



ISSN Print: 2664-844X
 ISSN Online: 2664-8458
 NAAS Rating (2026): 4.97
 IJAFA 2026; 8(10): 354-357
www.agriculturaljournals.com
 Received: 22-08-2026
 Accepted: 28-09-2026
 Published: 10-10-2026

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Integrated nutrient management through organic manures and microbial consortia for improving yield of zucchini (*Cucurbita pepo* L.)

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DOI: <https://www.doi.org/10.33545/2664844X.2026.v8.i10e.2039>

ABSTRACT

The present investigation was conducted during Rabi 2025–26 at Global Vikas Trust Krushikul Shirsala District Beed, Maharashtra to evaluate the effect of different organic manures and microbial consortia on yield of zucchini (*Cucurbita pepo* L.). The experiment consisted of nine treatments and was laid out in a Randomized Block Design with three replications. Yield observations were recorded for average fruit weight, yield per plant, yield per plot and yield per hectare.

Among the treatments T_7 (vermicompost @ 2 t/ha + NPK consortia @ 5 lit/ha) recorded superior performance for all the major yield parameters. The maximum average fruit weight was recorded under T_7 (210.60 g), followed by T_6 (208.80 g), while the minimum was recorded in T_1 (182.80 g). The highest yield per plant was also recorded in T_7 (2.17 kg) followed by T_6 (2.07 kg) and T_9 (1.97 kg) whereas T_1 recorded the lowest yield per plant (1.27 kg). Similarly, T_7 recorded the maximum yield per plot (79.53 kg) followed by T_6 (75.60 kg) and T_9 (72.00 kg). In terms of yield per hectare T_7 recorded the highest yield of 61.03 t/ha followed by T_6 (58.27 t/ha) and T_9 (55.57 t/ha) while the lowest yield was recorded under T_1 (36.13 t/ha). Overall, the findings indicate that application of vermicompost @ 2 t/ha with NPK consortia @ 5 lit/ha was associated with higher fruit weight and productivity of zucchini under the conditions of the present experiment

Keywords: Vermicompost, NPK consortia, Biomix, Organic manure, Integrated nutrient management, Yield

Introduction

Zucchini (*Cucurbita pepo* L.) is an important vegetable crop belonging to the family Cucurbitaceae and is cultivated for its tender fruits. The crop is characterized by a relatively short growth period and rapid vegetative and reproductive development, making efficient nutrient management important for achieving satisfactory growth and productivity. The performance of zucchini is strongly influenced by the availability of essential plant nutrients and the efficiency with which these nutrients are supplied and utilized during crop growth. Therefore, appropriate nutrient management practices are essential for maintaining vigorous plant growth and obtaining higher fruit yield.

Organic manures are important sources of plant nutrients and organic matter and play a significant role in maintaining soil fertility and supporting crop growth. Farmyard manure, vermicompost and animal manures supply nutrients gradually and contribute organic matter to the soil. Vermicompost in particular provides a readily available source of nutrients and may improve the physical and biological condition of the soil. The incorporation of organic nutrient sources can therefore support better vegetative development and reproductive growth of vegetable crops.

Microbial inoculants and microbial consortia have also gained importance as components of sustainable nutrient management. Beneficial microorganisms associated with the rhizosphere can contribute to nutrient mobilization and improve the availability of nutrients to plants. Their application in combination with organic manures may provide a complementary nutrient supply and improve nutrient-use efficiency. The integrated use of organic manures and beneficial microorganisms has been reported to improve vegetative growth and yield components in cucurbitaceous crops. Kharga *et al.* (2019) [1] reported improved vine growth under integrated application of NPK, vermicompost and microbial inoculants in cucumber. Prabhu *et al.* (2006) [2] also reported improvement in vine growth and yield of cucumber with combined application of NPK, vermicompost and biofertilizers. Similarly, Sahu *et al.* (2022) [3] reported improved vegetative growth under integrated nutrient management involving vermicompost and biofertilizer consortia.

In zucchini, balanced nutrient availability is particularly important because rapid vegetative growth, flowering, fruit setting and fruit development occur within a comparatively short crop period. Better plant growth

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can contribute to increased production of flowers and fruits and ultimately to higher fruit yield. In the present investigation, different organic manure sources were evaluated both alone and in combination with microbial formulations, namely Biomix and NPK consortia. The treatments included farmyard manure, vermicompost and goat manure as organic nutrient sources together with their combinations with microbial consortia at different rates. Such integration provides an opportunity to identify nutrient-management combinations capable of supporting vigorous plant growth and improved productivity while reducing dependence on individual nutrient sources.

