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Impact of integrated nutrient management on growth and yield of bottle gourd *Lagenaria siceraria* (Molina) Standl

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Abstract

A field experiment on “Impact of Integrated Nutrient Management on Growth and Yield of Bottle Gourd *Lagenaria siceraria* mol. Standl was conducted at Post Graduate College, Ghazipur (U.P.) during summer 2025. The experiment consisted of 7 treatments with 3 replications. The sandy loam soil was low in nitrogen and medium in phosphorus and potassium. The treatment T1 (NPK @ 60:30:30 Kg/ha + Vermicompost @ 5 t/ha + Micronutrients) significantly outperformed all others. It maximized growth parameters (e.g., vine length: 591.81 cm) and resulted in the highest fruit yield (337.31 q/ha) and best quality traits (e.g., fruit length: 39.72 cm). The lowest yield was 222.19 {q/ha} (NPK only). The study concludes that applying NPK @ 60:30:30 Kg/ha + Vermicompost @ 5 t/ha + Micronutrients is the optimal recommendation for maximum bottle gourd production in eastern U.P.

Keywords: NPK, micronutrients and yield, bottle gourd, vermicompost

Introduction

Bottle gourd (*Lagenaria siceraria*), one of the oldest cultivated vegetables in human history, cultivated over 10,000 years ago, even before cereals like wheat and rice. Holds a remarkable place at the intersection of agriculture, nutrition and culture. Widely grown across tropical and subtropical regions, known by many names-lauki, dudhi or ghiya in India. The vegetable have been a Global Traveler though native to Africa, bottle gourd spread naturally across continents; its hard shell allowed it to float across oceans, reaching Asia and the Americas thousands of years ago. Bottle gourd has adapted to diverse environments, symbolizing both resilience and sustainability in traditional farming systems. In India, bottle gourd is associated with simplicity and purity. It grows throughout the year, especially in frost-free areas, since it grows well in hot and humid weather or has adequate water in arid conditions ^[1].

Bottle gourd is a nutrient-rich vegetable that has nourished human populations for centuries. Immature, tender bottle gourd fruit is used as a fresh vegetable and in preparation of pickles and other products ^[2-3]. Revered in traditional medicine and valued in modern nutrition science, this humble green vegetable bridges the gap between food and therapy. Its tender fruit, composed of over 90% water, provides a cooling and hydrating effect-an attribute long recognized in Ayurvedic and folk healing systems. Nutritionally, bottle gourd is a powerhouse of essential nutrients packed in a low-calorie profile. It contains appreciable amounts of vitamins, dietary fiber, folate, and minerals such as magnesium, calcium, and potassium. They contain high level of vitamin E, A and C ^[4]. The tri-terpenoid cucurbitacins B, D, G, and H as well as the bitter cucurbitaceae main component-22-deoxy-cucurbitacin are said to be present in the vegetable ^[5]. Bottle gourd extracts have been observed to hold numerous therapeutic properties that are considered beneficial for human health ^[6]. It's the most choline of any vegetable which serves as a precursor to the neurotransmitter acetylcholine, which is essential for memory retention and enhancement ^[7]. Bottle gourd requires large quantity of both organic and inorganic fertētizers. It has been realised worldwide that chemical fertilizers, while increasing crop yield may have adverse effect on soil health and its fertility in case of imbalanced use. In order to improve and maintain soil fertility for sustained crop productivity, allavailable organic, inorganic and biotic resources must be optimised in an integrated manner that is appropriate to each cropping system and

farming situation with all of its ecological and economic replications. This process is known as integrated nutrient management or INM ^[8]. Chemical fertilizers, especially those containing nitrogen and phosphorus, play a vital role in fulfilling the nutrient requirements of bottle gourd. Yet, their overuse, prolonged application, and improper balance can lead to serious consequences, such as adverse effects on human health and the environment, as well as the degradation of soil's physical and chemical characteristics. The bottle gourd exhibits a high response to nitrogen application and a moderate response to phosphorus application, as demonstrated by the experimental findings” ^[9]. Consequently, there is a compelling need to identify alternative or complementary nutrient sources capable of enhancing crop yield without inducing adverse effects on soil integrity or produce quality. Organic manures and biofertilizers represent viable solutions, as they generate organic acids that possess a high capacity for chelation and retention of both cations and anions. Therefore, the integration of chemical nitrogenous fertilizers with organic manures and biofertilizers offers a superior strategy by

facilitating the slow, sustained release of cations for plant uptake. Furthermore, the incorporation of these organic amendments is known to buffer soil pH, thereby optimizing the bioavailability of essential nutrients.

