



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(8): 463-466
Received: 19-06-2026
Accepted: 23-07-2026

Gajendra Singh Jatav
School of Agriculture Science,
Vikrant University, Gwalior,
Madhya Pradesh, India

Hirdesh Kumar
School of Agriculture Science,
Vikrant University, Gwalior,
Madhya Pradesh, India

Arun Sahu
School of Agriculture Science,
Vikrant University, Gwalior,
Madhya Pradesh, India

Mandvi Srivastava
School of Agriculture Science,
Vikrant University, Gwalior,
Madhya Pradesh, India

Chandan Singh
School of Agriculture Science,
Vikrant University, Gwalior,
Madhya Pradesh, India

Bhagvati Jatav
School of Agriculture Science,
Vikrant University, Gwalior,
Madhya Pradesh, India

Corresponding Author:
Gajendra Singh Jatav
School of Agriculture Science,
Vikrant University, Gwalior,
Madhya Pradesh, India

Effect of integrated nutrient management on yield and economic parameters of lentil (*Lens culinaris* L.) under Gwalior conditions

Gajendra Singh Jatav, Hirdesh Kumar, Arun Sahu, Mandvi Srivastava, Chandan Singh and Bhagvati Jatav

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i8f.6277>

Abstract

A field experiment was conducted during Rabi 2024-25 at the Agriculture Research and Development Centre, Sakatpura, Vikrant University, Gwalior, Madhya Pradesh, to evaluate the effect of integrated nutrient management on yield attributes, yield and economics of lentil (*Lens culinaris* L.). The experiment was laid out in randomized block design with ten nutrient-management treatments and three replications using lentil variety RVL 11-6. The treatments included absolute control and combinations of recommended dose of fertilizer (RDF: 20:40:20 kg N:P₂O₅:K₂O ha⁻¹) with vermicompost, *Rhizobium* and phosphate-solubilizing bacteria at full, 75% and 50% RDF levels. The results showed that 100% RDF + vermicompost @ 2 t ha⁻¹ (T₂) recorded the highest pods plant⁻¹ (75.00), grains pod⁻¹ (1.75), test weight (28.00 g), grain yield (13.03 q ha⁻¹), straw yield (24.76 q ha⁻¹) and biological yield (37.80 q ha⁻¹). This treatment increased grain yield by 169.8% over the absolute control. The highest gross return (₹98,597 ha⁻¹) and net return (₹66,316 ha⁻¹) were also obtained under T₂. However, the highest benefit:cost ratio (2.7) was recorded under 100% RDF + *Rhizobium* @ 20 g kg⁻¹ seed (T₃), mainly because of its lower cost of cultivation and comparatively high grain yield. The study indicates that 100% RDF integrated with vermicompost is suitable for maximizing lentil yield and net profit, whereas 100% RDF with *Rhizobium* is economically efficient for higher return per rupee invested.

Keywords: Lentil, integrated nutrient management, vermicompost, *Rhizobium*, PSB, grain yield, economics

Introduction

Lentil (*Lens culinaris* L.) is an important Rabi pulse crop valued for its protein-rich grains, short duration and ability to improve soil fertility through biological nitrogen fixation. In India, lentil is commonly cultivated under resource-limited conditions where low soil fertility and imbalanced nutrient application restrict yield realization. The crop responds positively to balanced nutrition because reproductive development, pod formation, grain filling and final economic yield are closely linked with nutrient availability during vegetative and reproductive stages.

Integrated nutrient management combines mineral fertilizers with organic manures and biofertilizers to improve nutrient supply, root activity, microbial function and soil health. Vermicompost contributes organic carbon and slow-release nutrients, while *Rhizobium* supports biological nitrogen fixation and phosphate-solubilizing bacteria increase phosphorus availability. Such integration can improve yield attributes and may also reduce the economic risk associated with sole dependence on chemical fertilizers.

Earlier studies have shown that RDF combined with organic and biological nutrient sources improves pod number, seed yield, harvest index and profitability in lentil and related pulses. Similar findings have been reported by Kumar *et al.* (2014) [2], Balyan *et al.* (2017) [1], Singh and Meena (2018) [10], Yadav *et al.* (2019) [12], Singh *et al.* (2021) [11], Meena *et al.* (2023) [4] and Patel *et al.* (2024) [7]. However, the economic merit of a treatment depends not only on yield but also on the cost of inputs, gross return, net return and benefit:cost ratio. Therefore, the present paper was prepared to present the yield and economic response of lentil to integrated nutrient management under Gwalior conditions.

