



Effect of Organic Nutrient-Enriched Compost on Growth, Yield Attributes and Yield of Chickpea (*Cicer arietinum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

A field experiment was conducted during the rabi season of 2025–26 at the Research Farm of the Department of Soil Science, College of Agriculture, Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, to evaluate the effect of organic nutrient-enriched compost (ONEC) on growth, yield attributes and yield of chickpea (*Cicer arietinum* L.) cv. Akash (BDNG-797). The experiment was laid out in a randomised block design with nine treatments and three replications. The treatments comprised absolute control, recommended dose of fertiliser (RDF), different combinations of 50 and 75 % RDF with ONEC, sole 100 % ONEC and RDF combined with biochar and basalt dust. ONEC was applied at a recommended dose of 5 t ha⁻¹ and its fractional levels were used according to the treatment schedule. Treatment T3 (75% RDF + 50% ONEC) consistently recorded superior yield attributes and yield. This treatment recorded 84.00 pods plant⁻¹, 1780.92 kg ha⁻¹ grain yield and 2600.64 kg ha⁻¹ straw yield, and

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remained statistically at par with T8 and T4 for grain yield. The response indicates that partial substitution of mineral fertiliser with nutrient-enriched compost can maintain a favourable nutrient supply while supporting reproductive development and crop productivity. The combined use of organic and inorganic nutrient sources, therefore, offers a practical approach for improving chickpea yield under the experimental conditions.

Keywords: Chickpea; organic nutrient-enriched compost; integrated nutrient management; mineral fertiliser substitution; plant growth; pod number; grain yield; straw yield; biochar.

1. Introduction

Chickpea (*Cicer arietinum* L.) is an important food legume and a major source of dietary protein, minerals and other nutritionally valuable constituents. Its cultivation contributes to soil fertility through biological nitrogen fixation and makes the crop an important component of sustainable cropping systems. The productivity of chickpea, however, is influenced by the availability and balance of essential nutrients, particularly nitrogen and phosphorus, together with suitable soil physical and biological conditions. Nutrient management is therefore an important component in achieving stable yields and improving nutrient-use efficiency in pulse-based systems (Jukanti *et al.*, 2012; Ahlawat *et al.*, 2016).

Continuous dependence on mineral fertilisers alone may not adequately maintain soil organic matter and biological activity, whereas organic manures supply nutrients gradually and contribute organic matter to soil. Integrated nutrient management combines the immediate nutrient supply from fertilisers with the gradual release and soil-conditioning effects of organic materials. Studies on chickpea have reported improvement in growth, yield attributes and yield when organic sources were combined with mineral fertilisers (Patil *et al.*, 2012; Seleiman & Abdelaal, 2018; Sohu *et al.*, 2015).

Recent field evidence further supports this integrated approach. In chickpea-based systems, combining mineral fertiliser with organic manures and/or biofertilisers has improved crop productivity, nutrient uptake and post-harvest soil nutrient availability, while long-term phosphorus management has shown agronomic benefits when fertiliser P is integrated with farmyard manure (Meena & Suman, 2025; Thakur *et al.*, 2023; Venkatesh *et al.*, 2019). A recent synthesis of chickpea nutrient-management research likewise supports the coordinated use of chemical fertilisers, organic manures and biofertilisers to improve crop productivity while maintaining soil fertility (Kumar *et al.*, 2025). Field evidence from Kabuli chickpea also shows that integrated organic, inorganic and biofertiliser inputs can improve growth and productivity under nutrient-constrained soil conditions (Yadav *et al.*, 2025).

