PLANT SCIENCE TODAY
ISSN 2348-1900 (online)
Vol 11(3): 753-757
https://doi.org/10.14719/pst.3008

HORIZON
e-Publishing Group
HePG

RESEARCH ARTICLE

Effect of integrated use of organic and inorganic sources of nutrients on growth and yield of black gram (*Vigna mungo* (L.) Hepper)

Saumya Sharma[1], Dipak Gite[1], Nitin Misal[2] & Mayur Darvhankar[1*]

[1]Department of Agronomy, Lovely Professional University, Jalandhar, 144411, India

[2]Department of Soil Science and Agricultural Chemistry, School of Agricultural Sciences and Technology, SVKMS Narsee Monjee Institute of Management Studies, Shirpur, MH-425405, India

*Email: mayur.21878@lpu.co.in

OPEN ACCESS

ARTICLE HISTORY

Received: 14 December 2023
Accepted: 09 May 2024

Available online
Version 1.0 : 27 August 2024
Version 2.0 : 29 August 2024

Check for updates

Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

CITE THIS ARTICLE

Sharma S, Gite D, Misal N, Darvhankar M. Effect of integrated use of organic and inorganic sources of nutrients on growth and yield of black gram (*Vigna mungo* (L.) Hepper). Plant Science Today. 2024; 11(3): 753-757. https://doi.org/10.14719/pst.3008

Abstract

The present research study aimed to evaluate the combined influence of inorganic and organic nutrient sources on the growth and yield parameters of black gram (*Vigna mungo* (L.) Hepper). The result indicated that using a combination of 50% of the recommended dose of fertilizer and 50% vermicompost had a significant positive impact on growth attributes, yield parameters, and biochemical parameters. These findings suggests that the simultaneous application of organic and inorganic fertilizers can effectively improve soil fertility and crop yield. Notably, integrating 50% of the recommended fertilizer dose with 50% vermicompost proved to be particularly beneficial in enhancing both the growth and yield of black gram compared to other treatments, including the control group.

Keywords

Farmyard manure; organic manure; recommended dose of fertilizer; vermicompost

Introduction

Pulses, rich in protein, play a crucial role in Indian agriculture, being the second most important component after cereals in the human diet (1). Given their significant presence in the regular Indian diet and their status as a primary source of protein, pulses hold a special significance in Indian agriculture (2).They contribute to soil health by enhancing nitrogen levels, promoting long-term fertility and ensuring sustainability of cropping system (3). Pulses contain approximately three times more high-quality protein than grains (4). Among the various grain legumes, black gram (*Vigna mungo* (L.) Hepper) stands out as one of the most important pulse crops (5). Originating from central Asia and India, black gram boasts rich iron and calcium content (6, 7). On a dry weight basis, it comprises around 26% protein, 56.6% carbohydrates and 1.2% fat (8). With the global population steadily increasing, the degradation of natural resources, including soil and water, poses a significant challenge to meeting food demand (9).

Thus, preserving natural resources and safeguarding the environment have become pressing issues. The application of balanced fertilizers stimulates vegetative growth, enhances yield, and improves production efficiency (10). Key components of plant-available nutrients, notably nitrogen, phosphorus, and sulphur, are crucial for protein synthesis, phospholipid formation, and nitrogen metabolism (5). Both organic and synthetic fertilizers, or a combination thereof, can augment the

nutrient levels (NPK) already present in plants. Organic fertilizers, derived from plant- or animal-based materials, including manures, leaves, and compost, are products of natural processes. In contrast, synthetic fertilizers, produced artificially, contain minerals or man-made compounds, often utilizing natural gas or petroleum in the production of synthetic nitrogen fertilizer (11).

Vermicompost, derived from earthworms, is a valuable resource because it contains readily available plant nutrients, growth-promoting compounds, and various beneficial bacteria, including phosphorus-solubilizing and cellulose-digesting organisms (12). The incorporation of farmyard manure (FYM), either alone or in combination with chemical fertilizers or biofertilizers, enhances the soil's nutrient status by boosting biological activity. This increase in soil biological activity creates a favorable physical environment and improves nutrient availability in the rhizosphere. Consequently, this leads to better crop growth and an improved source-sink relationship (13).

