot) (1.20 cm).

Weight of fruit (cm) and Fruit yield per hectare (q)

The data on various yield attributes *viz*. weight of fruit (cm) fruit yield per hectare (q) as influenced by the nutrient management practices were recorded and presented in Table 2 and figure 3 and 4.Significantly higher weight of fruit was observed in treatment T2 100:60:50 kg NPK ha-1 through Urea, SSP and MOP (13.00 gm) followed by treatment T3 5.0 MT Vermicompost ha-1 (12.90 gm), T4 10.0 MT FYM ha-1 (12.60 gm), T5 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 2.5 MT Vermicompost ha-1 (12.32 gm), T6 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 5 MT FYM ha-1(11.60 gm), T7 25:15:12.5 kg NPK ha-1 through Urea, SSP and MOP + 1.875 MT Vermicompost ha-1 + 3.75 MT FYM ha-1 (11.40 gm). And significantly less weight of fruit was recorded in treatment T8 (Control Plot) (9.30 gm).

The present results are accordance wih the result of Gayatri and Reddy (2013) who studied the INM on okra plants fertilized with recommended dose of NPK (100: 50: 50 kg/ha) gave maximum plant height (104.42 cm), plant girth (3.18 cm), number of nodes per plant (15.07), and dry weight of the plant (53.77g), with least number of days to 50 % flowering (32.8 days), days to first picking (38.47 days), maximum number of pods per plant

(16.47), maximum pod length (17.07 cm), maximum pod weight (15 g), maximum pod yield per plant (238.33 g), maximum pod yield per plot (10.29 kg) and maximum pod yield (135.83/ha).

Significantly higher fruit yield per hactere was observed in treatment T2 100:60:50 kg NPK ha-1 through Urea, SSP and MOP (156.00 q) followed by treatment T3 5.0 MT Vermicompost ha-1 (149.85 q), T4 10.0 MT FYM ha-1 (148.03 q), T5 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 2.5 MT Vermicompost ha-1 (143.00 q), T6 50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 5 MT FYM ha-1(141.90 q), T7 25:15:12.5 kg NPK ha-1 through Urea, SSP and MOP + 1.875 MT Vermicompost ha-1 + 3.75 MT FYM ha-1 (136.00 q). And significantly less fruit yield per hactere was recorded in treatment T8 (Control Plot) (98.00 q).

More or less the present findings are agreement with the findings of Mishra *et al*., (2009) [10] who studied the effect of nutrients viz. organic, inorganic and biofertilizers on growth, yield and economics of okra cv. VRO-6. The experiment was conducted at Indian Institute of Vegetable Research, Varanasi during summer season of 2006-07 and 2007-08. The results revealed significant improvement in all the growth and yield parameters over recommended dose of N, P and K. The maximum length of fruit, diameter of fruit, fresh weight of fruit, dry weight of fruit and yield was recorded with application of Vermicompost @ 2-5 t/ha + NPK (120:60:60 kg/ha) + PSB + Azotobacter over rest of the treatments.

Table 1: Yield attributes (number of fruit per plant, length of fruit (cm) and diameter of fruit (cm)

Yield attributes and yield				
Tr. No.	**Treatment Details**	**Number of fruit per plant**	**Length of fruit (cm)**	**Diameter of fruit (cm)**
T_1	Control (No NPK)	14.20	7.83	1.20
T_2	100:60:50 kg NPK ha^{-1} through Urea, SSP and MOP	20.53	10.90	1.75
T_3	5.0 MT Vermicompost ha^{-1}	19.33	10.23	1.60
T_4	10.0 MT FYM ha^{-1}	18.75	9.99	1.59
T_5	50:30:25 kg NPK ha^{-1} through Urea, SSP and MOP + 2.5 MT Vermicompost ha^{-1}	17.20	9.63	1.53
T_6	50:30:25 kg NPK ha^{-1} through Urea, SSP and MOP + 5 MT FYM ha^{-1}	16.90	9.43	1.49
T_7	25:15:12.5 kg NPK ha^{-1} through Urea, SSP and MOP + 1.875 MT Vermicompost ha^{-1} + 3.75 MT FYM ha^{-1}	16.20	9.19	1.38
	Sem (±)	0.84	0.55	0.07
	CD (5%) =	2.61	1.71	0.24
	CV =	8.35	10.02	9.03