Materials and methods

The experiment on the effect of organic manures and microbial consortia on growth and yield of zucchini (*Cucurbita pepo* L.) was conducted during the *rabi* season of 2025–26 at Global Vikas Trust Krushikul, Shirsala, District Beed, Maharashtra. The experiment was laid out in a Randomized Block Design (RBD) with three replications and nine treatments. Zucchini cultivar 'Green Sharon' was used for the experiment. The experimental plots measured 3.6×3.6 m with a spacing of 60×60 cm between plants. The treatments comprised T₁ (FYM @ 20 t/ha), T₂ (vermicompost @ 6 t/ha) T₃ (goat manure @ 2.5 t/ha), T₄ (FYM @ 20 t/ha + Biomix @ 10 L/ha), T₅ (FYM @ 15 t/ha + NPK consortia @ 5 lit/ha), T₆ (vermicompost @ 4 t/ha + Biomix @ 10 L/ha), T₇ (vermicompost @ 2 t/ha + NPK consortia @ 5 lit/ha), T₈ (goat manure @ 2.5 t/ha + Biomix @ 10 lit/ha) and T₉ (goat manure @ 1.5 t/ha + NPK consortia @ 10 lit/ha). The experimental field was prepared to a fine tilth and laid out in raised plots before planting. Zucchini seeds were sown in pro-trays on 17 December 2025 and healthy 18-day-old seedlings were transplanted in the experimental field on 5 January 2026. The fruits were harvested at the mar-

ketable maturity stage when they attained the appropriate size, colour, and other desirable characteristics suitable for harvesting and marketing. at 5–6 day intervals. Observations were recorded from five representative plants selected randomly from each plot. Yield parameters included average fruit weight, yield per plant, yield per plot and yield per hectare. Average fruit weight was determined using a digital weighing scale while fruit yield was calculated from the cumulative harvests and expressed on a per plant, per plot and per hectare basis. The recorded observations were subjected to statistical analysis appropriate for the Randomized Block Design.

Result and discussion

Yield parameter

Fruit weight (g)

The data presented in Table 1 Was significantly influenced by different organic manure treatments. Fruit weight ranged from 182.80 g to 210.60 g. The significantly maximum fruit weight was recorded in T₇ (Vermicompost + NPK consortia) with 210.60 g, followed by T₆ with 208.80 g and minimum fruit weight was recorded in T₁ with 182.80 g.

The increased fruit weight under T₇ may be attributed to improved nutrient availability, enhanced photosynthetic efficiency and greater translocation of photosynthates to developing fruits. Integrated nutrient management can provide a continuous and balanced nutrient supply during fruit development. Ritika *et al.* (2024) [4] reported that summer squash is also increased the maximum average fruit weight (83.91g) in T₆ (Azotobacter @ 2 kg/ha + Vermicompost @ 2.5 t/ha) which was significantly highest among all the treatments.

Table 1. Effect of different organic manures on fruit weight (g) of zucchini

Tr. No	Treatment details	Fruit weight in (g)
T ₁	Farm yard manure (20 t/ha)	182.80
T ₂	Vermicompost (6 t/ha)	185.63
T ₃	Goat manure (2.5 t/ha)	184.47
T ₄	FYM + Biomix (20 t + 10 lit/ha)	192.83
T ₅	FYM + NPK Consortia (15 t + 5 lit/ha)	207.67
T ₆	Vermicompost + Biomix (4 t + 10 lit/ha)	208.80
T ₇	Vermicompost + NPK Consortia (2 t + 5 lit/ha)	210.60
T ₈	Goat manure + Biomix (2.5 t + 10 lit/ha)	204.73
T ₉	Goat manure + NPK Consortia (1.5 t + 10 lit/ ha)	203.77
S.E. m±		0.44
C.D. @ 5 %		1.32

Yield per plant (kg)

The data presented in Table 2 indicated significant variation in yield per plant among the organic manure treatments. Yield per plant ranged from 1.27 to 2.17 kg. The highest yield per plant was recorded in T₇ (Vermicompost + NPK consortia) with 2.17 kg, at par T₆ with 2.07 kg and T₉ with 1.97 kg. The minimum yield per plant was recorded in T₁ with 1.27 kg.

The superiority of T₇ may be attributed to the combined effect of increased plant growth, greater flower production, higher fruit number and increased fruit weight. The integrated nutrient supply may have maintained favourable plant nutrition throughout the crop period. Prabhu *et al.* (2006) [2] reported that integrated application of NPK, vermicompost and biofertilizers increased yield and yield components in cucumber. Similarly result found by Kharga *et al.* (2019) [1] recorded higher fruit yield under integrated application of NPK, vermicompost and microbial inoculants in cucumber.