Materials and Methods

This investigation was conducted in experimental field of the School of Agriculture at Lovely Professional University, Phagwara, Punjab, during the *Kharif* season of 2021. Lovely Professional University is located 8 km from the Phagwara, situated in a sub-tropical climate at 31° 13'28'' North latitude and 75° 46'25'' East longitude, with an altitude of 245 m above the mean sea level (AMSL) (Fig. 1). Soil samples were randomly collected from 10 different locations within the experimental field using a soil auger to a depth of 15 cm. These samples were analyzed to determine the physiochemical characteristics and fertility status of the soil. According to the triangle technique of soil classification approved by the International Society of Soil Science (ISSS), the soil in the experimental field is classified as sandy loam. The field study was designed using a Randomized Block Design with three replications and ten treatments to assess the individual and combined impacts of organic and inorganic nutrient sources. Each replication was divided into 30 plots, with treatments distributed randomly. Sowing was performed on 9th of July, 2021, at a seed rate of 20 kg ha^{-1}.

The treatments in the study were as follows:

- T_0 (Control)
- T_1 (100% RDF)
- T_2 (0% RDF + 100% Vermicompost)
- T_3 (0% RDF + 100% Farmyard manure)
- T_4 (50% RDF + 50% Vermicompost)
- T_5 (50% RDF + 50% Farmyard manure)
- T_6 (50% Vermicompost + 50% Farmyard manure)
- T_7 (50% RDF + 25% Vermicompost + 25% Farmyard manure)
- T_8 (25% RDF + 50% Vermicompost + 25% Farmyard manure), and
- T_9 (25% RDF + 25% Vermicompost + 50% Farmyard manure).

Data were recorded for various parameters including morphological parameters (plant height, number of branches plant^{-1}, dry weight plant^{-1}, number of root nodules plant^{-1} and leaf area index), biochemical attributes (grain nitrogen and grain protein content), yield attributes (grain yield, biological yield and harvest index).