Nutrient-enriched compost is particularly useful because the composting process can convert organic residues into a more stable material while incorporating nutrient-bearing materials such as rock phosphate. Rock phosphate-enriched compost has been reported to improve nodulation, growth and yield of chickpea, indicating that enriched organic materials can provide both nutrient and soil-conditioning benefits (Ditta *et al.*, 2018; Khan *et al.*, 2021). The inclusion of microbial inoculants and decomposer organisms can further support nutrient transformation and availability. Recent field research has further shown that a combined organic-inorganic nutrient regime can outperform sole nutrient-source approaches in chickpea, supporting the complementary role of vermicompost and mineral fertiliser (Himavarsha *et al.*, 2025). Integrated phosphorus management using reduced synthetic phosphorus together with organic amendments and biological inputs has likewise been shown to sustain chickpea productivity while improving phosphorus-use efficiency in a pearl millet-chickpea system (Dutta *et al.*, 2025).

Although the cited studies support integrated nutrient management in chickpea, they do not directly evaluate the specific ONEC-based fertiliser combinations examined in the present study alongside biochar- and basalt dust-based treatments under the agro-climatic conditions of Parbhani. A direct comparison is therefore needed to determine whether partial substitution of RDF with ONEC can maintain or improve chickpea growth, yield attributes, and grain and straw yield under these conditions.

In view of these considerations, the present investigation was undertaken to study the effect of organic nutrient-enriched compost, alone and in combination with inorganic fertiliser, on yield attributes and yield of chickpea. Particular emphasis was placed on identifying a treatment combination capable of reducing the proportion of mineral fertiliser while maintaining or improving reproductive growth and final grain and straw yield.

2. Materials and Methods

The field experiment was conducted during the rabi season of 2025–26 at the Research Farm of the Department of Soil Science, College of Agriculture, VNMKV, Parbhani, Maharashtra. Chickpea variety Akash (BDNG-797) was used. The experiment was laid out in a randomised block design comprising nine treatments replicated three times. Sowing was carried out on 12 November 2025 and the crop was harvested on 13 February 2026. The recommended fertiliser dose was 25:50:25 kg ha⁻¹ N: P₂O₅: K₂O. Organic nutrient-enriched compost was applied at 5 t ha⁻¹ as the full dose, with 25, 50 and 75 % levels used in the respective treatments. Biochar and basalt dust were included at 5 t ha⁻¹ in T8 and T9, respectively.

The treatment structure was: T1 absolute control; T2 100% RDF; T3 75% RDF + 50% ONEC; T4 75% RDF + 25% ONEC; T5 50% RDF + 50% ONEC; T6 50% RDF + 75% ONEC; T7 100% ONEC through soil application; T8 100% RDF + biochar @ 5 t ha⁻¹; and T9 75% RDF + basalt dust @ 5 t ha⁻¹. Standard agronomic practices were followed uniformly. Plant height, branches plant⁻¹ and pods plant⁻¹ were recorded at the specified growth stages, while grain and straw yield were expressed on a hectare basis. The observations were subjected to analysis of variance appropriate for the RBD, and treatment means were compared at 5 % probability following Gomez and Gomez (1984).

3. Results and Discussion

3.1 Growth Parameters

3.1.1 Plant Height

The data presented in Table 1 show that the integrated application of RDF and ONEC influenced plant height and the number of branches plant⁻¹ at both 30 and 60 days after sowing. Treatment T3 (75% RDF + 50% ONEC) recorded the highest plant height at 30 and 60 DAS, with values of 22.15 and 42.60 cm, respectively. The response of T3 was statistically comparable with T8, T4 and T2 at 30 DAS and with T8, T4, T2, T9 and T6 at 60 DAS. The control recorded the lowest plant height at both stages. Similar improvement in chickpea growth under integrated nutrient management has been reported by Patil *et al.* (2012), Seleiman and Abdelaal (2018) and Sri Abisankar *et al.* (2024).

The higher plant height under integrated nutrient application may be associated with a more balanced and sustained supply of nutrients. Mineral fertiliser provides readily available nutrients during active crop growth, whereas organic nutrient-enriched compost contributes gradually mineralisable nutrients and organic matter. The presence of rock phosphate and decomposer-derived nutrient transformations in enriched compost may also favour phosphorus availability and root development. Similar benefits of combining enriched organic materials with mineral nutrient sources have been documented in chickpea and other crops. The present findings are in agreement with the results reported by Ditta *et al.* (2018) and Khan *et al.* (2021).

