PLANT SCIENCE TODAY
Vol 12(sp1): 01–10
https://doi.org/10.14719/pst.12748

eISSN 2348-1900

RESEARCH ARTICLE

Effect of organic manures and biofertilizers on growth and yield of ridge gourd (*Luffa acutangula* L.)

K Sushma[1*], M Padma[2], M Rajkumar[3], Ch. Raja Goud[4], B Naveen Kumar[5] & P Gouthami[6]

[1]Department of Vegetable Science, College of Horticulture, Sri Konda Laxman Telangana State Horticultural University (SKLTSHU), Rajendranagar 500 030, Hyderabad, India

[2]Department of Spices, Plantation, Medicinal and Aromatic crops, Sri Konda Laxman Telangana State Horticultural University (SKLTSHU), Mulugu, Siddipet 502 279, Telangana, India

[3]Department of Fruit Science, Fruit Research Station, Sri Konda Laxman Telangana State Horticultural University (SKLTSHU), Sangareddy 502 001, Telangana, India

[4]Department of Entomology, Horticultural polytechnic, Sri Konda Laxman Telangana State Horticultural University (SKLTSHU), Adilabad 504 001, Telangana, India

[5]Department of Soil Science, Grape Research Station, Sri Konda Laxman Telangana State Horticultural University (SKLTSHU), Rajendranagar 500 030, Telangana, India

[6]Department of Crop Physiology, Sri Konda Laxman Telangana State Horticultural University (SKLTSHU), Mojerla 509 382, Telangana, India

*Correspondence email - kothasushma20@gmail.com

Received: 15 November 2025; Accepted: 16 December 2025; Available online: Version 1.0: 08 January 2026

Cite this article: Sushma K, Padma M, Rajkumar M, Ch. Raja G, Naveen KB, Gouthami P. Effect of organic manures and biofertilizers on growth and yield of ridge gourd (*Luffa acutangula* L.). Plant Science Today. 2026;12(sp1):01–10. https://doi.org/10.14719/pst.12748

Abstract

The present investigation entitled effect of organic manures and biofertilizers in ridge gourd was carried out during *Kharif*, 2021 and summer, 2022 at PG block, College of Horticulture, Rajendranagar, SKLTSHU, Hyderabad. The experiment was carried out with 20 treatments in randomized block design with 3 replications. The results reported that the T_{17} (recommended dose of fertilizers (RDF)-100:100:50 nitrogen (N), phosphorus (P) and potassium (K) (NPK) kg/ha + arka microbial consortium (AMC)) recorded highest in growth parameters like vine length, vine diameter, number of leaves per vine, leaf area, leaf area index, chlorophyll content and flowering parameters like days to first male flower, days to first female flower, days to 50 % flowering, sex ratio and yield parameters like days to first fruit harvest, days to last fruit harvest, fruit length, fruit width, average fruit weight, fruit yield per plot, fruit yield per hectare compared to other treatments.

Keywords: Arka prasan; biofertilizers; organic manures; ridge gourd

Introduction

Ridge gourd (*Luffa acutangula*) is a tropical, trailing vine belongs to gourd family (Cucurbitaceae), known botanically for its distinct ribbed fruits that are eaten young as a nutritious summer vegetable. It is a crop that thrives in warm seasons and is primarily cultivated from seeds. It is highly valued for its extensive cultivation and nutritional advantages like dietary fibers, water content (90-94 g), vitamin A, vitamin C (18 mg), iron, magnesium and vitamin B_6. Treating seeds with biofertilizers or applying them to the soil offers an environmentally friendly option that does not harm the soil or human health. All gourds are produced on 4.52 lakh hectares of land in India, producing 36.16 lakh metric tonnes (1). In Telangana, the crop is planted on 14087 hectares, producing 2.82 lakh metric tonnes and a productivity rate of 20 metric tonnes per hectare(2).

By reducing chemical residues and fruit production per vine, using organic manures and biofertilizers can improve the quality of produce for human consumption. Carbohydrates (3.5-4.2 g), protein (0.6-1.2 g) and extremely low fat (0.2-0.3 g) per 100 g are important macronutrients, as are micronutrients (Vitamin C, Potassium, Magnesium, Iron and Vitamin B_6). Besides supplying nutrients to plants, they improve the aggregation of fine soil particles, fostering a better soil structure, which is crucial for the healthy growth of soil microorganisms. Additionally, organic manures significantly contribute to the breakdown of organic matter by increasing soil microbial populations, which in turn aids in the release of vital plant nutrients (3).

Biofertilizers represent a crucial component of organic sources in integrated nutrient management (INM) and play a significant role in providing crop nutrients through biological nitrogen fixation and the solubilization of phosphorus bound in the soil. Microbial inoculants are known for their ability to mobilize available micronutrients in the soil and to produce growth-promoting substances (auxins, gibberellins, cytokinins) that support plant growth and development. The capacity of microbial inoculants to mobilize accessible micronutrients in the soil and generate growth-promoting compounds (auxins, gibberellins and cytokinins) that aid in plant development is well-known.

The most prevalent symbiotic connections in nature are those between arbuscular mycorrhizal (AM) fungi, which are distinguished by their extensive association with a variety of plants (4). These beneficial fungi inhabit soil and form symbiotic connections with plant roots. AM fungi establish relationships within the extracellular spaces of root cortical tissues to enhance water, phosphorus, nitrogen and micronutrient absorption in host plants (5).

Materials and Methods

The present study was carried out in the P G block at the College of Horticulture, SKLTSHU, located in Rajendranagar, Hyderabad, during the *Kharif* season of 2021 and the summer season of 2022. The experimental location is situated at a latitude of 17° 32' North, a longitude of 78° 40' East and an elevation of 542.3 m above sea level. The experiment was designed using a randomized block layout with twenty treatments, each replicated 3 times. The entire study was implemented on a creeping mesh. Pits measuring 60 × 60 cm were excavated at intervals of 1.5 × 1.0 m and were left uncovered for approximately 15 days for solarization. Throughout the crop period, proper recommended agronomic practices were followed. The experimental data collected on various growth and yield components of plant were subjected to Fisher's method of "analysis of variance" (ANOVA) were analyzed statistically.

Results and Discussion

Growth parameters

Vine length (cm)

The data presented in Table 1 showed that during *Kharif* season, the maximum vine length (77.79, 269.47 and 385.32 cm at 30, 60 and 90 days after sowing (DAS) respectively) was recorded with T_{17} (RDF-100:100:50 NPK kg/ha + Arka Microbial Consortium) and was at par with T_{18} (RDF -100:100:50 NPK kg/ha + vesicular arbuscular mycorrhizae (VAM)) (73.87, 253.41 and 362.41 cm) followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording the vine length of 69.11, 241.54 and 329.55 cm at 30, 60 and 90 DAS respectively. The minimum vine length (40.12, 155.67 and 237.66 cm at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

During the summer season a similar trend was observed. The significantly maximum vine length (79.48, 273.28 and 388.46 cm at 30, 60 and 90 DAS respectively) was recorded under T_{17} (RDF -100:100:50 NPK kg/ha + AMC) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (74.80, 255.35 and 365.67 cm). This was followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording the vine length of 69.65, 243.63 and 322.98 cm at 30, 60 and 90 DAS respectively. The minimum vine length (40.87, 160.90 and 242.95 cm at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

In both seasons, the treatment T_{17} (RDF-100:100:50 NPK kg/ha + AMC) demonstrated the greatest vine length. The increase observed in vine length can be linked to continuous vegetative growth encouraged by the split application of nitrogen. The enhanced vine length related to RDF could be attributed to the immediate nutrient availability, which boosts their absorption and transport within the plants more rapidly, resulting in heightened photosynthetic activity compared to alternative treatments. Furthermore, this might also be a result of augmented activity of beneficial microorganisms, which enrich the organic pool in the soil through the application of biofertilizer (Arka Microbial Consortium), leading to the generation of compounds that promote growth and improved nutrient accessibility over an extended duration as the crop develops, ultimately contributing to better photosynthetic performance (6-8).

