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EFFECT OF ORGANIC AND INORGANIC FERTILIZER COMBINATIONS ON GROWTH AND YIELD OF OKRA

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ABSTRACT

Okra is a very important crop which has nutrients and biochemical benefits that protect the human body from deficiency of iodine and act as medicinal properties. The present investigation was undertaken to evaluate the "Effect of organic and inorganic fertilizer combinations on growth and yield of okra" at the Experimental Farm, School of Agriculture Science, LNCT University, Bhopal, (M.P.) during two consecutive years of 2023 and 2024 in summer season. The research employed a Randomized Block Design for the experiment, which included three replications and eleven treatments (T_0 – T_{10}). The experiment included monitoring parameters of plant height, number of leaves per plant, number of nodes per plant, number of branches, days to first flowering, node at first flowering, days to 50% flowering, days to first harvest and fruit yield per plant. The use of fertilizer combinations at the place of the single fertilizer treatment produces higher fruits in the plants. The treatment T_7 (100 % RDF + Poultry manure @ 10 t ha^{-1}) produce higher yield in both seasons (summer) of 2023 and 2024.
Keywords **:** Nutrients, inorganic fertilizers, organic fertilizers, okra and yield

Introduction

Okra (*Abelmoschus esculentus* L.) is a widely recognized and most commonly used vegetable crop of the Malvaceae family. It is cultivated in tropical and subtropical regions around the world. It is also known as lady's finger or bhindi. The origin of okra is believed to be tropical Africa. The main reason for its cultivation is its tender, immature fruits, which are sold fresh, canned or dried as vegetables. Every 100 g edible portion of green okra fruits contains 2.08 g protein, 3.62 g carbohydrates, 0.22 g total fat, 4.08 g dietary fiber, 0.94 g ash content, 0.04 mg thiamine, 0.07 mg riboflavin, 0.61 mg niacin, 0.28 pantothenic acid, 22.51 mg ascorbic acid and 1233 µg total carotenoids. Apart from this, it also contains potassium (263 mg), calcium (86.12 mg), phosphorus (57.48 mg), magnesium (66.10 mg), sodium (7.37 mg), iron (0.84 mg), zinc (0.45 mg), manganese (0.30 mg), copper (0.13 mg) and other nutrients (Longvah *et al*., 2017). Flavonoid derivatives and phenolic compounds are two more antioxidant-rich foods found in okra. Nitrogen, phosphorus and potassium are the major components of fertilizers which are required by plants in large quantities for their growth and development (Shah *et al*., 2023). Crop production can be increased by using a combination of organic and inorganic fertilizers. According to Mal *et al*. (2013), vermicompost enrichment in soil provides nutrients that are missing from chemical fertilizers. However, the existing organic sources in the country can only meet about one-third of the total nutrients required to reach the desired agricultural production targets. Therefore, to maintain high levels of production and crop quality, it is important to implement prudent nutrient management. Farmyard manure (FYM) is an organic fertilizer that is produced from the decomposition of animal excreta, bedding material, and residual feed. This resource is highly helpful in strengthening soil fertility, increasing the accessibility of important

minerals such as nitrogen, phosphorus, and potassium, and stimulating beneficial microbial activity. FYM, or farmyard compost, enhances soil structure, increases water retention, and promotes sustainable farming practices by reducing dependence on chemical fertilizers. Consistent use of farmyard manure (FYM) can maintain soil productivity and environmental sustainability (Singh *et al*., 2016). Poultry manure is a powerful organic fertilizer that contains significant amounts of vital minerals including nitrogen, phosphorus, and potassium, making it an excellent choice for stimulating plant growth. This substance also contains substantial amounts of calcium and magnesium, which contribute to enhancing soil structure and promoting microbial activity (Moral *et al*., 2009). The objective of this study is to look into the response of organic and inorganic fertilizer combinations on the quantitative characteristics of okra.

