Effect of different organic manure and inorganic fertilizer on growth, yield and quality of okra (*Abelmoschus esculentus* L.)

Abstract

The experimentation entitled Effect of different organic manure and inorganic fertilizer on growth, yield and quality of okra (*Abelmoschus esculentus* L.) during kharif (Rainy) season at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, and PRAYAGRAJ (UP) during 2022. Due to the heavy application of chemical and fertilizer, land and water bodies are getting polluted So, to reduce the degradation of soil, we have used combination of organic and inorganic sources of nutrients. The experiment was laid out in a randomized block design with three replications and thirteen treatment combinations. F1 Hybrid Covi Plus was selected for this study. We have found that application of 75% NPK and 25% of vermicompost respectively gave highest yield (19.57 t/ha)

Keywords: Organic manure, Inorganic fertilizer, Okra, and Yield

INTRODUCTION

Okra [*Abelmoschus esculentus* L.] known as Lady's finger, is indigenous to tropical Africa and grown throughout India in summer and rainy seasons. Okra is erect, herbaceous, annual green and belong to the family *Malvaceae*. The tender green fruits of okra are cooked in curry and soup. To a limited extmt e finds use in canned, dehydrated or frozen forms for off-season consumption by the army at high altitudes and export. **(Sharma *et al.,* 2015)** The root and stem are used for clearing cane juice in preparation of 'gur'. The high iodine content of fruits helps to control of goiter disease. Okra is said to be very useful against genito-urinary disorders, and chronic dysentery. The dry seed contains 13-22 % edible oil and 20-24 % protein. The oil is used in soap and cosmetic industry, while the protein is used for fortified feed preparation. The crushed seed is fed to cattle for higher milk production and the fibre is utilized in jute textile and paper industry. All parts of okra (Lady's finger) like fresh leaves, buds, flowers, pods, stems and seeds can be used for different purposes and hence it is a multipurpose crop in terms of its uses **(Gemede *et al.,* 2015).**

The growth, yield and quality of okra are hampered severely by inefficient production methods or lack of knowledge about the best cultivation and management practices, low awareness on the nutritional and health benefits, low quality seed standards and limited market access. Its production and productivity are also seriously affected due to the use of local varieties (low yielding), sub or supra-optimal plant density (improper inter and intra-row spacing), inappropriate planting dates, soil nutrients, and severe attack of various insect pests, diseases and weeds **(Sarkar *et al.,* 2014).** The importance of sowing dates and spacing in okra cannot be overlooked as it affects different plant characters. Sowing dates have great impact on the seed production, growth and quality of okra. The different cultivars require different sowing times, as good cultivars sown at improper time give poor yield. Therefore, proper and suitable date of sowing is critical to increase the production of okra. Plant sown at proper time gets advantage of climatic factors, has high growth duration, receives proper rainfall, and experience optimal temperature during establishment and the early vegetative stage. As a result, fresh fruit yield and economic returns can be obtained. Improper sowing dates lead to shorter duration, inadequate utilization of rainfall, experiences cool temperature during establishment and the early vegetative stage, and fruit takes longer time to reach marketable size. The delayed sowing causes decreased fruit yield of okra **(Ghannad *et al.*, 2014)**. Proper sowing time gives high fresh weight of fruit, a greater number of fruits per plant and ultimately increases fruit yield per plant.

High application rate of fertilizer and manures are required for better fruit production to promote vigorous growth and quality. Never the less fertilizers are expensive and should be used efficiently and effectively to avoid wastage. Okra being a nutrient loving crop, it responds well to added nutrients. It has been experimentally proved that no single source of fertilizer is capable of supplying plant nutrients in adequate amount and in balanced proportion **(Yadav *et al.,* 2022).** Therefore, to maintain the soil fertility and to supply plant nutrients in balanced proportion for optimum growth, yield and quality of a crop, a combined use of inorganic, organic and biological sources of plant nutrients should be adopted. This helps in better utilization of added inorganic fertilizer thus helps in reducing its level of application and

reducing the deleterious effect of harsh chemical residues that the inorganic fertilizer level in soil**.**

This study aimed to find out the effect of Organic and inorganic fertilizers on growth, yield and quality of okra. **(Kaur *et al.*, 2015).**

MATERIALS AND METHODS

Location

The experiment was conducted during kharif (Rainy) season at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, and PRAYAGRAJ (UP) during 2022.

Prayagraj is situated at an elevation of 78 meters above sea level at 25.87 North latitude and 81.150 E longitudes. This region has a subtropical climate prevailing in the South-East part of U.P. with both the extremes in temperature, i.e., the winter and the summer. In cold winters, the temperature sometimes is as low as 20C in December – January and very hot summer with temperature reaching up to 500C in the months of May and June. During winter, frosts and during summer, hot scorching winds are also not uncommon. The average rainfall is around 1013.4 (cm) with maximum concentration during July to September months with occasional showers in winters.

