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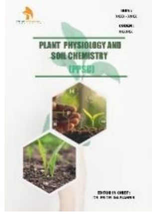

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RESEARCH ARTICLE

EFFICACY OF EFFECTIVE MICROORGANISMS AND DIFFERENT SOURCES OF NUTRIENTS ON PERFORMANCE OF OKRA (ABELMOSCHUS ESCULENTUS) IN RUPANDEHI, NEPAL

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ABSTRACT

The integrated use of fertilizers with biofertilizers plays a huge role in crop production and soil sustainability. The present study was carried out to investigate the interaction between different sources of fertilizers (control, recommended dose of fertilizer (RDF), RDF and vermicompost, effective microorganisms (EM), and Vermicompost) on okra production. The split design with three replications was used in Bhairahawa, Nepal, in one growing season. The results revealed that the use of EM significantly affected the plant height (33.62 cm), leaf number (17.22), and economic yield (405 $Kgha^{-1}$) while leaf area index (0.13), number of buds (6.68), and number of flowers (0.22) were seen significantly higher in without EM. Similarly, the use of RDF and compost significantly improved the plant height (34.86 cm), leaf number (20.83), number of buds (8.46), number of flowers (0.23), and economic yield (450.29 $Kgha^{-1}$). The application of EM with integrated fertilizers significantly affected the growth and yield of okra, so this combination should be applied to the field to improve okra production under similar soil and environmental conditions.

KEYWORDS

Compost, Effective microorganism, Integrated fertilizers, Okra, yield.

1. INTRODUCTION

Okra (*Abelmoschus esculentus*), a member of the Malvaceae family, originated in tropical America and was first cultivated in Egypt during the 12th century (Singh et al., 2014). The fruits are often used in the preparation of soups and salads, and are also consumed as vegetables (Penny et al., 2017). Okra mucilage possesses therapeutic properties; it increases blood volume, binds cholesterol and bile acids, and facilitates the transport of toxins to the liver (Karmakar et al., 2025). Okra seeds provide protein and oil and can serve as a non-caffeinated alternative to coffee (Graham et al., 2017). Okra is a significant vegetable crop in Nepal, extensively cultivated in Jhapa, Morang, Saptari, Bara, Chitwan, Rautahat, Kailali, and Dhanusa. Okra is predominantly grown in tropical and subtropical climates, along with certain warmer temperate zones (Budania and Dahiya, 2018). The significant potential for commercial production and marketing of agricultural products in Terai, due to its central location, necessitates improved nutrient management practices (Ghimirey et al., 2023). Despite this, Nepal is still not able to provide its own food and is experiencing a trade deficit (Chaurasia et al., 2020).

The current agricultural production system yields high output due to the massive application of agrochemicals; yet, this management approach results in environmental degradation and unsustainable practices (Mitra et al., 2021). The excessive use of agrochemicals in modern agriculture is detrimental to human health and environmental integrity due to the availability of polycyclic aromatic hydrocarbons (Chaurasia et al., 2024). The utilization of chemical fertilizers in Nepal increased significantly from 262,000 metric tons in 2003 to 409,000 metric tons in 2010 (Takeshima, 2019). Despite a notable rise in okra output in Nepal, the production challenges remain untouched (Koirala et al., 2025). The most important challenge in okra cultivation is the low germination rate. The excessive application of chemical fertilizers and pesticides is prevalent among Nepalese farmers (Paudel et al., 2020). This ultimately results in decreasing soil fertility and heightened pollutant levels. Research on effective microorganisms for okra cultivation is less prominent than chemical production approaches (Manjunath et al., 2016). They advocated in their findings that agriculturists persist in employing detrimental environmental farming methods and have not enhanced their understanding of beneficial microorganisms as a crucial source of nutrition for plants (Singh et al., 2011).