Materials and Methods

The study was conducted during Zaid season at the main horticulture farm of Post Graduate College Ghazipur during Zaid season of 2024-2025. The experimental site is located just about half km away from the river Ganga. The experiment was laid out in Randomized Block Design with seven treatments and three replications. Treatment details are presented on Table 1. The bottle gourd variety NDBG-6 is used in the experiment. All standard package of practices for cultivation were followed for irrigation, weeding and plant protection. All the characters studied like days to seed germination, Vine length at 15, 30, 45 and 60 DAS, number of leaves at 15, 30, 45 and 60 DAS, Fruit length (cm), Fruit diameter (cm), fruit thickness (cm), fruit cavity (cm) and fruit yield, treatments showed significant differences. Treatment details are given below:-

Table 1: List of treatments used for the study

Treatment-1	NPK-120:60:60 kg/ha
Treatment-2	Vermicompost-10 t/ha
Treatment-3	FYM-20 t/ha
Treatment-4	NPK (60:30:30 kg/ha) + vermicompost 5 t/ha
Treatment-5	NPK (60:30:30 kg/ha)+FYM 10t/ha
Treatment-6	NPK (60:30:30 kg/ha) + vermicompost 5vhz + Micronutrients
Treatment-7	NPK (60:30:30 kg/ha)+ FYM 10 t/ha+ micronutrients

Results and Discussion

The results obtained in respect to vegetative parameters like Days to seed germination, Vine length at 15, 30, 45 and 60 DAS, number of leaves at 15, 30, 45 and 60 DAS, Fruit length (cm), Fruit diameter (cm), fruit thickness (cm), fruit cavity (cm) and fruit yield, treatments showed significant differences. The integrated nutrient management have contributed better performance towards vine length of plant, number of leaves/ vine, fruit length, fruit width and yield. The fruit length, fruit diameter, flesh thickness, cavity, total fruit weight per plot, yield (q/ha) which is higher with the application of treatment T₆ (NPK ½+ Vermicompost + micronutrients). The enhanced growth parameters likely resulted from improved nutrient supply and soil health. These findings are consistent with the reports of Tirumalesh *et al.* ^[10] Patle *et al.* ^[11], Shree *et al.* ^[12], Tripathi *et al.* ^[13], Rabari *et al.* ^[14], Kumar *et al.* ^[15], Pathak *et al.* ^[16] and Niharika *et al.* ^[17]. Followed by T₇, (NPK1/2+ FYM1/2+Micronutrients). The minimum Fruit yield (222.19q/ha) under treatment T₁ (NPK-120:60:60 Kg/ha).

Vine length

The results clearly demonstrate that vine length of bottle gourd varied significantly across different nutrient management treatments. The treatment T₆ (½ NPK + ½

vermicompost + micronutrients) consistently produced the longest vines at all growth stages 15, 30, 45, 60 DAS, and at final harvest with corresponding lengths of 20.05, 42.28, 142.85, 294.01, and 591.80 cm, respectively. This superior performance may be attributed to the combined effect of balanced inorganic fertilization, improved soil structure, and sustained nutrient release from vermicompost, supported further by micronutrient application. Such synergy likely enhanced vegetative growth by improving nutrient uptake efficiency and physiological activity. The next best performance was noted in T₇ (½ NPK + FYM + micronutrients), indicating that FYM also contributed positively to vine elongation, though its nutrient release pattern might have been comparatively slower than vermicompost. In contrast, the shortest vine lengths across all stages 15.83, 35.42, 129.04, 270.56, and 572.09 cm were observed in T₁ (NPK 120:60:60 kg/ha). This suggests that the sole application of chemical fertilizers, without the support of organic sources, may not provide sustained nutrient availability or improved soil physical conditions needed for vigorous vine growth. Overall, the findings highlight that integrating organic sources such as vermicompost or FYM with reduced chemical fertilizers and micronutrients significantly enhances vine growth in bottle gourd compared to the exclusive use of inorganic fertilizers.

