Determining the impact of Organic manures and Inorganic fertilizers on growth, yield andqualityofOkra(*Abelmoschusesculentus*L.Moench)

ABSTRACT

AtrialwasconductedattheVegetableResearchFarm,DepartmentofHorticulture,NainiAgriculturalInstitute,SamHigginbottomUniversityofAgriculture,Technology&Sciences, Prayagraj (UP) during 2022. Thepurposeofthestudyistoevaluatetheplantsintermsofvariousparameterssuchas plant height, Leaf Area Index, days to 50% flowering, days to first harvesting, number of podsperplant,podlength,podgirth,pod weight,podyield perplant,podyieldperplot,podyieldperhectare, total soluble solids (TSS), Vitamin C and benefit-cost ratio. The results of the studyindicated that the application of mixture of 50% inorganic fertilizers and 50% FYM improved thegrowth and yield of Okra. The highest pod yield (12.06 t/ha), pod weigh (25.42 g), TSS (9.47Brix) and Vitamin C content (24.26) were observed in the plants treated with 50 % throughChemical fertilizer + 50 % through FYM. The benefit-cost ratio was also found to be higher in thetreated plants compared to the control. Overall, the study suggests that the application of 50 %through Chemical fertilizer + 50 % through FYM can be an effective and sustainable methodforenhancingthegrowth, yield, and quality of Okra.

Keywords: *Okra, FYM, Inorganic fertilizers, TSS.*

1.INTRODUCTION

Okra are horticulture crop belongs to the family *Malvaceae* bearing chromosome number 2n=130 (**Skovsted, 1935**). Okra is an allopolyploid of uncertain parentage. However, proposed progenitor includes *Abelmoschus ficulneus*, *A. tuberculatus* is a reported "diploid" form of okra. The geographical origin of okra is disputed, with supporters of Southeast Asian, South Asian, Ethiopian, and West African origins. It originated from Ethiopia (**Vavilov, 1935**). Pods and vegetables have historically held a place in dietary guidance because of their concentrations of vitamins, especially vitamin A and C; minerals, especially electrolytes; and more recently phytochemicals especially antioxidant. India is world's second largest pod and vegetable producer, produced around 107.10 million metric tonnes pods and 204.61 million metric tonnes of vegetables which accounts for nearly 16.38% of country's share in the world production of vegetables in the year 2020-21 (**APEDA, 2020-21**). India, being the second largest producer of vegetable in the world, next only to

China, shares about 15 per cent of the world output of vegetables from about 3 per cent of total cropped area in the country (**NHB, 2021**). Raw okra is 90% water, 2% protein, 7% carbohydrates and contains negligible fat. In a 100-gram reference amount, raw okra is a rich source (20% or more of the Daily Value, DV) of dietary fibre, vitamin C (23 mg), and vitamin K 31.3 μg), with moderate contents of thiamine (1.2 mg), folate (60 μg) and magnesium (57 mg), Calcium (52 mg), Phosphorous (61 mg), Potassium (299 mg). Okra has valuable anti diabetic property. Greenish-yellow edible okra oil is pressed from okra seeds; it has a pleasant taste and odour and is high in unsaturated fats such as oleic acid and linoleic acid. The oil content of some varieties of the seed is about 40%. At 794 kilograms per hectare (708 lb/acre), the yield was exceeded only by that of sunflower oil in one trial. Organicmanure generally ameliorates the entire soil physical,chemical andbiological properties of the soilas it energies the activities of soil microbes, which help in the liberation of plant nutrients and thehealthy growth of the plants. Organic manure has also been found to sustain yield under continuouscroppingandimprovethefertilityofadegradedsoil**(Eghareyba &Ogbe, 2002).** Vermicompost is produced by worm composting, which uses earthworms to create a mixture of vegetable or food waste, bedding materials, and vermicast. The resulting product is rich in minerals, including NPK (nitrogen, phosphorus, and potassium), micronutrients, beneficial soil microbes, plant growth hormones, and enzymes. Vermicompost has been scientifically proven to be a "miracle growth promoter" and protects plants from pests and diseases. It contains 2-3% nitrogen, 1.55-2.25% phosphorus, and 1.85-2.25% potassium. Cow dung blended with urine provides a balanced diet for plants, and the availability of potassium and phosphorus is like inorganic sources. Farmyard manure improves soil fertility and contains an average of 0.5% nitrogen, 0.2% phosphate, and 0.5% potassium. Okra is one of the chief vegetable crops grown for its immature pods that can be consumed as afried or boiled vegetable or may be added to salads, soups and stews. Use of organic manures andinorganic fertilizers in okra has been reported to show rapid increased in plantheight, improvedsoil physical, chemical and biological properties along with conserving moisture holding capacityof soil and thus resulting in enhanced crop productivity along with maintaining the quality of cropproduce and significantly higher values of fresh pod length and fresh pod weight of okra undernormal plant population. Keeping in view the above points, present investigation was undertakenwithfollowingobjective to study the influence of different organic manures and inorganic fertilizers on growth, yield and quality of okra.