Effective microorganisms (EM) are blended cultures of advantageous, naturally occurring organisms that can be utilized as inoculants to improve the microbial diversity of soil ecosystems (Hidalgo et al., 2022). They primarily comprise photosynthetic bacteria (*Rhodopseudomonas palustris*), lactic acid bacteria (*Lactobacillus plantarum*), yeasts (*Saccharomyces cerevisiae*), actinomycetes (*Streptomyces albus*), and fermentative fungi (*Aspergillus oryzae*). These microbes exhibit physiological compatibility and can persist in liquid culture (Mikesková et al., 2012). Evidence indicates that EM inoculation in soil can enhance soil quality, promote plant growth, and increase production (Kengo and Hui-lian, 2000). We employed commercially available EM-1 for our

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investigation. EM-1 was created by Dr. Teruo Higa, a professor at the College of Agriculture, University of the Ryukyus, Okinawa, Japan. It comprises three categories of microorganisms: lactic acid bacteria, yeasts, and photosynthetic bacteria. Organic molecules incorporated into the soil undergo fermentation by lactobacillus species and lactic acid-producing bacteria, resulting in the release of amino acids and saccharides as soluble organic compounds that are assimilated intact by plants (Higa and Wididana, 1991). They indicated that the application of EM2 in soil inhibited the occurrence of pathogenic fungal and bacterial germs (Higa and Wididana, 1991). The application of EM to soil and leaf surfaces enhances the proliferation of photosynthetic and nitrogen-fixing organisms, indicated by higher growth, yield, and improved plant quality (Chaurasia et al., 2024).

They found that the foliar application of effective microorganisms (EM), combined with soil application of organic manure and the recommended dose of fertilizer (RDF), significantly enhanced reproductive traits and yield (Demir et al., 2024; Ghimirey et al., 2025). The preparation of EM inoculation is both economical and cost-effective within the framework of low-input, use-intensive agriculture. Various studies have demonstrated enhanced soil and plant resistance to water stress, increased rates of carbon mineralization, improved soil properties, and superior penetration of plant roots after the application of EM, tillage practices combined with phosphorus fertilizers (Ghimirey et al., 2024a; Harish et al., 2022). The application of microorganisms presents significant potential for the growth of okra in Nepal. Most commercially available EM consist of a mixture of non-pathogenic, facultative anaerobic microbes, which can thrive in low to no oxygen environments (Andrade et al., 2020). Their facultative nature indicates that they can also endure aerobic conditions, thus, they will not perish upon exposure to air.

The primary limitation in okra production is the low germination rate. This study investigates the efficacy of EM on okra plants to identify an appropriate mixture of microorganisms to address this issue. Research on EM remains underdeveloped in Nepal, indicating the necessity for this type of study to be conducted. The study focused primarily on investigating the probable changes in yield and yield parameters, assuming there would be a notable difference in the yield of the okra because of EM culture and different combinations of several nutrient sources. The study aimed to investigate, under several combinations of EM and different nutrient sources, the growth and reproductive characteristics of the okra plant. This study hypothesized that the use of various organic fertilizer sources, when combined with EM, influences the growth, yield, and yield characteristics of okra. In order to motivate growers to start growing the promising "Arka Anamika" variety, we aimed to provide them with the necessary production information. This study aims to identify the optimal combination of effective microorganisms (EM) and various sources of organic fertilizer for okra cultivation. It will enhance decision-making regarding the application of EM and organic fertilizers, nutrient management, and sustainable production practices among smallholder farmers.

2. Materials and Methods

2.1 Description of the experimental site

2.1.1 Location of the study area

The study was conducted at the agronomy farm of the Institute of Agriculture and Animal Science (IAAS) located in Siddharthanagar municipality of Rupandehi district. The experimental site lies at 27° 28′ North latitude and 83° 26′ East longitude at an elevation of 108 meters above sea level.

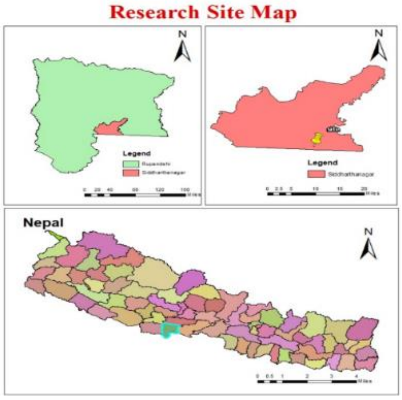

Figure 1: Map of experimental site

2.1.2 Agrometeorological conditions of the experimental site

The agro-meteorological data was collected from the meteorological station of the National Wheat Research Program at Bhairahawa. During the month of March in the year 2021, the experimental location had a tropical environment with a maximum air temperature of 36.4 °C and a minimum air temperature of 26 °C (Figure 2).

