Available online at www.agrifarming.org

DOI: http://dx.doi.org/10.18782/2582-7146.328

ISSN: 2582 – 7146

Current Research in Agriculture and Farming

Curr. Rese. Agri. Far. (2026) *7*(3), 71-77

Research Article

Peer-Reviewed, Refereed, Open Access Journal

Integrated Use of Phosphorus and Organic Manures for Enhancing Yield and Quality of Cow pea (*Vigna Unguiculata* L.)

Vikash Kumar Meena*, P.K. Sharma, Arjun Lal Prajapat and Abhinav

Department of Agriculture, Vivekananda Global University, Jaipur, India

*Corresponding Author E-mail: vikasshmeena02@gmail.com

Received: 2.04.2026 | Revised: 19.05.2026 | Accepted: 8.06.2026

ABSTRACT

Rapeseed–mustard is one of the most important oilseed crops in India and plays a significant role in the country's edible oil economy. Despite considerable improvement in area, production, and productivity, the average yield of mustard remains below its potential due to imbalanced nutrient management, declining soil fertility, and cultivation under rainfed and marginal conditions. Integrated nutrient management (INM) has emerged as a sustainable approach to enhance crop productivity while maintaining soil health. The combined application of inorganic fertilizers with organic manures such as farmyard manure, vermicompost, and poultry manure improves nutrient availability, nutrient use efficiency, soil physical properties, and microbial activity. Sulphur and zinc are particularly important nutrients for mustard because of their role in oil synthesis, protein formation, enzyme activation, and seed development. Balanced fertilization involving macro- and micronutrients significantly enhances growth, yield attributes, oil content, and quality of mustard. Therefore, adoption of integrated nutrient management practices can substantially improve rapeseed–mustard productivity, soil sustainability, and nutritional security in India.

Keywords: *Indian mustard, Integrated, Vermicompost, Fertilizers, Organic Manures.*

INTRODUCTION

Indian mustard [*Brassica juncea* (L.) Czern & Coss.] is one of the most important oilseed crops of India and plays a significant role in the national edible oil economy. India ranks third in the world in terms of area and production of rapeseed–mustard, covering about 9.5–10.0 million hectares with a production of nearly 13.5–14.0 million tonnes during 2024–25. Despite notable progress in productivity, the average yield of mustard in India still remains below its potential due to imbalanced nutrient management, poor soil fertility, and cultivation under rainfed and marginal conditions, particularly in arid and semi-arid regions. Rajasthan, the leading mustard-producing state, contributes nearly 40–45% of the total national production owing to the crop's adaptability to low-moisture environments and diverse cropping systems.

Cite this article: Meena, V. K., Sharma, P. K., Prajapat, A. L., & Abhinav (2026). Integrated Use of Phosphorus and Organic Manures for Enhancing Yield and Quality of Cow pea (*Vigna Unguiculata* L.), *Curr. Rese. Agri. Far. 7*(3), 71-77. doi: http://dx.doi.org/10.18782/2582-7146.328

Continuous use of chemical fertilizers without adequate organic supplementation has resulted in nutrient depletion and deterioration of soil health. Deficiencies of sulphur and micronutrients, especially zinc, have become widespread in Indian soils, adversely affecting mustard productivity and oil quality. Sulphur is essential for protein synthesis, oil formation, and stress tolerance, while zinc regulates enzymatic activities, growth hormones, and seed development. Integrated nutrient management involving vermicompost and micronutrients offers a sustainable approach for improving nutrient availability, enhancing soil health, and increasing crop productivity. Vermicompost not only supplies essential macro- and micronutrients but also improves soil biological activity and nutrient use efficiency. Therefore, the present investigation was undertaken to study the effect of vermicompost and micronutrients on growth, yield, quality, nutrient uptake, and economic viability of mustard under semi-arid conditions.

MATERIALS AND METHODS

A field experiment entitled "Integrated Use of Phosphorus and Organic Manures for Enhancing Yield and Quality of Cowpea (*Vigna unguiculata* L.)" was conducted during the kharif season of 2025 at the Agriculture Research Farm, Department of Agriculture, Vivekananda Global University. The experimental site is situated at 26°05′ N latitude and 75°28′ E longitude with an altitude of 427 m above mean sea level and falls under Agro-climatic Zone IIIA (Semi-Arid Eastern Plains of Rajasthan). The region experiences a semi-arid climate with annual rainfall of about 400–500 mm, mainly received during the south-west monsoon. During the crop season, total rainfall recorded was 449.5 mm, while maximum and minimum temperatures ranged between 30.2–35.2°C and 9.9–23.0°C, respectively.

