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Impact of Integrated Nutrient Management on Growth and Yield of Okra Crop (*Abelmoschus esculentus* L.) *var.* Deepika

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Research was conducted by using effective management application of FYM and *Azospirillum* with inorganic fertilizer with objective to enhance the growth and yield of okra crop. It has been concluded from the trial that the different level of FYM with inorganic fertilizers in the experiment gave the highest value. Effective results were obtained with T_9 treatment with combination FYM 20 t ha^{-1}, *Azospirillum* 2 kg ha^{-1} with RDF 100: 60: 50 kg ha^{-1}. This treatment result shown best plant height with the most leaves, a high number of branches, a greater number of fruits per plant and highest yield in compared with the control treatment T_1 had the lowest results in all categories. T_9 was found to be the best for the improvement of growth and yield of okra therefore, farmers of Prayagraj region can adopt this combination to give the highest yield of Okra.

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1. INTRODUCTION

Okra (*Abelmoschus esculentus* L.) requires well-draining soil that is rich in organic matter and nutrients such as nitrogen, phosphorus, and potassium. Soil also affects the water holding capacity and pH level, which can impact the plant's growth and yield. Additionally, soil health is crucial for the prevention of diseases and pests that can damage the okra plant. Therefore, it is important to maintain soil fertility and quality through proper management practices such as crop rotation, composting, and appropriate irrigation. In summary, soil is a critical component in the successful cultivation of okra and must be managed carefully to ensure optimal plant growth and yield Kumar et al. [1].

Farm Yard Manure (FYM) remains the most popular organic manure applied to the field and it can be potentially supply about 6.8 million tons N P and K per year Bio fertilizers and organic manure together can make significant contribution in maintaining soil health and balancing soil fertility through supply of plant nutrition at optimum level. FYM contains 0.25% N, 0.50% P and 0.25% K. It may have wonderful effects on physical, chemical, biological properties of the soil Singh et al. [2].

Azospirillum works by colonizing the roots of the okra plant and fixing atmospheric nitrogen, which is then used by the plant for its growth and development. This results in improved plant vigor, increased shoot and root growth, and increased flower and fruit production Shree et al. [3].

2. MATERIALS AND METHODS

The field experiment which was carried out at the research farm of soil science and agricultural chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during in *Zaid* season 2022. The maximum temperature of the location ranges between 46^0C-48^0C and seldom falls below 4^0C-5^0C. The relative humidity ranges between 20-94%. The average rainfall of this area is around 1100mm annually. The experiment was laid out in Randomized Block Design (RBD) with 9 treatments detailed combination of treatment are given in Table 1. The treatments have been replicated three times. The different treatments were employed randomly in each replication. The details of the treatment combinations are given Table 1 and observation were recorded plant height, number of leaves, number of branches, fruits per plants and yield.

Table 1. Treatment combination

Treatment	Treatment combination
T_1	ABSOLUTE CONTROL
T_2	[NPK @0% + FYM @50% + *Azospirillum* @50%]
T_3	[NPK @0% + FYM @100% + *Azospirillum* @50%]
T_4	[NPK @50 % + FYM @0% + *Azospirillum* @50%]
T_5	[NPK @50% + FYM @50% + *Azospirillum* @50%]
T_6	[NPK @50% +FYM @100% + *Azospirillum* @50%]
T_7	[NPK @100% + FYM @0% + *Azospirillum* @50%]
T_8	[NPK @100% + FYM @50% + *Azospirillum* @50%]
T_9	[NPK @100% + FYM @100% + *Azospirillum* @50%]

Note: NPK – Nitrogen, Phosphorus, Potassium and FYM- Farm yard manure

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm) at 25, 50 and 75 DAS

The effect of organic and inorganic source of nutrients NPK, FYM and *Azospirillum* on plant height was found significant at 25, 50 and 75 DAS. The maximum plant height 25.08, 88.32 and 114.19 cm was recorded in T_9 (NPK @100% + FYM @100% + *Azospirillum* @50%) and minimum plant height 18.99, 78.77 and 101.84 cm was recorded in T_1 (Absolute Control) at 25, 50 and 75 DAS respectively. The application of NPK, FYM and *Azospirillum* in combination can result in a synergistic effect on plant growth and development. NPK provides essential nutrients to plants. This leads to improved plant growth and development, resulting in an increase in plant height at different growth stages Kumar et al. [1]. Increase in plant height due to increase in NPK, FYM and Azospirillum may be due to adequate supply of nutrients which in turn helps in vigorous vegetative growth of plants and subsequently increase the plant height through cell elongation, cell division and photosynthesis of plant cell. Similar findings were reported by Singh et al. [4].