Soil Characteristics of the Experimental Site

The experimental site is levelled land with sandy loam soil of uniform fertility status with low clay and high sand percentage. Soil samples were collected randomly from depth of 0-30 cm and the soil was analysed for pH (6.9), electrical conductivity (EC) 0.36, organic carbon (0.358), available nitrogen (212.56 kg/h.), available phosphorus (40.50 kg/h.), and available potassium (225.1 kg/h.)

TREATMENT COMBINATION

TREATMENT	TREATMENT COMBINATION
T0	NPK (UREA, SSP, MOP)- 100% (Control)
T1	VERMI COMPOST- 100%
T2	POULTRY MANURE- 100%
T3	FYM- 100%
T4	NPK- 50% +VERMI COMPOST- 50%
T5	NPK- 50% +POULTRY MANURE- 50%
T6	NPK- 50% +FYM- 50%
T7	NPK- 75% +VERMI COMPOST- 25%
T8	NPK- 75% +POULTRY MANURE- 25%
T9	NPK- 75% +FYM- 25%
T10	NPK- 25% +VERMI COMPOST- 75%
T11	NPK- 25% +POULTRY MANURE- 75%
T12	NPK- 25% +FYM- 75%

Note: Recommended Dose of Fertilizer: Nitrogen :100kg ha^{-1}, Phosphorus: 60kg ha^{-1}, Potassium: 50kg ha^{-1}
Urea = Nitrogen, SSP = Phosphorus, MOP = Potassium

RESULTS AND DISCUSSION

Growth Parameters

Plant height (cm) at 20, 40, and 60 DAS

The maximum plant height was recorded in T7 treatment (11.50, 69.17 and 118.73 cm) which is receiving 75% RDF + 25% vermicompost. This was followed by T8 treatment (10.63, 67.73 and 116.23 cm) which is receiving 75% RDF + 25% farmyard manure. The treatment receiving pure inorganic fertilizer i.e., T1 treatment recorded better results (9.27, 64.57 and 107.73 cm) compared to those receiving pure organic treatments, which recorded lower plant height of all the treatments T3 recorded minimum plant height (9.07, 53.03 and 95.57 cm). Similar findings were reported by **Lakera *et al.,* (2017).**

Leaf Area (cm^2) at harvest time

The observation in term of Leaf Area (cm^2) at harvest time of Okra the results showed that maximum leaf area (cm^2) was recorded in T7 treatment (5124.88 cm^2) which is receiving 75% RDF + 25% vermicompost. This was followed by T8 treatment (4797.07 cm^2) which is receiving 75% RDF + 25% farmyard manure. The treatment receiving pure inorganic fertilizer i.e., T1 treatment recorded better results (2639.63 cm^2) compared to those receiving pure organic treatments, which recorded lower leaf area of all the treatments T3 recorded minimum leaf area (2318.09 cm^2). Similar findings were reported by **Yadav *et al.,* (2017)** and **Harish *et al., (*2011).**

Number of Leaves $Plant^{-1}$ at 20, 40, and 60 DAS

The results showed that maximum Number of Leaves $Plant^{-1}$ was recorded in T7 treatment (6.53, 14.30 and 42.47 cm) which is receiving 75% RDF + 25% vermicompost. This was followed by T8 treatment (6.40, 14.23 and 41.03 cm) which is receiving 75% RDF + 25% farmyard manure. The treatment receiving pure inorganic fertilizer i.e., T1 treatment recorded better results (4.43, 12.33 and 33.53 cm) compared to those receiving pure organic treatments, which recorded lower Number of Leaves Plant-1 of all the treatments T3 recorded minimum Number of Leaves $Plant^{-1}$ (4.00, 9.73 and 28.87 cm). Similar findings were reported by **Singh *et al.,* (2018).**

Number of Branches $Plant^{-1}$ at 20, 40, and 60 DAS

The maximum Number of Branches $Plant^{-1}$ was recorded in T7 treatment (1.88, 4.07 & 6.40) which is receiving 75% RDF + 25% vermicompost. This was followed by T8 treatment (1.70, 3.90 & 6.20) which is receiving 75% RDF + 25% farmyard manure. The treatment receiving pure inorganic fertilizer i.e., T1 treatment recorded better results (1.24, 3.30 & 5.17) compared to those receiving pure organic treatments, which recorded lower Number of branches Plant-1 of all the treatments T3 recorded minimum Number of Branches $Plant^{-1}$ (1.18, 2.63 & 4.23). Similar findings were reported by **Yadav *et al., (*2017)** and **Suthar *et al.,* (2017).**

Table 1. Various growth parameters of okra as influenced by different organic manure and inorganic fertilizer.

