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EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON PLANT GROWTH AND FRUIT YIELD OF BITTER GOURD (*MOMORDICA CHARANTIA L.*)

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ABSTRACT

The present investigation, entitled "*Effect of Organic and Inorganic Fertilizer on Plant Growth and Fruit Yield of Bitter Gourd (Momordica charantia* L.)", was carried out during the summer season of 2024–25 at the Department of Vegetable Science, CHRS Sankara Patan, Durg (C.G.). The experiment was conducted in grow bags (20 × 20 × 35 cm) laid out in a Completely Randomized Design (CRD) with ten treatments replicated thrice to assess the influence of integrated nutrient management on growth, yield, fruit quality, and economic performance. The treatments included inorganic fertilizers (NPK), organic manures (FYM, vermicompost, neem cake), their combinations, and an untreated control (T_0). At 80 DAS, T_6 (50% NPK + 25% Vermicompost + 25% FYM) produced the tallest vines (259.6 cm), maximum branching (1.98 branches/plant), and delayed flowering (46.35 DAS), reflecting enhanced vegetative vigor. The same treatment also achieved superior fruit traits, including maximum fruit length (24.61 cm), fruit weight (54.76 g), and fruit width (0.72 cm). In terms of productivity, T_6 recorded the highest fruit yield (1.78 kg/plant) and seed number (16.57/fruit), followed closely by T_5 (50% NPK + 25% FYM + 25% Neem Cake), which also demonstrated significant improvements in growth and yield attributes. Conversely, the control (T_0) consistently recorded the lowest values for vine length (178.5 cm), branching (1.22 branches/plant), fruit traits (8.34 cm length, 23.54 g weight, 0.39 cm width), and yield (0.52 kg/plant). The study concludes that the partial substitution of chemical fertilizers with organic amendments, particularly vermicompost and FYM, provides a balanced nutrient supply that improves soil health, enhances vegetative growth, and boosts fruit yield in bitter gourd. Integrated nutrient management thus represents a sustainable and efficient strategy for maximizing productivity in grow bag-based cultivation systems.

***Keywords*:** Bitter gourd, Integrated nutrient management, Organic and inorganic fertilizers, Growth and yield.

Introduction

Momordica charantia L., commonly known as bitter gourd or bitter melon, is an important tropical and subtropical vegetable valued for its nutritional and medicinal properties. It is a low-calorie, nutrient-dense crop rich in vitamins (notably vitamin C), minerals (potassium, calcium, magnesium, iron), dietary fiber, and bioactive compounds that contribute to its hypoglycemic, antioxidant, and health-promoting effects. Due to these properties, bitter gourd plays a dual role as a vegetable and a functional food in human diets (Suresh *et al.*, 2019).

In crop production, nutrient management is a critical factor influencing vegetative growth, flowering, fruit yield, and quality. While chemical fertilizers supply readily available nutrients and enhance productivity, their excessive use can lead to soil degradation and environmental concerns. Organic manures such as farmyard manure (FYM), vermicompost, and neem cake improve soil health by enhancing microbial activity, nutrient cycling, and long-term fertility, though they often release nutrients more slowly. Integrated Nutrient Management (INM), which combines organic and inorganic sources, has been shown to improve growth, yield, and fruit quality

in bitter gourd while ensuring sustainability and economic profitability. Several studies have demonstrated that integrated approaches outperform single nutrient sources in terms of yield and quality traits (Hamaiel *et al.*, 2015).

However, limited research exists on the effect of integrated nutrient management under confined cultivation systems such as grow bags, which are increasingly used for intensive vegetable production. Therefore, the present study was conducted to evaluate the effect of organic and inorganic fertilizers, individually and in combination, on the growth, yield, fruit quality, and economics of bitter gourd grown in polybags under Chhattisgarh conditions (Ghimire *et al.*, 2018).