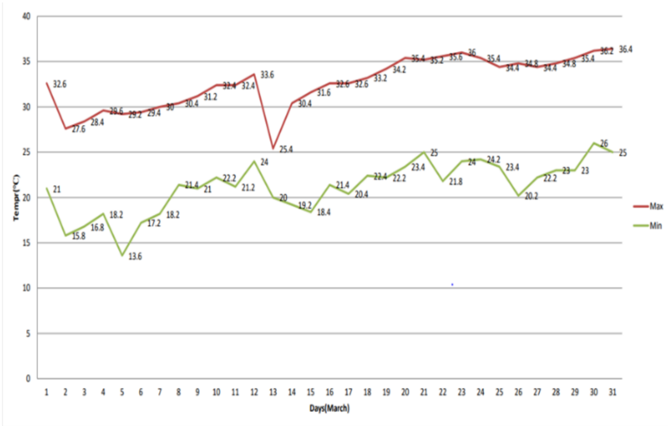

Figure 2: Agro-meteorological information of the experimental site

2.1.3 Physicochemical properties of soil before experiment

Composite soil samples were randomly taken from different spots in Z manner with the help of a tube auger from 25 cm to test the chemical properties of the soil. The soil sample was then air dried, ground, and sieved through a 2 mm sieve. Finally, the sample was taken to the laboratory for analysis of physicochemical properties. The chemical properties of the soil of the research field are shown in Table 1.

Table 1: Physicochemical properties of the soil of the experimental plot before sowing.

S.N.	Properties	Value	Status
1.	Soil PH	8	Alkaline
2.	Electrical conductivity(μScm^{-1})	358	Low
3.	Organic matter (%)	1.57	Low
4.	Total nitrogen (%)	0.07	Low
5.	Available phosphorus(Kgha^{-1})	34.28	Medium
6.	Available potassium(Kgha^{-1})	134.40	High

2.2 Experimental details

2.2.1 Treatment details

A field experiment was conducted in one season using a two factorial split plot design where factor A consists of use of effective microorganism (EM) and no use of effective microorganism (EM_0) and factor B consists of use of different fertilizers namely control (T_1), RDF and compost (T_2), compost (T_3), RDF and vermicompost (T_4), vermicompost (T_5). Combining these two factors resulted in ten treatments. Factor A was used for the main plot, while factor B was used as a sub-plot where treatments were randomly distributed as per research protocol, as illustrated in Table 2. There are three replications used to minimize the experimental error.

Table 2: Treatment combinations used in the experiment		
Factor A	**Factor B**	**Treatment combinations**
Use of effective microorganism (EM)	Control (T_1)	EM T_1
	RDF and compost (T_2)	EM T_2
	Compost (T_3)	EM T_3
	RDF and vermicompost (T_4)	EM T_4
	Vermicompost (T_5)	EM T_5
No use of microorganisms (EM_0)	Control (T_1)	EM_0 T_1
	RDF and compost (T_2)	EM_0 T_2
	Compost (T_3)	EM_0 T_3
	RDF and vermicompost (T_4)	EM_0 T_4
	Vermicompost (T_5)	EM_0 T_5

2.2.2 Layout of the experimental site

There was a total of 30 plots with a dimension of 3.67 m^2 (2.1 m x 1.75 m). The net area and gross area of the experiment were 110.25 m^2 and 178.1 m^2, respectively. The distance between the plots was 0.5 and between the blocks was 1 m was maintained. The row-to-row distance was 35 cm, and between the plants was 25 cm (Figure 3). There were 5 rows in each plot and 6 plants in each row, giving a total of 30 plants in each plot.