TREATMENT	TREATMENT COMBINATION	Plant Height			Number of leaves per plan			Leaf area (cm^2) at Harvest time	Number of Branches per plant		
		20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS		20 DAS	40 DAS	60 DAS
T0	NPK (UREA, SSP, MOP)- 100% (Control)	10.23	67.50	107.90	4.93	12.73	31.97	2388.55	1.35	3.10	5.50
T1	VERMI COMPOST- 100%	9.27	64.57	107.73	4.43	12.33	33.53	2639.63	1.24	3.30	5.17
T2	POULTRY MANURE- 100%	9.67	60.80	105	4.13	11.20	32.07	2561.16	1.20	3.20	4.83
T3	FYM- 100%	9.07	53.03	95.57	4.00	9.73	28.87	2318.09	1.18	2.63	4.23
T4	NPK- 50% +VERMI COMPOST- 50%	10.13	65.80	107.47	5.40	12.13	37.27	3870.27	1.62	3.40	5.60
T5	NPK- 50% +POULTRY MANURE- 50%	9.53	64.73	109.73	5.27	11.63	36.90	3766.51	1.55	3.23	5.50
T6	NPK- 50% +FYM- 50%	9.60	66.63	109.37	5.33	12.27	35.90	3673.40	1.27	3.07	5.43
T7	NPK- 75% +VERMI COMPOST- 25%	11.50	69.17	118.73	6.53	14.23	42.47	5124.88	1.88	4.07	6.40
T8	NPK- 75% +POULTRY MANURE- 25%	10.63	67.73	116.23	6.40	14.30	41.03	4797.07	1.70	3.90	6.20
T9	NPK- 75% +FYM- 25%	10.37	67.27	112.33	6.00	13.73	39.37	4348.05	1.41	3.73	6.17
T10	NPK- 25% +VERMI COMPOST- 75%	10.03	65.07	108.20	6.10	13.20	35.97	3416.11	1.44	3.10	5.37
T11	NPK- 25% +POULTRY MANURE- 75%	9.27	65.37	109.33	5.73	12.47	34.80	3183.39	1.45	2.97	5.27
T12	NPK- 25% +FYM- 75%	9.37	63.80	108.33	5.23	12.90	34.57	3042.10	1.43	3.00	5.27
F-Test		**S**	**S**	**S**	**S**	**S**	**S**	S	**S**	**S**	**S**
S. Ed. ±		**0.55**	**3.31**	**2.96**	**0.35**	**0.62**	**2.04**	**2.78**	**0.13**	**0.13**	**0.48**
CD at 5%		**1.13**	**6.84**	**6.10**	**0.71**	**1.28**	**4.21**	**5.75**	**0.27**	**0.64**	**0.99**
CV		**6.80**	**6.27**	**3.32**	**7.92**	**6.06**	**6.99**	**3.56**	**11.02**	**11.68**	**10.82**

Yield parameters

Number of fruits per plant

The results showed that highest number of fruits per plant were recorded with T7 treatment receiving 75% RDF + 25% vermicompost (18.73) followed by T8 treatment receiving 75% RDF + 25% FYM (18.20). T9 and T4 treatments recorded lesser number of fruits per plant. T3 treatment (FYM-100%) recorded minimum number of fruits per plant (14.27) compared to all other treatments. Similar results were also reported by **Rudra *et al.*, (2022).**

Length of fruit (cm)

The results showed that highest Length of fruits (cm) were recorded with T7 treatment receiving 75% RDF + 25% vermicompost (12.10 cm) followed by T8 treatment receiving 75% RDF + 25% FYM (11.53 cm). T9 and T6 treatments recorded lesser length of fruits. T3 treatment (FYM-100%) recorded minimum length of fruits per plant (9.03 cm) compared to all other treatments. Similar results were also reported by **Yadav *at el.* (2017)** and **Kumar *et al.* (2018).**

Weight of fruit (g)

The results showed that highest Weight of fruits (g) per fruit were recorded with T7 treatment receiving 75% RDF + 25% vermicompost (14.10 g) followed by T8 treatment receiving 75% RDF + 25% FYM (13.23 g). T9 and T6 treatments recorded lesser Weight of fruits (g) per fruit. T3 treatment (FYM-100%) recorded minimum Weight of fruits (9.77 g) per fruit compared to all other treatments. Similar results were also reported by **Ghosh *at el.* (2018)** and **Singh *et al.*, (2018).**

Weight of fruit/plant (g)

The results showed that highest Weight of fruits/plant (g) per fruit were recorded with T7 treatment receiving 75% RDF + 25% vermicompost (264.18 g) followed by T8 treatment receiving 75% RDF + 25% FYM (241.59 g). T9 and T6 treatments recorded lesser Weight of fruits (g) per fruit. T3 treatment (FYM-100%) recorded minimum Weight of fruits (139.37 g) per fruit compared to all other treatments. Similar results were also reported by **kumar *et al.* (2017)**.