Materials and Methods

The field experiment was conducted during *Rabi* 2024-25 at the Agriculture Research and Development Centre, Sakatpura, Vikrant University, Gwalior, Madhya Pradesh. The experimental soil was sandy loam in texture with pH 7.5, electrical conductivity 0.33 dS m⁻¹, organic carbon 0.45%, available nitrogen 184 kg ha⁻¹, available phosphorus 16.7 kg ha⁻¹ and available potassium 347 kg ha⁻¹. The crop was lentil variety RVL 11-6. The experiment was laid out in randomized block design with ten treatments and three replications. The gross plot size was 4.0 m × 3.6 m and the net plot size was 3.4 m × 3.0 m. The crop was sown at 30 cm row spacing using a seed rate of 40 kg ha⁻¹. The recommended dose of fertilizer was 20:40:20 kg N:P₂O₅:K₂O ha⁻¹ and was applied according to treatment. The crop was sown on 10 November 2024 and harvested on 20 February 2025. Yield attributes were recorded from representative plants. Grain yield and straw yield from the net plot were converted into q ha⁻¹. Biological yield was computed as the sum of grain and straw yield, while harvest index was expressed as the ratio of grain yield to biological yield. Economic analysis was performed by calculating total cost of cultivation, gross return, net return and benefit:cost ratio from the treatment-wise input cost and yield returns. The data on yield attributes and yield were analysed statistically according to randomized block design, and treatment means were compared by critical difference at 5% probability.

Table 1: Treatment details used for yield and economic analysis of lentil

Treatment	Treatment details
T ₁	Absolute control (no fertilizer)
T ₂	100% RDF + vermicompost @ 2 t ha ⁻¹
T ₃	100% RDF + <i>Rhizobium</i> @ 20 g kg ⁻¹ seed
T ₄	100% RDF + PSB @ 20 g kg ⁻¹ seed
T ₅	75% RDF + vermicompost @ 2 t ha ⁻¹
T ₆	75% RDF + <i>Rhizobium</i> @ 20 g kg ⁻¹ seed
T ₇	75% RDF + PSB @ 20 g kg ⁻¹ seed
T ₈	50% RDF + vermicompost @ 2 t ha ⁻¹
T ₉	50% RDF + <i>Rhizobium</i> @ 20 g kg ⁻¹ seed
T ₁₀	50% RDF + PSB @ 20 g kg ⁻¹ seed

RDF = recommended dose of fertilizer; PSB = phosphate-solubilizing bacteria. Treatment labels are used consistently in all tables and figures

Results and Discussion

Yield attributes differed clearly among nutrient-management treatments (Table 2). The highest number of pods plant⁻¹ (75.00), grains pod⁻¹ (1.75) and test weight (28.00 g) were obtained under

T₂, where 100% RDF was integrated with vermicompost @ 2 t ha⁻¹. This treatment was followed by T₃, which combined 100% RDF with *Rhizobium* @ 20 g kg⁻¹ seed. The improvement in yield attributes under T₂ may be attributed to a more balanced nutrient supply, better soil biological activity and improved assimilate partitioning towards reproductive organs. Vermicompost supplies nutrients gradually and may improve the root environment, while RDF provides readily available nutrients during critical stages. These findings support earlier reports that organic amendments and biofertilizers improve yield components of lentil (Balyan *et al.*, 2017; Singh and Meena, 2018; Meena *et al.*, 2023) ^[1, 10, 4].

Table 2: Effect of integrated nutrient management on yield attributes of lentil

Treatment	Pods plant ⁻¹	Grains pod ⁻¹	Test weight (g)
T ₁	40.00	1.45	24.10
T ₂	75.00	1.75	28.00
T ₃	71.25	1.70	27.50
T ₄	64.17	1.67	27.00
T ₅	62.86	1.63	26.50
T ₆	59.29	1.61	26.00
T ₇	52.14	1.58	25.50
T ₈	56.83	1.56	25.20
T ₉	47.50	1.52	24.70
T ₁₀	45.00	1.49	24.30
S.Em. ±	2.90	0.01	0.06
CD (P=0.05)	8.68	0.01	0.18

Treatment details are provided in Table 1.

Grain, straw and biological yields followed the same general trend as the yield attributes (Table 3 and Fig. 1). The highest grain yield (13.03 q ha⁻¹), straw yield (24.76 q ha⁻¹) and biological yield (37.80 q ha⁻¹) were recorded with T₂. This treatment produced 169.8% higher grain yield than the absolute control. The next best treatment was T₃, which produced 11.30 q ha⁻¹ grain yield and 20.34 q ha⁻¹ straw yield, giving a 134.0% yield increase over the control. The higher yield under T₂ and T₃ indicates that full RDF combined with either vermicompost or *Rhizobium* created a better nutrient environment for crop growth and reproductive development. Although harvest index was numerically highest under T₉ and T₁₀ (43.48%), their absolute grain yield was low; therefore, harvest index alone was not a sufficient indicator of treatment superiority. Similar yield advantages from integrated nutrient management have been reported by Yadav *et al.* (2019) ^[12], Kumar *et al.* (2023) ^[3] and Patel *et al.* (2024) ^[7].