Previous studies have demonstrated that both organic and inorganic fertilizers play vital roles in enhancing the growth and yield of bitter gourd (*Momordica charantia* L.). Organic amendments such as FYM, vermicompost, poultry manure, and neem cake improve soil structure, microbial activity, and long-term fertility, with vermicompost shown to outperform traditional compost in nutrient availability and yield improvement (Patle BG *et al*, 2018). Inorganic fertilizers, particularly NPK, provide readily available nutrients and significantly boost productivity, though their overuse may degrade soil health. Integrated nutrient management (INM), combining organic and inorganic sources, consistently delivers superior results, improving vine growth, fruit quality, yield, and profitability compared to single sources (Geethu et al., 2016). These findings highlight INM as the most sustainable and economically viable strategy for bitter gourd cultivation, though limited research exists under confined systems such as grow bags, which the present study addresses.

Material and Methods

The present investigation, entitled "*Effect of Organic and Inorganic Fertilizers on Plant Growth and Fruit Yield of Bitter Gourd (Momordica charantia L.) in Grow Bags,"* was conducted during the summer season of 2024–25 at the Research cum Instructional Farm, College of Horticulture and Research Station, Sankra, Patan, Durg (C.G.). The College of Horticulture and Research Station, Durg, is situated in the central part of the Chhattisgarh plains, between latitudes 20°54′ and 21°32′ N and longitudes 81°10′ and 81°36′ E. The district has an average elevation of about 317 meters above mean sea level. The experiment was laid out in a Randomized Complete Design (RCD) with ten treatments (T_0–T_9), as detailed in Table 1, and three replications, using three grow bags per treatment per replication. The Harkani variety of bitter gourd was transplanted into grow bags, and standard agronomic practices, including irrigation, trellising, pruning, and plant protection, were uniformly followed. At 40 and 80 days after sowing (DAS), five healthy plants per treatment were randomly selected and tagged for observation. Vine length was measured from the soil surface to the tip of the main vine using a ruler, and the number of primary branches per plant was counted. Days to 50% flowering were recorded as the number of days from sowing until at least half of the plants exhibited one fully opened flower, while the node of the first female flower was determined by counting nodes from the base of the main stem. Fruit length and width were measured on 3–5 fruits per plant using a ruler or vernier caliper, and individual fruit weight was recorded with a digital balance. The number of fruits per plant was counted at harvest, and total fruit yield per plant was determined by weighing all mature fruits. Observations were recorded in a datasheet, and mean values for each parameter were calculated for each treatment to assess growth, flowering, and yield performance of bitter gourd. The collected data were statistically analyzed using ANOVA appropriate for RCD, and treatment means were compared at a 5% significance level.

Table 1 : Treatment Detail:

T_0	Control (no fertilizer)
T_1	100% NPK
T_2	100% FYM
T_3	100% Neem cake
T_4	100% Vermicompost
T_5	50% NPK+ 25% FYM+ 25% Neem Cake
T_6	50% NPK+ 25% VC+ 25 % FYM
T_7	25% NPK+ 37.5 % FYM+ 37.5 % Neem Cake
T_8	25% NPK+ 25 % FYM+ 25 % Neem Cake+ 25 % VC
T_9	25% NPK+ 37.5 % VC+ 37.5% FYM

Results and Discussion

Vine length (cm) of Bitter Gourd

The data on vine length of bitter gourd at 40 and 80 days after sowing (DAS) under different nutrient treatments are presented in Table 2 and Figure 1. At 40 DAS, the tallest vines were observed in T_6 (50% NPK + 25% Vermicompost + 25% FYM)**,** measuring 189.7 cm, followed by T_5 (187.9 cm), T_7 (176.6 cm), and T_8 (173.9 cm), while the shortest vine growth occurred in the control T_0 (119.5 cm). By 80 DAS, T_6 again recorded the maximum vine length (259.4 cm)**,** outperforming all other treatments, followed closely by T_5 (254.6 cm), T_7 (251.3 cm), and T_8 (248.4 cm), whereas the control T_0 recorded the lowest growth

(178.5 cm). These results indicate that T_6 was the best-performing treatment, demonstrating the most vigorous vegetative growth due to the synergistic effect of combining 50% NPK with 25% FYM and 25% Vermicompost. Other integrated nutrient management treatments (T_5–T_8) also significantly enhanced vine growth compared to sole nutrient sources or control. The reduced growth in T_0 underscores the importance of nutrient supplementation for optimal bitter gourd development. These observations are in agreement with the findings of Singh V. *et al*, 2012, who reported that integrated nutrient management improves vegetative growth and overall plant vigor in bitter gourd.