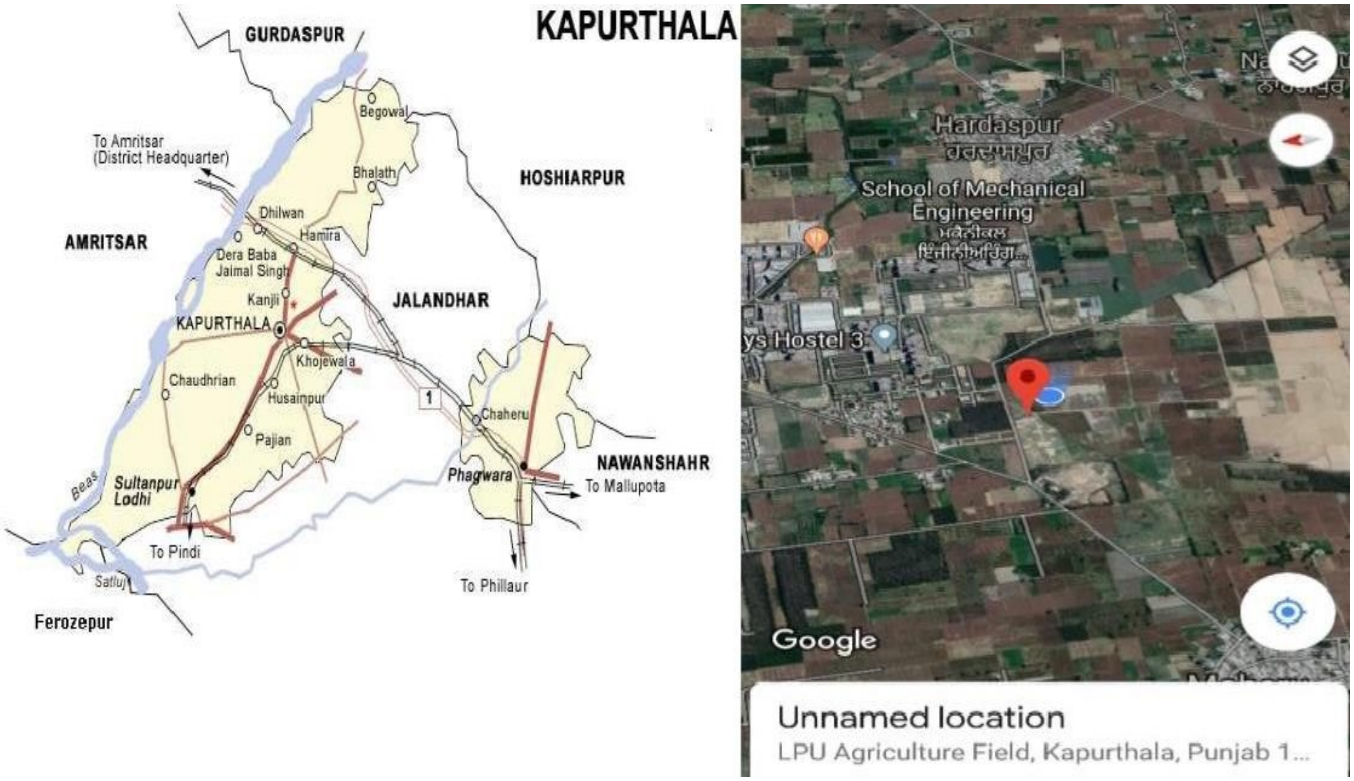


Fig .1. Experimental site.