Vine diameter (mm)

The data presented in Table 2 showed that during *Kharif* season, the maximum vine diameter (2.25, 3.25 and 4.37 mm at 30, 60 and 90 DAS respectively) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) and was at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (2.11, 3.17 and 4.19 mm) followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording the vine diameter of 2.04, 3.02 and 3.92 mm at 30, 60 and 90 DAS respectively. The minimum vine diameters 1.44, 2.07 and 2.51 mm at 30, 60 and 90 DAS respectively was recorded with T_{20} (absolute control).

During the summer season a similar trend was observed. The significantly maximum vine diameter (2.38, 3.27 and 4.46 mm at 30, 60 and 90 DAS respectively) was recorded under T_{17}

Table 1. Effect of organic manures and biofertilizers on vine length (cm) of ridge gourd at 30, 60 and 90 DAS during *Kharif* 2021 and Summer 2022

Treatments	30 DAS		60 DAS		90 DAS	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1: FYM (25 t/ha) + AMC	45.36	45.73	170.56	179.69	253.18	265.74
T_2: FYM (25 t/ha) + VAM	43.62	44.26	168.52	177.45	251.54	255.62
T_3: FYM (30 t/ha) + AMC	46.48	48.97	174.43	185.74	259.81	269.27
T_4: FYM (30 t/ha) + VAM	43.86	45.82	171.67	180.32	255.44	257.66
T_5: Vermicompost (10 t/ha) + AMC	51.52	53.88	200.76	202.82	275.31	281.47
T_6: Vermicompost (10 t/ha) + VAM	55.45	57.45	181.44	200.91	267.17	274.72
T_7: Vermicompost (12 t/ha) + AMC	61.67	63.79	205.07	218.19	276.57	284.36
T_8: Vermicompost (12 t/ha) + VAM	58.23	60.34	201.78	213.66	262.11	272.71
T_9: Poultry manure (6 t/ha) + AMC	50.69	52.47	183.28	186.83	264.55	264.64
T_{10}: Poultry manure (6 t/ha) + VAM	45.91	47.74	179.83	182.55	273.33	260.76
T_{11}: Poultry manure (8 t/ha) + AMC	52.32	52.82	185.92	191.68	287.76	272.60
T_{12}: Poultry manure (8 t/ha) + VAM	49.73	50.66	182.85	184.53	270.88	267.73
T_{13}: Neem cake (1 t/ha) + AMC	47.15	49.16	189.38	187.85	283.18	286.49
T_{14}: Neem cake (1 t/ha) + VAM	45.77	47.51	185.70	187.69	257.72	270.26
T_{15}: Neem cake (2 t/ha) + AMC	48.69	52.23	196.77	199.43	288.28	294.87
T_{16}: Neem cake (2 t/ha) + VAM	48.33	49.42	191.86	196.46	271.43	279.28
T_{17}: RDF + AMC	77.79	79.48	269.47	273.28	385.32	388.46
T_{18}: RDF + VAM	73.87	74.80	253.41	255.35	362.41	365.67
T_{19}: RDF	69.11	69.65	241.54	243.63	329.55	322.98
T_{20}: Absolute control	40.12	40.87	155.67	160.90	237.66	242.95
SEm±	1.70	1.70	5.61	6.92	8.47	9.12
CD (P=0.05)	4.87	4.88	16.07	19.81	24.24	26.10

Table 2. Effect of organic manures and biofertilizers on vine diameter (mm) of ridge gourd at 30, 60 and 90 DAS during *Kharif* 2021 and Summer 2022

Treatments	30 DAS		60 DAS		90 DAS	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1: FYM (25 t/ha) + AMC	1.65	1.66	2.61	2.59	3.59	3.56
T_2: FYM (25 t/ha) + VAM	1.60	1.64	2.37	2.48	3.23	3.29
T_3: FYM (30 t/ha) + AMC	1.69	1.68	2.71	2.70	3.63	3.69
T_4: FYM (30 t/ha) + VAM	1.64	1.61	2.58	2.66	3.38	3.46
T_5: Vermicompost (10 t/ha) + AMC	1.89	2.03	3.00	3.03	3.56	3.72
T_6: Vermicompost (10 t/ha) + VAM	1.84	1.90	2.89	2.93	3.42	3.51
T_7: Vermicompost (12 t/ha) + AMC	2.01	2.09	3.02	3.03	3.69	3.79
T_8: Vermicompost (12 t/ha) + VAM	1.93	1.96	3.00	3.01	3.55	3.64
T_9: Poultry manure (6 t/ha) + AMC	1.75	1.88	2.71	2.98	3.52	3.66
T_{10}: Poultry manure (6 t/ha) + VAM	1.73	1.70	2.69	2.77	3.40	3.61
T_{11}: Poultry manure (8 t/ha) + AMC	1.99	1.95	2.83	2.94	3.66	3.68
T_{12}: Poultry manure (8 t/ha) + VAM	1.86	1.86	2.77	2.89	3.64	3.59
T_{13}: Neem cake (1 t/ha) + AMC	1.87	1.76	2.75	2.87	3.51	3.87
T_{14}: Neem cake (1 t/ha) + VAM	1.69	1.71	2.63	2.76	3.45	3.63
T_{15}: Neem cake (2 t/ha) + AMC	1.93	1.96	2.80	3.11	3.79	4.07
T_{16}: Neem cake (2 t/ha) + VAM	1.78	1.82	2.59	2.74	3.50	3.75
T_{17}: RDF + AMC	2.25	2.38	3.25	3.27	4.37	4.46
T_{18}: RDF + VAM	2.11	2.22	3.17	3.18	4.19	4.14
T_{19}: RDF	2.04	2.14	3.02	3.04	3.92	3.99
T_{20}: Absolute control	1.44	1.47	2.07	2.22	2.51	2.97
SEm±	0.06	0.06	0.08	0.08	0.11	0.13
CD (P=0.05)	0.16	0.16	0.22	0.22	0.30	0.37

(RDF-100:100:50 NPK kg/ha) + AMC) which was statistically at par with T_{18} (RDF -100:100:50 NPK kg/ha + VAM) (2.22, 3.18 and 4.14 mm). This was followed by T_{19} (RDF -100:100:50 NPK kg/ha) (2.14, 3.04 and 3.99 mm at 30, 60 and 90 DAS respectively). The minimum vine diameter (1.47, 2.22 and 2.97 mm at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

T_{17} (RDF-100:100:50 NPK kg/ha + AMC) showed the biggest vine diameter in both seasons. This demonstrates unequivocally how important it is to use biofertilizer since it greatly increases nutrient availability and promotes plant growth. The growth in vine diameter may be attributed to the plants' increased absorption of essential nutrients, which supported both cell division and elongation (9, 10).