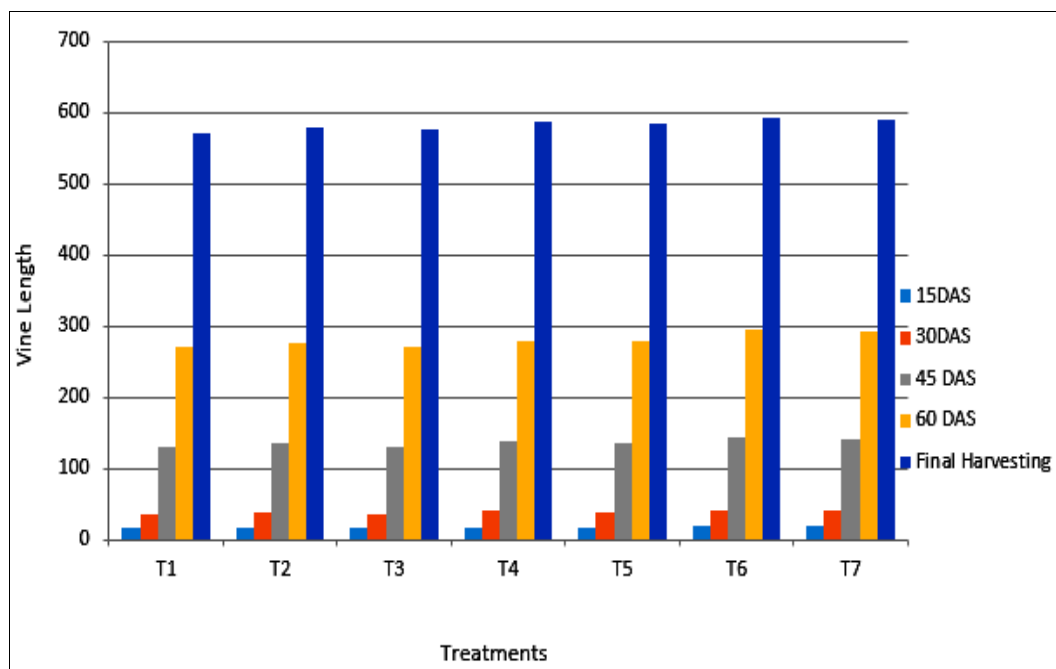


Fig 1: Vine length of bottle gourd under different nutrient management treatments at various growth stages

Leaves/vine (No)

The number of leaves per vine exhibited significant variation across the nutrient management treatments at all growth stages. A consistent increasing trend was observed from 15 DAS to final harvesting, indicating progressive vegetative development in bottle gourd. Among the treatments, T₆ ($\frac{1}{2}$ NPK + $\frac{1}{2}$ vermicompost + micronutrients) recorded the highest number of leaves at every stage 8.18 (15 DAS), 18.19 (30 DAS), 57.54 (45 DAS), 230.47 (60 DAS), and 290.54 at final harvest. This superior performance suggests that the integration of inorganic fertilizers with vermicompost and micronutrients ensures balanced nutrient availability, improved soil structure, and enhanced physiological activity, resulting in greater leaf formation. The second-best response was observed under T₇ ($\frac{1}{2}$ NPK + FYM + micronutrients). Plants using organic

fertilizers showed significantly increased nutrient content and plant growth compared to control [18], further supporting the advantage of combined nutrient sources over chemical fertilizers alone. In contrast, the lowest leaf count 6.28 (15 DAS), 11.51 (30 DAS), 41.64 (45 DAS), 212.75 (60 DAS), and 271.79 at final harvest was recorded in T₁ (NPK 120:60:60 kg/ha). The inferior performance of this treatment indicates that sole reliance on chemical fertilizers may not supply nutrients in a sustained manner, thereby limiting vegetative growth. Overall, the results highlight that integrated nutrient management, particularly the combination of NPK with organic sources and micronutrients, significantly enhances leaf production in bottle gourd by improving nutrient availability and promoting better vegetative vigor.