Recent field studies provide further support for this interpretation. Integrated nutrient programmes based on partial mineral fertilisation combined with organic inputs and biofertilisers have increased plant height and related vegetative growth in chickpea, indicating that coordinated nutrient supply can sustain canopy development without relying on mineral fertiliser as the sole nutrient source (Meena & Suman, 2025; Raghuwanshi *et al.*, 2025; Sri Abisankar *et al.*, 2026).

3.1.2 Number of Branches Plant⁻¹

Number of branches plant⁻¹ followed a similar treatment response (Table 1). T3 recorded 3.95 and 8.20 branches plant⁻¹ at 30 and 60 DAS, respectively, and remained at par with T8 and T4 at both stages. The lowest branching was recorded under the absolute control. Greater branching provides a larger framework for reproductive sites and can consequently contribute to greater pod formation. Ali and Ali (2019) also reported improvement in growth and yield components of chickpea with the use of organic fertiliser in combination with inorganic nitrogen, while Sohu *et al.* (2015) reported improved growth and yield under integrated nutrient management.

The superiority of integrated treatments over the control indicates that the crop responded favourably to a combined nutrient supply rather than to an isolated source. The relatively strong response of T3, despite receiving only 75 % RDF, suggests that the nutrient contribution and soil-conditioning effect of ONEC complemented the reduced mineral fertiliser dose. Comparable responses to integrated nutrient management in chickpea have been reported by Jakhar *et al.* (2020) and Zala *et al.* (2024).

Likewise, recent experiments have reported greater branch formation under integrated nutrient regimes that combine mineral fertiliser with vermicompost, *Rhizobium* or other microbial inputs. This supports the view that the branching response under T3 is consistent with improved nutrient acquisition and vegetative development rather than with mineral fertiliser rate alone (Meena & Suman, 2025; Raghuwanshi *et al.*, 2025; Sri Abisankar *et al.*, 2026).

3.2 Yield Attributes and Yield

3.2.1 Number of Pods Plant⁻¹

Treatment effects became more pronounced during reproductive development as shown in Table 2. T3 recorded the highest number of pods plant⁻¹ at both 60 and 90 DAS, with 35.45 and 84.00 pods plant⁻¹, respectively. At both stages, T3 was statistically at par with T8 and T4. The lowest pod production was recorded under the absolute control. The greater pod number under integrated nutrient management is consistent with the findings of Das *et al.* (2016), Seleiman and Abdelaal (2018) and Sohu *et al.* (2015) who reported that adequate and balanced nutrient availability improves branching, reproductive-site formation and pod development in chickpea.

The improvement in pod formation under T3 may be attributed to the complementary role of mineral fertiliser and ONEC. Nitrogen supplied through fertiliser supports vegetative development, while phosphorus is important for root growth and reproductive development. The organic fraction of ONEC may additionally improve nutrient retention, microbial activity and gradual nutrient release. Rock phosphate-enriched compost has been shown to enhance nodulation, growth and yield of chickpea, supporting the role of enriched compost as a supplementary nutrient source. The present findings are in agreement with the results reported by Ditta *et al.* (2018) and Singh and Sharma (2011).

The higher pod number observed under T3 is also consistent with recent chickpea studies in which integrated nutrient treatments increased pod formation alongside vegetative growth. Because pod number reflects the successful transition from vegetative to reproductive growth, the response suggests that combined nutrient sources supported reproductive-site retention under the present conditions (Dwivedi *et al.*, 2026; Meena & Suman, 2025; Raghuwanshi *et al.*, 2025).

