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Aaradhana Sonwani
Department of Horticulture, Sardar Patel University, Balaghat, Madhya Pradesh, India

AS Choudhary
Department of Horticulture, Sardar Patel University, Balaghat, Madhya Pradesh, India

Shani Raj
Department of Horticulture, Sardar Patel University, Balaghat, Madhya Pradesh, India

Ankit Paswan
Department of Horticulture, Sardar Patel University, Balaghat, Madhya Pradesh, India

Pooja Sonloi
Department of Horticulture, Sardar Patel University, Balaghat, Madhya Pradesh, India

Corresponding Author:
Aaradhana Sonwani
Department of Horticulture, Sardar Patel University, Balaghat, Madhya Pradesh, India

Effect of nutrient management on yield parameters of okra

Aaradhana Sonwani, AS Choudhary, Shani Raj, Ankit Paswan and Pooja Sonloi

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 "Impact of nutrient management on green pod yield and cost ratio of okra." Totally 08 different treatments consisting of different organic and inorganic and fertilizers, alone and in both combination have been tried. Among the different nutrient management practices, The application of nutrient management significantly enhanced significantly enhanced yield parameters *viz.* characters like Number of fruit per plant, Length of fruit (cm), Diameter of fruit (cm), Weight of fruit (g), Fruit yield per hectare (q) were also significantly superior in the T_1 (100% NPK + PSB + Azotobactor) followed by treatment T_3 (75% NPK + Vermicompost + Azotobactor) and proved significantly superior over all other remaining treatments. There for it may be concluded that treatment T_1 (100% NPK + PSB + Azotobactor) may be prefer for higher growth, green pod yield and cost ratio of Okra.

Keywords: Nutrient, management, parameters, okra, *Abelmoschus esculentus* L.

Introduction
Okra (*Abelmoschus esculentus* (L.) Moench) commonly known as lady's finger or bhindi, belongs to the family Malvaceae and is a fast growing annual vegetable crop grown in tropical and sub-tropical regions of the world. It is said to have originated from Africa (Markosa and Peter, 1990) [6] but according to Zeven and Zhukovsky (1975) [7] it originated from Hindustan centre of origin. It is one of the most important vegetable crops grown for its tender green fruits in almost all parts of the world.

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). 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) [2]. 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) [3].

Among the bulky organic manures, the farm yard manure, goat manure, vermicompost and compost are the most commonly used for crop production. FYM is easily available and extensively used organic source of plant nutrient. Vermicompost is also seems to be very dynamic manure for quality and production of the crop. The combination of manures in addition with chemical fertilizers may be helpful to maintain the soil richness and health by increase content of organic carbon in soil for sustaining the productivity.

Neither inorganic nor organic amendments alone can maintain organic matter status of soil and sustain the productivity in a particular area and crop. Okra being a nutrient livening crop responds well to added nutrient, in soil. Thus the integrated nutrient supply system involving the combined use of chemical, organic sources and bio-fertilizers has been thought to be best option for meeting out the nutrient requirement of the crop and ultimately increasing the seed yield and quality.

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 8 treatments *viz*. T_1: 100% NPK, T_2: 75% NPK + Vermicompost + PSB, T_3: 75% NPK + Vermicompost + Azotobactor, T_4: 50% NPK + Vermicompost + Azotobactor + PSB, T_5: 75% NPK + FYM + PSB, T_6: 75% NPK + FYM + Azotobactor, T_7: 50% NPK + FYM + Azotobactor + PSB and T_7: Control Plot which was arranged in Randomized Block Design with three replications. The recommended fertilizer dose of 100:50:50 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. 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. To protect the crop from the attack of insect pests mainly Jassids, borers and whitefly, spray of pesticides as per recommendation were done as and when needed. The fruits were picked manually when they were green, tender and at marketable size. The picked fruits were weighed and subjected to other observations immediately, after each picking.

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 1 and figure 1 and 2. Significantly higher number of fruits was observed in treatment T_1 100% NPK + PSB + Azotobactor (20.10) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (18.90), T_2 75% NPK + Vermicompost + PSB (18.40), T_4 75% NPK + FYM + Azotobactor (18.10), T_5 75% NPK + FYM + PSB (17.70), T_6 50% NPK + Vermicompost + PSB + Azotobactor (17.50), T_7 50% NPK + FYM + PSB + Azotobactor (17.10). And significantly less number of fruits was recorded in treatment T_8 (Control Plot) (15.00).