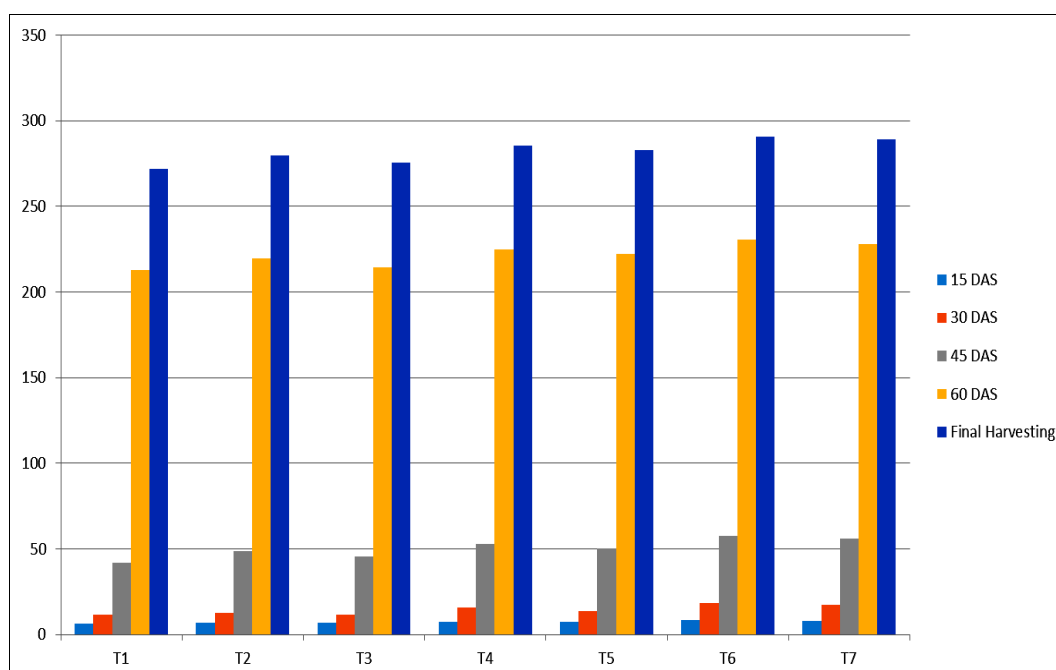


Fig 2: Number of leaves per vine in bottle gourd as influenced by nutrient management

Fruit Length

The results presented in Table 5 and Figure 5 indicate that fruit length of bottle gourd varied significantly among the different nutrient management treatments. The treatment T₆ (NPK + $\frac{1}{2}$ vermicompost + micronutrients) produced the longest fruits (39.71 cm), demonstrating the superior effect of integrating inorganic fertilizers with organic amendments and micronutrients. The enhanced fruit length under T₆ may be attributed to improved nutrient availability, better soil structure, and sustained nutrient release from vermicompost, which together support vigorous vine growth and enhanced assimilate translocation towards developing fruits. Vermicompost improves nutrient availability, microbial activity and plant growth via biologically active compounds [19]. The next best performance was observed in T₇ (NPK + FYM $\frac{1}{2}$ + micronutrients), indicating that both

vermicompost and FYM positively influence fruit development when combined with micronutrients. These organic sources supply essential macro- and micronutrients, improve microbial activity, and enhance root growth, contributing to better fruit elongation. In contrast, the minimum fruit length (32.39 cm) was recorded in T₇ (NPK 120:60:60 kg/ha), where only chemical fertilizers were applied. The comparatively lower fruit length under this treatment suggests that relying solely on inorganic fertilizers may not optimize fruit development due to lack of organic matter and insufficient micronutrient supply. Overall, the findings highlight that integrated nutrient management, especially combining NPK with vermicompost or FYM along with micronutrients, is more effective than sole chemical fertilizer application in enhancing fruit length in bottle gourd.

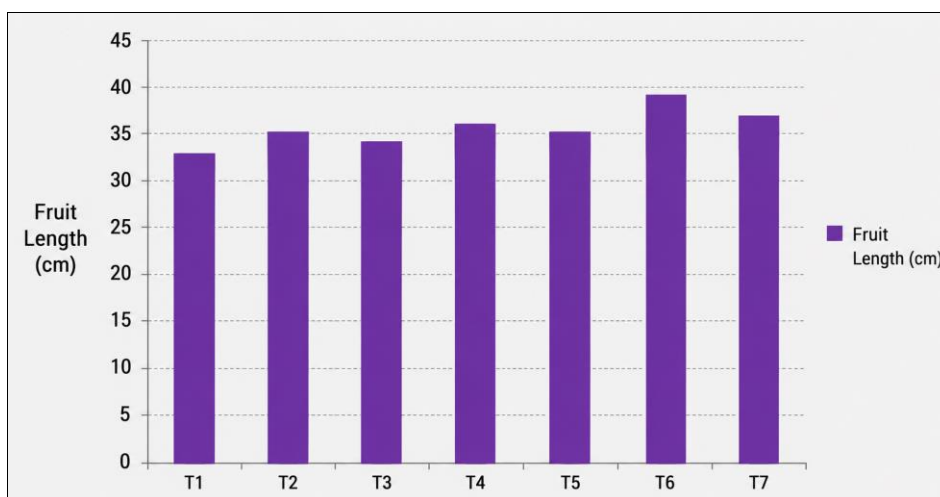


Fig 3: Variation in fruit length of bottle gourd across various nutrient treatments