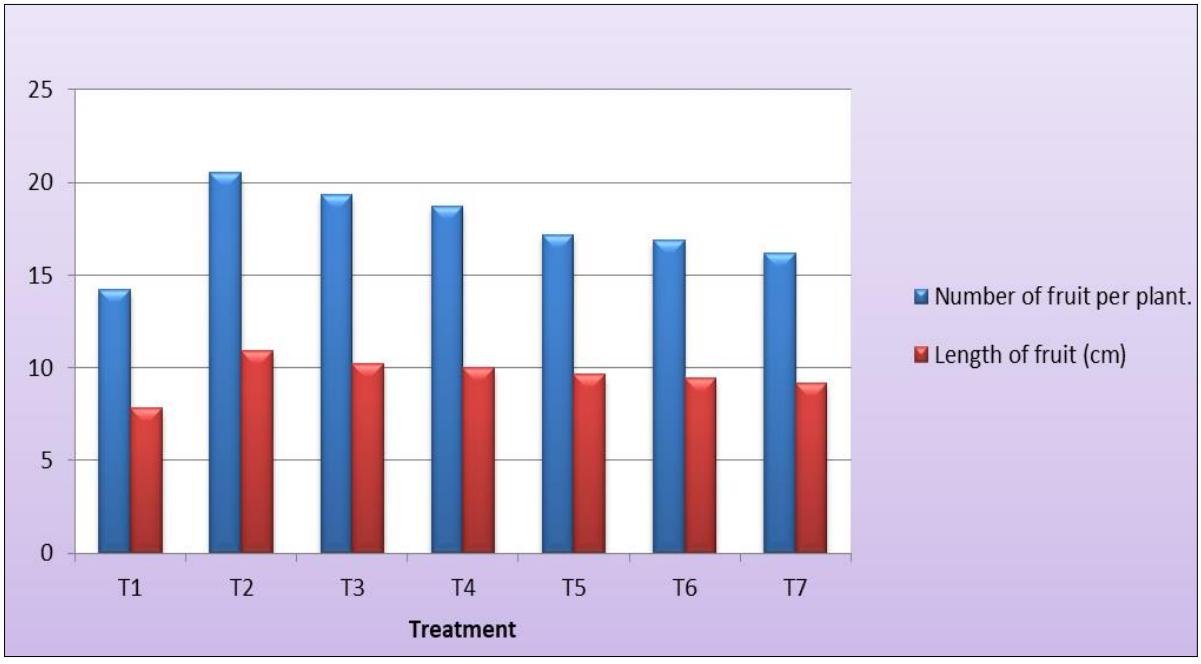

Fig 1: Number of fruit per plant and Length of fruit (cm)