2. MATERIALS AND METHODS

The present investigation was done to understand the impact of combine application of organic manures and inorganic fertilizers on plant growth, pod yield and quality of pod of okra variety TMOH-346. The investigation was carried out at Horticultural Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology

and Sciences (SHUATS), Prayagraj during the *Kharif* season of 2022. The experiment was laid in Randomized block design with 9 treatments and 3 replications. with different combination of organic manures and inorganic fertilizers.Observations were recorded at different stages of growth periods and studied for growth parameters like plant height, leaf area index, earliness parameters like days to 50% flowering, days to first harvesting, yield parameters like pod length, pod girth, pod weight and quality parameters TSS and vitamin C content. The data were analysed by the method suggested by **Fisher and Yates, 1963.** The height of five randomly selected plants from each plot was measured in cm with of a 100 cm meter scale from ground level to tip of the shoot at 60 DAT stage. The numbers of days taken from the date of transplanting to the date at which 50% flower appeared in plants were recorded as days to 50% flowering, similarly days to first harvesting. The percentage of total soluble solids of the pod was determined with the help of Portable Hand Refractometer. The sample of juice for this purpose was taken from the strained juice. The observed value of T.S.S. was recorded from the scale of the instrument (0-32 range). Vitamin C content or Ascorbic acid content in the pulp was estimated by using 2, 6 dichlorophenol indophenol dye as reported by **Ranganna (1986)**.

The details of treatment combination used are **T_0** (100:50:50NPK + FYM 20 t/ha (control); **T_1** (100% through chemical fertilizer + 10t
Vermicompost); **T_2** (100% through chemical fertilizer + 2t Neem cake); **T_3** (75% RDN through chemical fertilizer + (25%) RDN through FYM); **T_4** (75% through chemical fertilizer + 25% through Vermicompost); **T_5** (75% through chemical fertilizer + 25% through Neem cake); **T_6** (50% through chemical fertilizer + 50% through FYM); **T_7** (50% through chemical fertilizer + 50% through Vermicompost) and **T_8** (50% through chemical fertilizer + 50% through Neem cake).

3. RESULTS AND DISCUSSION:

3.1 Growth parameters

3.1.1 Influence of Organic manures and inorganic fertilizers on Plant height (cm)

There was a significant effect of various treatment on plant height at 60 days after transplanting. Among different levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM) recorded maximum height of 111.24 cm whereas minimum plant height of 78.80 cm was recorded in T_0 {100:50:50 NPK + FYM 20t/ha (Control)}.The superior plant height in the treatment combining 50% chemical fertilizer with 50% farmyard manure (FYM) for okra cultivation can be attributed to the synergistic effects of nutrient-rich chemical fertilizers and organic FYM. This combination optimally supplies essential nutrients, promoting robust growth and height. The chemical fertilizer boosts rapid nutrient availability, while FYM enhances soil structure, water retention, and microbial activity. This balanced approach fosters healthier root development and

overall plant vigour, resulting in the observed improved plant height compared to other combinations. Similar findings were also reported by **Fagwalawa and Yahaya (2016); Miglani *et al.*, (2017); Bamboriya *et al.*, (2018)** in okra.

3.1.2 Influence of Organic manures and inorganic fertilizers on leaf area index (cm^2)

There was a significant effect of various treatment on leaf area index. Among different levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM) recorded maximum leaf area index of 6.71 cm2 whereas minimum leaf area index of 4.57 cm2 was recorded in T_0 {100:50:50 NPK + FYM 20t/ha (Control)}. The enhanced leaf area index (LAI) in the treatment comprising 50% chemical fertilizer and 50% farmyard manure (FYM) for okra can be attributed to the synergistic impact of nutrient-rich chemical fertilizers and organic FYM. This blend optimally enriches the soil, fostering vigorous foliage growth. Chemical fertilizers rapidly supply vital nutrients, while FYM enhances soil structure and microbial activity, aiding nutrient uptake. This balanced approach encourages extensive leaf development, resulting in the observed superior LAI compared to alternative combinations. Similar findings were also reported by **Samar (2018); Aderemi *et al.*, (2020); Singh and Tiwari (2020); Devanda *et al.*, (2021)** in okra.