3.2.2 Grain and Straw Yield

Grain yield and straw yield differed significantly among the treatments (Table 2). T3 produced the highest grain yield of 1780.92 kg ha⁻¹ and was statistically at par with T8 (1671.44 kg ha⁻¹) and T4 (1646.06 kg ha⁻¹). This was higher than the absolute control (1376.51 kg ha⁻¹). Straw yield showed a similar pattern, with the maximum value of 2600.64 kg ha⁻¹ under T3, which was at par with T8, T4 and T2. The control recorded 2153.02 kg ha⁻¹ straw yield. The improvement in grain and straw production with integrated nutrient supply is in agreement with the findings of Patil *et al.* (2012), Tolanur (2008), Sohu *et al.* (2015) and Sri Abisankar *et al.* (2024).

The response of T3 is particularly relevant because it combined 75 % RDF with 50 % of the recommended ONEC dose rather than relying entirely on mineral fertiliser. The improved yield under this combination may have resulted from better synchronisation between readily available nutrients from fertiliser and gradually released nutrients from compost. Similar positive responses to the integration of organic nutrient sources with fertiliser have been reported in chickpea by Khan *et al.* (2021), Zala *et al.* (2024) and Yadav *et al.* (2017). These findings indicate that enriched compost can complement mineral fertiliser and contribute to maintaining productive performance under a reduced fertiliser proportion.

Recent field evidence similarly shows that integrated nutrient management can increase grain, straw or biological yield when organic and biological inputs are combined with mineral fertiliser. The agreement across studies supports the interpretation that the yield advantage of T3 arose from cumulative improvements in vegetative growth and reproductive development, while the magnitude of response remains dependent on soil and input characteristics (Dwivedi *et al.*, 2026; Meena & Suman, 2025; Sri Abisankar *et al.*, 2026).

Table 1. Effect of organic nutrient-enriched compost on growth parameters of chickpea

No.	Treatment	Plant height (cm)		Branches plant ⁻¹	
		30 DAS	60 DAS	30 DAS	60 DAS
T1	Absolute control	17.45	37.40	2.69	4.62
T2	100% RDF	20.39	40.65	3.48	6.86
T3	75% RDF + 50% ONEC	22.15	42.60	3.95	8.20
T4	75% RDF + 25% ONEC	20.98	41.30	3.64	7.30
T5	50% RDF + 50% ONEC	18.62	38.70	3.00	5.52
T6	50% RDF + 75% ONEC	19.21	39.35	3.16	5.96
T7	100% ONEC	18.04	38.05	2.85	5.07
T8	100% RDF + biochar @ 5 t ha ⁻¹	21.56	41.95	3.79	7.75
T9	75% RDF + basalt dust 5 t ha ⁻¹	19.18	40.00	3.32	6.41
	SE m±	0.91	1.27	0.10	0.34
	CD at 5%	2.72	3.80	0.31	1.03

Note: ONEC = organic nutrient-enriched compost. ONEC was applied at 5 t ha⁻¹ as 100% dose; therefore 25%= 1.25 t ha⁻¹, 50%= 2.50 t ha⁻¹, 75%= 3.75 t ha⁻¹, 100%= 5.00 t ha⁻¹

Table 2. Effect of organic nutrient-enriched compost on yield attributes and yield of chickpea

No.	Treatment	Pods plant ⁻¹		Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)
		60 DAS	90 DAS		
T1	Absolute control	25.22	58.00	1376.51	2153.02
T2	100% RDF	31.60	74.25	1581.63	2390.34
T3	75% RDF + 50% ONEC	35.45	84.00	1780.92	2600.64
T4	75% RDF + 25% ONEC	32.88	77.50	1646.06	2455.27
T5	50% RDF + 50% ONEC	27.77	64.50	1470.48	2270.27
T6	50% RDF + 75% ONEC	29.05	67.75	1515.85	2335.38
T7	100% ONEC	26.50	61.25	1425.09	2225.21
T8	100% RDF + biochar 5 t ha ⁻¹	34.15	80.75	1671.44	2500.35
T9	75% RDF + basalt dust 5 t ha ⁻¹	30.32	71.00	1539.95	2310.65
	SE m±	0.94	2.40	62.46	85.01
	CD at 5%	2.81	7.20	187.25	254.87