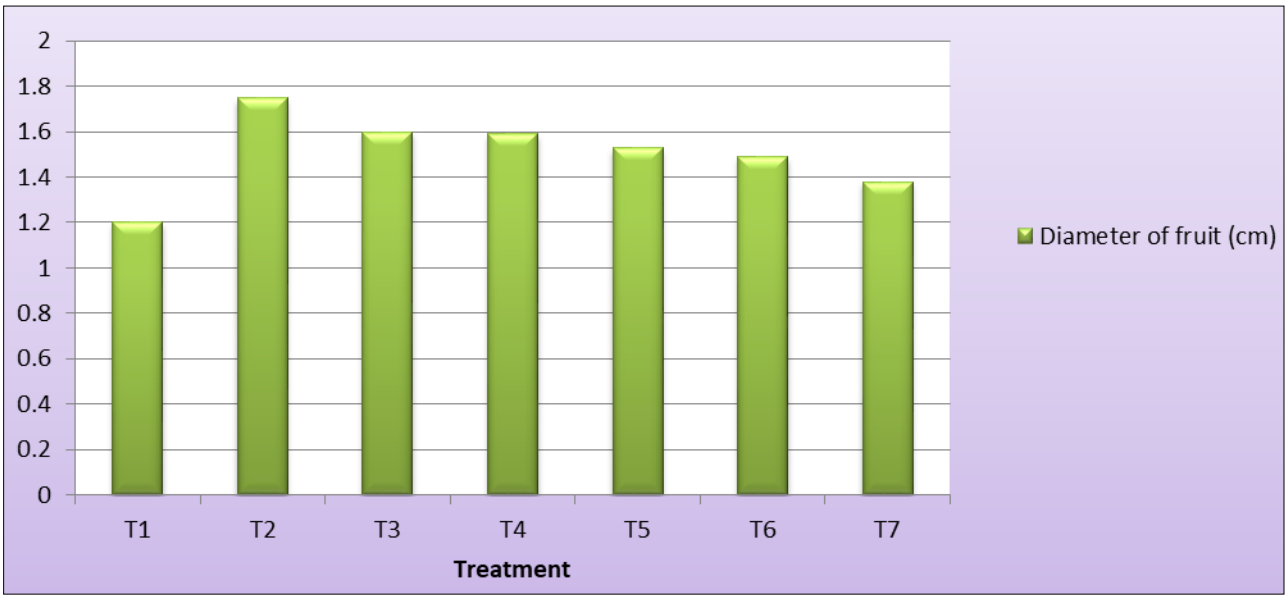

Fig 2: Diameter of fruit (cm)

Table 2: Yield attributes (Weight of fruit (g) and Fruit yield per hectare (q)

Tr. No.	Treatment Details	Weight of fruit (g)	Fruit yield per hectare (q)
T_1	Control (No NPK)	9.30	98.00
T_2	100:60:50 kg NPK ha^{-1} through Urea, SSP and MOP	13.00	156.00
T_3	5.0 MT Vermicompost ha^{-1}	12.90	149.85
T_4	10.0 MT FYM ha^{-1}	12.60	148.03
T_5	50:30:25 kg NPK ha^{-1} through Urea, SSP and MOP + 2.5 MT Vermicompost ha^{-1}	12.32	143.00
T_6	50:30:25 kg NPK ha^{-1} through Urea, SSP and MOP + 5 MT FYM ha^{-1}	11.60	141.90
T_7	25:15:12.5 kg NPK ha^{-1} through Urea, SSP and MOP + 1.875 MT Vermicompost ha^{-1} + 3.75 MT FYM ha^{-1}	11.40	136.00
	Sem (±)	0.57	6.75
	CD (5%) =	1.78	20.83
	CV =	8.43	8.42