Fruit diameter

The findings of the present study clearly demonstrate that fruit diameter of bottle gourd responded significantly to different nutrient management treatments. The maximum fruit diameter (8.21 cm) was obtained under treatment T₆ ($\frac{1}{2}$ NPK + $\frac{1}{2}$ vermicompost + micronutrients), indicating that the integration of inorganic fertilizers with organic sources and micronutrients plays a crucial role in enhancing fruit development. Such improvement in fruit girth under integrated nutrient management may be attributed to better nutrient synchrony, increased microbial activity, and enhanced soil physical properties, which together promote efficient nutrient uptake and physiological processes responsible for cell expansion. The second-best performance was observed in T₇ ($\frac{1}{2}$ NPK + $\frac{1}{2}$ FYM + micronutrients), further supporting the positive impact of combining organic and inorganic nutrient sources. The balanced nutrient supply throughout the crop growth period likely created favorable conditions for continuous fruit growth and better structural development. In contrast, treatments receiving only inorganic fertilizer (T₂: NPK 120:60:60 kg/ha) or only organic manure (T₃: FYM 20 t/ha) recorded the lowest fruit diameters (6.28 cm and 5.94 cm, respectively). These results suggest that relying solely on either chemical fertilizers or organic manures is insufficient to meet the crop's nutrient demand efficiently. The inferior performance under these treatments may be due to imbalanced nutrient availability, slower mineralization rates, or reduced nutrient-use efficiency. Overall, the results highlight that integrated nutrient management, particularly the combination of NPK,

organic amendments, and micronutrients, is essential for achieving superior fruit diameter in bottle gourd by ensuring sustained nutrient availability and improved soil health.

Fruit thickness

The findings presented in the graph indicate that flesh thickness of bottle gourd varied significantly among the different nutrient management treatments. The highest flesh thickness (0.77 cm) was recorded in treatment T₆ (NPK $\frac{1}{2}$ + vermicompost $\frac{1}{2}$ + micronutrients), demonstrating the positive influence of integrated nutrient management on internal fruit quality. The superior performance of T₆ may be attributed to improved nutrient availability and better physiological functioning, which promote enhanced cell division and cell enlargement in the fruit flesh. Conversely, the lowest flesh thickness values (0.61 cm) were observed in T₁ (NPK 120:60:60 kg/ha) and T₃ (FYM 20 t/ha). The reduced flesh development under these treatments suggests that relying solely on chemical fertilizers or only FYM does not provide a balanced and sustained nutrient supply required for optimal fruit tissue formation. The results further indicate that neither inorganic fertilizers alone nor organic manure alone could match the beneficial effects of integrated nutrient sources. Overall, the study clearly shows that combining NPK fertilizers with vermicompost and micronutrients leads to a significant improvement in flesh thickness. This highlights the effectiveness of Integrated Nutrient Management (INM) in enhancing fruit quality attributes of bottle gourd, likely due to improved soil fertility, nutrient uptake, and enhanced metabolic activity.