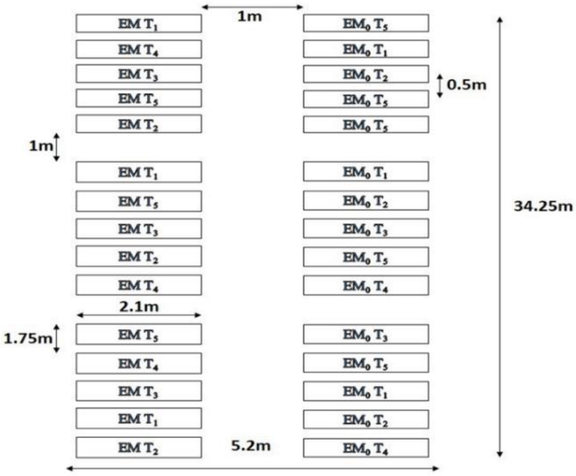

Figure 3: Layout of experimental plot

2.3 Field preparation and seed sowing

The field was prepared by deep ploughing, followed by light ploughing, harrowing, and planking was done to make the soil fine and pulverized. The layout of the field was made in accordance with the design, with proper spacing. The recommended dose of manure and fertilizer was applied according to the respective allocated plots. The Arka Anamika variety was used for sowing. Healthy seeds were primed in cool water 24 hours before sowing to facilitate uniform germination. Seed rate at $Kgha^{-1}$ is sown in line, maintaining row-to-row distance of 35 cm and plant-to-plant distance of 25 cm.

2.4 Preparation and application of EM solution

EM1 inoculation from the market under the trade name Emco Nepal was bought, and the solution was prepared at the time of sowing. For preparation, 1 liter of inoculum was mixed thoroughly in 5 liters of water, and foliar spray was done using a knapsack sprayer. EM solution was applied four times during research, i.e., 1 Day after sowing (DAS), 10 DAS,

20 DAS, and 30 DAS.

2.5 Observation recorded

Different types of growth and yield attributes were recorded during the entire period of the research.

2.5.1 Growth parameters

Plant Height: The plant height was recorded from the base of the plant, just above the soil surface, to the tip of the longest leaf with the help of a scale. The height of 5 randomly selected and tagged plants was measured at 10 DAS, 20 DAS, and 30 DAS.

Number of leaves per plant: The number of leaves from 5 sample plants of each plot was measured at 10 DAS, 20 DAS, and 30 DAS.

Leaf Area Index (LAI): Leaf area from one leaf of each sample plant was measured using graph paper plotting, and leaf area index was calculated using the following formula.

$$LAI = \frac{\text{Leaf area}}{\text{plant spacing} * \text{row spacing}}$$

2.5.2 Yield and yield attributing parameters

Number of flowers: Number of flowers from each tagged plant was recorded on 30 DAS, 40 DAS, and 50 DAS.

Number of flower buds: Flower bud numbers were counted from each tagged plant on 30 DAS, 40 DAS, and 50 DAS.

Fresh weight: Total harvested fruits from each plot were weighed after every harvesting.

Dry weight: Fruits from tagged plants from each plot were dried in an oven for 24 hours at 75°c and weighed on a digital balance.

2.6 Statistical analysis

All the plant data were recorded and entered into MS Excel. The convenience of the data was analyzed in MS Excel. After cleaning, the data were analyzed with the help of RStudio. The significant difference between the treatments was determined using the Least Significant Difference (LSD) and Duncan's Multiple Range Test (DMRT) at a 1% or 5% level of significance.

3. RESULT

3.1 Biometric observation

3.1.1 Plant height

From the given data in Table 3, it showed that EM and various nutrition sources did not have a significant impact on the height of the plant at any of the locations where observations were made. Similarly, the interaction between these two parameters did not reveal any significant differences. It was found that the plants treated with RDF + Compost had the highest plant height (34.86) at 30 DAS, while compost had the lowest plant height (29.75) at 30 DAS. Likewise, EM had the highest plant height (33.62) at 30 DAS. It is possible that the insignificant result that is provided in Table 3 is related to the limited amount of time that we were able to participate in the observation.

3.1.2 Leaf number

At all of the dates of observation that are presented in Table 3, the number of leaves was not significantly affected by EM, the various sources of nutrients, or the interaction between these factors. On the other hand, after 30 DAS, a significant difference in leaf number was seen between the various nutrition sources. In a similar way, the highest number of leaves was recorded from RDF + Compost (20.83), while the lowest number was acquired from Control (13.73) at 30 DAS, as can be shown in Table 3. At the same time, plants that were treated with EM had the highest possible number of leaves (17.22) at 30 DAS.