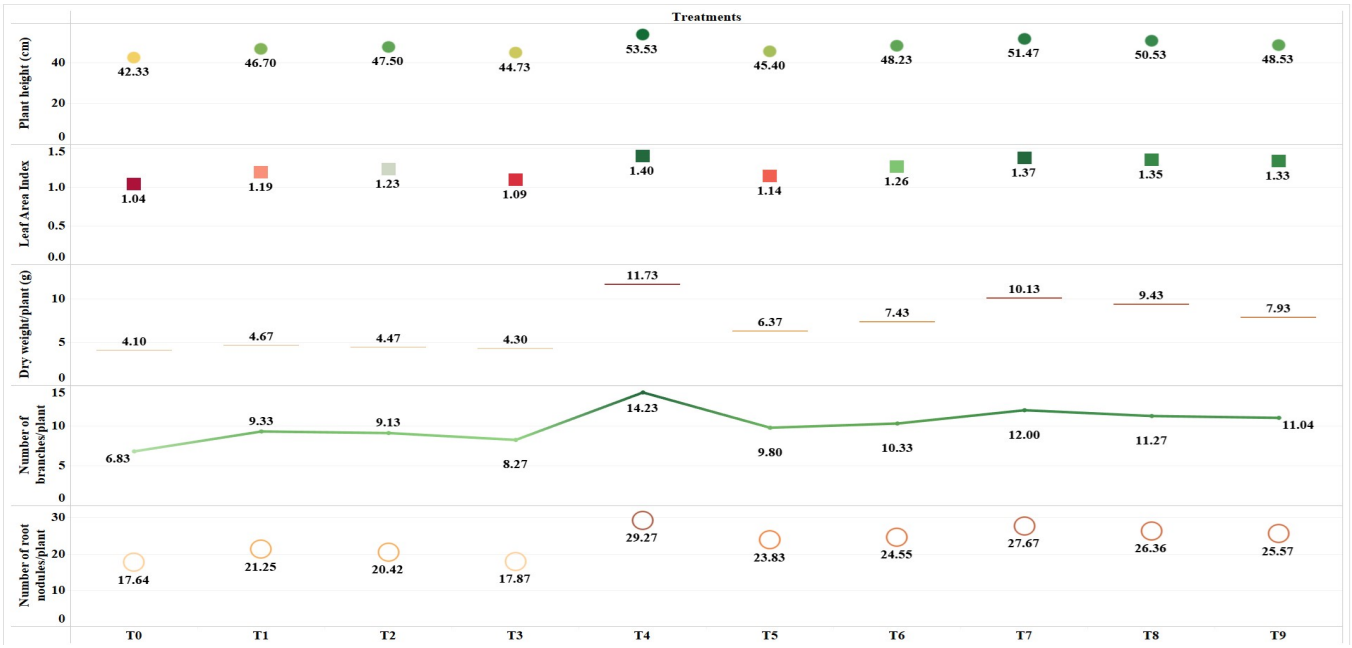
Results

Morphological parameters

Growth parameters, including plant height, number of branches, dry weight, number of root nodules, and leaf area index, varied significantly depending on the levels of organic and inorganic nutrient sources used, as well as the control. Black gram plant height at different growth stages showed significant differences among all the treatments. The treatment T_4 (50% RDF + 50% VC) recorded the highest plant height at 55.53 cm, followed by T_7 (51.47 cm), which was statistically at par with T_8 (50.53 cm). For the number of branches per plant, treatment T_4 (50% RDF + 50% VC) again showed the best results, followed by T_7 with 12.00 branches per plant. The combination of 50% RDF + 50% VC also proved to be the most effective for dry weight per plant and the number of root nodules per plant. Regarding leaf area index, treatment T_4 showed best result with an index of 1.40, outperforming all the treatments (Fig. 2).

Yield and yield attributes

The grain yield of black gram at different growth stages showed significant differences among all the treatments. Treatment T_4 (50% RDF + 50% VC) achieved the highest grain yield at 1.03 t ha^{-1}. Grain yield ranged from 0.64 t ha^{-1} (T_0) to 1.03 t ha^{-1} (T_4). For biological yield $plant^{-1}$ and harvest index, the maximum values were observed for treatment T_4 (50% RDF + 50% VC). Biological yield varies from 2.84 t ha^{-1} (T_0) to 3.53 t ha^{-1} (T_4). The harvest index ranged from 22.39% (T_0) to 29.15% (T_4) (Fig. 3).



Note: T0= Control, T1= 100% RDF, T2= 100% VC; T3= 100%FYM, T4= 50%RDF+50%VC, T5= 50%RDF+50%FYM, T6= 50%VC+50%FYM, T7= 50%RDF+25% VC+25%FYM, T8= 25%RDF+50%VC+25%FYM, T9= 25%RDF+25%VC+50%FYM

Fig. 2. Effect of integrated use of organic and inorganic sources of nutrients on growth parameters of black gram.

Note: T0= Control, T1= 100% RDF, T2= 100% VC, T3= 100% FYM, T4= 50% RDF + 50% VC, T5= 50% RDF + 50% FYM, T6= 50% VC + 50% FYM, T7 = 50% RDF + 25% VC + 25% FYM, T8= 25% RDF + 50% VC + 25% FYM, T9= 25% RDF + 25% VC + 50% FYM

Fig. 3. Effect of integrated use of organic and inorganic sources of nutrients on yield and quality parameters of black gram.

Biochemical parameters

Grain nitrogen and protein content (%)

Biochemical parameters, including grain nitrogen and protein content, showed significant difference depending on the levels of organic and inorganic nutrient sources used, as well as the control. Treatment T_4 (50% RDF + 50% VC) had the highest grain nitrogen content at 3.57%. Grain nitrogen content ranged from 2.52% (T_0) to 3.57% (T_4). For grain protein content, the maximum value was also observed in treatment T_4 (50% RDF + 50% VC). Protein content varied from 15.77% (T_0) to 22.33% (T_4) (Fig. 3).

Discussion

The combined application of 50% RDF and 50% VC enhanced plant access to essential nutrients, potentially accelerating early root growth and cell division. This facilitates greater nutrient uptake from deeper soil layers, thereby promoting overall plant growth characteristics and, increasing the plant growth rate. The increased production characteristics and yield can be attributed to the translocation of photosynthetic products influenced by the inorganic nutrient sources, which enhance the availability of essential nutrients. Furthermore, the application of 50% RDF and 50% vermicompost boosted photosynthetic translocation and accumulation, leading to improved seed yield, straw yield, and biological yield, ultimately resulting in a higher harvest index.