Number of leaves per vine

The data presented in Table 3 showed that during *Kharif* season, the maximum number of leaves per vine (16.59, 58.37 and 81.27 at 30, 60 and 90 DAS respectively) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) which was statistically at par with T_{18} (RDF -100:100:50 NPK kg/ha + VAM) (15.74, 56.65 and 76.34) followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording the number of leaves per vine 13.43, 50.43 and 72.65 at 30, 60 and 90 DAS respectively. The minimum number of leaves per vine (7.15, 26.57 and 50.07 at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

During the summer season a similar trend was observed. The maximum number of leaves per vine (16.75, 60.46 and 83.73 at 30, 60 and 90 DAS respectively) was recorded under T_{17} (RDF-100:100:50 NPK kg/ha + AMC) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha+ Vesicular arbuscular mycorrhizae) (15.83, 58.28 and 79.11) followed by T_{19} (RDF-100:100:50 NPK kg/ha) (13.53, 52.01 and 76.34 at 30, 60 and 90 DAS respectively). The minimum number of leaves per vine (7.39, 30.89 and 50.13 at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

T_{17} (RDF-100:100:50 NPK kg/ha + AMC) had the greatest values throughout all development phases in both seasons. This

Table 3. Effect of organic manures and biofertilizers on number of leaves per vine of ridge gourd at 30, 60 and 90 DAS during *Kharif* 2021 and Summer 2022

Treatments	30 DAS		60 DAS		90 DAS	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1: FYM (25 t/ha) + AMC	8.81	8.33	33.93	36.34	58.43	63.58
T_2: FYM (25 t/ha) + VAM	8.27	7.98	33.54	35.25	53.78	55.35
T_3: FYM (30 t/ha) + AMC	9.13	9.45	36.47	37.12	57.67	61.86
T_4: FYM (30 t/ha) + VAM	8.24	8.29	34.71	35.74	55.66	56.23
T_5: Vermicompost (10 t/ha) + AMC	11.57	11.64	44.43	42.31	64.18	64.33
T_6: Vermicompost (10 t/ha) + VAM	9.76	9.89	40.06	42.16	60.67	63.06
T_7: Vermicompost (12 t/ha) + AMC	12.43	12.47	47.57	43.98	66.73	69.92
T_8: Vermicompost (12 t/ha) + VAM	10.44	10.52	41.56	45.06	61.53	62.36
T_9: Poultry manure (6 t/ha) + AMC	9.39	9.51	36.65	38.44	57.59	59.67
T_{10}: Poultry manure (6 t/ha) + VAM	8.74	8.86	32.95	34.56	52.26	54.36
T_{11}: Poultry manure (8 t/ha) + AMC	11.42	11.56	41.66	43.35	61.77	66.58
T_{12}: Poultry manure (8 t/ha) + VAM	9.73	9.82	39.74	38.26	54.34	60.48
T_{13}: Neem cake (1 t/ha) + AMC	9.26	9.48	37.04	37.26	58.76	59.68
T_{14}: Neem cake (1 t/ha) + VAM	8.45	8.67	35.55	36.71	51.91	53.52
T_{15}: Neem cake (2 t/ha) + AMC	10.32	10.41	40.63	37.97	62.27	64.84
T_{16}: Neem cake (2 t/ha) + VAM	8.97	8.92	36.78	36.82	53.38	54.83
T_{17}: RDF + AMC	16.59	16.75	58.37	60.46	81.27	83.73
T_{18}: RDF + VAM	15.74	15.83	56.65	58.28	76.34	79.11
T_{19}: RDF	13.43	13.53	50.43	52.01	72.65	76.34
T_{20}: Absolute control	7.15	7.39	26.57	30.89	50.07	50.13
SEm±	0.31	0.33	1.21	1.44	1.81	1.82
CD (P=0.05)	0.88	0.93	3.47	4.14	5.17	5.22

may be explained by the prompt availability of all nutrients, which greatly improved plant development and raised the number of leaves each vine generated. The use of biofertilizers may have helped Azotobacter fix nitrogen, while the presence of Bacillus and phosphate-solubilizing bacteria increased phosphorus availability, leading to more leaves per vine than with other treatments (11).

Leaf area (cm^2)

The data presented in Table 4 showed that during *Kharif* season, the maximum leaf area (45.98, 107.78 and 167.17 at 30, 60 and 90 DAS respectively) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (43.69, 103.96 and 159.34) followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording the leaf area of 40.76, 95.63 and 149.83 at 30, 60 and 90 DAS respectively.

The minimum leaf area (29.78, 59.85 and 78.65 at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

During the summer season a similar trend was observed. The maximum leaf area (48.79, 115.67 and 181.55 at 30, 60 and 90 DAS respectively) was recorded under T_{17} (RDF-100:100:50 NPK kg/ha + AMC) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (44.88, 109.42 and 173.12). This was followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording the leaf area of 41.57, 93.17 and 152.65 at 30, 60 and 90 DAS respectively. The minimum leaf area (30.82, 61.54 and 80.87 at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

T_{17} (RDF-100:100:50 NPK kg/ha + AMC) showed the largest leaf area in both seasons. The leaf area is the portion of the plant responsible for photosynthesis, which is crucial for developing total biomass and the quality of the plant's produced food. It is widely acknowledged that a greater photosynthetic surface area enables the plant to maintain productivity over time and enhances overall crop yield. The additional nutrients resulted in the largest leaf area, which likely facilitated the plant's food production, contributing to the highest fruit yield (12, 13).

Leaf area index

The data presented in Table 5 showed that during *Kharif* season, significantly highest leaf area index (0.094, 0.777 and 1.677 at 30, 60 and 90 DAS respectively) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) followed by T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (0.085, 0.727 and 1.492) and T_{19} (RDF-100:100:50 NPK kg/ha) recording the leaf area index of 0.068, 0.595 and 1.344 at 30, 60 and 90 DAS respectively. The minimum leaf area index (0.026, 0.196 and 0.486 at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

During the summer season, the maximum leaf area index (0.101, 0.863 and 1.877 at 30, 60 and 90 DAS respectively) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC). This was followed by T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (0.088, 0.780 and 1.652) and T_{19} (RDF-100:100:50 NPK kg/ha) recording the leaf area index of 0.069, 0.598 and 1.439 at 30, 60 and 90 DAS respectively. The minimum leaf area index (0.028, 0.235 and 0.500 at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

In both growing seasons, T_{17} (RDF-100:100:50 NPK kg/ha + AMC) exhibited the highest leaf area index. This enhancement could be attributed to the greater number of leaves per plant (14).

SPAD chlorophyll meter readings

The data presented in Table 6 showed that during *Kharif* season, the maximum SPAD chlorophyll meter readings (39.78, 48.51 and 52.32 at 30, 60 and 90 DAS respectively) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) and was significantly at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (38.51, 47.48 and 50.91) followed by T_{19} (RDF-100:100:50 NPK kg/ha) (36.36, 45.06 and 48.30 at 30, 60 and 90 DAS respectively). The minimum SPAD chlorophyll meter readings (27.02, 34.84 and 37.02 at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

During the summer season, the maximum SPAD chlorophyll readings (39.87, 49.31 and 56.88 at 30, 60 and 90 DAS respectively) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) and was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (37.73, 47.93 and 53.16). This was followed by T_{19} (RDF-100:100:50 NPK kg/ha) (36.24, 45.62 and 50.28 at 30, 60 and 90 DAS respectively). The minimum SPAD chlorophyll meter readings (29.17, 35.22 and 37.53 at 30, 60 and 90 DAS respectively) was recorded with T_{20} (absolute control).

Table 4. Effect of organic manures and biofertilizers on leaf area (cm^2) of ridge gourd at 30, 60 and 90 days after sowing during *Kharif* 2021 and Summer 2022