Weight of fruit/plot (kg)

The results showed that highest Weight of fruit/plot (kg) were recorded with T7 treatment receiving 75% RDF + 25% vermicompost (2.38 kg) followed by T8 treatment receiving 75% RDF + 25% FYM (2.17 kg). T9 and T6 treatments recorded lesser Weight of fruit/plot (kg). T3 treatment (FYM-100%) recorded minimum Weight of fruits (1.25 kg) per plot compared to all other treatments. Similar results were also reported by **Singh *et al.* (2018)** and **Mishra *et al.* (2009).**

Yield (t/ha)

The results showed that highest Yield ha^{-1} were recorded with T7 treatment receiving 75% RDF + 25% vermicompost (19.57 t) followed by T8 treatment receiving 75% RDF + 25% FYM (17.82 t). T9 and T6 treatments recorded lesser Yield t/ha. T3 treatment (FYM-100%) recorded minimum Yield (10.32 t) per hector compared to all other treatments. Similar findings were reported by **Krishna *et al.*, (2002)** and **Davenda *et al.*, (2021).**

Table 2. Effect of different organic manure and inorganic fertilizer on yield parameters of okra

Treat-ment	**TREATMENT COMBINATION**	**No. of Fruits/Plant**	**Aaverage fruit length(cm)**	**Aaverage fruit Weight(g)**	**Weight of fruit/plant (g)**	**Weight of fruit/plot (kg)**	**Yield (t/ha.)**
T1	NPK (UREA, SSP, MOP)- 100% (Control)	15.07	10.08	11.94	179.91	1.62	13.33
T2	VERMI COMPOST- 100%	15.27	9.44	10.40	158.88	1.43	11.77
T3	POULTRY MANURE- 100%	14.90	9.32	9.83	146.47	1.32	10.85
T4	FYM- 100%	14.27	9.03	9.77	139.37	1.25	10.32
T5	NPK- 50% +VERMI COMPOST- 50%	16.07	10.50	12.13	194.86	1.75	14.43
T6	NPK- 50% +POULTRY MANURE- 50%	15.80	10.47	11.79	186.10	1.67	13.78
T7	NPK- 50% +FYM- 50%	16.00	11.03	11.36	181.58	1.63	13.45
T8	NPK- 75% +VERMI COMPOST- 25%	18.73	12.10	14.10	264.18	2.38	19.57
T9	NPK- 75% +POULTRY MANURE- 25%	18.20	11.53	13.23	241.59	2.17	17.82
T10	NPK- 75% +FYM- 25%	17.27	11.23	12.27	211.86	1.91	15.69
T11	NPK- 25% +VERMI COMPOST- 75%	15.87	10.16	11.81	187.37	1.69	13.88
T12	NPK- 25% +POULTRY MANURE- 75%	15.23	10.09	11.70	178.43	1.61	13.22
T13	NPK- 25% +FYM- 75%	15.20	10.34	11.61	176.44	1.59	13.07
F-Test		**S**	**S**	**S**	**S**	**S**	**S**
S. Ed. ±		**0.67**	**0.45**	**0.28**	**8.59**	**0.07**	**0.64**
CD at 5%		**1.38**	**0.93**	**0.58**	**17.73**	**0.16**	**1.31**
CV		**5.14**	**5.32**	**2.96**	**5.59**	**5.59**	**5.59**

Disease incidences and pest occurrence

No diseases were observed in the present experiment, however few insects viz. red cotton bugs were observed during last harvesting of okra fruits.

CONCLUSION

From the present investigation it is concluded that F1 Hybrid Covi Plus okra performed best in treatment T7- (75%RDF + 25% vermicompost) in terms of plant height (118.73) cm, No. of branches (6.40), No. of leaves (42.47), Number of fruits per plant (18.73), Average Fruit length (12.10) cm, Average Fruit weight (14.10) g and yield (19.56 /ha).

Combination of organic and inorganic fertilizer resultant in maximum number of pods of okra crop in treatment T7. Hence with the application of appropriate ratio of organic and inorganic fertilizer in the field they act as growth promoter for the okra crop. Combination of vermicompost and NPK in treatment T7 (NPK 75% + 25% VC) were found to be the best combination. Thus, from the results obtained it can be concluded that organic manures can enhance the nutrient status of okra fruit as well as at appropriate combination with inorganic fertilizer it helps to increase the plant growth. Organic farming is an effective option for agricultural fields in cropping of *A. esculentus*, which will yield the quality product with least soil damage and helps to maintain its fertility for a longer period.

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