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Impact of Integrated Nutrient Management on Growth, Yield, and Economics of Bottle Gourd (*Lagenaria siceraria* (Molina) Standl.)

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Abstract

A field experiment was conducted during 2025-2026 at the Agriculture Research Farm, Rama University, Mandhana, Kanpur (U.P.) to study the impact of integrated nutrient management (INM) on bottle gourd cv. Kashi Ganga. The experiment was laid out in a Randomized Block Design with 12 treatments and three replications. The treatments consisted of various combinations of Recommended Dose of Fertilizer (RDF: 80:50:50 kg NPK ha⁻¹), Farm Yard Manure (FYM), and Vermicompost. The treatment T12 (50% RDF + FYM @ 10 t ha⁻¹ + Vermicompost @ 5 t ha⁻¹) recorded the best performance across most parameters: maximum vine length (390.12 cm), earliest male flower appearance (45 days), earliest female flower appearance (47.14 days), minimum nodes for first female flower (6.06), minimum nodes for first male flower (5.78), maximum fruit length (30.46 cm), maximum fruit diameter (66.12 cm), highest average fruit weight (924.58 g), highest yield (620.14 q ha⁻¹), and highest benefit-cost ratio (1.82). Results demonstrated that integrated use of organic manures with reduced chemical fertilizers significantly improved growth, flowering, yield, and economic returns compared to sole chemical fertilizer or control. T12 was found superior and economically viable for sustainable bottle gourd production.

Keywords: Bottle gourd, integrated nutrient management, FYM, vermicompost, yield, economics

Introduction

Bottle gourd [*Lagenaria siceraria* (Molina) Standl.], belonging to the family Cucurbitaceae and having a chromosome number of $2n = 2x = 22$, is one of the most important warm-season cucurbit vegetables cultivated extensively throughout India. It is commonly known as Lauki, white-flowered gourd, or calabash gourd. The crop is believed to have originated in tropical Africa; however, archaeological evidence suggests its cultivation in India dates back to before 2000 BC, indicating its long history of domestication in the Indian subcontinent.

In India, bottle gourd occupies an area of approximately 0.19 million hectares with a productivity of 3.17 metric tonnes per hectare (Ministry of Agriculture & Farmers Welfare, 2024-25). It is highly preferred by Indian farmers among cucurbits due to its high yield potential, steady market demand, good economic returns, and wide adaptability. The crop can be grown successfully throughout the year in different agro-climatic zones, particularly during the rainy and summer seasons in northern plains. Bottle gourd is a rich source of nutrition. The immature fruits contain about 96.1% moisture, 0.29 g protein, 2.5 g carbohydrates, 30.7 mg minerals, and 0.51 mg vitamins per 100 g of fresh edible portion (Gopalan *et al.*, 1982)^[3]. Besides being easily digestible and having cooling properties, the fruit possesses several medicinal and functional properties such as anti-hyperlipidemic, antioxidant, anti-inflammatory, diuretic, hepato-protective, cardio-protective, anti-diabetic, and immuno-modulatory activities. It is also a rich source of choline, which plays a

vital role in memory enhancement. The seeds contain essential fatty acids, amino acids, and phytochemicals. Apart from culinary uses (vegetable, kheer, kofta, pickles, etc.), the hard dried shells are used for making utensils, musical instruments, and fishing floats. Nutrient management plays a pivotal role in realizing the maximum genetic potential of high-yielding bottle gourd varieties. Although chemical fertilizers are essential for rapid nutrient supply, their excessive and imbalanced use leads to soil degradation, reduced microbial activity, nutrient imbalances, and environmental pollution. On the other hand, organic manures alone, being bulky and low in nutrient concentration, often fail to meet the high nutrient demand of intensive vegetable cultivation, resulting in suboptimal yields. Integrated Nutrient Management (INM), which involves the judicious combination of inorganic fertilizers, organic manures (such as FYM and vermicompost), and biofertilizers, offers a sustainable solution. INM not only ensures balanced and timely nutrient availability but also improves soil physical, chemical, and biological properties, enhances nutrient use efficiency, and promotes long-term soil health and sustainability.

Materials and Methods

The present investigation entitled “Impact of Integrated Nutrient Management on Growth, Yield and Economics of Bottle Gourd (*Lagenaria siceraria* (Molina) Standl.)” was conducted during the year 2025-2026 at the Agriculture Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Mandhana, Kanpur, Uttar