Note: Note: ONEC = organic nutrient-enriched compost. ONEC was applied at 5 t ha⁻¹ as 100% dose; therefore 25%= 1.25 t ha⁻¹, 50%= 2.50 t ha⁻¹, 75%= 3.75 t ha⁻¹, 100%= 5.00 t ha⁻¹

4. Conclusion

The present investigation demonstrated that the integrated application of mineral fertiliser and organic nutrient-enriched compost improved yield attributes and yield of chickpea compared with the absolute control. Treatment T3, comprising 75 % RDF + 50 % ONEC, consistently recorded superior plant growth, pod production, grain yield and straw yield and remained statistically comparable with the leading integrated treatments for several observations. The results indicate that ONEC can effectively complement mineral fertiliser and may contribute to sustaining chickpea productivity while reducing the proportion of inorganic fertiliser. The response observed under the experimental conditions supports the use of integrated nutrient management as a practical approach for improving nutrient availability, reproductive development and crop productivity in chickpea.

5. Limitations

The findings are limited to the field experiment conducted during the rabi season of 2025–26 at Parbhani using chickpea cultivar Akash (BDNG-797) and the specified nine nutrient treatments. The observed responses therefore represent the location, season, cultivar and management conditions evaluated. The study assessed plant growth, yield attributes, grain yield and straw yield; conclusions should remain confined to these measured outcomes. Validation across additional seasons, locations and chickpea cultivars would be required before broader recommendation of the identified ONEC–RDF combination.

Declaration of AI Use

This manuscript was prepared through the intellectual contributions of the author(s) to the study design, data analysis, interpretation of results, and scholarly content. Grammarly and ChatGPT were used solely to assist with grammatical refinement and reference formatting during manuscript revision. The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