The incorporation of RDF and vermicompost produced the best growth characteristics, consistent with findings from previous studies (14, 15). Nutrient absorption is crucial as it enhances photosynthesis, plant nitrogen metabolism, and carbohydrate synthesis. Therefore, the beneficial effects of vermicompost and RDF led to a significant improvement in the seed yield and straw yield of black gram. These results align with those reported in earlier research (11, 14, 16-19).

Combining the use of organic and inorganic fertilisers positively impacts production by reducing the risk of nutrient leaching after applying inorganic fertilizers in the soil. Similar results were observed in the studies by (11, 16, 20).

The increase in nitrogen and protein content can be attributed to the incorporation of various sources of both organic and inorganic nutrients. Our findings are consistent with those of (21).

Conclusion

In summary, treatment T4 (50% recommended dose of fertilizer + 50% vermicompost) yielded the best results for morphological parameters, yield attributes, and biochemical parameters for black gram. This suggests that T4 may be a preferred option for farmers. The impact of organic and inorganic fertilizers on black gram cultivation is multifaceted. Organic fertilizers contribute to long-term soil health and environmental sustainability, while inorganic fertilizers offer immediate nutrient availability and higher initial yields. When choosing between these options, factors such as ecological impact, economic viability, and soil fertility should be considered. Integrating both organic and inorganic fertilizers in a balanced manner appears to be an effective strategy to maximize black gram production. Future studies should explore climate-resilient practices, biofertilizers, and precision agriculture methods to enhance nutrient management and increase the adaptability of black gram production to changing environmental and agricultural conditions. Sustainable and productive black gram farming can be achieved by maintaining a careful balance of organic and inorganic fertilizers.

Acknowledgements

The authors are grateful to the School of Agriculture, LPU for providing research area and lab facilities.

Authors' contributions

SS carried out the field trial and research work, DG participated and helped in research work, NM helped and participated in editing, MD suggested the final editing and suggestions for the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None.

References

1. Serawat R, Swaroop N, Thomas T, David AA, Rao PS. Effect of different levels of NPK and molybdenum on soil physico chemical properties and yield attribute of black gram (*Vigna mungo* L.) VAR. TAU-1. Journal of Pharmacognosy and Phytochemistry. 2018;7(3):p. 2209-11.
2. Phogat M, Rai AP, Kumar S. Interaction effect of phosphorus and sulphur application on nutrient uptake, yield and yield attributing parameters of black gram (*Vigna mungo* (L.) Hepper). Legume Research- An International Journal. 2020;43 (2):p.212-20.
3. Markam A, Swaroop N, Thomas T, Dhruw SS. Effects of different levels of NPK and molybdenum on soil physico-chemical properties of black gram (*Vigna mungo* L.) var. Shekhar-2. International Journal of Current Microbiology and Applied Sciences. 2017;6(8):p. 1082-88. https://doi.org/10.20546/ijcmas.2017.608.134
4. Divyavani BR, Ganesh V, Dhanuka D. Effect of integrated nutrient management on growth and yield in black gram (*Vigna mungo* L. Hepper) under doon valley condition. Journal of Pharmacognosy and Phytochemistry. 2020;9(5):p.2928-32.
5. Chatterjee N, Sahu G, Ghosh GK. Effect of balanced nutrient management on blackgram (*Vigna mungo* L.) in red and lateritic soils of West Bengal. The Bioscan. 2020;15(4):p.453-57.
6. Jansen PCM. *Vigna mungo* (L.) Hepper. Record from Protabase. Brink M & Belay G (Editors). PROTA (Plant Resources of Tropical Africa / Ressourcesvégétales de l'Afriquetropicale), Wageningen, Netherlands; 2006.