Pradesh, India. The experimental field was characterized by sandy loam soil having a pH range of 7.2-7.5, low organic matter content, and low available nitrogen status. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The total number of treatments was twelve. Each experimental plot measured 4 m × 4 m (16 m²). The crop was planted at a spacing of 1.5 m × 1.5 m using the bottle gourd variety 'Kashi Ganga'. The Recommended Dose of Fertilizer (RDF) for bottle gourd was taken as 80:50:50 kg NPK ha⁻¹. Different combinations of inorganic Fertilizers, Farmyard Manure (FYM), and vermicompost were applied as treatment combinations to

evaluate their effect on growth, flowering, yield, and economics of bottle gourd. The treatments were as follows:- The experiment consisted of twelve treatments, namely T₁ - Control (No fertilizer), T₂ - 100% RDF (80:50:50 kg NPK ha⁻¹), T₃ - FYM @ 20 t ha⁻¹, T₄ - Vermicompost @ 10 t ha⁻¹, T₅ - 50% RDF + FYM @ 10 t ha⁻¹, T₆ - 50% RDF + Vermicompost @ 5 t ha⁻¹, T₇ - FYM @ 10 t ha⁻¹, T₈ - 50% RDF, T₉ - Vermicompost @ 5 t ha⁻¹, T₁₀ - 100% RDF + FYM @ 10 t ha⁻¹, T₁₁ - 100% RDF + Vermicompost @ 5 t ha⁻¹, and T₁₂ - 50% RDF + FYM @ 10 t ha⁻¹ + Vermicompost @ 5 t ha⁻¹.

Table 1: Effect of integrated nutrient management on growth, yield and economic parameters of bottle gourd

Symbol	Vine Length (cm)	Days to 1st Male Flower	Days to 1st Female Flower	Nodes 1st Female Flower	Nodes 1st Male Flower	Fruit Length (cm)	Fruit Diameter (cm)	Avg. Fruit Weight (g)	Yield (q/ha)	B:C Ratio
T1	265.08	55.68	59.26	14.84	13.28	20.38	55.14	580.74	440.32	1.02
T2	350.74	46.78	49.56	7.78	7.32	28.92	63.88	832.84	572.65	1.68
T3	301.84	50.16	52.78	10.54	10.12	25.89	60.64	686.18	518.27	1.39
T4	318.46	48.56	51.94	9.32	9.10	26.50	61.72	728.64	541.62	1.52
T5	326.62	47.72	51.34	8.66	8.38	27.86	62.36	764.38	550.78	1.60
T6	340.35	47.08	50.84	8.12	7.74	27.12	63.14	792.04	562.84	1.65
T7	286.86	52.48	54.56	11.62	11.78	24.16	58.30	640.78	490.65	1.14
T8	308.46	49.20	52.46	9.98	9.80	25.08	61.08	700.70	528.48	1.44
T9	295.25	50.88	53.12	10.28	10.62	24.78	59.76	662.42	504.35	1.28
T10	365.48	46.24	48.98	7.24	6.98	28.46	64.64	865.54	590.62	1.72
T11	370.54	45.68	48.28	6.84	6.16	29.64	65.38	890.42	602.54	1.78
T12	390.12	45.00	47.14	6.06	5.78	30.46	66.12	924.58	620.14	1.82
C.D. (0.05)	2.347	2.347	2.347	2.347	2.347	2.347	2.347	2.347	2.347	2.347
SEm (±)	0.766	0.766	0.766	0.766	0.766	0.766	0.766	0.766	0.766	0.766