Competing Interests

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

References

- Ahlawat, I. P. S., Sharma, P., & Singh, U. (2016). Production, demand and import of pulses in India. *Indian Journal of Agronomy*, 61(4th IAC Special Issue), S33–S41.
- Ali, S. S., & Ali, T. S. (2019). Assessment of chickpea (*Cicer arietinum* L.) growth and yield component by application of local granular organic fertilizer, peat and inorganic fertilizer: Comparative study. *Kurdistan Journal of Applied Research*, 4(2), 195–205. <https://doi.org/10.24017/science.2019.2.19>
- Das, S. K., Biswas, B., & Jana, K. (2016). Effect of farm yard manure, phosphorus and sulphur on yield parameters, yield, nodulation, nutrient uptake and quality of chickpea (*Cicer arietinum* L.). *Journal of Applied and Natural Science*, 8(2), 545–549. <https://doi.org/10.31018/jans.v8i2.833>
- Ditta, A., Muhammad, J., Imtiaz, M., Mehmood, S., Qian, Z., & Tu, S. (2018). Application of rock phosphate enriched composts increases nodulation, growth and yield of chickpea. *International Journal of Recycling of Organic Waste in Agriculture*, 7(1), 33–40. <https://doi.org/10.1007/s40093-017-0187-1>
- Dutta, A., Hazra, K. K., Nath, C. P., Kumar, N., Singh, R., Praharaj, C. S., & Patra, A. (2025). Assessing integrated phosphorus management practices on crop performance and soil–plant phosphorus dynamics under pearl millet–chickpea system in alkaline Fluvisol. *Frontiers in Sustainable Food Systems*, 9, Article 1583697. <https://doi.org/10.3389/fsufs.2025.1583697>
- Dwivedi, A., Gangwar, B. J., & Kumar, N. (2026). Effect of integrated nutrient management through organic sources on yield and economics of chickpea (*Cicer arietinum* L.) in Bundelkhand region. *Agricultural Science Digest*, 46(3), 464–469. <https://doi.org/10.18805/ag.D-6163>
- Gomez, K. A., & Gomez, A. A. (1984). Statistical procedures for agricultural research (2nd ed.). *John Wiley & Sons*. <https://sipus.usu.ac.id/opac2.2/buku/539/Statistical-procedures-for-agricultural-research.html>
- Himavarsha, P., Tomar, S. S., Kasirao, G., Ahlawat, J., & Pradhan, P. R. (2025). Ecosystem-level impacts of chickpea intercropping and nutrient management on phenology, land equivalent ratio and microbial populations. *Uttar Pradesh Journal of Zoology*, 46(20), 152–162. <https://doi.org/10.56557/upjz/2025/v46i205310>
- Jakhar, M., Sharma, P. K., Mandeewal, R. L., & Choudhary, R. (2020). Effect of integrated nutrient management on growth attributes, nitrogen content, nitrogen uptake and quality of chickpea (*Cicer arietinum* L.). *International Journal of Chemical Studies*, 8(6), 1125–1127. <https://doi.org/10.22271/chemi.2020.v8.i6p.10913>
- Jukanti, A. K., Gaur, P. M., Gowda, C. L. L., & Chibbar, R. N. (2012). Nutritional quality and health benefits of chickpea (*Cicer arietinum* L.): A review. *British Journal of Nutrition*, 108(S1), S11–S26. <https://doi.org/10.1017/S0007114512000797>
- Khan, M. I., Afzal, M. J., Bashir, S., Naveed, M., Anum, S., Cheema, S. A., Wakeel, A., Sanaullah, M., Ali, M. H., & Chen, Z. (2021). Improving nutrient uptake, growth, yield and protein content in chickpea by the co-addition of phosphorus fertilizers, organic manures, and *Bacillus* sp. MN-54. *Agronomy*, 11(3), Article 436. <https://doi.org/10.3390/agronomy11030436>
- Kumar, A., Prakash, R., Pawar, Y. A. S., Jain, M., Shekhar, C., Bochalya, R. S., Mehta, L., & Dwivedi, S. (2025). Integrated nutrient management practices for sustainable chickpea: A review. *Journal of Advances in Biology & Biotechnology*, 28(1), 82–97. <https://doi.org/10.9734/jabb/2025/v28i11862>
- Meena, H. O., & Suman, B. (2025). Effect of organic and inorganic fertilizers on growth, yield, nutrient uptake and economic returns of chickpea (*Cicer arietinum* L.). *Journal of Experimental Agriculture International*, 47(9), 320–327. <https://doi.org/10.9734/jeai/2025/v47i93752>
- Patil, S. V., Halikatti, S. I., Hiremath, S. M., Babalad, H. B., Sreenivasa, M. N., Hebsur, N. S., & Somanagouda, G. (2012). Effect of organics on growth and yield of chickpea (*Cicer arietinum* L.) in vertisols. *Karnataka Journal of Agricultural Sciences*, 25(3), 326–331. ONLINE version not available
- Raghuwanshi, M., Suman, B., Bairwa, R., Regar, C. L., & Chaturvedi, F. (2025). Effect of integrated nutrient management on growth, yield and quality of chickpea (*Cicer arietinum* L.) crop. *Asian Journal of Advances in Agricultural Research*, 25(7), 149–157. <https://doi.org/10.9734/ajaar/2025/v25i7654>