Significantly higher fruits length was observed in treatment T_1 100% NPK + PSB + Azotobactor (10.20 cm) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (10.10 cm), T_2 75% NPK + Vermicompost + PSB (9.80 cm), T_4 75% NPK + FYM + Azotobactor (9.60 cm), T_5 75% NPK + FYM + PSB (9.50 cm), T_6 50% NPK + Vermicompost + PSB + Azotobactor (9.30 cm), T_7 50% NPK + FYM + PSB + Azotobactor (9.10 cm). And significantly less fruits length was recorded in treatment T_8 (Control Plot) (7.67 cm).

More or less the present findings are similar with the results of Chattoo and Ahmad (2006) who reported that, the treatment T_4 (FYM 3t ha^{-1} + 5t Poultry manure + VC 6 t ha^{-1} + BF 7 kg ha^{-1} + 60:30 30 NPK kg ha^{-1}) recorded significantly maximum (28.93) number of fruits per plant, (14.74 cm} fruit length, (1.41 cm) fruit diameter, (14.14 g) average fruit weight and seed yield (272 >l q) per hectare in okra.

Significantly higher fruits diameter was observed in treatment T1 100% NPK + PSB + Azotobactor (1.50 cm) followed by treatment T3 75% NPK + Vermicompost + Azotobactor (1.45 cm), T2 75% NPK + Vermicompost + PSB (1.43 cm), T4 75% NPK + FYM + Azotobactor (1.41 cm), T5 75% NPK + FYM + PSB (1.40 cm), T6 50% NPK + Vermicompost + PSB + Azotobactor (1.39 cm), T7 50% NPK + FYM + PSB + Azotobactor (1.38 cm). And significantly less fruits diameter was recorded in treatment T8 (Control Plot) (1.10 cm).

The present findings are similar with the results of Prasad and Naik (2013) who reported that plant height at 30 days, plant height at 60 days, number of branches, number of leaves, number of fruits, fruit length, fruit diameter, fruit yield per plot and fruit yield per ha were significantly maximum in the plants receiving 50% recommended dose of fertilizer (RDF) + Azotobactor + Azospirillum + PSB + FYM with good yield (196.97 q/ha) and export quality fruit of okra.

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 fruits weight was observed in treatment T_1 100% NPK + PSB + Azotobactor (12.80 gm) followed by treatment T_3 75% NPK + Vermicompost + Azotobactor (12.60 gm), T_2 75% NPK + Vermicompost + PSB (12.40 gm), T_4 75% NPK + FYM + Azotobactor (12.10 gm), T_5 75% NPK + FYM + PSB (11.90 gm), T_6 50% NPK + Vermicompost + PSB + Azotobactor (11.70 gm), T_7 50% NPK + FYM + PSB + Azotobactor (11.60 gm). And significantly less fruits weight was recorded in treatment T_8 (Control Plot) (9.67 gm).

Significantly higher fruits yield was observed in treatment T1 100% NPK + PSB + Azotobactor (155.50 q) followed by treatment T3 75% NPK + Vermicompost + Azotobactor (149.52 q), T2 75% NPK + Vermicompost + PSB (148.12 q), T4 75% NPK + FYM + Azotobactor (142.60 q), T5 75% NPK + FYM + PSB (141.23 q), T6 50% NPK + Vermicompost + PSB + Azotobactor (138.00 q), T7 50% NPK + FYM + PSB + Azotobactor (137.00 q). And significantly less fruits yield was recorded in treatment T_8 (Control Plot) (95.00 q).

The present results are similar with the Hisham *et al*., (2014) [5] who observed that application of FYM @ 25 t/ha significantly increased growth, yield and quality attributes *viz*. number of leaves, number of branches and plant height, average number of fruit per plant, average fresh weight of fruit, fruit yield per plant, fruit yield/ha, maximum average fruit yield per hectare (16.25 t/ha), maximum T.S.S and maximum ascorbic acid (15.58 mg/100g) in okra fruits.

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	100% NPK + PSB + Azotobactor	20.10	10.20	1.50
T_2	75% NPK + Vermicompost + PSB	18.40	9.80	1.43
T_3	75% NPK + Vermicompost + Azotobactor	18.90	10.10	1.45
T_4	75% NPK + FYM + Azotobactor	18.10	9.60	1.41
T_5	75% NPK + FYM + PSB	17.70	9.50	1.40
T_6	50% NPK + Vermicompost + PSB + Azotobactor	17.50	9.30	1.39
T_7	50% NPK + FYM + PSB + Azotobactor	17.10	9.10	1.38
T_8	Control Plot	15.00	7.67	1.10
	S.Em (±)	0.91	0.45	0.07
	CD (5%) =	2.70	1.37	0.22
	CV =	11.03	8.34	8.92