Table 3: Effect of EM and different nutrient sources on plant height (cm) and leaf number.

Treatments	Plant height (cm)			Leaf number		
	10 DAS	20 DAS	30 DAS	10 DAS	20 DAS	30 DAS
Use of EM						
EM	11.04 ±0.595	19.72 ±1.27	33.62 ±2.10	7.28 ±0.48	10.69 ±1.09	17.22 ±1.57
EM_0	12.42 ±0.519	19.00 ±0.84	30.27 ±1.43	6.14 ±0.26	9.360 ±0.55	15.42 ±1.09
P value	NS	NS	NS	NS	NS	NS
CV%	14.09	38.74	48.87	49.93	77.038	52.903
LSD (0.05)	2.59	11.77	24.51	5,26	12.135	13.570
Integrated Recommended dose (RDF)						
Control	12.00 ±0.91	19.04 ± 1.16	32.60 ± 2.64	6.36 ±0.33	9.0 ±0.55	13.73^{b} ±1.69
RDF + Compost	11.48 ±0.98	21.19 ± 1.27	34.86 ± 2.48	7.46 ±0.44	11.30 ±1.05	20.83^{a} ±1.32
Compost	10.78 ±1.11	16.77 ± 1.88	29.75 ± 3.32	6.86 ±0.93	9.53 ±1.81	15.07^{b} ±2.54
RDF + Vermicompost	11.16 ±0.34	20.00 ± 1.06	31.26 ± 2.39	6.33 ±0.80	9.36 ±1.52	15.60^{b} ±1.66
Vermicompost	13.23 ±0.98	19.80 ± 2.58	31.26 ± 3.93	6.53 ±0.64	10.93 ±1.77	16.40^{b} ±2.6
P value	NS	NS	NS	NS	NS	*
CV%	14.09	38.74	48.87	15.5	19.31	21.48
LSD (0.05)	2.59	11.77	24.51	1.280	2.37	4.293
Grand Mean	11.73	19.36	31.95	6.71	10.02	16.32

Notes: SEM (±) = Standard Error of mean, LSD = Least Significant Difference, CV = Coefficient of Variation, RD = Recommended Dose, Means followed by different letters within the same column are significantly different at least 5% DMRT, NS, * indicates non-significant, significant at 5% respectively

3.1.3 Leaf Area Index (LAI)

LAI was not significantly influenced by EM and different nutrient sources at all dates of observation (Table 4). The maximum leaf area index was found to be 0.23 at control, followed by RDF + vermicompost (0.08), while the minimum was in RDF + compost, compost, and vermicompost (0.07). The highest leaf area index (0.13) was obtained in EM_0 at 30 DAS, while the lowest LAI was found to be 0.08 due to EM.

Table 4: Effect of EM and different nutrient sources on leaf area index (LAI).

Treatments	Leaf area index (LAI)		
	10 DAS	20 DAS	30 DAS
Use of EM			
EM	0.0102 ±0.001	0.044 ±0.004	0.08 ±0.007
EM_0	0.0107 ±0.001	0.041 ±0.002	0.13 ±0.053
P value	NS	NS	NS
CV%	17.602	32.934	149.51
LSD (0.05)	0.00289	0.022	0.259
Integrated Recommended dose (RDF)			
Control	0.0102 ±0.001	0.0459 ±0.003	0.23 ±0.12
RDF + Compost	0.0106 ±0.001	0.0446 ±0.004	0.07 ±0.008
Compost	0.0101±0.001	0.0420 ±0.004	0.07 ±0.01
RDF + Vermicompost	0.0109 ±0.001	0.0451 ±0.006	0.08 ±0.007
Vermicompost	0.0103 ±0.001	0.0374 ±0.006	0.07 ±0.014
P value	NS	NS	NS
CV%	13.90	26.13	126.22
LSD (0.05)	0.0017	0.0137	0.170
Grand Mean	0.01	0.04	0.11

Notes: SEM (±) = Standard Error of mean, LSD = Least Significant Difference, CV = Coefficient of Variation, RD = Recommended Dose, Means followed by different letters within the same column are significantly different at least 5% DMRT, NS, * indicates non-significant and significant at 5% respectively

3.2 Yield and yield attributing parameters

3.2.1 Number of buds

Neither the EM nor the interaction between the EM and the various nutrient sources had a substantial impact on the quantity of buds at any of the dates that were observed. On the other hand, a significant variation in the number of buds was only observed at 30 DAS by the various nutrient sources. According to the data presented in Table 5, the RDF + Compost combination produced the highest number of buds (8.46), while the Control group produced the lowest number of buds (5.50 each). At 30 DAS, the plants that were treated with EM_0 had the highest number of buds (6.68), followed by EM (6.41).