- Seleiman, M. F., & Abdelaal, M. S. (2018). Effect of organic, inorganic and bio-fertilization on growth, yield and quality traits of some chickpea (*Cicer arietinum* L.) varieties. *Egyptian Journal of Agronomy*, 40(1), 105–117. <https://doi.org/10.21608/agro.2018.2869.1093>
- Singh, Y. P., & Sharma, A. (2011). Effect of sources of phosphorus and microbial inoculation on productivity, nutrient availability in soil and uptake of nutrients by chickpea (*Cicer arietinum*) grown on sandy loam soil. *The Indian Journal of Agricultural Sciences*, 81(9), 834–837. <https://doi.org/10.56093/ijas.v81i9.10025>
- Sohu, I., Gandahi, A. W., Bhutto, G. R., Sarki, M. S., & Gandahi, R. (2015). Growth and yield maximization of chickpea (*Cicer arietinum*) through integrated nutrient management applied to rice-chickpea cropping system. *Sarhad Journal of Agriculture*, 31(2), 131–138. <https://doi.org/10.17582/journal.sja/2015/31.2.131.138>
- Sri Abisankar, M., Augustine, R., Isaac Manuel, R., Balaganesh, B., & Kumar, D. (2024). Study of physiological growth indices and yield of chickpea (*Cicer arietinum* L.) to soil and foliar application through integrated nutrient management practices. *Asian Journal of Soil Science and Plant Nutrition*, 10(2), 190–197. <https://doi.org/10.9734/ajsspn/2024/v10i2275>
- Sri Abisankar, M., Augustine, R., Jeshwin Giftson, S. P., Graceson, R. S., Ramesh Kumar, P., Indira Petchiammal, K., Praveena Katharine, S., Dhivyalakshmi, T., & Santhosh Anto Kumar, R. (2026). Enhanced chickpea (*Cicer arietinum* L.) growth and yield attributes via agronomic modulation using nano-emulsion biofertilizer for sustainable crop productivity improvement. *Frontiers in Microbiology*, 17, Article 1795467. <https://doi.org/10.3389/fmicb.2026.1795467>
- Thakur, R. K., Bisen, N. K., Shrivastava, A. K., Rai, S. K., & Sarvade, S. (2023). Impact of integrated nutrient management on crop productivity and soil fertility under rice (*Oryza sativa*)–chickpea (*Cicer arietinum*) cropping system in Chhattisgarh plain agro-climatic zone. *Indian Journal of Agronomy*, 68(1), 9–13. <https://doi.org/10.59797/ija.v68i1.195>
- Tolanur, S. I. (2008). Integrated effect of organic manuring and inorganic fertilizer N on yield and uptake of micronutrients by chickpea in vertisol. *Legume Research: An International Journal*, 31(3), 184–187. <https://arccjournals.com/journal/legume-research-an-international-journal/ARCC2446>
- Venkatesh, M. S., Hazra, K. K., Ghosh, P. K., & Mishra, J. P. (2019). Integrated phosphorus management in maize-chickpea rotation in moderately-alkaline Inceptisol in Kanpur, India: An agronomic and economic evaluation. *Field Crops Research*, 233, 21–32. <https://doi.org/10.1016/j.fcr.2019.01.001>
- Yadav, J. K., Sharma, M., Yadav, R., & Yadav, S. K. (2017). Effect of different organic manures on growth and yield of chickpea (*Cicer arietinum* L.). *Journal of Pharmacognosy and Phytochemistry*, 6(5), 1857–1860.
- Yadav, V., Pandey, A. K., Singh, M., Kumar, R., Singh, A., Singh, R. R., Kumar, A., & Kumar, D. (2025). Assessment of plant growth and productivity of Kabuli chickpea crop as influenced by organic, inorganic inputs and biofertilizer application under a partially reclaimed sodic soil. *Legume Research: An International Journal*, 48(11), 1918–1923. <https://doi.org/10.18805/LR-5513>
- Zala, D. A., Dadarwal, R. S., Jat, R. D., Prakash, R., Asif, M., & Kavita. (2024). Optimizing integrated nutrient management (INM) for enhanced growth and yield of chickpea (*Cicer arietinum* L.) under irrigated conditions. *Journal of Experimental Agriculture International*, 46(12), 872–881. <https://doi.org/10.9734/jeai/2024/v46i123196>

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