The soil of the experimental field was sandy loam in texture, low in organic carbon (0.32%) and available nitrogen (154.46 kg ha^{-1}), medium in available phosphorus (20.14 kg ha^{-1}) and potassium (230.24 kg ha^{-1}), with pH 7.65 and EC 0.24 dS m^{-1}. The experiment consisted of 12 treatment combinations comprising four phosphorus levels (0, 20, 40 and 60 kg P_2O_5 ha^{-1}) and three organic manure treatments [control, FYM @ 5 t ha^{-1} and castor cake @ 0.5 t ha^{-1}], laid out in a Factorial Randomized Block Design with three replications.

Cowpea variety RC-101 was sown on 21 July 2025 at a spacing of 30 × 10 cm using a seed rate of 20 kg ha^{-1}. Phosphorus was applied through single super phosphate (SSP) as basal dose, while organic manures were incorporated before sowing according to treatments. Recommended agronomic practices were followed throughout the crop season. Observations on growth attributes, yield components, seed and straw yield, nutrient content and uptake, crude protein content, and economics were recorded using standard procedures. The experimental data were statistically analyzed using analysis of variance (ANOVA) as described by Panse and Sukhatme (1985), and treatment means were compared at 5% level of significance.

RESULTS

The field experiment conducted during kharif 2025 on the integrated use of phosphorus and organic manures significantly influenced the growth, yield attributes, and yield performance of cowpea, while plant population and harvest index remained unaffected. The analysis of variance revealed non-significant interaction effects between phosphorus and organic manures; therefore, only the main effects are discussed.

Effect on Growth Attributes

The plant population per metre row length at 20 DAS and at harvest did not differ significantly due to phosphorus levels or organic manure treatments, indicating uniform germination and establishment of the crop under all treatments. The plant stand varied from 10.82 to 11.14 plants m^{-1} at 20 DAS and from 10.12 to 10.44 plants m^{-1} at harvest under different phosphorus levels.

Plant height was significantly influenced by phosphorus application at 50 DAS and harvest stages. Application of 40 kg P_2O_5 ha^{-1} recorded markedly higher plant height (38.07 cm at 50 DAS and 59.24 cm at harvest) over control and 20 kg P_2O_5 ha^{-1}, but remained statistically at par with 60 kg P_2O_5 ha^{-1}. Increased phosphorus availability might have enhanced root growth, nutrient uptake, and cell division, resulting in vigorous vegetative growth. Among organic manures, application of castor cake @ 0.5 t ha^{-1} produced the tallest plants (58.65 cm at harvest), which remained at par with FYM @ 5 t ha^{-1} and significantly superior to control.

Dry matter accumulation was also significantly enhanced due to phosphorus and organic manure application. At harvest, the highest dry matter accumulation (16.68 g $plant^{-1}$) was recorded with 60 kg P_2O_5 ha^{-1}, closely followed by 40 kg P_2O_5 ha^{-1} (16.48 g $plant^{-1}$). Application of FYM and castor cake significantly improved dry matter production over control, owing to better nutrient availability and improved soil physical conditions. Similarly, the number of branches $plant^{-1}$ increased significantly with increasing phosphorus levels. Maximum branches $plant^{-1}$ (11.33) were observed under 60 kg P_2O_5 ha^{-1}, whereas among organic sources, castor cake @ 0.5 t ha^{-1} recorded the highest value (10.17).

Effect on Yield Attributes and Yield

Yield attributes of cowpea responded positively to phosphorus and organic manure application. Application of 40 kg P_2O_5 ha^{-1} significantly increased the number of pods $plant^{-1}$ (28.54) and seeds pod^{-1} (10.80) over control and 20 kg P_2O_5 ha^{-1}, remaining statistically at par with 60 kg P_2O_5 ha^{-1}. Adequate phosphorus supply likely promoted better flowering, pod formation, and translocation of photosynthates towards reproductive organs. Organic manures also exerted significant influence on yield attributes. Castor cake @ 0.5 t ha^{-1} recorded the highest pods $plant^{-1}$ (28.02) and seeds pod^{-1} (10.70), which remained at par with FYM @ 5 t ha^{-1}. However, test weight was not significantly affected by either phosphorus or organic manure treatments, suggesting that seed size remained genetically stable.