Materials and Methods

The present experiment was conducted to evaluate the "Effect of organic and inorganic fertilizer combinations on growth and yield of okra" at the Experimental Farm, School of Agriculture Science, LNCT University, Bhopal, (M.P.) during two consecutive years of 2023 and 2024. The experiment was laid out in Randomized Block Design with three replications and eleven treatments *i.e.* T_0 (Control), T_1 (100 % RDF), T_2 (Vermicompost @ 10 t ha^{-1}), T_3 (75 % RDF + Vermicompost @ 10 t ha^{-1}), T_4 (100 % RDF + Vermicompost @ 10 t ha^{-1}), T_5 (Poultry manure @ 10 t ha^{-1}), T_6 (75 % RDF + Poultry manure @ 10 t ha^{-1}), T_7 (100 % RDF + Poultry manure @ 10 t ha^{-1}), T_8 (FYM @ 10 t ha^{-1}), T_9 (75 % RDF + FYM @ 10 t ha^{-1}) and T_{10} (100 % RDF + FYM @ 10 t ha^{-1}). During the study, the observations were recorded on plant height (cm), number of leaves per plant, number of nodes per plant, number of branches, days to first flowering, node at first flowering, days to 50% flowering, days to first harvest and fruit yield per plant (g) in five tagged plants. The software OPSTAT developed by the Department of Mathematics Statistics, CCS HAU, Hisar Haryana was used to analyze the data collected during the experiment.

Results and Discussion

Growth parameters

The data on growth parameters like plant height, number of leaves, number of branches, days to first flowering, days to 50% flowering, days to first harvest and fruit yield per plant (g) in both seasons were significantly influenced by different doses of organic and inorganic nutrient combinations (Table 1).

Plant height (cm)

During summer season 2023, at final harvest the range of plant height varied from 129.17 cm to 183.70 cm and in summer 2024, ranged from 126.41 cm to 180.58 cm. The highest plant height (183.70 cm & 180.58 cm) during 2023 and 2024 both seasons observed in treatment T_7 respectively. In this study it was evaluated the effect of different nutrient combinations in treatments on plant height trait and it showed clear differences among the treatments. Treatments containing two fertilizers (organic and inorganic fertilizers) responsible for higher heights as compared to control. Therefore, use of organic nutrients along with chemical fertilizers provides better height without much impact on the environment. The same experimental finding of previous research given by Singh *et al*. (2016), Lakra *et al*. (2017), Sharma *et al*. (2020) and Kumari *et al*. (2023).

Number of nodes per plant

The data of number of nodes in both seasons, which were non-significantly affected by different types and doses of organic and inorganic nutrient combinations. The value of number of nodes varied non-significantly from 14.50 to 16.51 for summer 2023 and from 14.28 to 16.25 for summer 2024. In summer season of 2023, the maximum number of nodes showed in T_7 (16.51 & 16.25) respectively. Plants grown with only organic nutrients showed a good number of nodes. This happened because additional nutrients are released by organic matter but during the main growth period the plants did not take up enough nutrients as per their requirement. In most cases the number of nodes depends on the plant genes that are passed from one generation to the next. The number of nodes is directly related to the height of the plant. Sometimes the height of the plant may not affect the number of nodes as a smaller plant also has a higher number of nodes. The similar experimental finding was given by Tripathy *et al*. (2004) and Kumar *et al*. (2013).

Number of leaves per plant

The number of leaves per plant observed significant among treatments. At final harvest during 2023 (summer season) the number of leaves was significantly varied from 27.64 to 32.82 and for summer 2024, it ranged between 26.23 to 31.50. During both summer seasons (2023 and 2024) the highest value (32.82 & 31.50) found in T_7 respectively. This experiment examined the performance of different combinations of organic and inorganic both types of nutrients for number of leaves per plant that responsible for high vegetative growth of plants along

with yield. The experimental results observed a positive relationship with number of leaves increases when either of the two types of nutrients was used as compared to organic and inorganic fertilizers alone. So, this leads to sufficient and balance nutrients during the growth periods of plants when it required nutrients. Some other studies also conducted by Ibrahim and Hamma (2012), Lakra *et al*. (2017), Bhandari *et al.* (2019) and Kumari *et al.* (2023) found similar results.

Number of branches

The number of branches in plants significantly affected by different treatment containing organic and inorganic fertilizers. The values ranged significantly between 23.87 to 27.70 for summer season 2023 and during summer season 2024 the values varied from 2.32 to 3.30. The maximum number of branches in both seasons showed in T_7 (3.30 & 3.03) respectively. Only plants grown with organic manure had a significantly higher number of branches but in 2024 season of summer not found significant effect due to variation of soil nutrients distribution to the plants was not equal. During 2023 the results point to INM systems being more effective in enhancing the growth and development of branches. These techniques combine the best aspects of both fertilizers. Such types of practices of nutrient management help increases the vegetative growth of plants while ensuring soil fertility and sustainability in systems of crop production for the long term. The same experimental finding of previous research given Thirunavukkarasu and Balaji (2015), Singh *et al*. (2016) and Lakra *et al.* (2017).