Table 2 : Vine Length (cm) of Bitter Gourd under Different Treatments

Treatment	Vine Length (cm) at 40 DAS	Vine Length (cm) at 80 DAS
T_0	119.5	178.5
T_1	157.8	189.4
T_2	140.8	221.0
T_3	151.9	215.7
T_4	159.3	211.5
T_5	187.9	254.4
T_6	189.7	259.6
T_7	176.6	251.3
T_8	173.9	248.4
T_9	169.6	199.4
S.E. (m) ±	4.5	5.37
C.D. (5%)	6.2	8.78

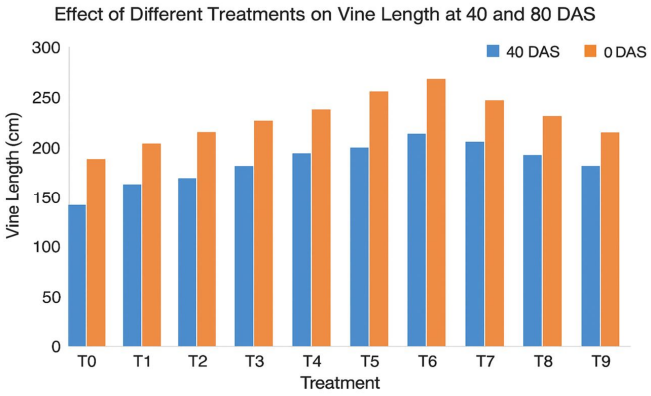

Fig. 1 : Vine length (cm) of bitter gourd under different treatments (T_0–T_9) at 40 and 80 days after sowing (DAS).

Number of branches and days to 50% flowering

The effect of different nutrient treatments on the number of branches and days to 50% flowering of bitter gourd is presented in Table 3. The maximum number of branches per plant was observed in T_6 (50% NPK + 25% vermicompost + 25% FYM), 1.98 branches, followed closely by T_5 (50% NPK + 25% FYM + 25% Neem Cake, 1.91 branches) and T_8 (1.89 branches), whereas the minimum number of branches was recorded in the control T_0 (1.22 branches). Similarly, days to 50% flowering were significantly influenced by the treatments. The earliest flowering occurred in T_0 (24.90 days), while the latest flowering was recorded in T_6 (46.35 days), followed by T_5 (41.98 days) and T_8 (38.88 days). These results indicate that integrated nutrient management treatments, particularly T_5 and T_6, promoted enhanced vegetative growth, resulting in increased branching and delayed flowering, which may contribute to higher yield potential. The improved branching under combined chemical and biologically enriched organic amendments, such as vermicompost, can be attributed to better nutrient availability and overall plant vigor, as supported by Sharma *et al.* (2017), who reported that integrated nutrient management significantly enhances vegetative growth and development in bitter gourd.

Table 3 : Effect of different nutrient treatments on the number of branches and days to 50% flowering in Bitter Gourd

Treatment	Number of Branches	Days to 50% Flowering
T_0	1.22	24.90
T_1	1.84	34.89
T_2	1.82	29.42
T_3	1.80	34.10
T_4	1.43	32.85
T_5	1.91	41.98
T_6	1.98	46.35
T_7	1.85	35.53
T_8	1.89	38.88
T_9	1.83	33.43
S.E. (m) ±	0.075	1.86
C.D. 5%	0.22	5.58