Seed yield increased significantly with increasing phosphorus levels up to 40 kg P_2O_5 ha^{-1}. The application of 40 kg P_2O_5 ha^{-1} produced 1123 kg ha^{-1} seed yield, representing a substantial improvement over control (872 kg ha^{-1}). Further increase to 60 kg P_2O_5 ha^{-1} did not produce significant gains, indicating that 40 kg P_2O_5 ha^{-1} was the optimum dose under the prevailing conditions. Organic manures also enhanced seed yield considerably. The highest seed yield (1197 kg ha^{-1}) was obtained with castor cake @ 0.5 t ha^{-1}, followed closely by FYM @ 5 t ha^{-1} (1135 kg ha^{-1}).

Straw yield and biological yield followed trends similar to seed yield. Application of 60 kg P_2O_5 ha^{-1} produced the maximum straw yield (2378 kg ha^{-1}) and biological yield (3524 kg ha^{-1}), although these values remained statistically at par with 40 kg P_2O_5 ha^{-1}. Among organic manures, castor cake @ 0.5 t ha^{-1} recorded the highest biological yield (3681 kg ha^{-1}). The harvest index remained statistically unaffected by different treatments, indicating proportional improvement in both economic and biological yield components.

Overall, the results clearly demonstrated that application of 40 kg P_2O_5 ha^{-1} along with organic manures, particularly castor cake or FYM, substantially improved growth and productivity of cowpea under kharif conditions.

Table: Effect of phosphorus and organic manure on yield attributes of Cow pea

Treatments	Yield attributes		
	Number of pods $plant^{-1}$	Number of seeds pod^{-1}	Test weight (g)
Phosphorus (kg ha^{-1})			
0	22.70	9.26	82.88
20	26.08	10.14	83.41
40	28.54	10.80	83.92
60	29.54	11.00	84.53
SEm±	0.73	0.22	1.20
CD (p=0.05)	2.13	0.65	NS

Organic manures			
Control	25.01	9.79	82.52
FYM @ 5 t ha^{-1}	27.12	10.42	83.58
Castor cake @ 0.5 t ha^{-1}	28.02	10.70	84.95
SEm±	0.63	0.19	1.04
CD (p=0.05)	1.84	0.56	NS
CV (%)	8.47	7.17	8.43

NS – Non significant

Table: Effect of phosphorus and organic manure on number of branches plant-1 of Cow pea

Treatments	**Number of branches plant^{-1} at harvest**
Phosphorus (kg ha^{-1})	
0	8.77
20	9.47
40	10.13
60	11.33
SEm±	0.19
CD (p=0.05)	0.56
Organic manures	
Control	9.00
FYM @ 5 t ha^{-1}	9.86
Castor cake @ 0.5 t ha^{-1}	10.17
SEm±	0.17
CD (p=0.05)	0.49
CV (%)	6.63

NS- Non significant

Table: Effect of phosphorus and organic manure on dry matter accumulation of Cow pea

Treatments	**Dry matter accumulation (g plant^{-1})**		
	At 25 DAS	**At 50 DAS**	**At harvest**
Phosphorus (kg ha^{-1})			
0	1.69	7.38	12.14
20	1.74	8.05	14.82
40	1.82	8.72	16.48
60	1.81	8.92	16.68
SEm±	0.04	0.22	0.27
CD (p=0.05)	NS	0.65	0.80
Organic manures			
Control	1.73	7.55	13.75
FYM @ 5 t ha^{-1}	1.76	8.48	15.46
Castor cake @ 0.5 t ha^{-1}	1.80	8.78	15.89
SEm±	0.03	0.19	0.24
CD (p=0.05)	NS	0.56	0.69
CV (%)	6.40	8.08	5.45

NS – Non significant

DISCUSSION

The present investigation on the integrated use of phosphorus and organic manures in cowpea demonstrated that both nutrient management practices exerted a significant influence on crop growth, productivity, nutrient uptake, quality parameters, and economics. The observed responses clearly indicate the importance of balanced nutrient supply for achieving higher productivity and sustainability in legume-based production systems.

Application of phosphorus significantly improved growth attributes such as plant height, dry matter accumulation, number of branches, and nodulation in cowpea. Among the different phosphorus levels, application of 40 kg P_2O_5 ha^{-1} proved most effective and remained statistically at par with 60 kg P_2O_5 ha^{-1}. The enhancement in growth parameters might be attributed to the pivotal role of phosphorus in energy transfer, root development, cell division, and biological nitrogen fixation. Phosphorus is an integral component of ATP, ADP, nucleic acids, and phospholipids, which regulate several physiological and metabolic processes in plants. Adequate phosphorus availability improves root proliferation and nodulation, thereby enhancing nutrient absorption and nitrogen fixation efficiency. Enhanced nutrient uptake subsequently promotes photosynthesis and carbohydrate synthesis, resulting in vigorous vegetative growth. Similar findings have been reported by Anuradha et al. (2017), Naik et al. (2021).