Table 3: Effect of integrated nutrient management on yield and harvest index of lentil

Treatment	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Biological yield (q ha ⁻¹)	Harvest index (%)
T ₁	4.83	7.25	12.08	40.00
T ₂	13.03	24.76	37.80	34.48
T ₃	11.30	20.34	31.64	35.77
T ₄	9.97	16.94	26.91	37.04
T ₅	8.97	14.35	23.31	38.46
T ₆	8.47	12.70	21.17	40.00
T ₇	7.65	11.08	18.73	40.82
T ₈	7.25	10.15	17.40	41.67
T ₉	6.67	8.67	15.34	43.48
T ₁₀	6.25	8.12	14.37	43.48
S.Em. ±	0.39	0.57	0.85	0.51
CD (P=0.05)	1.15	1.71	2.55	1.52

Treatment details are provided in Table 1.

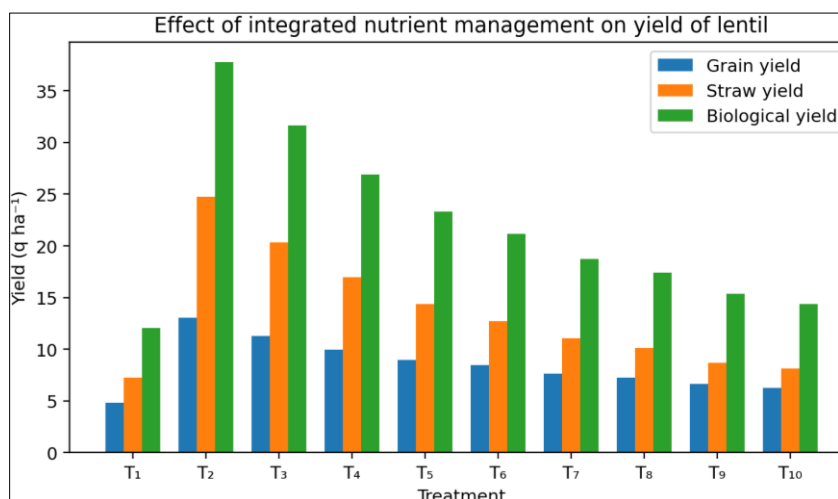


Fig 1: Effect of integrated nutrient management on yield of lentil.

Economic analysis revealed that nutrient-management treatments varied widely in cost and monetary return (Table 4 and Fig. 2). The highest total cost of cultivation was recorded under T₂ (₹32,281 ha⁻¹), mainly due to the cost of vermicompost, whereas T₁ had the lowest cost (₹18,876 ha⁻¹). The highest gross return (₹98,597 ha⁻¹) and net return (₹66,316 ha⁻¹) were obtained under T₂ because this treatment produced the highest grain and straw yield. T₃ also produced a high net return (₹61,926 ha⁻¹) with a lower cultivation cost than T₂, which improved its cost efficiency.

The highest benefit:cost ratio (2.70) was recorded under T₃, followed by T₄ (2.20) and T₂ (2.10). This indicates that 100% RDF + Rhizobium was the most cost-efficient treatment because it combined high economic return with comparatively low input cost. However, when maximum yield and maximum net profit are considered together, 100% RDF + vermicompost @ 2 t ha⁻¹ (T₂) was the most productive and profitable treatment under the conditions of the present experiment.

Table 4: Effect of integrated nutrient management on economics of lentil

Treatment	Total cost (₹ ha ⁻¹)	Gross return (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	B:C ratio
T ₁	18,876	35,404	16,528	0.90
T ₂	32,281	98,597	66,316	2.10
T ₃	22,881	84,807	61,926	2.70
T ₄	22,831	74,202	51,371	2.20
T ₅	31,429	66,219	34,790	1.10
T ₆	22,029	62,018	39,989	1.80
T ₇	21,979	57,874	35,895	1.60
T ₈	30,575	55,698	25,123	0.80
T ₉	21,175	48,994	27,819	1.30
T ₁₀	21,125	44,671	23,546	1.10

Treatment details are provided in Table 1. B:C ratio values are presented as calculated in the treatment-wise economic analysis.

Fig. 2 combines cost, gross return, net return and B:C ratio in a single economic graph.