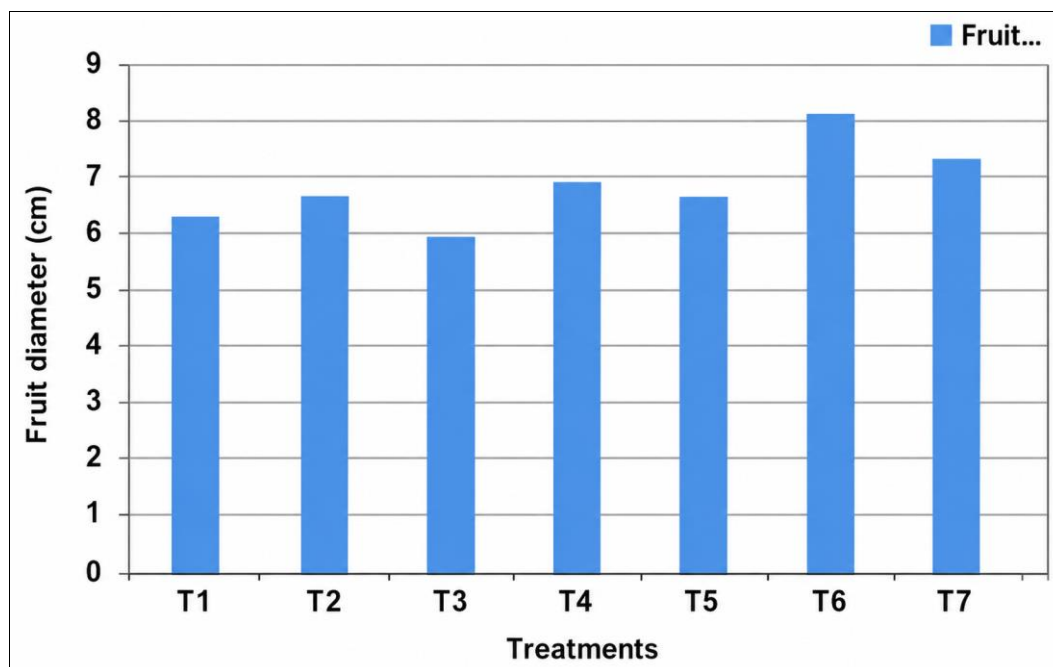


Fig 4: Impact of integrated nutrient management on bottle gourd fruit diameter

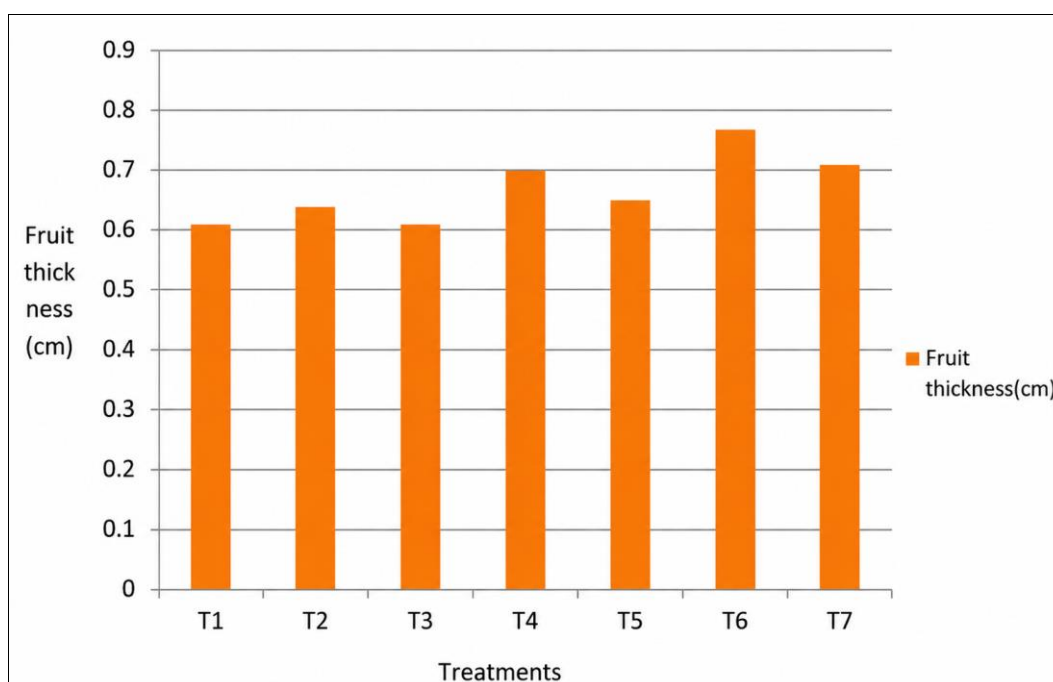


Fig 5: Flesh thickness of bottle gourd fruits under different treatment combinations

Fruit yield

The data presented in the graph indicate that the yield per plot of bottle gourd was significantly influenced by different integrated nutrient management practices. Among all the treatments, the highest yield (50.63 kg/plot) was obtained from treatment T₆, which consisted of NPK + vermicompost ($\frac{1}{2}$) + micronutrients. This suggests that the combined use of chemical fertilizers with organic amendments and micronutrients enhances nutrient availability, improves soil health, and promotes better crop growth, ultimately leading to higher productivity. The next best performance was observed in treatment T₁, where NPK + FYM ($\frac{1}{2}$) + micronutrients produced comparatively higher yield,

emphasizing the positive role of farmyard manure when used in an integrated manner. In contrast, the lowest yield (33.34 kg/plot) was recorded in treatment T₄ receiving only the recommended dose of NPK (120:60:60 kg/ha), indicating that sole application of inorganic fertilizers is less efficient than integrated nutrient approaches. Furthermore, none of the treatments were found statistically at par with each other, highlighting the distinct effects of each nutrient combination on yield performance. Overall, the results clearly demonstrate that integrated nutrient management, particularly involving vermicompost along with NPK and micronutrients, is more effective in enhancing yield compared to inorganic fertilizers alone.