Table 5: Effect of EM and different nutrient sources on number of buds.

Treatments	Number of buds		
	30 DAS	40 DAS	50 DAS
Use of EM			
EM	4.68 ±0.38	4.53 ±0.47	6.41 ±0.78
EM_0	4.49 ±0.17	3.24 ±0.38	6.68 ±0.49
P value	NS	NS	NS
CV%	41.05	101.81	72.817
LSD (0.05)	2.955	6.14	7.483
Integrated Recommended dose (RDF)			
Control	4.23 ±0.26	2.76 ±0.57	5.50^{b} ±0.58
RDF + Compost	5.16 ±0.5	4.46 ±0.58	8.46^{a} ±1.08
Compost	4.63 ±0.68	3.90 ±0.65	5.50^{b} ±0.89
RDF + Vermicompost	4.36 ±0.67	3.86 ±0.91	6.73^{ab} ±1.28
Vermicompost	4.53 ±0.45	4.23 ±0.82	6.53^{ab} ±0.92
P value	NS	NS	*
CV%	14.09	38.74	24.28
LSD (0.05)	2.59	11.77	1.946
Grand Mean	11.73	19.36	6.546

Notes: SEM (±) = Standard Error of mean, LSD = Least Significant Difference, CV = Coefficient of Variation, RD = Recommended Dose, Means followed by different letters within the same column are significantly different at least 5% DMRT, NS, *indicates non-significant and significant at 5% respectively

3.2.2 Number of flowers

At every date of observation, the quantity of flowers could not be significantly affected by EM or any of the other sources of nutrients. In addition, the interaction between these two parameters failed to demonstrate any significant differences. In the given data in Table 6, the RDF + Compost combination produced the highest average number of flowers (34.86), while the compost contributed the lowest average number of flowers (29.75) at 50 DAS (Table 6). At the same time, the plants that had been treated with EM_0 had the largest number of flowers (0.22) when they were 50 days after sowing. The foliar application of EM, combined with the application of organic manure to the soil and the administration of the recommended dose of fertilizer (RDF), finally resulted in a significant increase in reproductive characteristics such as the number of flowers produced between 40 and 50 DAS.

3.3.2 Economic yield

The average maximum economic yield was recorded in EM (405.08 Kgha^{-1}) while 302.14 Kgha^{-1} in EM_0. The average maximum economic yield was recorded in RDF+Compost (450.29 Kgha^{-1}), followed by RDF + Vermicompost (352.93), and compost (347.83). Similarly, the average minimum was found in vermicompost (297.66 Kgha^{-1}), followed by control (319.35 Kgha^{-1}), as illustrated in Table 6. Economic yield was not found to be significantly influenced by EM and different nutrient sources at any date of observation. The interaction between these two factors also didn't show any significant difference.

Table 6: Effect of EM and different nutrient sources on the number of flowers and economic yield.

Treatments	Number of flowers			Economic yield
	30 DAS	40 DAS	50 DAS	
Use of EM				
EM	0.17 ±0.04	0.20 ±0.04	0.14 ±0.05	405.08 ±40.8
EM_0	0.26 ±0.05	0.33 ±0.16	0.22 ±0.06	302.14 ±30.5
P value	NS	NS	NS	NS
CV%	14.09	38.74	48.87	66.167
LSD (0.05)	2.59	11.77	24.51	367.2877
Integrated Recommended dose (RDF)				
Control	12.00 ±0.91	19.04 ± 1.16	32.60 ± 2.64	319.35 ±52.5
RDF + Compost	11.48 ±0.98	21.19 ± 1.27	34.86 ± 2.48	450.29 ±28.0
Compost	10.78 ±1.11	16.77 ± 1.88	29.75 ± 3.32	347.83 ±63.9
RDF + Vermicompost	11.16 ±0.34	20.00 ± 1.06	31.26 ± 2.39	352.93 ±88.9
Vermicompost	13.23 ±0.98	19.80 ± 2.58	31.26 ± 3.93	297.66 ±50.8
P value	NS	NS	NS	NS
CV%	14.09	38.74	48.87	35.24
LSD (0.05)	2.59	11.77	24.51	152.546
Grand Mean	11.73	19.36	31.95	353.616