3.2. Earliness parameter

3.2.1 Influence of Organic manures and inorganic fertilizers on Days to 50% flowering and days to first harvesting

Among different levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM) recorded minimum days to 50% flowering of 39.55 whereas maximum days to 50% flowering of 47.37 was recorded in T_0 {100:50:50 NPK + FYM 20t/ha (Control)}. Among different levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM) recorded minimum days to 1st harvesting of 46.21 whereas maximum days to 1st harvesting of 54.47 was recorded in T_0 {100:50:50 NPK + FYM 20t/ha (Control)}.The accelerated earliness in the treatment combining 50% chemical fertilizer with 50% farmyard manure (FYM) for okra can be attributed to the synergistic effects of nutrient-rich chemical fertilizers and organic FYM. This combination optimally nourishes the soil, promoting robust root development and efficient nutrient uptake. Chemical fertilizers provide rapid nutrient availability, while FYM enhances soil structure, water retention, and microbial activity. These factors collectively expedite vegetative growth and flowering, leading to earlier pod set and maturation. The balanced approach of utilizing both inputs contribute to the observed early yield in comparison to other combinations. Similar findings were reported by **Sundari and Gandhi (2013); Aderemi *et al.*, (2020); Nwanne *et al.*, (2019)** in okra.

3.3 Yield Parameters

3.3.1 Influence of Organic manures and inorganic fertilizers on number of pods per plant

Among different levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM) recorded maximum number of pods per plant of 6.43 whereas minimum number of pods per plant of 4.32 was recorded in T_0 {100:50:50 NPK + FYM 20t/ha (Control)}. The higher number of pods per plant in the treatment combining 50% chemical fertilizer with 50% farmyard manure (FYM) for okra can be attributed to the synergistic effects of nutrient-rich chemical fertilizers and organic FYM. This blend optimally nourishes the plant, promoting robust vegetative growth and enhanced flowering. Chemical fertilizers ensure swift nutrient availability, while FYM improves soil structure, water retention, and microbial activity. This balanced approach supports increased flower formation, leading to a greater pod set. Thus, the observed outcome of more pods per plant is a result of the combined benefits of both inputs. Similar findings were also reported by **Sundari and Gandhi (2013); Bamboriya *et al.*, (2018); Singh and Tiwari (2020); Devanda *et al.*, (2021)** in okra.

3.3.2 Influence of Organic manures and inorganic fertilizers on pod length (cm) and pod girth (cm)

Among different levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM) recorded maximum pod length of 19.06 cm whereas minimum pod length of 14.10 cm was recorded in T_0 {100:50:50 NPK + FYM 20t/ha (Control)}. Among different levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM) recorded maximum pod girth of 6.90 cm whereas minimum pod girth of 4.26 cm was recorded in T_0 {100:50:50 NPK + FYM 20t/ha (Control)}. The notable improvement in pod length and girth in the treatment involving a 50% combination of chemical fertilizer and 50% farmyard manure (FYM) for okra is attributed to the synergistic effects of nutrient-rich chemical fertilizers and organic FYM. This blend optimizes nutrient availability, fostering vigorous vegetative growth and robust flowering. Chemical fertilizers rapidly provide essential nutrients, while FYM enhances soil structure, moisture retention, and microbial activity. This balanced approach facilitates enhanced nutrient uptake, resulting in larger and more substantial pod development. The combined benefits of these inputs contribute to the observed superior pod characteristics. The findings of this study are in accordance with those of **Devanda *et al.*, (2021)** in okra.

3.3.3 Influence of Organic manures and inorganic fertilizers on pod weight (g); pod yield per plant (g/plant) and pod yield per hectare (q/ha)

Among different levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM) recorded maximum pod weight of 25.42 g whereas minimum pod weight of 15.14 g was recorded in T_0 {100:50:50 NPK + FYM 20t/ha (Control)}. Among different levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM) recorded maximum pod yield per plant of

156.08 g whereas minimumpod yield per plant of 45.13 g was recorded in T_0 {100:50:50 NPK + FYM 20t/ha(Control)}. Among different levels of treatments T_6 (50% throughchemical fertilizer +50%throughFYM)recordedmaximumpodyieldperhectareof12.06q/hawhereasminimumpodyieldper hectare of 7.34q/hawasrecordedinT_0{100:50:50NPK+FYM20t/ha (Control)}. Similar findings were also reported by **Sundari and Gandhi (2013); Fagwalawa and Yahaya (2016); Bamboriya *et al.*, (2018); Samar (2018)** in okra.

3.4. Quality Parameters

3.4.1. Influence of Organic manures and inorganic fertilizers on TSS (° Brix)

Amongdifferent levels of treatments T_6 (50% through chemical fertilizer + 50% through FYM)recordedmaximumTSSof9.47^{0}BrixwhereasminimumTSSof4.47^{0}BrixwasrecordedinT_0{100:5 0:50NPK+FYM20t/ha (Control)}. Similar inferences were reported by **Singh and Tiwari (2020); Devanda *et al.*, (2021)** in okra.