Treatments	**30 DAS**		**60 DAS**		**90 DAS**	
	Kharif	**Summer**	***Kharif***	**Summer**	***Kharif***	**Summer**
T_1: FYM (25 t/ha) + AMC	32.55	35.62	68.34	69.72	96.92	92.43
T_2: FYM (25 t/ha) + VAM	34.47	34.74	63.07	67.52	83.33	88.25
T_3: FYM (30 t/ha) + AMC	37.34	35.91	69.85	70.22	97.12	95.55
T_4: FYM (30 t/ha) + VAM	35.29	35.56	65.16	67.75	84.72	89.83
T_5: Vermicompost (10 t/ha) + AMC	37.72	38.08	74.65	76.31	109.82	100.65
T_6: Vermicompost (10 t/ha) + VAM	34.68	37.72	70.28	71.14	95.82	99.53
T_7: Vermicompost (12 t/ha) + AMC	41.38	42.18	78.61	83.23	102.76	108.87
T_8: Vermicompost (12 t/ha) + VAM	37.67	38.11	75.77	79.41	99.04	97.55
T_9: Poultry manure (6 t/ha) + AMC	37.51	39.43	70.03	74.81	102.32	103.64
T_{10}: Poultry manure (6 t/ha) + VAM	35.62	37.62	65.96	69.47	91.35	88.65
T_{11}: Poultry manure (8 t/ha) + AMC	39.73	40.19	67.41	77.53	107.10	99.64
T_{12}: Poultry manure (8 t/ha) + VAM	36.66	38.27	71.80	74.02	96.38	97.57
T_{13}: Neem cake (1 t/ha) + AMC	38.38	37.14	73.62	78.41	92.43	111.58
T_{14}: Neem cake (1 t/ha) + VAM	36.53	36.75	70.37	69.34	90.95	90.38
T_{15}: Neem cake (2 t/ha) + AMC	39.52	39.73	84.33	89.62	88.81	115.51
T_{16}: Neem cake (2 t/ha) + VAM	36.76	38.17	73.64	75.12	86.46	91.48
T_{17}: RDF + AMC	45.98	48.79	107.78	115.67	167.17	181.55
T_{18}: RDF + VAM	43.69	44.88	103.96	109.42	159.34	173.12
T_{19}: RDF	40.76	41.57	95.63	93.17	149.83	152.65
T_{20}: Absolute control	29.78	30.82	59.85	61.54	78.65	80.87
SEm±	1.18	1.41	2.26	2.40	3.06	3.22
CD (P=0.05)	3.37	4.03	6.48	6.87	8.77	9.21

Table 5. Effect of organic manures and biofertilizers on leaf area index of ridge gourd at 30, 60 and 90 DAS during *Kharif* 2021 and Summer 2022

Treatments	30 DAS		60 DAS		90 DAS	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1: FYM (25 t/ha) + AMC	0.035	0.037	0.286	0.313	0.699	0.726
T_2: FYM (25 t/ha) + VAM	0.035	0.034	0.261	0.294	0.553	0.603
T_3: FYM (30 t/ha) + AMC	0.042	0.042	0.314	0.322	0.691	0.730
T_4: FYM (30 t/ha) + VAM	0.036	0.036	0.279	0.299	0.582	0.624
T_5: Vermicompost (10 t/ha) + AMC	0.054	0.055	0.409	0.399	0.870	0.799
T_6: Vermicompost (10 t/ha) + VAM	0.042	0.046	0.348	0.370	0.718	0.775
T_7: Vermicompost (12 t/ha) + AMC	0.064	0.065	0.462	0.452	0.847	0.940
T_8: Vermicompost (12 t/ha) + VAM	0.049	0.049	0.389	0.442	0.752	0.751
T_9: Poultry manure (6 t/ha) + AMC	0.043	0.046	0.317	0.355	0.727	0.763
T_{10}: Poultry manure (6 t/ha) + VAM	0.038	0.041	0.268	0.296	0.589	0.595
T_{11}: Poultry manure (8 t/ha) + AMC	0.056	0.057	0.347	0.415	0.817	0.819
T_{12}: Poultry manure (8 t/ha) + VAM	0.044	0.046	0.352	0.350	0.647	0.729
T_{13}: Neem cake (1 t/ha) + AMC	0.044	0.043	0.337	0.361	0.671	0.822
T_{14}: Neem cake (1 t/ha) + VAM	0.038	0.039	0.309	0.314	0.583	0.597
T_{15}: Neem cake (2 t/ha) + AMC	0.050	0.051	0.423	0.420	0.683	0.925
T_{16}: Neem cake (2 t/ha) + VAM	0.041	0.042	0.334	0.341	0.570	0.619
T_{17}: RDF + AMC	0.094	0.101	0.777	0.863	1.677	1.877
T_{18}: RDF + VAM	0.085	0.088	0.727	0.780	1.492	1.652
T_{19}: RDF	0.068	0.069	0.595	0.598	1.344	1.439
T_{20}: Absolute control	0.026	0.028	0.196	0.235	0.486	0.500
SEm±	0.001	0.001	0.006	0.006	0.013	0.014
CD (P=0.05)	0.002	0.002	0.018	0.018	0.037	0.041

Table 6. Effect of organic manures and biofertilizers on SPAD chlorophyll content of ridge gourd at 30, 60 and 90 DAS during *Kharif* 2021 and Summer 2022

Treatments	30 DAS		60 DAS		90 DAS	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1: FYM (25 t/ha) + AMC	32.45	32.02	38.56	39.08	40.45	42.92
T_2: FYM (25 t/ha) + VAM	31.63	31.88	37.11	38.23	41.26	41.75
T_3: FYM (30 t/ha) + AMC	32.67	33.46	39.92	42.81	41.59	44.23
T_4: FYM (30 t/ha) + VAM	31.81	32.25	39.98	41.45	40.25	42.30
T_5: Vermicompost (10 t/ha) + AMC	34.55	35.23	36.25	36.97	43.33	46.78
T_6: Vermicompost (10 t/ha) + VAM	32.78	34.04	35.38	36.61	41.11	50.97
T_7: Vermicompost (12 t/ha) + AMC	35.82	36.59	40.62	40.73	44.28	48.55
T_8: Vermicompost (12 t/ha) + VAM	34.03	35.15	36.86	37.41	45.85	47.76
T_9: Poultry manure (6 t/ha) + AMC	31.65	32.37	38.67	40.32	43.30	44.02
T_{10}: Poultry manure (6 t/ha) + VAM	30.56	34.56	37.09	38.35	41.80	42.97
T_{11}: Poultry manure (8 t/ha) + AMC	34.84	35.33	39.80	40.54	42.52	43.45
T_{12}: Poultry manure (8 t/ha) + VAM	31.82	31.12	39.27	37.80	40.28	41.08
T_{13}: Neem cake (1 t/ha) + AMC	33.67	34.53	38.42	39.31	40.37	45.81
T_{14}: Neem cake (1 t/ha) + VAM	34.44	31.16	36.12	38.86	42.16	42.46
T_{15}: Neem cake (2 t/ha) + AMC	33.79	35.14	38.75	39.13	43.65	46.94
T_{16}: Neem cake (2 t/ha) + VAM	31.23	32.50	37.31	39.68	40.77	42.53
T_{17}: RDF + AMC	39.78	39.87	48.51	49.31	52.32	56.88
T_{18}: RDF + VAM	38.51	37.73	47.48	47.93	50.91	53.16
T_{19}: RDF	36.36	36.24	45.06	45.62	48.30	50.28
T_{20}: Absolute control	27.02	29.17	34.84	35.22	37.02	37.53
SEm±	0.92	1.03	1.20	1.20	1.35	1.39
CD (P=0.05)	2.64	2.96	3.43	3.44	3.85	3.99

The enhancement in growth traits may result from an increased availability of nitrogen in a form that is easily accessible to plants, particularly with divided applications. This resulted in improved vegetative development, primarily by elongating cells and to a lesser extent by increasing cell quantity. In addition to being a vital part of plant cell architecture, nitrogen is needed for the synthesis of chlorophyll. More carbohydrates, amino acids and other essential plant chemicals are produced when chlorophyll levels are higher (15, 16).

Flowering parameters

The data pertaining to the flowering parameters *viz*., days to first male flower, days to first female flower, days to 50 % flowering and sex ratio were recorded as influenced by the effect of organic manures and biofertilizers on flowering in ridge gourd (*Luffa acutangula* L.) is tabulated in Table 7.

Days to first male flower

There was significant difference observed among the treatments with respect to days to first male flower during *Kharif* season. Significantly minimum days taken to first male flower (31.21 days) was recorded in T_{17} (RDF-100:100:50 NPK kg/ha + AMC) followed by T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (33.10 days) and T_{19} (RDF-100:100:50 NPK kg/ha) (35.54 days), while the maximum days to first male flower (58.38 days) was recorded with T_{20} (absolute control).

During the summer season among all the treatments, T_{17} (RDF-100:100:50 NPK kg/ha + AMC) recorded minimum days to first male flower (30.44 days). This was followed by T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (32.78 days) and T_{19} (RDF-100:100:50 NPK kg/ha) (33.86 days), while the maximum days to first male flower (56.95 days) was recorded with T_{20} (absolute control).