7. Arora RK, Mauria SS. *Vigna mungo* (L.) Hepper. Record from Proseabase. van der Maesen, L. J. G.; Somaatmadja, S. (Eds). PROSEA (Plant Resources of South-East Asia) Foundation, Bogor, Indonesia; 1989.
8. Amruta N, Devaraju PJ, Mangalagowri M, Kiran SP, Ranjitha HP, Teli K. Effect of integrated nutrient management and spacing on seed quality parameters of black gram cv. Lbg-625 (rashmi). Journal of Applied and Natural Science. 2016;8(1):p.340-45. https://doi.org/10.31018/jans.v8i1.797
9. Tungoe R, Gohain T, Kikon N. Response of black gram (*Vigna mungo* L. Hepper) to spacing and fertilizer doses under rainfed conditions. Agricultural Science Digest- A Research Journal. 2018;38(1):p.27-31. https://doi.org/10.18805/ag.D-4659
10. Singh G, Choudhary P, Meena BL, Rawat RS, Jat BL. Integrated nutrient management in blackgram under rainfed condition. International Journal of Recent Scientific Research. 2016;7 (10):p.13875-94.
11. Kumar R, Baba AY, Bhusan A, Singh K, Kumar M. Growth, yield and economics performance of black gram (*Vigna mungo* (L.) Hepper) as influenced by organic and inorganic source of nutrients under sodic soil conditions. Plant Archives. 2020;20 (2):p.7991-94.
12. Kadam S, Kalegore NK, Patil S. Effect of phosphorus, vermicompost and PSB on seed yield, yield attributes and economics of black gram (*Vigna mungo* L.). International Journal of Innovative Research and Development. 2014;3 (9):p.189-93.
13. Kudi VK, Singh JK. Effect of biofertilizers and fertility levels on black gram (*Vigna mungo* L.) under custard apple (*Annona squamosa* L.) based agri-horti system in Vindhyan region of Uttar Pradesh. International Journal of Agriculture Sciences. 2016;8(52):p.2534-37.
14. Mehta HK, Reddy RS, Jayamma P, Kumar RN. Influence of biofertilizers, vermicompost and chemical fertilizers on growth, nodulation, nutrient uptake, seed yield and economics of black gram. International Journal of Applied Biology Pharmaceutical Technology. 2015;6(3):p.3.
15. Armin W, Ashraf-Uz-Zaman K, Zamil SS, Rabin MH, Bhadra AK, Khatun F. Combined effect of organic and inorganic fertilizers on the growth and yield of mung bean (Bari Mung 6). International Journal of Scientific and Research Publications. 2016;6(7):p.557-61.
16. Anasuyamma B, Singh S, Asirinaidu B, Abhigna K. Effect of organic manures and inorganic fertilizers on the growth and yield of black gram (*Vigna mungo* L.). The Pharma Innovation Journal. 2022;11(4):p.1214-18.
17. Kumari A, Singh ON, Kumar R. Effect of integrated nutrient management on growth, seed yield and economics of field pea (*Pisum sativum* L.) and soil fertility changes. Journal of Food legumes. 2012;25(2):p.121-24.
18. Verma SN, Sharma N, Verma A. Effect of integrated nutrient management on growth, quality and yield of soybean (*Glycine max*). Annals of Plant and Soil Research. 2017;19(4):p.372-76.
19. Tyagi PK, Singh VK. Effect of integrated nutrient management on growth, yield and nutrients uptake of summer black gram (*Vigna mungo*). Annals of Plant and Soil Research. 2019;21(1):p.30 -35.
20. Kumawat NA, Singh RP, Kumar RA, Yadav TP, Om H. Effect of integrated nutrient management on productivity, nutrient uptake and economics of rainfed pigeon pea (*Cajanus cajan*) and black gram (*Vigna mungo*) intercropping system. Indian Journal of Agricultural Sciences. 2015;85(2):p.171-76. https://doi.org/10.56093/ijas.v85i2.46474
21. Parthasarathi K, Balamurugan M, Ranganathan LS. Influence of vermicompost on the physico-chemical and biological properties in different types of soil along with yield and quality of the pulse crop-black gram. Journal of Environmental Health Science and Engineering. 2008;5(1):p.51-58.