3.4.2. Influence of organic manures and inorganic fertilizers on Ascorbic Acid (mg/100g)

AmongdifferentlevelsoftreatmentsT_6(50%throughchemicalfertilizer+50%throughFYM)recordedma ximumVitaminCof24.26mgwhereasminimumVitaminCof17.78mgwasrecordedinT_0{100:50:50NPK +FYM20t/ha(Control)}. Similar findings were also concluded by**Sharma *et al.*, (2014); Fagwalawa and Yahaya (2016); Singh and Tiwari (2020); Devanda *et al.*, (2021)** in okra.

4. CONCLUSION

According to the current research, the use of Organic manures and inorganic fertilizers had a significantly positive impact on the growth and development of okra. Among the various treatments that were evaluated, T_6(50% through chemical fertilizer + 50% through FYM) yielded the most favourable results in terms of growth viz., plant height (111.24 cm at 60 DAT), leaf area index (6.71 cm^2), early days to 50% flowering (39.55 days) and yield viz., pod weight (25.42 g), length of pod (14.10 cm), pod girth (6.90 cm), number of pods per plant (6.43 pods), and yield per plant (156.08 g/plant).

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Table 1 Effect of Organic manure and inorganic fertilizers on different treatments for various parameters of Okra.

Treatment Details		Plant height (cm) [60 DAT]	Leaf area index (cm^2)	Days to 50% flowering	Days to first harvesting	Number of pods per plant	Pod length (cm)
T_0	100:50:50NPK + FYM 20 t/ha (control)	78.80	4.57	47.37	54.47	3.42	14.10
T_1	100% through chemical fertilizer + 10t	83.40	5.78	43.04	49.78	4.16	16.52
T_2	Vermicompost	92.11	5.96	42.92	49.10	4.36	14.59
T_3	100% through chemical fertilizer + 2t Neem cake	110.33	6.43	41.68	48.00	6.32	17.42
T_4	75% RDN through chemical fertilizer + (25%) RDN through FYM	108.32	5.99	45.04	51.83	5.10	15.19
T_5	75% through chemical fertilizer + 25% through Vermicompost	103.92	5.75	46.25	52.59	4.93	16.40
T_6	75% through chemical fertilizer + 25% through Neem cake	111.24	6.71	39.55	46.21	6.43	19.06
T_7	50% through chemical fertilizer + 50% through FYM	96.50	5.44	46.90	54.01	4.83	16.62
T_8	50% through chemical fertilizer + 50% through Vermicompost	89.41	6.33	41.91	48.88	5.10	17.71
F-Test		**S**	**S**	**S**	**S**	**S**	**S**
SE(d)		**0.76**	**0.03**	**0.01**	**0.52**	**0.06**	**0.14**
$CD_{0.05}$		**1.62**	**0.03**	**0.02**	**1.10**	**0.12**	**0.29**
CV		**0.96**	**0.09**	**0.02**	**1.26**	**1.40**	**1.10**

Table 2 Effect of Organic manure and inorganic fertilizers on different treatments for various parameters of Okra.

Treatment Details	Pod girth	Pod	Pod yield	Pod yield	TSS	Vitamin C

		(cm)	weight (g)	per plant (g/plant)	per hectare (q/ha)	[°Brix]	content (mg/100g)
T_0	100:50:50NPK + FYM 20 t/ha (control)	4.26	15.14	45.13	7.34	4.47	17.78
T_1	100% through chemical fertilizer + 10t	5.25	15.56	57.59	9.24	5.33	18.65
T_2	Vermicompost	6.04	19.86	77.90	9.49	6.91	20.25
T_3	100% through chemical fertilizer + 2t Neem cake	6.32	20.83	96.42	11.66	8.28	22.93
T_4	75% RDN through chemical fertilizer + (25%) RDN through FYM	4.72	18.44	88.68	8.85	5.20	18.57
T_5	75% through chemical fertilizer + 25% through Vermicompost	5.90	16.11	72.73	9.41	5.57	19.01
T_6	75% through chemical fertilizer + 25% through Neem cake	6.90	25.42	156.08	12.06	9.47	24.26
T_7	50% through chemical fertilizer + 50% through FYM	5.20	18.75	85.32	8.91	7.80	21.17
T_8	50% through chemical fertilizer + 50% through Vermicompost	6.12	15.91	95.54	9.43	7.35	20.68
F-Test		**S**	**S**	**S**	**S**	**S**	**S**
SE(d)		**0.04**	**0.01**	**2.88**	**0.02**	**0.02**	**0.06**
$CD_{0.05}$		**0.09**	**0.01**	**6.10**	**0.01**	**0.04**	**0.13**
CV		**0.95**	**0.04**	**4.09**	**0.07**	**0.20**	**0.38**