Table 7. Effect of organic manures and biofertilizers on flowering parameters of ridge gourd during *Kharif* 2021 and Summer 2022

Treatments	Days to first male flower		Days to first female flower		Days to 50 % flowering		Sex ratio	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1: FYM (25 t/ha) + AMC	47.72	46.37	50.26	49.14	71.24	70.54	9.82	9.76
T_2: FYM (25 t/ha) + VAM	48.24	47.73	53.62	52.51	73.64	72.47	9.98	9.95
T_3: FYM (30 t/ha) + AMC	46.94	45.15	49.85	48.82	67.52	67.27	9.77	9.63
T_4: FYM (30 t/ha) + VAM	47.08	47.41	52.22	51.65	72.77	71.83	9.89	9.84
T_5: Vermicompost (10 t/ha) + AMC	45.12	44.32	47.08	46.86	67.08	66.68	8.99	8.92
T_6: Vermicompost (10 t/ha) + VAM	46.73	45.84	48.39	47.44	70.83	69.27	9.04	9.01
T_7: Vermicompost (12 t/ha) + AMC	44.22	43.56	46.64	45.70	65.55	64.44	8.89	8.66
T_8: Vermicompost (12 t/ha) + VAM	45.31	44.82	49.82	48.19	69.75	68.47	8.91	8.82
T_9: Poultry manure (6 t/ha) + AMC	40.74	37.48	46.27	44.76	60.82	59.32	9.46	9.41
T_{10}: Poultry manure (6 t/ha) + VAM	41.19	40.69	47.76	45.62	63.46	62.38	9.62	9.57
T_{11}: Poultry manure (8 t/ha) + AMC	39.18	39.73	45.68	43.23	62.38	61.85	9.32	9.28
T_{12}: Poultry manure (8 t/ha) + VAM	41.75	41.55	47.12	46.72	61.69	60.12	9.53	9.44
T_{13}: Neem cake (1 t/ha) + AMC	42.16	41.87	49.26	48.18	62.85	61.56	9.07	9.03
T_{14}: Neem cake (1 t/ha) + VAM	43.22	42.54	47.89	47.37	64.42	63.37	9.38	9.32
T_{15}: Neem cake (2 t/ha) + AMC	42.35	40.31	48.47	45.80	61.24	60.05	9.10	9.07
T_{16}: Neem cake (2 t/ha) + VAM	44.06	42.27	46.55	46.31	65.36	64.89	9.22	9.14
T_{17}: RDF + AMC	31.21	30.44	37.82	37.25	53.12	51.36	8.32	8.21
T_{18}: RDF + VAM	33.10	32.78	39.95	38.78	55.78	54.55	8.46	8.27
T_{19}: RDF	35.54	33.86	40.72	39.65	57.27	57.79	8.51	8.45
T_{20}: Absolute control	58.38	56.95	63.49	61.87	80.05	79.86	10.42	10.28
SEm±	0.57	0.56	0.63	0.62	0.88	0.87	0.12	0.12
CD (P=0.05)	1.63	1.61	1.82	1.77	2.52	2.48	0.35	0.35

T_{17} (RDF-100:100:50 NPK kg/ha + AMC) showed the fewest days till the first male flower opened in both seasons. The duration until the appearance of the initial flower is a crucial factor that influences both earliness and high yield. The earlier emergence of male flowers following the application of RDF and biofertilizers may be attributed to an improved nutritional status of the plant, which enhances photosynthesis and leads to the prompt initiation of flowering (17, 18).

Days to first female flower

The results revealed a significant difference among treatments with respect to days to first female flower during *Kharif* season. Significantly minimum days to first female flower (37.82 days) was recorded in T_{17} (RDF-100:100:50 NPK kg/ha + AMC) followed by T_{18} (RDF-100:100:50 NPK kg/ha) + VAM) (39.95 days) and T_{19} (RDF-100:100:50 NPK kg/ha) (40.72 days), while the maximum days to first female flower (63.49 days) was recorded with T_{20} (absolute control).

During the summer season among all the treatments, T_{17} (RDF-100:100:50 NPK kg/ha + AMC) recorded minimum days to first female flower (37.25 days) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (38.78 days). This was followed by T_{19} (RDF-100:100:50 NPK kg/ha) (39.65 days), while the maximum days to first female flower (61.87 days) was recorded with T_{20} (absolute control).

T_{17} (RDF-100:100:50 NPK kg/ha + AMC) showed the fewest days until female flower production in both seasons. This may be attributed to the application of RDF and biofertilizers, which promoted bud differentiation leading to earlier flowering. The earlier onset of flowering along with a greater quantity of flowers could be a result of improved nutrient translocation to the above-ground parts (19, 20).

Days to 50 % flowering

The data clearly indicated a significant difference among the treatments with respect to days to 50 % flowering during *Kharif* season. Significantly minimum days to 50 % flowering (53.12 days) was recorded in T_{17} (RDF-100:100:50 NPK kg/ha + AMC) and was at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (55.78 days) followed by T_{19} (RDF-100:100:50 NPK kg/ha) (57.27 days) respectively, while the maximum days to 50 % flowering (80.05 days) was recorded with T_{20} (absolute control).

During the summer season among all the treatments, T_{17} (RDF-100:100:50 NPK kg/ha + AMC) recorded minimum days to 50 % flowering (51.36 days) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (54.55 days). This was followed by T_{19} (RDF -100:100:50 NPK kg/ha) (57.79 days), while the maximum days to 50 % flowering (79.86 days) was recorded with T_{20} (absolute control).

In both seasons, T_{17} (RDF -100:100:50 NPK kg/ha + AMC) showed the least number of days to reach 50 % flowering. It may be attributed to enhanced production of growth-promoting substances that improved physiological activities, thereby inducing earlier flowering (21).

Sex ratio

The data presented in Table 7 showed that during *Kharif* and Summer season, there was significant difference observed among all the treatments. The treatment T_{17} (RDF-100:100:50 NPK kg/ha + AMC) expressed the lowest sex ratio 8.32 and 8.21 which was on par with the T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (8.46 and 8.27) and T_{19} (RDF-100: 100: 50 NPK kg/ha) (8.51 and 8.45) respectively, whereas wider sex ratio (10.42 and 10.28) was observed in T_{20} (absolute control).

In both seasons, T_{17} (RDF-100:100:50 NPK kg/ha + AMC) achieved the narrowest values for growth and flowering parameters, leading to the narrowest sex ratio among all treatments (22).

Yield parameters

The data on yield parameters *viz.,* days to first fruit harvest, days to last fruit harvest, fruit length (cm), fruit width (cm), number of fruits per plant, average fruit weight (g), number of fruits per plant, fruit yield per plant (kg), fruit yield per plot (kg) and fruit yield per hectare tonnes (t) as influenced by the effect of organic manures and biofertilizers are presented in the Table 8 - 10.