Days to first flowering

The days taken to first flowering was significantly influenced by different doses of two types of fertilizers (organic and inorganic). During summer season of 2023, the value of trait ranged from 36.66 to 39.23 days. Among the treatments, the lowest value recorded in T_0 (36.66 & 37.25) in both seasons of summer (2023-2024) respectively. Days to days to first flowering has very immense value for earliness. In this research, I was studied and understood that the plants are highly affected by environmental conditions. The variation between the two seasons is due to temperature and relative humidity (Tripathy *et al*., 2007; Bharadiya *et al*., 2007). The experiment observed a variation of days to first flowering among the eleven different treatments. Different combinations of fertilizers resulted in earlier flowering than using single organic or inorganic fertilizers. On the other hand, slow nutrient release in all treatments caused delayed flowering while sometimes the use of inorganic fertilizers caused nutrient imbalance. A similar finding was also made by the experiment Bharadiya *et al*. (2007), Kumar *et al*. (2017) and Kumari *et al*. (2023).

Node of first flowering

The node at which first flower appear were significantly influenced by fertilizer treatments. During 2023 (summer season) significantly ranged from 3.05 to 3.72 and for summer 2024, it ranged between 3.18 to 3.86. During both seasons of 2023 and 2024, the highest value observed in T_0 (3.72 and 3.86) and T_1 (3.69 and 3.84) respectively. The research revealed that the node where the flowers first emerged did not appears differences across the different nutrient management techniques. This non-significance meanings that the emergence of flowering at specific nodes may be affected by the characteristics of plants genetic instead of external nutrients. Whether through combinations or individual use of fertilizers organic and inorganic management of nutrients may not directly affect the positioning of nodes for flower emergence. In addition, factors such as temperature, light and length of days likely play a role in determining the node to flower emergence, which can reduce the effect of nutrients. The similar experimental finding was given by Kumar *et al*. (2013).

Days to 50% flowering

The trait days to 50% flowering in plants during both seasons significantly affected by different treatment containing organic and inorganic fertilizers. The values ranged significantly between 49.72 to 54.55 for summer season 2023 and during summer season 2024, it varied from 50.53 to 56.04. The minimum value showed in T_0 (49.72 & 50.53) during both seasons respectively. The investigation found that there was a 50% difference in flowering among the eleven experimental treatments. Different mixtures of fertilizers resulted in earlier flowering than using only organic or inorganic fertilizers. This difference in days to 50% flowering may be due to the nutrients provided by the integrated treatments, which stimulate plant metabolism. The combination of organic and inorganic fertilizers increases nutrition availability, resulting in early flowering. The variation between the treatments is due to temperature and relative humidity (Tripathy *et al*., 2007; Bharadiya *et al*., 2007). A similar finding was also made by some following researchers *viz.*, Kumar *et al*. (2017) and Kumari *et al*. (2023).

Days to first harvest

During summer season 2023 the value of trait was found significant and varied from 42.67 to 45.19, while in summer 2024, the values significantly varied from 43.43 to 45.87. During both seasons, the lowest value

for the trait was observed in T_0 (42.67 & 43.43). During days to first fruit harvest, it studied and understood that the plants are highly affected by environmental conditions. As in summer season the crop has taken more times to early flowering so, variation between genotypes considerably also found. The early harvesting is a desirable trait for higher yields that brings higher returns when the crop is marketed as an early genotype. Different combinations of fertilizers (T_0–T_{10}) resulted in earlier harvesting as compared to single organic or inorganic fertilizers. This difference for the traits may depend on the nutrient provided by integrated treatments which increases the metabolism of okra plant. A similar finding was also made by Bairwa *et al*. (2009) and Thirunavukkarasu *et al.* (2014).

Yield parameters

The yield parameter *i.e*., fruit yield per plant during the years 2023 and 2024 significantly affected by different treatments consisting of organic and inorganic fertilizers, which is depicted in Table 1.

Fruit yield per plant (g)

The value of fruit yield per plant ranged significantly from 103.96 g to 179.00 g for summer season 2023 and for summer season 2024 the values varied from 101.12 g to 173.00 g. The maximum fruit yield in both seasons showed in T_7 (179.00 g & 173.00 g) respectively. Fruit yield per plant in okra is affected by several factors such as fruit size, number of fruits, and overall plant health are really important. Fruit yield per plant also affected by the biotic and abiotic factors. When studied in field deeply on fruit yield per plant are depends upon the different factors such as number of nodes, number of leaves, fruit length, fruit diameter and other contributing traits. High yields usually obtained by the mix of these factors. It has noticed that the fruit output for each plant of 11 treatment is very different in combining different mixtures of organic and inorganic fertilizers. Compared to the use of single fertilizer, the combinations of fertilizer treatment produce most of the fruits in plants. A similar finding was also made by some following researchers *viz*., Chaudhari *et al*. (2024), Santos *et al*. (2019) and Kumari *et al*. (2023).