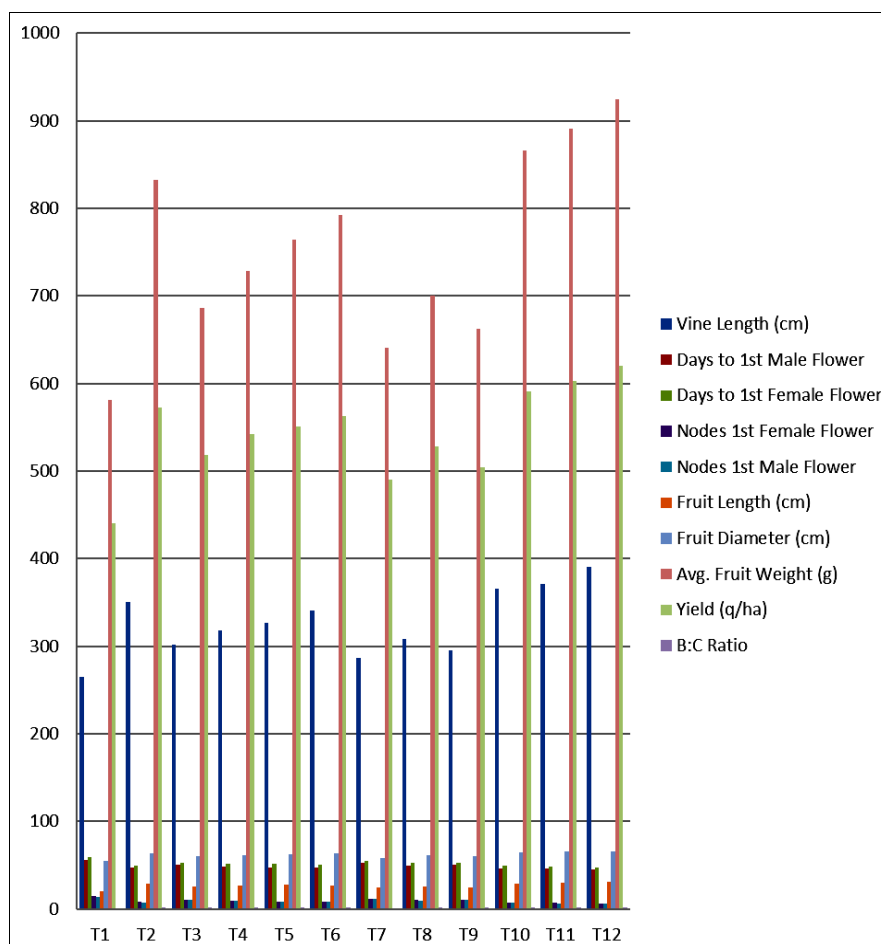


Fig 1: Effect of integrated nutrient management on growth, yield and economic parameters of bottle gourd

Growth parameters

Vine length at final harvest: The longest vine length (390.12 cm) was recorded in T12, which was significantly superior to all other treatments. It was followed by T11 (370.54 cm) and T10 (365.48 cm). The shortest vine (265.08 cm) was observed in the control (T1). The significant improvement in vine length under T12 may be attributed to the balanced and continuous supply of macro and micronutrients from the integration of inorganic fertilizers with organic manures. FYM and vermicompost improve soil physical properties, enhance microbial activity, and release growth-promoting substances, while chemical fertilizers provide immediate nutrient availability. These results are in conformity with the findings of Das *et al.* (2015)^[2], Baghel *et al.* (2017)^[1], and Hemant and Anjali (2026)^[4].

Flowering parameters

Days to 1st male and female flower appearance: The earliest male flower appearance (45.00 days) and female flower appearance (47.14 days) were recorded in T12. The control treatment took the maximum days (55.68 and 59.26 days respectively).

Number of nodes bearing 1st male and female flowers: The lowest number of nodes for first female flower (6.06) and first male flower (5.78) were recorded in T12. Integrated nutrient management accelerated the transition from vegetative to reproductive phase by providing balanced nutrition, leading to early flowering at lower nodes. This is in agreement with the reports of Singh *et al.* (2010)^[12], Nagar *et al.* (2017)^[7], Sebastian *et al.* (2021)^[11], and Muskan *et al.* (2025)^[6].

Yield attributes

Fruit length and Fruit diameter: Maximum fruit length (30.46 cm) and fruit diameter (66.12 cm) were recorded in T12, followed by T11. Average fruit weight: The highest average fruit weight (924.58 g) was observed in T12. Better vegetative growth, improved photosynthetic efficiency, and higher availability of assimilates under INM resulted in superior fruit development and increased fruit size and weight. Similar observations were recorded by Pravallika and Deepanshu (2020)^[9] and Das *et al.* (2015)^[2].

Yield

The highest fruit yield (620.14 q ha⁻¹) was obtained in T12, followed by T11 (602.54 q ha⁻¹) and T10 (590.62 q ha⁻¹). The minimum yield (440.32 q ha⁻¹) was recorded in the control. The remarkable increase in yield under T12 was due to the cumulative effect of improved growth, early and balanced flowering, better fruit set, and enhanced fruit size and weight. The integration of organic and inorganic sources not only supplied essential nutrients but also improved soil health and nutrient use efficiency. These findings are strongly supported by Muskan *et al.* (2025)^[6], Hemant and Anjali (2026)^[4], and earlier workers like Singh *et al.* (2010)^[12] and Narayanamma *et al.* (2009)^[8].

Economics

The highest benefit-cost ratio (1.82) was recorded in T12, followed by T11 (1.78). The lowest B:C ratio (1.02) was observed in the control. Treatment T12 was not only superior in terms of yield but also proved to be the most

economically viable due to higher returns and relatively lower cost of cultivation through partial substitution of chemical fertilizers with organic manures. These results are in line with the findings of Purnima Kumari and Devi Singh (2024)^[10] and Muskan *et al.* (2025)^[6].

Conclusion

Among all the treatments, T12 (50% RDF + FYM @ 10 t ha⁻¹ + Vermicompost @ 5 t ha⁻¹) was found to be the most effective integrated nutrient management practice. It produced significantly higher growth, earlier flowering, better yield attributes, maximum yield (620.14 q ha⁻¹), and highest economic return (B:C ratio 1.82). The integration of organic manures with reduced doses of chemical fertilizers proved highly beneficial for sustainable production of bottle gourd by improving soil fertility, nutrient availability, and overall plant performance. This treatment can be recommended to farmers for commercial cultivation of bottle gourd in the Kanpur region and similar agro-climatic conditions.

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