Days to first fruit harvest

The data presented in Table 8 showed that there was significant difference observed among the treatments with respect to days to first fruit harvest during *Kharif* season. Significantly, minimum days to first fruit harvest (42.55 days) was recorded in T_{17} (RDF-100:100:50 NPK kg/ha + AMC) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (44.41 days). This was

Table 8. Effect of organic manures and biofertilizers on yield parameters of ridge gourd during *Kharif* 2021 and Summer 2022

Treatments	Days to first fruit harvest		Days to last fruit harvest		Fruit length (cm)		Fruit width (mm)	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1: FYM (25 t/ha) + AMC	60.47	59.45	117.54	119.46	37.32	38.66	35.52	34.30
T_2: FYM (25 t/ha) + VAM	63.54	61.76	110.46	111.72	35.55	37.33	34.11	34.25
T_3: FYM (30 t/ha) + AMC	59.78	57.22	122.25	121.43	36.85	38.08	33.03	35.67
T_4: FYM (30 t/ha) + VAM	62.22	61.83	113.86	115.32	36.23	37.84	32.91	33.76
T_5: Vermicompost (10 t/ha) + AMC	55.76	54.31	126.64	127.76	39.30	40.57	36.22	36.51
T_6: Vermicompost (10 t/ha) + VAM	57.57	55.55	125.50	126.08	37.27	38.54	35.67	34.56
T_7: Vermicompost (12 t/ha) + AMC	53.48	52.77	126.88	128.57	39.39	41.05	36.64	36.60
T_8: Vermicompost (12 t/ha) + VAM	56.09	55.16	125.98	126.64	38.44	39.65	34.18	34.67
T_9: Poultry manure (6 t/ha) + AMC	59.85	59.87	120.77	122.18	37.89	39.11	35.01	35.44
T_{10}: Poultry manure (6 t/ha) + VAM	61.29	60.22	119.41	120.05	36.45	36.86	36.05	34.53
T_{11}: Poultry manure (8 t/ha) + AMC	57.63	55.81	125.21	127.86	38.60	40.97	34.24	35.65
T_{12}: Poultry manure (8 t/ha) + VAM	58.37	58.32	123.83	124.31	37.77	38.74	33.09	34.40
T_{13}: Neem cake (1 t/ha) + AMC	57.36	56.29	122.59	124.77	39.24	39.62	33.62	35.59
T_{14}: Neem cake (1 t/ha) + VAM	59.59	58.87	120.55	121.66	37.17	38.45	34.11	34.76
T_{15}: Neem cake (2 t/ha) + AMC	56.84	55.19	126.33	127.28	38.92	40.18	35.23	36.87
T_{16}: Neem cake (2 t/ha) + VAM	58.26	56.96	124.18	125.92	38.56	38.92	33.50	32.61
T_{17}: RDF + AMC	42.55	41.82	131.72	133.43	42.84	44.78	38.32	38.74
T_{18}: RDF + VAM	44.41	43.73	129.53	130.32	42.67	41.46	37.24	37.65
T_{19}: RDF	45.94	44.55	127.92	128.78	40.45	40.37	36.81	36.63
T_{20}: Absolute control	69.72	68.98	102.18	106.41	30.26	33.63	25.92	27.97
SEm±	0.74	0.73	1.65	1.67	1.18	1.19	0.47	0.47
CD (P=0.05)	2.13	2.10	4.74	4.79	3.38	3.40	1.35	1.36

Table 9. Effect of organic manures and biofertilizers on yield parameters of ridge gourd during *Kharif* 2021 and Summer 2022

Treatments	Average fruit weight (g)		Number of fruits per vine	
	Kharif	Summer	*Kharif*	Summer
T_1: FYM (25 t/ha) + AMC	142.97	147.85	9.54	9.71
T_2: FYM (25 t/ha) + VAM	136.52	139.46	8.63	8.75
T_3: FYM (30 t/ha) + AMC	145.25	149.54	9.85	9.78
T_4: FYM (30 t/ha) + VAM	139.74	142.75	8.72	8.99
T_5: Vermicompost (10 t/ha) + AMC	160.06	164.78	11.86	12.32
T_6: Vermicompost (10 t/ha) + VAM	156.80	157.38	11.28	11.45
T_7: Vermicompost (12 t/ha) + AMC	161.45	165.83	12.52	12.59
T_8: Vermicompost (12 t/ha) + VAM	157.83	160.55	11.64	11.76
T_9: Poultry manure (6 t/ha) + AMC	149.09	150.26	10.91	11.31
T_{10}: Poultry manure (6 t/ha) + VAM	138.97	139.44	10.35	10.52
T_{11}: Poultry manure (8 t/ha) + AMC	150.68	152.57	11.60	11.79
T_{12}: Poultry manure (8 t/ha) + VAM	138.56	141.48	10.87	10.96
T_{13}: Neem cake (1 t/ha) + AMC	145.73	152.02	12.01	12.05
T_{14}: Neem cake (1 t/ha) + VAM	143.25	149.74	11.07	11.86
T_{15}: Neem cake (2 t/ha) + AMC	152.04	155.82	12.09	12.13
T_{16}: Neem cake (2 t/ha) + VAM	150.52	150.67	11.42	11.58
T_{17}: RDF + AMC	175.30	178.65	15.06	15.10
T_{18}: RDF + VAM	171.51	176.03	14.62	14.79
T_{19}: RDF	166.56	169.25	13.36	13.48
T_{20}: Absolute control	112.47	117.01	6.90	6.98
SEm±	2.07	2.11	0.16	0.16
CD (P=0.05)	5.92	6.05	0.45	0.46

Table 10. Effect of organic manures and biofertilizers on yield parameters of ridge gourd during *Kharif* 2021 and Summer 2022

Treatments	Fruit yield per plant (kg)		Fruit yield per plot (kg)		Fruit yield per hectare (t)	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1: FYM (25 t/ha) + AMC	1.36	1.44	13.64	14.36	12.63	13.29
T_2: FYM (25 t/ha) + VAM	1.18	1.22	11.78	12.20	10.91	11.30
T_3: FYM (30 t/ha) + AMC	1.43	1.46	14.31	14.63	13.25	13.54
T_4: FYM (30 t/ha) + VAM	1.22	1.28	12.19	12.83	11.28	11.88
T_5: Vermicompost (10 t/ha) + AMC	1.90	2.03	18.98	20.30	17.58	18.80
T_6: Vermicompost (10 t/ha) + VAM	1.77	1.80	17.69	18.02	16.38	16.69
T_7: Vermicompost (12 t/ha) + AMC	2.02	2.09	20.21	20.88	18.72	19.33
T_8: Vermicompost (12 t/ha) + VAM	1.84	1.89	18.37	18.88	17.01	17.48
T_9: Poultry manure (6 t/ha) + AMC	1.63	1.70	16.27	16.99	15.06	15.74
T_{10}: Poultry manure (6 t/ha) + VAM	1.44	1.47	14.38	14.67	13.32	13.58
T_{11}: Poultry manure (8 t/ha) + AMC	1.75	1.80	17.48	17.99	16.18	16.66
T_{12}: Poultry manure (8 t/ha) + VAM	1.51	1.55	15.06	15.51	13.95	14.36
T_{13}: Neem cake (1 t/ha) + AMC	1.75	1.83	16.90	18.32	15.21	15.66
T_{14}: Neem cake (1 t/ha) + VAM	1.59	1.78	15.86	17.76	14.68	15.44
T_{15}: Neem cake (2 t/ha) + AMC	1.84	1.89	18.38	18.90	17.02	16.50
T_{16}: Neem cake (2 t/ha) + VAM	1.72	1.74	17.19	17.45	15.92	16.16
T_{17}: RDF + AMC	2.64	2.70	26.40	26.98	24.44	25.38
T_{18}: RDF + VAM	2.51	2.60	25.07	26.03	23.22	24.71
T_{19}: RDF	2.23	2.28	22.25	22.81	20.60	23.62
T_{20}: Absolute control	0.78	0.82	7.76	8.17	7.19	7.56
SEm±	0.03	0.03	0.25	0.26	0.23	0.24
CD (P=0.05)	0.07	0.07	0.72	0.74	0.66	0.69

followed by T_{19} (RDF-100:100:50 NPK kg/ha) (45.94 days), while the maximum days to first fruit harvest (69.72 days) was recorded with T_{20} (absolute control).

During the summer season among all the treatments, T_{17} (RDF-100:100:50 NPK kg/ha + AMC) recorded minimum days to first fruit harvest (41.82 days) and was at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (43.73 days) followed by T_{19} (RDF-100:100:50 NPK kg/ha) (44.55 days), while the maximum days to first fruit harvest (68.98 days) was recorded with T_{20} (absolute control).

The treatment that recorded the shortest time for the first fruit harvest in T_{17} (RDF-100:100:50 NPK kg/ha + AMC) also recorded the shortest time for the first appearance of female flowers when compared to the other treatments (23).