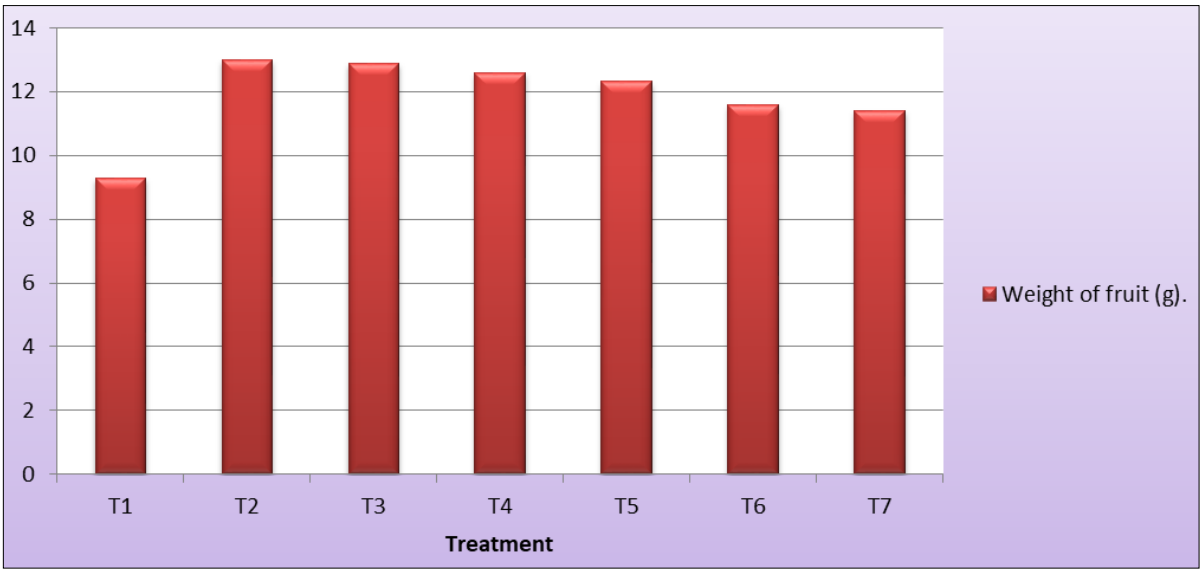

Fig 3: Weight of fruit (g).

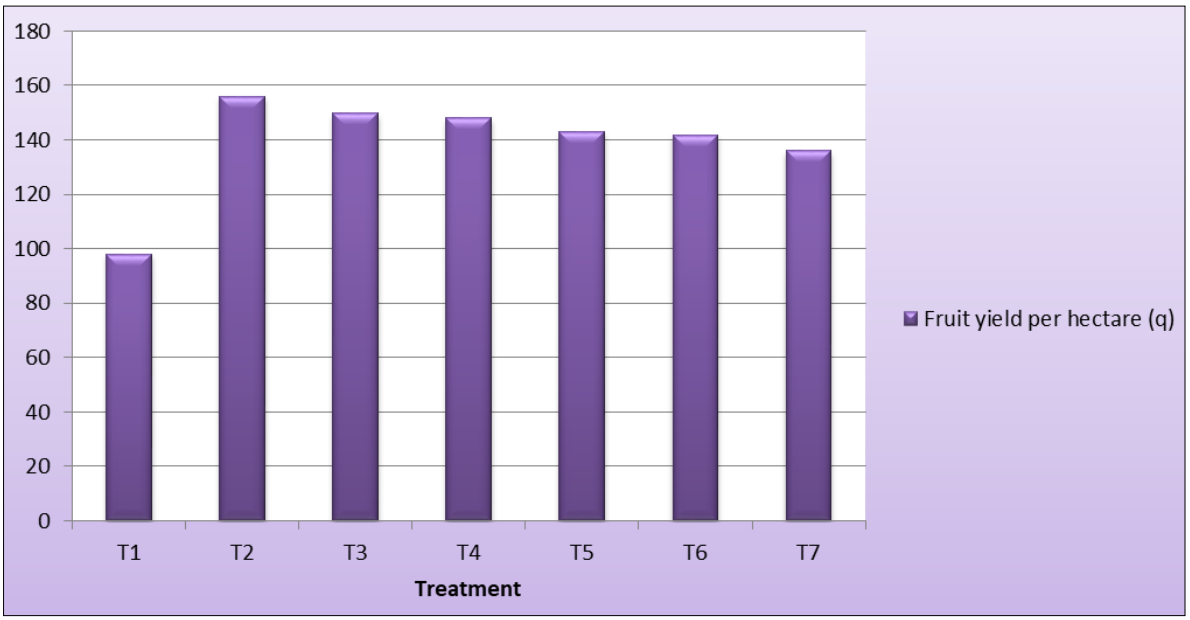

Fig 4: Fruit yield per hectare (q)

Conclusion

On the basis of above findings, treatment T2 (100:60:50 kg NPK ha-1 through Urea, SSP and MOP) stand first in position and T3 (5.0 MT Vermicompost ha-1) stand in second order of preference. However, treatment T4 (10.0 MT FYM ha-1) comes in next in order. There for it may be concluded that treatment T5 (50:30:25 kg NPK ha-1 through Urea, SSP and MOP + 2.5 MT Vermicompost ha-1) may be prefer for integrated nutrient management in okra.

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