The improvement in growth attributes due to phosphorus application ultimately translated into higher yield attributes and yield. Application of 40 kg P_2O_5 ha^{-1} significantly increased pods $plant^{-1}$, seeds pod^{-1}, seed yield, straw yield, and biological yield over control and lower phosphorus levels. The beneficial effect of phosphorus on reproductive growth may be associated with enhanced translocation of photosynthates from source to sink during reproductive stages. Phosphorus plays a crucial role in carbohydrate metabolism and energy transformation, which supports flowering, pod development, and seed formation. Improved nodulation and nitrogen fixation under adequate phosphorus supply may also have contributed to greater assimilate accumulation and partitioning toward reproductive organs. Similar observations were reported by Choudhary et al. (2014a).

Phosphorus application also enhanced nutrient concentration and uptake of nitrogen, phosphorus, and potassium in both seed and straw. Increased uptake may be attributed to improved root growth and greater availability of nutrients in the rhizosphere. Since nutrient uptake is directly related to biomass production and nutrient concentration, higher seed and straw yields under phosphorus fertilization resulted in greater total nutrient uptake. Furthermore, phosphorus application improved protein content in seed, which may be due to enhanced nitrogen assimilation and protein synthesis under improved energy availability. These findings corroborate the results reported by Raiger et al. (2017) and Kumar, S., & Yadav, S. S. (2018).

Acknowledgements:
The authors sincerely acknowledge the valuable support and cooperation of all co-authors in the preparation and timely completion of this manuscript.

Funding:
This research received no external funding.

Conflict of Interest:
The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Author Contributions:
All authors contributed significantly to the conception, critical revision, and final approval of the manuscript.

REFERENCES

Anonymous 2023-24. 3rd advance estimates of area, production and yield of crops in respect of Rajasthan state.

Anuja, S., & Vijayalakshmi, C. N. (2014). Effect of organic nutrients on growth and yield of vegetable Cow pea.*Asian Journal of Horticulture 9*(1), 136-139.

Anuradha, Singh, R. K., Pareek, B., Kumar, D., Meena, S., & Dubey, S. K. (2017). Different levels of fertilizers on growth and yield of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub]in rainfed area of Uttar Pradesh, India. *International Journal of Current Microbiology and Applied Sciences* 6(4), 2029 – 2036.

Choudhary, K. M., Patel, M. M., & Pagar, R. D. (2014a). Effect of foliar application of panchgavya and leaf extracts of endemic plants on groundnut. *Legume Research 37*(2), 223-226.

Choudhary, R., Pandey, I. B., Singh, R. S., Singh, S. K., Meena, H., & Singh, K. (2023). Effect of phosphorus and sulphur levels on growth and yield of summer greengram [*Vigna Unguiculata* (L.) Wilczek.] in middle Indo-gangatic Zone. *Legume Research 46*(2), 186-190.

Chouksey, V. P., Vaishya, U. K., Tembhare, B. R., Rathore, G. S., & Johar, M. S. (1995). Effect of continuous cropping and manuring in a soybean-wheat-maize fodder sequence in microbial population, nodulation and N_2-fixation by soybean. *JNKVV Research Journal 27*(1), 45-48.

Khan, V. M., Manohar, K. S., Kumawat, S. K., & Verma, H. P. (2013). Effect of Castor cake and biofertilizer on yield and soil nutrient status after harvest of cowpea [*Vigna unguiculata* (L.) Walp]. *Agriculture for Sustainable Development 1*(1), 7 9-81.

Kumar, D. P., Shankar, T., & Maitra, S. (2019). Growth, yield and quality of summer groundnut (*Arachis hypogaea* L.) as affected by graded levels of phosphorous. *International Journal of Bioresource Science 6*(2), 81-86.

Kumar, S., Singh, R. C., & Kadian, V. S. (2003). Performance of Cow pea[*Vigna radiatus* (L.) Wilczek] influenced by seed inoculation with Rhizobium and levels of fertility levels. *Indian Journal of Pulses Research 16*(3), 67-68.