Days to last fruit harvest

The data on days to last fruit harvest as influenced by organic manures and biofertilizers on yield in ridge gourd is presented in Table 8.

From the data there was significant difference observed among the treatments with respect to days to last fruit harvest during *Kharif* season. The maximum number of days to last fruit harvest (131.72 days) was recorded in T_{17} (RDF-100:100:50 NPK kg/ ha + AMC) and was significantly at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (129.53 days) and T_{19}(RDF-100: 100: 50 NPK kg/ ha) (127.92 days), while the minimum days to last fruit harvest (102.18 days) was recorded with T_{20} (absolute control).

During the summer season among all the treatments, T_{17} (RDF-100:100:50 NPK kg/ha + AMC) recorded maximum days to last fruit harvest (133.43 days) which was statistically at par with T_{18} (RDF -100:100:50 NPK kg/ha + VAM) (130.32 days) and T_{19}(RDF-100: 100: 50 NPK kg/ha) (128.78 days), while the minimum days to last fruit harvest (106.41 days) was recorded with T_{20} (absolute control).

T_{17} (RDF-100:100:50 NPK kg/ha + AMC) showed the most days needed for the final fruit harvest in both seasons, probably because it also produced the most leaves. This leaf abundance led to higher stomatal conductance and chlorophyll formation, which in turn increased photosynthate synthesis and extended the fruit production period (24).

Fruit length (cm)

From the data there was significant difference during *Kharif* season. The maximum fruit length (42.84 cm) with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) which was at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) recording fruit length of 42.67 cm followed by T_{19}(RDF-100: 100: 50 NPK kg/ha) (40.45 cm). The minimum fruit length (30.26 cm) was recorded with T_{20} (absolute control).

During the summer season among all the treatments, T_{17} (RDF-100:100:50 NPK kg/ha + AMC) recorded maximum fruit length (44.78 cm) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (41.46 cm). This was followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording the fruit length of 40.37 cm. The minimum fruit length (33.63 cm) was recorded with T_{20} (absolute control).

The steady increase in fruit length can be linked to the use of both chemical fertilizers and biofertilizers, likely resulting in better establishment, availability and nutrient absorption. This, in turn, resulted in better vegetative growth, an increase in beneficial bacterial and fungal populations and stimulated the metabolic activities of the plants, ultimately leading to carbohydrate synthesis and an increase in fruit size (25).

Fruit width (mm)

The data recorded on fruit width as influenced by the effect of organic manures and biofertilizers is presented in Table 8.

There was significant difference observed among the treatments with respect to fruit width during *Kharif* season. The maximum fruit width (38.32 mm) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) and was significantly at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (37.24 mm) followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording fruit width of 36.81 mm. The minimum fruit width (25.92 mm) was recorded with T_{20} (absolute control).

During the summer season among all the treatments, maximum fruit width (38.74 mm) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (37.65 mm). This was followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording the fruit width of 36.63 mm. The minimum fruit width (27.97 mm) was recorded with T_{20} (absolute control).

This may be due to the greater accessibility of NPK and water during crucial phases of crop development, which encourages early establishment, robust growth and flourishing plant development, resulting in larger and thicker fruits. An increased fruit diameter associated with the combined application of fertilizers and biofertilizers was also observed in okra (26).

Average fruit weight (g)

The data enunciated on the average fruit weight as influenced by the effect of organic manures and biofertilizers on yield in ridge gourd is presented in Table 9.

There was significant difference observed among the treatments with respect to average fruit weight during *Kharif* season. The maximum average fruit weight (175.30 g) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) and was significantly at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (171.51 g) followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording average fruit weight of 166.56 g. The minimum average fruit weight (112.47 g) was recorded with T_{20} (absolute control).

During the summer season among all the treatments, maximum average fruit weight (178.65 g) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) and was at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (176.03 g). This was followed by T_{19} (RDF-100:100:50 NPK kg/ha) (169.25 g). The minimum average fruit weight (117.01 g) was recorded with T_{20} (absolute control).

The result could have been affected by an expanded photosynthetic area and the distribution of photosynthates within the plants, which in turn facilitated the growth of a larger number of bigger fruits with more seeds per fruit, resulting in a rise in total fruit weight (27-29).

Number of fruits per vine

The data pertaining to number of fruits per vine as influenced by the effect of organic manures and biofertilizers on yield in ridge gourd is presented in Table 9.

All the treatments differed significantly with respect to number of fruits per vine during *Kharif* season. The maximum number of fruits per vine (15.06) was observed with T_{17}

(RDF -100:100:50 NPK kg/ha + AMC) and was significantly at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (14.62) followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording 13.36 number of fruits per vine. The minimum number of fruits per vine (6.90) was recorded with T_{20} (absolute control).

During the summer season among all the treatments, maximum number of fruits per vine (15.10) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (14.79). This was followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording 13.48 number of fruits per vine. The minimum number of fruits per vine (6.98) was recorded with T_{20} (absolute control).

The treatment T_{17} (RDF-100:100:50 NPK kg/ha + AMC) produced more fruits per vine during both growth seasons. This implies a higher metabolic rate and a greater buildup of carbohydrates, creating ideal conditions for auxin production, which increases the number of female flowers and as a result, the quantity of fruits per vine (30, 31).

Fruit yield per vine (kg)

The data presented in Table 10 showed that during *Kharif* season, significantly maximum fruit yield per vine (2.64 kg) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) followed by T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (2.51 kg) and T_{19} (RDF-100:100:50 NPK kg/ha) (2.23 kg). The minimum fruit yield per vine (0.78 kg) was recorded with T_{20} (absolute control).

During the summer season, significantly maximum fruit yield per vine (2.70 kg) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) followed by T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (2.60 kg) and T_{19} (RDF-100:100:50 NPK kg/ha) recording the fruit yield of 2.28 kg per vine. The minimum fruit yield per vine (0.82 kg) was recorded with T_{20} (absolute control).

It's possible that the strong vegetation growth accelerated photosynthesis, increasing the amount of carbohydrates available. Additionally, better digestion of carbohydrates may have promoted auxin production, which would have increased the number of female flowers and eventually, the number of fruits on each vine, potentially increasing the total output (32).

Fruit yield per plot (kg)

The data presented in Table 10 showed that during *Kharif* season, the maximum fruit yield per plot (26.40 kg) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) followed by T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (25.07 kg) and T_{19} (RDF-100:100:50 NPK kg/ha) recording the fruit yield of 22.25 kg per plot. The minimum fruit yield per plot (7.76) was recorded with T_{20} (absolute control).

During the summer season, maximum fruit yield per plot (26.98 kg) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC). This was followed by T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (26.03 kg) and T_{19} (RDF-100:100:50 NPK kg/ha) recording the fruit yield of 22.81 kg per plot. The minimum fruit yield per plot (8.17 kg) was recorded with T_{20} (absolute control).

Fruit yield per hectare (tonnes)

The data presented in Table 10 showed that during *Kharif* season, the maximum fruit yield per hectare (24.44) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) followed by T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (23.22) and T_{19} (RDF-100:100:50 NPK kg/ha) recording the fruit yield of 20.60 tonnes per hectare. The minimum fruit yield per hectare (7.19) was recorded with T_{20} (absolute control).

During the summer season, significantly maximum fruit yield per hectare (24.80) was observed with T_{17} (RDF-100:100:50 NPK kg/ha + AMC) which was statistically at par with T_{18} (RDF-100:100:50 NPK kg/ha + VAM) (24.71). This was followed by T_{19} (RDF-100:100:50 NPK kg/ha) recording the fruit yield of 23.62 tonnes per hectare. The minimum fruit yield per hectare (7.56) was recorded with T_{20} (absolute control).

The treatment T_{17} (RDF-100:100:50 NPK kg/ha + AMC) rise in yield could be attributed to enhanced efficiency, which includes a greater investment of photosynthesis into the economic parts of the plant, as well as a balanced hormonal system within the plant (33).