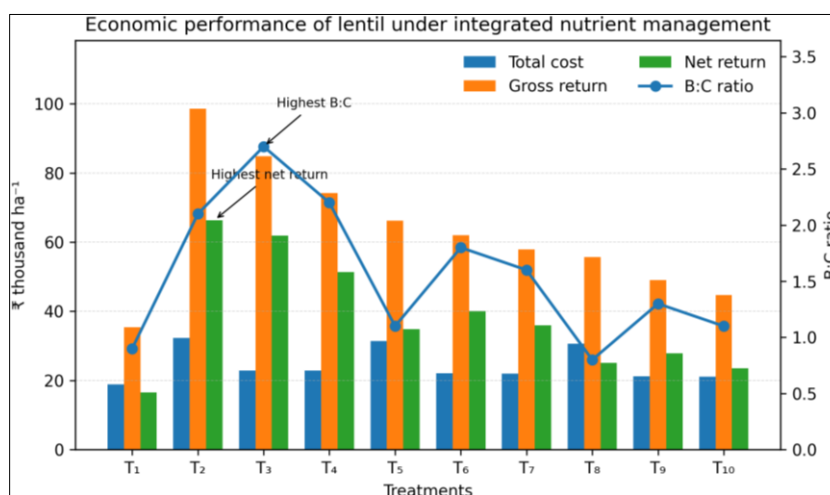


Fig 2: Combined economic performance of lentil under integrated nutrient management.

Conclusion

The study showed that integrated nutrient management markedly improved yield attributes, yield and profitability of lentil under Gwalior conditions. Application of 100% RDF + vermicompost @ 2 t ha⁻¹ (T₂) gave the highest pods plant⁻¹, grains pod⁻¹, test weight, grain yield, straw yield, biological yield, gross return and net return. Therefore, this treatment is suitable where the objective is to maximize productivity and total profit. However, 100% RDF + *Rhizobium* @ 20 g kg⁻¹ seed (T₃) recorded the highest benefit:cost ratio because of lower input cost and high yield performance. Thus, T₂ may be recommended for higher yield and net return, while T₃ may be preferred by farmers seeking higher economic efficiency with lower investment.

Acknowledgement

The authors acknowledge the School of Agriculture Science, Vikrant University, Gwalior, Madhya Pradesh, for providing field and academic support during the study.

References

1. Balyan JK, Singh P, Kumar R. Effect of *Rhizobium*, PSB, vermicompost and RDF on yield attributes of lentil. *Journal of Food Legumes*. 2017;30(3):215-219.
2. Kumar R, Singh A, Yadav DS. Effect of integrated nutrient management on yield and quality of lentil under rainfed conditions. *Journal of Food Legumes*. 2014;27(2):145-149.
3. Kumar S, Verma A, Singh R. Effect of RDF, FYM, vermicompost and biofertilizers on productivity and economics of lentil. *Journal of Food Legumes*. 2023;35(2):99-104.
4. Meena VS, Pratap T, Maurya R. Economic feasibility of integrated nutrient management packages in lentil at Varanasi. *Legume Research*. 2023;46(4):512-518.
5. Mishra A, Tiwari R, Patel A. Influence of vermicompost and foliar nutrition on yield and economics of lentil in Madhya Pradesh. *International Journal of Current Microbiology and Applied Sciences*. 2018;7(5):2496-2504.
6. Mitra S, Ghosh A, Roy D. Influence of integrated nutrient management on yield and economics of lentil in West Bengal. *Legume Research*. 2022;45(2):167-173.
7. Patel J, Sharma A, Chouhan R. Effect of integrated nutrient management on growth and yield of lentil in central India. *International Journal of Agriculture Sciences*. 2024;16(2):55-60.
8. Rahman MM, Alam MS, Uddin MM. Integrated nutrient management effects on lentil productivity in low organic matter soils of Bangladesh. *Legume Research*. 2019;42(3):354-359.
9. Shukla S, Tyagi V. Integrated nutrient management in pulses: a review. *Agricultural Reviews*. 2009;30(4):283-289.
10. Singh AK, Meena RP. Effect of integrated nutrient management on yield and harvest index of lentil. *Journal of Pharmacognosy and Phytochemistry*. 2018;7(5):1703-1707.
11. Singh P, Tiwari D, Verma S. Effect of biofertilizer enriched INM on productivity of lentil in Madhya Pradesh. *Journal of Food Legumes*. 2021;34(1):35-40.
12. Yadav D, Tripathi H, Singh R. Effect of integrated nutrient management on yield and profitability of lentil in Uttar Pradesh. *Legume Research*. 2019;42(6):801-807.
13. Zaman M, Singh AK, Yadav R. Integrated nutrient management in lentil: a review. *Legume Research*. 2024;47(7):825-832.