Fruits Morphology of Bitter Gourd

The effect of different nutrient treatments on fruit length, fruit weight, and fruit width of bitter gourd is presented in Table 4 and Figure 2. Among the treatments, T_6 (50% NPK + 25% Vermicompost + 25% FYM) produced the maximum fruit length (24.61 cm), fruit weight (54.76 g), and fruit width (0.72 cm), followed closely by T_5 (50% NPK + 25% FYM + 25% Neem Cake) with 21.95 cm length, 51.87 g weight, and 0.67 cm width. Moderate improvements were observed in T_8 (20.32 cm length, 44.78 g weight, 0.47 cm width) and T_7 (13.62 cm length, 37.67 g weight, 0.61 cm width), while the minimum fruit size and weight were recorded in the control T_0 (8.34 cm length, 23.54 g weight, 0.39 cm width), as shown in Figure 3. The results indicate that integrated nutrient management, particularly the combination of partial chemical fertilizers with organic amendments, significantly enhanced fruit growth parameters compared to sole nutrient sources or the control. The superior

performance of T_6 and T_5 can be attributed to improved nutrient availability, enhanced soil fertility, and increased plant vigor resulting from the combined application of NPK with vermicompost, FYM, and neem cake. For instance, research by Ghimire *et al.* (2023) highlights that the integrated use of organic and inorganic fertilizers enhances the growth and yield potential of bitter gourd plants. Similarly, Ali *et al.* (2024) discuss the benefits of integrated nutrient management in various crops, including bitter gourd, which leads to increased yield and improvements in growth parameters.

Table 4 : Effect of different nutrient treatments on fruit length, fruit weight, and fruit width of Bitter Gourd

Treatment	Fruit Length (cm)	Fruit Weight (g)	Fruit Width (cm)
T_0	8.34	23.54	0.39
T_1	9.93	26.65	0.43
T_2	11.73	27.43	0.48
T_3	12.66	31.43	0.53
T_4	10.06	34.76	0.59
T_5	21.95	51.87	0.67
T_6	24.61	54.76	0.72
T_7	13.62	37.67	0.61
T_8	20.32	44.78	0.47
T_9	16.00	41.40	0.49
S.E. (m) ±	0.78	0.022	0.27
C.D. (0.05)	2.36	0.066	0.082