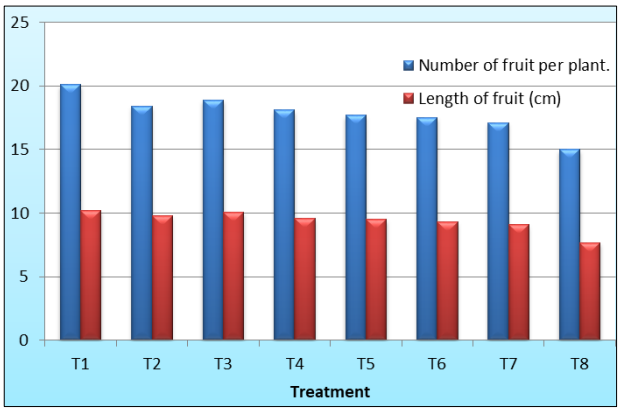

Fig 1: Number of fruit per plant and Length of fruit (cm)

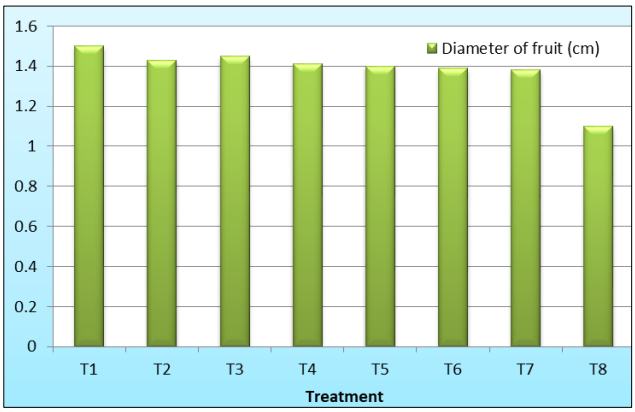

Fig 2: Diameter of fruit (cm)

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	100% NPK + PSB + Azotobactor	12.80	155.50
T_2	75% NPK + Vermicompost + PSB	12.40	148.12
T_3	75% NPK + Vermicompost + Azotobactor	12.60	149.52
T_4	75% NPK + FYM + Azotobactor	12.10	142.60
T_5	75% NPK + FYM + PSB	11.90	141.23
T_6	50% NPK + Vermicompost + PSB + Azotobactor	11.70	138.00
T_7	50% NPK + FYM + PSB + Azotobactor	11.60	137.00
T_8	Control Plot	9.67	95.00
	S.Em (±)	0.57	5.67
	CD (5%) =	1.75	16.87
	CV =	8.44	8.88

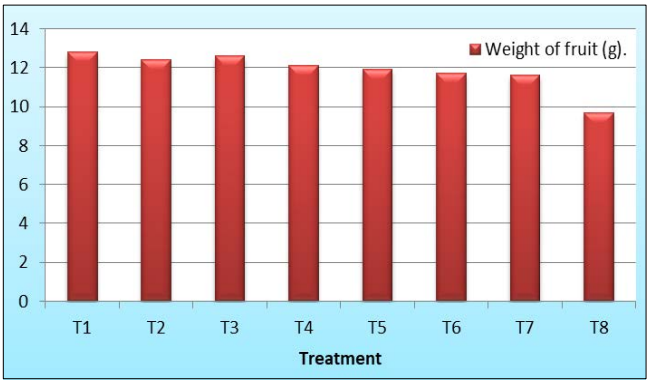

Fig 3: Weight of fruit (g)

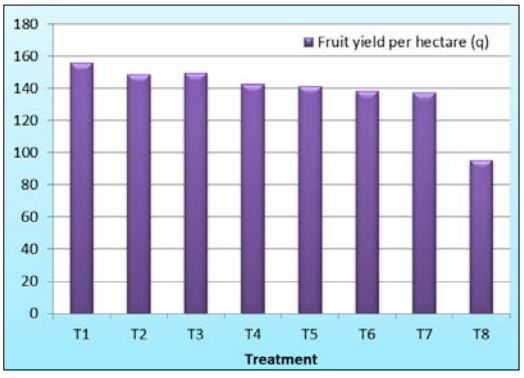

Fig 4: Fruit yield per hectare (q)

Conclusion

On the basis of above findings, treatment T_1 100% NPK + PSB + Azotobactor stand first in position and T_3 75% NPK + Vermicompost + Azotobactor stand in second order of preference. However, treatment T_2 75% NPK + Vermicompost + PSB comes in next in order.

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