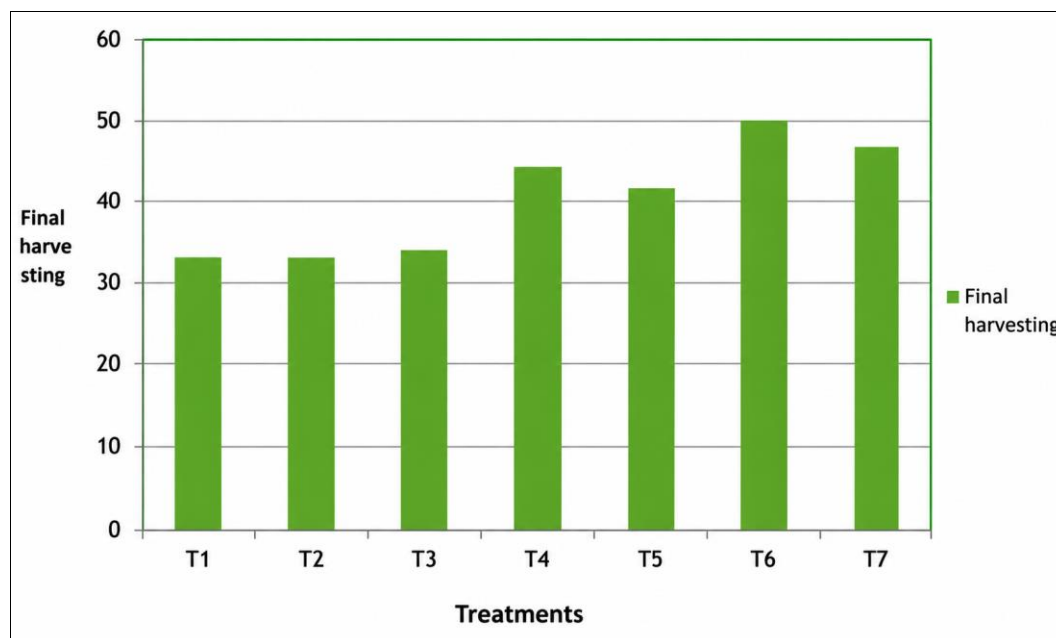


Fig 6: Total fruit yield of bottle gourd per plot as affected by nutrient management

Table 2: Growth parameters under the influence of integrated nutrient management

Treatment	Vine Length (cm)	Leaves/Vine No	Fruit Length (cm)	Fruit Diameter (cm)	Fruit Thickness (cm)	Fruit cavity	Fruit yield (kg/plot)
NPK-120:60:60 Kg/ha	572.09	60.86	32.39	6.28	0.61	5.65	33.34
Vermicompost-10t/ha	580.10	65.51	34.41	6.66	0.64	6.00	33.29
FYM-20t/ha	577.53	62.15	33.46	5.94	0.61	5.31	34.48
NPK (60:30:30 Kg/ha) + Vermicompost 5t/ha	586.85	70.53	35.66	6.91	0.70	6.19	44.68
NPK (60:30:30 Kg/ha) + FYM 10t/ha	584.75	68.97	34.71	6.64	0.65	5.98	41.48
NPK (60:30:30 Kg/ha) + Vermicompost 5t/ha + micronutrients	591.80	73.64	39.71	8.21	0.77	7.41	50.63
NPK (60:30:30 Kg/ha) + FYM 10t/ha + micronutrients	589.91	71.51	37.24	7.36	0.71	6.63	46.88
CD at 5%	21.63	16.65	0.73	0.20	0.01	0.10	1.14

Conclusion

The study clearly demonstrates that integrating chemical fertilizers with organic amendments significantly enhances the growth and yield of bottle gourd. Among all treatments, the combination of NPK @ 60:30:30 kg/ha + Vermicompost @ 5 t/ha + Micronutrients proved most effective, producing superior vine growth, fruit size, and overall yield. Therefore, this integrated nutrient management approach is recommended for achieving maximum and high-quality bottle gourd production under the open-field conditions of Eastern Uttar Pradesh.