Kumar, S., & Yadav, S. S. (2018). Effect of phosphorus fertilization and bio-organics on growth, yield and nutrient content of Mungbean (*Vigna Unguiculata L.*L.). *Research Journal of Agricultural Sciences*, *9*(6), 1252-1257.

Kumawat, N., Sharma, O. P., & Kumar, S. (2009). Effect of organic manures, PSB and phosphorus fertilization on yield and economics of Mungbean (*Vigna Unguiculata L.*L.). *Environment & Ecology, 27*(1), 5-7.

Mohan, S. C., & Chandaragiri, K. K. (2007). Effect of organic manure on growth and yield attributes in cotton + blackgram intercropping system. *International Journal of Plant Science 2*(1), 156-160.

Naik, S. E., Balachandra, Y., Dawson, J., & Munagala, S. K. (2021). Influence of phosphorus and sulphur levels on evolution and yield of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub].*Biological Forum – An International Journal 13*(3), 95-100.

Namakka, A., Jibrin, D. M., Hamma, I. L., & Bulus, J. (2017). Effect of phosphorus levels on growth and yield of cowpea {*Vigna unguiculata* (L). Walp.} in Zaria, Nigeria. *Journal of Dryland Agriculture 3*(1), 85-93.

Puniya, M. (2011). Response of mothbean to phosphorus and zinc fertilization. MSc Ag. *Thesis, Swami Keshwanand Rajasthan Agriculture University*, Bikaner.

Rahman, M. M, Adan, M. J. M., Chowdhury, S. N., Ali, M. S., & Mahabub, T. S. (2015). Effects of Phosphorus and Zinc on the Growth and Yield of Mungbean (BARI mug 6). *International Journal of Scientific and Research Publications*, *5*(2), 2250-3153.

Raiger, R., Kumawat, B. L., Sanwal, R. C., Kumawat, S. R., & Kumawat, S. R. (2017). Response of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] to phosphorus and sulphur in tropopsamments of Rajasthan, India. *International Journal of Current Microbiology and Applied Sciences 6*(6), 2003-2008.

Rajkhowa, D. J., Gogali, A. K., Kandali, R., & Rajkhowa, K. M. (2000). Effect of Castor cake on greengram[*Vigna radiatus* (L.) Wilczek]nutrition. *Journal of the Indian Society of Soil Science 48*, 207-208.

Subbiah, B. V., & Asija, G. L. (1956). A rapid procedure for determination of available nitrogen in soil, *Current Science 25*(1), 259-260.

Sunder, S., Pareek, B. L., & Sharma, S. K. (2003). Effect of phosphorus and zinc on dry matter, uptake of nutrients and quality of clusterbean [*Cyamopsis tetragonoloba* (L) Tabu.]. *Annals of Agricultural Research 24*(5), 195-196.

Sutaria, G. S., Kabari, K. N., Vora, V. D., Hirpara, D. S., & Padmani, D. R. (2010). Response of legume crops to enriched compost and Castor cake on Ustochrept under rainfed Agriculture. *Legume Research 33*(2), 128-130.

Tak, S. (2003). Effect of Castor cake and zinc on growth and yield of Cow pea (*Vigna Unguiculata L.*(L.) Wilczek). M.Sc. (Ag.), Thesis, *Rajasthan Agricultural University*, Bikaner.

Thiyageshwari, S., & Perumal, R. (2002. Integrated use of sources of phosphorus with Castor cake and phospho-bacteria in Urdbean. *Indian Journal of Pulses Research 15*(2), 81-82.

Todawat, A., Sharma, S. R., Lakhran, H., & Hemraj (2017). Effect of Castor cake and zinc on growth, yield attributes and yield of greengram [*Vigna radiatus* (L.) Wilczek]under Semi-Arid Region of Rajasthan. *International Journal of Current Microbiology and Applied Science 6*(9), 175-180.

Upadhayay, R. G., Sharma, S., & Drawal, N. S. (1999). Effect of *Rhizobium* inoculation and graded level of P on the growth and yield of greengram[*Vigna radiatus* (L.) Wilczek]. *Legume Research 22*(2), 277-279.

Vasanti, D., & Subramanian, V. (2004). Effect of Castor cake on nutrient uptake and protein content in blackgram. *Legume Research 27*(5), 293- 295.

Yuganthra, B., Rajendran, K., Joseph, P. A., Katharine, S. P., Sharmili, K., & Balaganesh, B. (2023). Effect of integrated nutrient management on growth and yield of irrigated blackgram. *International Journal of Environment and Climate Change 13*(8), 1566-1571.