Conclusion

It can be concluded that using biofertilizers can lead to a reduction of 30-35 % in the use of chemical fertilizers, which also lowers costs. Based on the current experimental results, it was determined that treatment T_{17} (RDF-100:100:50 NPK kg/ha + AMC) was the most effective in promoting the growth, flowering and yield parameters like fruit yield per vine of ridge gourd.

Acknowledgements

The authors are highly thankful to SKLTSHU, Rajendranagar, Hyderabad for the help and support rendered in carrying out the research trial.

Authors' contributions

KS, MP and MR framed the research work, participated in the sequence alignment and drafted the manuscript. CRG, BNK and PG conceived of the study and participated in its design and coordination. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

References

1. Anonymous. Area and production published by Ministry of Agriculture and Cooperation. 2019a.
2. Anonymous. Crop wise area and production of horticultural crops in Telangana state. 2019b.
3. Suresh KR, Karuppaiah P. Effect of integrated nutrient management on growth and yield of bitter gourd (*Momordica charantia* L.). Journal of Plant Archives. 2008;867-8.
4. Harley JL, Smith SE. Mycorrhizal symbiosis. London (UK): Academic Press; 1983. p. 483.
5. Brundrett M. Mycorrhizas in natural ecosystems. Advances in Ecological Research. 1991;21:131-71. https://doi.org/10.1016/S0065-2504(08)60099-9

6. Choudhary K, More SJ, Bhanderi DR. Impact of biofertilizers and chemical fertilizers on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench). Journal of Environmental Science. 2015;9:67-70.
7. Das AK, Prasad B, Singh R. Response of chemical fertilizer and vermicompost on okra (*Abelmoschus esculentus* L.) cv. Parbhani Kranti. The Asian Journal of Horticulture. 2014;9:372-6. https://doi.org/10.15740/HAS/TAJH/9.2/372-37
8. Gayathri K, Sundar PR. Effect of integrated nutrient management on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench) cv. Arka Anamika. Vegetable Science. 2013;40:246-8.
9. Kumaran SS, Natarajan S, Thamburaj S. Effect of organic and inorganic fertilizers on growth, yield and quality of tomato. South Indian Horticulture. 1998;46:203-5.
10. Reddy VC. Effect of urban garbage compost on growth and yield of tomato. Current Research. 1999;28:43-4.
11. Rathod P, Salvi VG, Jadhav S. Growth, yield and quality of ridge gourd as influenced by integrated nutrient management in coastal region of Maharashtra. International Journal of Chemical Studies. 2018;6:2357-60.
12. Meena DR, Chauhan JS, Singh M, Singh RH, Meena ML. Genetic variation and correlation among physiological characters in Indian mustard (*Brassica juncea* L.) under high temperature stress. Indian Journal of Genetics and Plant Breeding. 2013;73:101-4. https://doi.org/10.5958/j.0019-5200.73.1.015
13. Reddy KP, Reddy VSK, Padma SSV. Performance of parents and hybrids for yield and yield attributing characters in ridge gourd (*Luffa acutangula* (Roxb.) L.). The Bioscan. 2013;8:1373-7.
14. Hampton MO, Vavrina CS, Obreza TA. Yard trimming-biosolids compost: Possible alternative to sphagnum peat mass in tomato transplant production. Compost Science and Utilization. 1999;7:42-9. https://doi.org/10.1080/1065657X.1999.10701983
15. Ashish RJ, Vinit C. Effect of integrated nutrient management on growth and yield of okra (*Abelmoschus esculentus*). Journal of Horticulture. 2006;16:11-3.
16. Barani VS, Anburani A. Integrated nutrient management in bhendi. Journal of the Indian Society of Soil Science. 2004;42:166-71.
17. Bairwa LN, Fageria MS. Effects of zinc and integrated use of nitrogen on seed production of bottle gourd var. Pusa Naveen. Indian Journal of Horticulture. 2008;65:506-8.
18. Nagar M, Soni AK, Sarolia DK. Effect of organic manures and different levels of NPK on growth and yield of bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). International Journal of Current Microbiology and Applied Sciences. 2017;6:1776-80. https://doi.org/10.20546/ijcmas.2017.605.193
19. Kirnak H, Higgs D, Kaya C, Tas I. Effects of irrigation and nitrogen rates on growth, yield and quality of muskmelon in semiarid regions. Journal of Plant Nutrition. 2005;28:621-38. https://doi.org/10.1081/PLN-200052635
20. Karuthamani M, Natarajan S, Thamburaj S. Effect of inorganic and biofertilizers on growth, flowering and yield of pumpkin (*Cucurbita moschata* L.) cv. CO-2. South Indian Horticulture. 1995;43:134-6.
21. Shahriazzaman MC, Mazed HEMK, Pulok MAI, Mehraj H, Jamaluddin AFM. Responses of organic manures on growth and yield of okra (*Abelmoschus esculentus*). Journal of Science, Technology and Environment Informatics. 2014;1:60-7.
22. Suresh R, Kumar A. Effect of drip irrigation and mulch on pointed gourd in calcareous soil of north Bihar. Indian Journal of Soil Conservation. 2006;32:83-5.
23. Prasad G, Nandi G, Swain PK. Soil amendment and integrated nutrient management on growth, yield, soil health and economics of bottle gourd. International Journal of Vegetable Science. 2014;22:3-13. https://doi.org/10.1080/19315260.2014.915280
24. Thriveni V, Mishra HN, Pattanayak SK, Sahoo GS, Thomson T. Effect of inorganic, organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd (*Momordica charantia* L.). International Journal of Farm Sciences. 2015;5:24-9.
25. Bhushan A, Bhat KL, Sharma JP. Effect of Azotobacter and inorganic fertilizers on fruit and seed yield of okra cv. Hisar Unnat. Agricultural Science Digest. 2013;33:135-8.
26. Mal B, Mahapatra P, Mohanty S, Mishra HN. Growth and yield parameters of okra (*Abelmoschus esculentus* L.) influenced by diazotrophs and chemical fertilizers. Journal of Crop and Weed. 2014;9:109-12.
27. Bairwa HL, Shukla AK, Mahawer LN, Kaushik RA, Shukla KB, Ameta KD. Response of integrated nutrient management on yield, quality and physico-chemical characteristics of okra cv. Arka Anamika. Indian Journal of Horticulture. 2009;66:3-9.
28. Shelar RB, Kadam AS, Patil VK, Narsude PB. Effect of different sources of nitrogen on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench). International Journal of Agricultural Sciences. 2011;7:70-3.
29. Wagh SS, Laharia GS, Iratkar AG, Gajare AS. Effect of integrated nutrient management on nutrient uptake, yield and quality of okra (*Abelmoschus esculentus* (L.) Moench). Asian Journal of Soil Science. 2014;9:21-4.
30. Das MK, Maity TK, Som MG. Growth and yield of pointed gourd (*Trichosanthes dioica* Roxb.) as influenced by nitrogen and phosphorus fertilizers. Vegetable Science. 1987;14:18-26.
31. Irfan A, Muhammad Z, Mubeen S, Karim YA, Mubashir A. Role of different levels of nitrogen, phosphorus and potassium on growth, yield and quality attributes of bitter gourd (*Momordica charantia* L.). Food Science and Technology. 2019;7:16-21. https://doi.org/10.13189/fst.2019.070202
32. Shivashankaramurthy TC, Nagegowda VB, Farooqui AA. Influence of nitrogen, phosphorus and potassium on the yield and quality of gherkin. Indian Journal of Horticulture. 2007;64:228-30.
33. Sareedha P, Anburani A, Samruban J. Influence of integrated nutrient management on growth of gherkin (*Cucumis sativus* L.) cv. Ajax hybrid. Vegetable Science. 2006;33:196-7.

Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

Publisher information: Plant Science Today is published by HORIZON e-Publishing Group with support from Empirion Publishers Private Limited, Thiruvananthapuram, India.