Recommendation

For maximum qualitative and quantitative production of bottle gourd in Eastern Uttar Pradesh, this specific combination of half-recommended NPK, Vermicompost, and Micronutrients is highly recommended.

References

1. Minocha S. An overview on *Lagenaria siceraria* (Mol.) Standl. (Bottle gourd). J Biomed Pharm Res. 2015;4(3):4-10.
2. Iswas A, Prasad VM, Topno SE. Effect of nano fertilizer on growth, quality and yield of bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) var. Sarita under Prayagraj agro climatic conditions. Int J Environ Clim Change. 2023;13(9):2557-63.
3. Chimonyo VGP, Modi TA. Seed performance of selected bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). J Exp Agric Int. 2013;3(4):740-66.
4. Hassan LG, Sani NA, Dangoggo, Ladan MJ. Nutritional value of bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). Global J Pure Appl Sci. 2008;14(3):301-6.
5. Shirwalkar A, Sreenivasan KK. Chemical investigation and antihepatotoxic activity of the fruits of *Lagenaria siceraria* (Mol.) Standl. Indian J Pharm Sci. 1996;8:197-202.
6. Zahoor M, Ikram M, Nazir N, Naz S, Batiha GES, Kamran AW, et al. A comprehensive review on the medicinal importance biological and therapeutic efficacy of *Lagenaria siceraria* (Mol.) Standl. (Bottle gourd) fruit. Curr Top Med Chem. 2021;21(20):1788-803.
7. Parle M, Kaur S. Is bottle gourd a panacea? Int. Res J Pharm. 2011;2(6):13-7.
8. Paricha NS, Singh Y, Singh B, Khind CS. Integrated nutrient management for sustainable crop production. J Res Punjab Agric Univ. 1996;33(1-4):101-17.
9. Meena OP, Bhati A. Effect of nitrogen and phosphorous levels on growth and yield of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Chem Sci Rev Lett. 2017;6(24):2332-6.
10. Tirumalesh M, Mandal J, Dhangra VK. Variation in flowering characters of bottle gourd. HortFlora Res Spectr. 2016;5(1):39-42.
11. Patle BJ, Wagh AP, Umbarkar PS, Bondre SV. Integrated nutrient management studies in bottle gourd.

- J Pharmacogn Phytochem. 2018;7(5):1383-5.
12. Shree S, Regar CL, Ahmad F, Singh VK, Kumari R, Kumari A. Effect of organic and inorganic fertilizers on growth, yield and quality attributes of hybrid bitter gourd (*Momordica charantia* L.). Int J Curr Microbiol App Sci. 2018;7(4):2256-66.
 13. Tripathi YK, Kasera S, Mishra SK, Prasad VM, Dwivedi A. Integrated nutrient management (INM) practices influenced vegetative growth and flowering of rainy season bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). Pharma Innov J. 2018;7(7):555-8.
 14. Rabari SS, Vadodaria JR, More SG, Acharya MD, Chaudhary BM. Effect of different organic sources of nitrogen with biofertilizers on plant growth, flowering and sex expression of bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) cv. Pusa Naveen. J Entomol Zool Stud. 2019;7(5):1092-5.
 15. Kumar M, Ranjan A, Kumari S, Singh BK, Kumari M, Kumari K, *et al.* Effect of plant growth regulators on growth and seed yield of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. J Pharmacogn Phytochem. 2020;9(2):794-7.
 16. Pathak M, Dash SK, Sahu GS, Tripathy P, Mishra A. Effect of different nutrient management sources on the vegetative growth, flowering and sex expression of the bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] cv BBOG-3-1. Int J Plant Soil Sci. 2022;34(20):194-201.
 17. Niharika, Deepanshu, Singh D, Marak ACM. Effect of different inorganic fertilizers and bio-fertilizers on growth, yield and quality of sponge gourd (*Luffa cylindrica* L.). Int J Environ Clim Change. 2023;13(9):3426-33.
 18. Selvakumar S, Dhanapal AR, Balakrishnan E, SornalathaSelvapitchai. Quantitative and qualitative analysis of bottle gourd (*Lagenaria siceraria* (Mol.) Standl.): Impact of organic liquid fertilizer. Energy Nexus. 2022;5:100058.
 19. Baghel SS, Bose US, Singh SS, Dudvey TS. Effect of integrated nutrient management growth and yield of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Int Q J Environ Sci. 2017;4(1):813-7.