Conclusion

The organic and inorganic fertilizer both are essential for growth and development of plants. Different nutrient combinations on quantitative trait showed clear differences among the treatments. Treatments containing two fertilizers (organic and inorganic) responsible for higher yield as compared to control (T_0). Therefore, effect of treatment T_7 with organic nutrients along with chemical fertilizers provides better yield without much impact on the environment during two seasons of summer (2023 & 2024). This treatment is therefore useful in the Bhopal region of Madhya Pradesh for commercial farming. The highest value of B:C ratio and net return found also in T_7 treatment.

Table 1 : Effect of organic and inorganic fertilizer combinations on yield parameters of okra

Treatments	Plant height (cm)		Number of nodes per plant		Number of leaves per plant		Number of Branches		Days to first flowering		Node of first flower appearance		Days to 50% flowering		Days to first harvest		Fruit yield per plant (g)	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
T_0	129.17	126.41	14.50	14.28	27.64	26.23	2.32	2.27	36.66	37.25	3.72	3.86	49.72	50.53	42.67	43.43	103.96	101.12
T_1	164.84	161.85	16.08	15.83	31.94	30.60	2.56	2.46	37.60	38.16	3.69	3.84	54.19	55.10	44.43	45.13	143.57	139.13
T_2	155.84	159.59	15.58	15.34	28.50	27.10	2.50	2.41	37.07	37.64	3.59	3.74	53.51	54.41	43.67	44.39	134.05	130.12
T_3	173.24	161.85	15.77	15.53	31.77	30.43	2.56	2.46	37.39	37.95	3.55	3.70	54.04	54.95	44.33	45.03	142.86	138.67
T_4	180.57	177.47	16.44	16.18	32.63	31.30	3.08	2.87	38.56	39.09	3.49	3.63	55.10	56.04	45.14	45.82	170.87	165.32
T_5	162.57	152.91	15.40	15.16	28.10	26.70	2.44	2.36	36.92	37.50	3.41	3.55	53.43	54.33	43.33	44.06	135.32	131.45
T_6	174.44	165.15	16.16	15.90	32.23	30.90	2.67	2.55	37.86	38.41	3.38	3.51	53.97	54.88	44.62	45.32	158.10	153.27
T_7	183.70	180.58	16.51	16.25	32.82	31.50	3.30	3.03	39.23	39.74	3.32	3.46	54.55	55.47	45.19	45.87	179.00	173.00
T_8	149.04	146.15	14.95	14.72	27.81	26.40	2.38	2.32	36.77	37.36	3.30	3.44	53.12	54.01	43.20	43.94	127.56	123.93
T_9	163.44	160.45	15.80	15.56	31.55	30.20	2.52	2.43	37.21	37.78	3.12	3.26	53.57	54.47	43.98	44.70	139.67	135.56
T_{10}	168.17	165.16	16.27	16.01	32.53	31.20	2.75	2.60	38.12	38.67	3.05	3.18	53.61	54.51	44.90	45.59	155.34	150.38
SEm ±	2.69	2.30	0.48	0.40	0.57	0.49	0.19	0.15	0.48	0.50	014	0.15	088	0.85	0.44	0.46	9.16	8.97
CD (5%)	7.94	6.78	NS	NS	1.71	1.47	0.56	NS	1.43	1.50	NS	NS	2.60	2.52	1.32	1.37	27.02	26.46

T_0: Control, **T_1:** 100 % RDF, **T_2:**Vermicompost @ 10 t ha^{-1}, **T_3:** 75 % RDF + Vermicompost @ 10 t ha^{-1}, **T_4:** 100 % RDF + Vermicompost @ 10 t ha^{-1}, **T_5:** Poultry manure @ 10 t ha^{-1}, **T_6:** 75 % RDF + Poultry manure @ 10 t ha^{-1}, **T_7:** 100 % RDF + Poultry manure @ 10 t ha^{-1}, **T_8:** FYM @ 10 t ha^{-1}, **T_9:** 75 % RDF + FYM @ 10 t ha^{-1}, **T_{10}:** 100 % RDF + FYM @ 10 t ha^{-1}

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