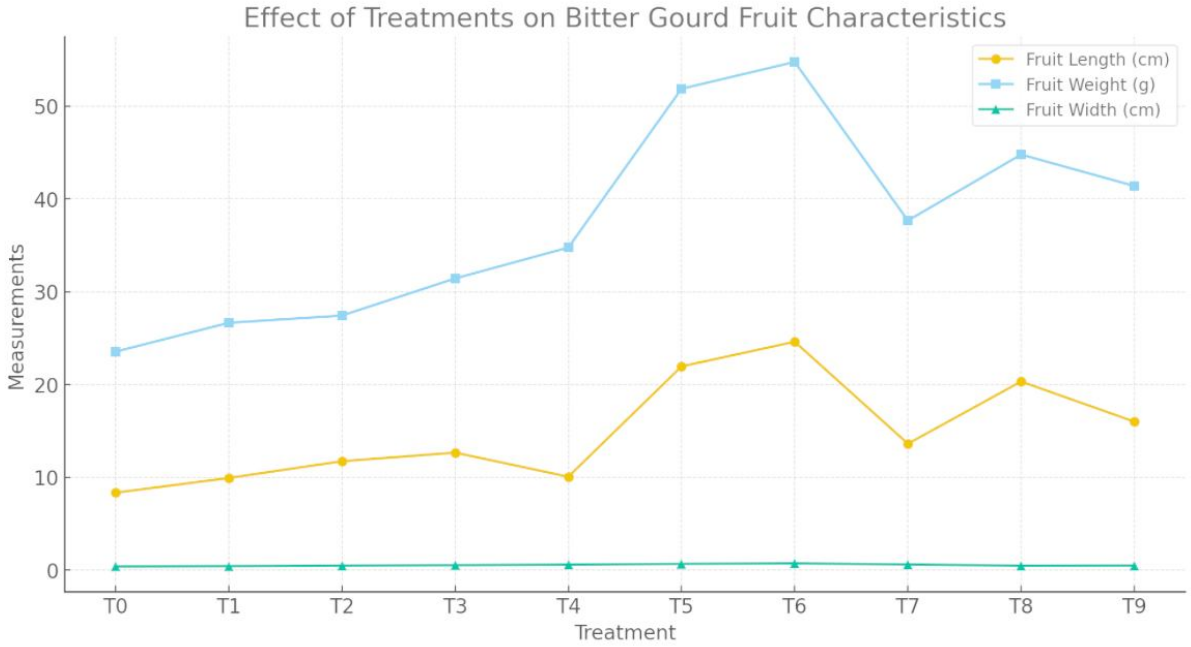

Fig. 2 : Effect of different treatments (T_0–T_9) on bitter gourd fruit characteristics: fruit length (cm), fruit weight (g), and fruit width (cm).

Fruit yield per plant and No. of Seeds per Fruit of Bitter Gourd

The data presented in Table 5 indicate that fertilizer treatments significantly influenced fruit yield per plant and the number of seeds per fruit in bitter gourd. The control (T_0) recorded the lowest values (0.52 kg/plant and 8.6 seeds/fruit), while the highest fruit yield (1.78 kg/plant) and seed number (16.57) were obtained with T_6 (50% NPK + 25% Vermicompost + 25% FYM). Treatments T_5 (1.68 kg, 15.18 seeds) and T_8 (1.59 kg, 14.57 seeds) also performed considerably better than the sole applications of FYM, Neem Cake, or Vermicompost, which showed moderate responses. These results clearly suggest that the integrated use of organic manure with chemical fertilizers enhances both yield and reproductive efficiency by ensuring a balanced nutrient supply and improved soil health. (Patel R.K. *et al*, 2020, and Jagdishprashad *et al.*, 2024) have studied that such integrated nutrient management strategies are essential for sustainable bitter gourd production in grow bag systems, offering higher productivity without compromising soil fertility.

Table 5 : Fruit Yield per Plant and Number of Seeds per Fruit of Bitter Gourd under Different Treatments

Treatment	Fruit Yield per Plant (kg)	No. of Seeds per Fruit
T_0	0.52	8.6
T_1	1.46	11.4
T_2	1.43	9.4
T_3	1.42	10.43
T_4	1.41	12.44
T_5	1.68	15.18
T_6	1.78	16.57
T_7	1.47	14.5
T_8	1.59	14.57
T_9	1.49	13.4
S.E. (m) ±	0.022	0.27
C.D. (0.05)	0.066	0.082

Plate 1: The recorded observations of the bitter gourd plant, including nodes, flowers, and fruits, revealed the following traits in terms of size, shape, and developmental characteristics.

Conclusion

The present study clearly demonstrates that integrated nutrient management significantly enhances the growth, yield, and reproductive performance of bitter gourd compared to sole applications of either organic or inorganic sources. Among the treatments, T_6 (50% NPK + 25% Vermicompost + 25% FYM) consistently outperformed others by producing the maximum vine growth, higher branching, delayed flowering, and superior fruit attributes, ultimately resulting in the highest fruit yield and seed number per fruit. T_5 (50% NPK + 25% FYM + 25% Neem Cake) also exhibited excellent performance, followed by T_8, indicating the positive synergistic effect of combining chemical fertilizers with enriched organic amendments. In contrast, the control treatment (T_0) recorded the lowest growth and yield, highlighting the necessity of nutrient supplementation for optimal crop development. These results confirm that the integrated use of NPK with organic sources, such as vermicompost, FYM, and neem cake, not only improves soil fertility and nutrient availability but also enhances vegetative vigor, reproductive efficiency, and fruit quality. Therefore, adopting integrated nutrient management practices offers a sustainable and productive strategy for bitter gourd cultivation, ensuring higher yields while maintaining soil health for long-term agricultural sustainability.

Competing interests

The authors declare no relevant financial or non-financial interests.

Author contributions

AK contributed to the conception and design of the study. SY carried out the experiments, curated the information, and wrote the first draft. Authors have contributed to the draft manuscript revision and have critically reviewed and edited the submitted manuscript. .

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