Notes: SEM (±) = Standard Error of mean, LSD = Least Significant Difference, CV = Coefficient of Variation, RD = Recommended Dose, Means followed by different letters within the same column are significantly different at least 5% DMRT, NS indicates non-significant

4. Discussions

Use of microorganisms helps to improve the height of the okra by enhancing microbial activity, which accelerates the nutrient mineralization and its uptake, especially nitrogen and phosphorus (Ghimirey et al., 2024b). Also, EM promotes the root development and hormone production (Miaha et al., 2020). Using integrated fertilizers helps influence the height of okra because it supplies a balanced concentration of nutrients; its synergy escalates nutrient use efficiency by soil conservation, which ultimately supports vegetative growth and makes the plant taller (Afe and Oluleye, 2017; Ghimirey et al., 2024d).

The application of EM encourages the chlorophyll synthesis and beneficial microbial interactions, which stimulates phytohormone production; this process speeds cell division and initiation of leaves, leading to more number of leaves in the plant (Mukhtar et al., 2022; Kudoyarova et al., 2019). The integrated use of fertilizer helps to encourage a greater number of leaves in okra because the combination of macro and micro-nutrients supplies balanced nutrient that stimulates photosynthetic efficiency (Abbas et al., 2019; Ghimirey et al., 2024c).

There is no effect of application of EM on the field to improve leaf area index because LAI not only depends upon the microbes but also on the availability of water, sunlight, etc (Sankar et al., 2024). Use of a mixture of organic and inorganic fertilizers helps to improve the LAI of okra; it may be due to the availability of nutrients, which ultimately influence the absorption of primary and secondary nutrients (Karmakar et al., 2020). It is essential for the proper growth and development of the leaf (Shahbaz et al., 2014).

Effective microbes in soil help to enhance the bioavailability of micronutrients such as boron and zinc, which are very crucial for the initiation of flowers and the development of reproductive organs (Gorain et al., 2022). Additionally, EM boosts the synthesis of phytohormones like cytokinin, which helps to differentiate buds and their formation (Shireen et al., 2018). Application of chemical fertilizers with organic fertilizer increases the bud number in okra plants by escalating overall metabolic activity and energy that is essential for the development of reproductive organs. Moreover, it enhances soil enzyme activity and root growth, which is crucial for the initiation of buds (Sharma et al., 2023; Parajuli et al., 2022).

The synergies of chemical and organic fertilizers help to improve soil health, which supports vegetative as well as reproductive growth (Singh et al., 2024). While organic fertilizer assists soil health and microbial activity with other soil-dwelling creatures like earthworms, inorganic fertilizer ensures immediate availability of nutrients to the plant (Marahatta et al., 2024; Le Bayon et al., 2021). They both promote hormonal balance and energy allocation for the initiation of flower and development. Effective microorganisms help to improve nutrient uptake efficiency, which leads to increased plant vigor and fruit set. EM also reduces the biotic stress of soil pathogens, which ultimately leads to favorable conditions for better yield (Olle and Williams, 2013). Integrated use of nutrients promotes overall development of okra, which is ideal for the increment of yield (Kumar et al., 2013).

5. Conclusion

It was concluded that application of EM helps to improve plant growth parameters like plant height, leaf number, and yield attributes such as buds per plant, flowers per plant, and economic yield of okra as comparison to no application. Similarly, application of RDF with compost at 280:180:60 $Kgha^{-1}$ and 15 tha^{-1} was found to increase in plant and yield characteristics of okra. Integrated fertilizers are the best alternative to crop production, which not only helps to sustain agricultural crop production but also helps to cut the entire dependency on synthetic fertilizers.

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