3.2 Number of Leaves per Plant at 25, 50 and 75 DAS

The effect of organic and inorganic source of nutrients NPK, FYM and *Azospirillum* on number of leaves was found significant at 25, 50 and 75 DAS. The maximum number of leaves 14.27, 27.54 and 39.33 cm was recorded in T_9 (NPK @100% + FYM @100% + Azospirillum @50%) and minimum number of leaves 8.03, 21.19 and 28.87 was recorded in T_1 (Absolute Control) at 25, 50 and 75 DAS respectively. The combination of organic and inorganic fertilizer can have a synergistic effect on plant growth and development. FYM provides a source of organic matter and nutrients, while Azospirillum enhances nutrient uptake and produces plant growth regulators. The combination of these two inputs can promote vegetative growth and increase the number of leaves in okra plants Verma et al. [5].

3.3 Number of Branches per Plant at 25, 50 and 75 DAS

The effect of organic and inorganic source of nutrients NPK, FYM and *Azospirillum* on number of branches was found significant at 25, 50 and 75 DAS. The maximum number of branches 8.03, 9.73 and 10.07 was recorded in T_9 (NPK @100% + FYM @100% + *Azospirillum* @50%) and minimum number of branches 4.12, 5.07 and 6.38 was recorded in T_1 (Absolute Control) at 25, 50 and 75 DAS respectively. The combined application of FYM, Azospirillum, and inorganic fertilizers can positively influence the number of branches in okra plants by improving nutrient availability, enhancing microbial activity, and promoting overall plant vigor Singh et al. [4].

3.4 Number of Fruits per Plant

The Table 2 show the effect of organic and inorganic source of nutrients NPK, FYM and *Azospirillum* on number of fruits per plant. The effect of organic and inorganic source of nutrients NPK, FYM and *Azospirillum* on number of fruits per plant was found significant. The maximum number of fruits per plant 18.69 was recorded in T_9 (NPK @100% + FYM @100% + *Azospirillum* @50%) and minimum number of branches 13.09 was recorded in T_1 (Absolute Control) after harvesting respectively. The specific effects of FYM, *Azospirillum* and inorganic fertilizers on fruit production in okra can vary depending on factors such as soil conditions, environmental factors, crop management practices, and the specific formulations and concentrations of the fertilizers used Yadav et al. [6].

3.5 Yield (q ha^{-1})

The Table 2 show the effect of organic and inorganic source of nutrients NPK, FYM and *Azospirillum* on yield. The effect of organic and inorganic source of nutrients NPK, FYM and Azospirillum on yield was found significant. The maximum yield of okra 128.42 q ha^{-1} recorded in T_9 (NPK @100% + FYM @100% + Azospirillum @50%) and minimum yield of okra 99.02 q ha^{-1} was recorded in T_1 (Absolute Control) after harvesting respectively [7-9].

Table 2. Impact of Integrated Nutrient Management on plant height, number of leaves, number of branches, fruits per plant and yield of okra crop *var.* Deepika at different days interval and after crop harvest

S. No.	Plant height (cm)			No. of Leaves			No. of branches			Fruits per plant	Grain yield (q ha^{-1})
	25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS		
T_1	18.99	78.77	101.84	8.03	21.19	28.87	4.12	5.07	6.38	13.09	99.02
T_2	20.49	80.31	102.38	8.59	21.73	29.62	4.16	5.35	6.67	13.76	104.22
T_3	21.22	81.25	105.49	9.21	22.63	30.81	5.59	6.39	7.02	14.43	108.26
T_4	21.92	82.79	107.27	10.21	23.59	31.51	5.71	6.47	7.15	15.02	105.42
T_5	22.59	83.26	109.81	10.98	24.61	32.29	5.94	6.85	7.47	17.29	115.86
T_6	23.04	85.43	110.28	11.52	25.67	34.56	6.72	7.74	8.31	18.23	124.98
T_7	23.90	86.69	111.02	12.29	26.13	36.47	7.31	8.63	8.84	17.59	108.51
T_8	24.67	87.46	113.13	13.43	26.91	37.64	7.53	8.92	9.53	18.04	118.52
T_9	25.08	88.32	114.19	14.27	27.54	39.33	8.03	9.73	10.07	18.69	128.42

The application of NPK and FYM in T_9 (NPK @100% + FYM @100% + Azospirillum @50%) resulted in higher yield of okra as compared to T_1 (Absolute control). This can be attributed to the availability of essential nutrients and improved soil health, which led to better growth and development of the plants and ultimately, higher yield. The combined application of these nutrients resulted in synergistic effects, leading to an overall improvement in the yield of okra. The higher yield in treatment T_9 (NPK @100% + FYM @100% + Azospirillum @50%) indicates the importance of integrated nutrient management practices in improving crop productivity Kumar et al. [1].

4. CONCLUSION

It revealed from the trial that application of FYM and Azospirillum with inorganic fertilizers in treatment T_9 was found best in increasing growth and yield of okra. Since the results is based on one season experiment, further trail is needed to substantiate the result.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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