Yield per plot (kg)

The data on yield per plot as influenced by different organic manure, are presented in Table 2. Different organic manure treatments yield ranged from 46.77 to 79.53 kg per plot. The maximum yield per plot (79.53 kg) was recorded in treatment T₇ i.e. Vermicompost + NPK Consortia which was statistically at par with treatment T₆ (75.60 kg) Vermicompost + Biomix and T₉ (72.00 kg) Goat manure + NPK Consortia.

The lowest yield was obtained under T₁ (Farm Yard Manure @ 20 t/ha) 46.77 kg per plot. The superiority of T₇ may be associated with the complementary effects of vermicompost and NPK consortia. Vermicompost supplies nutrients and improves soil physical conditions while the microbial consortia may enhance nutrient availability and uptake by the crop. Their combined application could therefore have supported better vegetative growth, flowering, fruit development and fruit weight. and efficient nutrient uptake. ultimately resulted in greater yield per plot.

Similar improvement in yield under integrated nutrient management has been reported in cucumber by Sahu *et al.* (2022) [3]. Also, Tomar

et al. (2024) [5] found that the treatment which contains 50% RDE, 50% Vermicompost, and *Azospirillum* @ 1 kg/ha was the most effective in enhanced yield and the number of fruits per plant (17.41)

recorded highest yield (79.84 q/ha) Similar results reported by *Kaur et al.* (2021) [6]

Table 2. Crop yield was measured at yield per plant (kg), yield per plot (kg) and yield per hectare (ton) of zucchini.

Tr. No	Treatment details	Yield per plant (kg)	Yield per plot (kg)	Yield per hectare (ton)
T ₁	Farm yard manure (20 t/ha)	1.27	46.77	36.13
T ₂	Vermicompost (6 t/ha)	1.47	54.00	41.67
T ₃	Goat manure (2.5 t/ha)	1.40	50.40	38.90
T ₄	FYM + Biomix (20 t + 10 lit/ha)	1.63	57.23	44.40
T ₅	FYM + NPK Consortia (15 t + 5 lit/ha)	1.83	64.80	50.00
T ₆	Vermicompost + Biomix (4 t + 10 lit/ha)	2.07	75.60	58.27
T ₇	Vermicompost + NPK Consortia (2 t + 5 lit/ha)	2.17	79.53	61.03
T ₈	Goat manure + Biomix (2.5 t + 10 lit/ha)	1.87	68.37	53.83
T ₉	Goat manure + NPK Consortia (1.5 t + 10 lit/ha)	1.97	72.00	55.57
	S.E. m±	0.09	0.09	0.90
	C.D. @ 5 %	0.28	0.28	2.70

Yield per hectare (t/ha)

The data presented in Table 2 indicated that different organic manure treatments significantly affected fruit yield of zucchini. The yield ranged from 36.13 to 61.03 t/ha.

Data revealed that, yield per hectare was significantly affected by different organic manure treatments yield of 61.03 t/ha was recorded in T₇ (Vermicompost + NPK consortia), followed by T₆ with 58.27 t/ha. The minimum yield of 36.13 t/ha was recorded in T₁ i.e. (farm yard manure).

The highest yield under T₇ the combined effect of vermicompost and NPK consortia is due to the synergetic improvement of soil fertility, nutrient availability and rhizosphere biology. Vermicompost is a direct source of nutrients both macro and micronutrients, while improving soil structure, water retention capacity and microbial community. may be attributed have improved nutrient availability and nutrient-use efficiency, thereby supporting sustained vegetative and reproductive development.

Prabhu et al. (2006) [2] reported maximum cucumber yield under a combination of NPK, vermicompost and biofertilizers. and *Patel et al.* (2024) [7] maximum yield (16.34, 15.92 and 16.13 t/ha) was recorded in combination of 45 × 30 cm spacing with application of 25% RDF + 50% RDN through Vermicompost + NPK consortium

Conclusion

The analysis of yield parameters revealed that different organic manure treatments significantly influenced the fruit weight and yield of zucchini. With the highest fruit weight (210.60 g), yield per plant (2.17 kg), yield per plot (79.53 kg) and yield per hectare (61.03 t/ha) recorded in T₇ (Vermicompost 2 t/ha + NPK consortia 5 lit/ha).

Overall, the combined application of vermicompost and NPK consortia under T₇ resulted in comparatively higher fruit weight, yield per plant, yield per plot and yield per hectare than the other treatments. The higher yield associated with T₇ may be attributed to improved nutrient availability and uptake which supported better fruit development and productivity under the experimental conditions.

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How to cite this article: Ghukse S, Shinde V, Kamble V, Pole S, Kakade A, Pawar S, et al. Integrated nutrient management through organic manures and microbial consortia for improving yield of zucchini (*Cucurbita pepo* L.). *International Journal of Agriculture and Food Science*. 2026;8(10):354-357. doi: <https://www.doi.org/10.33545/2664844X.2026.v8.i10e.2039>

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