International Journal of Environment, Agriculture and Biotechnology
Vol-10, Issue-4; Jul-Aug, 2025
Peer-Reviewed International Journal
Journal Home Page Available: https://ijeab.com/
Journal DOI: 10.22161/ijeab

Effect of Integrated Nutrient Management on Nutrient Content and Uptake of Blackgram

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Received: 13 Jun 2025; Received in revised form: 09 Jul 2025; Accepted: 13 Jul 2025; Available online: 20 Jul 2025

Abstract— *A field experiment was conducted during the kharif season of 2024 at the Agronomy Instructional Farm, Rajasthan College of Agriculture, Udaipur, to evaluate the effect of integrated nutrient management (INM) on nutrient content and uptake in blackgram (Vigna mungo L.). The experiment followed a factorial randomized block design with 18 treatment combinations involving three fertility levels (100% RDF, 100% RDF + Zn, 100% RDF + Zn + Mo), three vermicompost levels (0, 1, and 2 t ha^{-1}), and two biofertilizer levels (control and NPK liquid consortia). Results revealed that the combined application of 100% RDF + Zn + Mo + vermicompost 2 t ha^{-1} + NPK consortia significantly enhanced nitrogen, phosphorus and potassium content in seed and improved their uptake in both seed and haulm. The treatment also recorded the highest total N, P, and K uptake by seed and haulm.*

Keywords— ***Blackgram, INM, Vermicompost, NPK consortia, Zinc, Molybdenum, Growth, Yield, Nutrient uptake.***

I. INTRODUCTION

Blackgram (*Vigna mungo* L.), also known as urdbean, is an important pulse crop originated in India with a secondary origin in Central Asia extending from India to Myanmar (Vavilov, 1951), where it has been cultivated since ancient times. Belonging to the Fabaceae family, it plays a vital role in Indian agriculture and diet due to its high protein content and ability to fix atmospheric nitrogen and also enhancing soil fertility. Being widely grown across South and South East Asia, blackgram is valued both as a food legume and a green manure crop. Its short duration and adaptability to diverse agro-climatic conditions make it suitable for multiple cropping systems. Blackgram is drought to lerant flourishes in tropical climate particularly in hot and humid conditions where other legumes may struggle (Chhatwani *et al.,* 2022). Major producers include Madhya Pradesh, Uttar Pradesh, and Andhra Pradesh. Rajasthan's key districts are Kota, Pratapgarh, Rajsamand, and Ajmer (ANGRAU, 2024). Blackgram contains approximately 26% protein, 1.2% fat, and 56.6% carbohydrates (dry weight), and is a rich source of calcium and iron. Besides its nutritional value, it serves as silage, green manure, and forage, helping prevent soil erosion through dense vegetative cover. It significantly enhances soil fertility via biological nitrogen fixation, contributing about 22.10 kg N ha^{-1} through Rhizobium symbiosis (Kannan et al., 2014).

II. MATERIALS AND METHODS

A field experiment was conducted during the *kharif* season of 2024 at the Agronomy Instructional Farm, Rajasthan College of Agriculture, MPUAT, Udaipur, situated at 24°35′ N latitude and 73°42′ E longitude with an altitude of 581.13 m above MSL. The soil of the site was clay loam, alkaline (pH 7.8), with medium organic carbon (0.53%), low available nitrogen (302.53 kg ha^{-1}), medium phosphorus (23.18 kg ha^{-1}) and high potassium (372.25 kg

ha⁻¹). The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three replications, comprising 18 treatment combinations. These treatments included three fertility levels: F_1 (100% Recommended Dose of Fertilizer), F_2 (100% RDF + Zinc), and F_3 (100% RDF + Zinc + Molybdenum); three levels of organic manure: M_1 (Control), M_2 (Vermicompost @ 1 t ha⁻¹), and M_3 (Vermicompost @ 2 t ha⁻¹); and two levels of biofertilizer: B_1 (Control) and B_2 (Seed treatment with NPK liquid consortia). The recommended fertilizer dose applied was 20:40:20 kg N:P_2O_5:K_2O per hectare. The blackgram variety used was MU-2, which is moderately resistant to Yellow Mosaic Virus and matures in approximately 60 days. The following methods were followed for determination of nutrient content and uptake of blackgram:

Nutrient content

For estimation of nitrogen, phosphorus and potassium contents, representative plant samples were collected at harvest, oven dried and ground to fine powder by willey mill for estimating nutrient content in seed and haulm of blackgram. Nutrient content in seed and haulm was estimated as per the method adopted for determination of nutrients content (Table 1).

Table 1: Plant nutrient content analysis methods

Nutrient	Method of analysis	Reference
Nitrogen (N)	Wet digestion of plant sample with H_2SO_4 and H_2O_2, estimated colorimetrically after color development with Nessler's reagent	Snell and Snell (1949)
Phosphorus (P)	Ammonium vanadomolybdo phosphoric acid yellow colour method	Richards (1968)
Potassium (K)	Flame Photometric Method	Richards (1968)

Nutrient uptake

The uptake of nutrients (nitrogen, phosphorus, potassium) at harvest was estimated by using the following formula:

$$\text{Nutrient uptake by seed (kg ha}^{\wedge} - 1) = \frac{\text{Nutrient content in seed (\%) x Seed yield (kg ha}^{\wedge} - 1)}{100}$$

$$\text{Nutrient uptake by seed (kg ha}^{\wedge} - 1) = \frac{\text{Nutrient content in stover (\%) x Stover yield (kg ha}^{\wedge} - 1)}{100}$$

III. RESULT AND DISCUSSION

The application of integrated nutrient management (INM) significantly influenced nitrogen (N), phosphorus (P), and potassium (K) content and uptake in both seed and haulm of blackgram.

Nutrient Content

Among the fertility levels (Table 2 and 3), the application of 100% RDF + Zn + Mo recorded the highest nutrient content—N (4.189% seed, 0.863% haulm), P (0.490% seed, 0.270% haulm), and K (1.146% seed, 1.595% haulm)—which was significantly superior over 100% RDF alone. The improvement can be attributed to the synergistic effects of Zn and Mo in enhancing nutrient assimilation and transport within the plant. Application of vermicompost @ 2 t ha⁻¹ also significantly improved nutrient content. It recorded N (4.132% seed, 0.851% haulm), P (0.485% seed, 0.257% haulm), and K (1.104% seed, 1.592% haulm), significantly outperforming the lower dose and control. The steady nutrient release and improved microbial activity from vermicompost enhanced nutrient availability. Similarly, the application of NPK liquid consortia resulted in significantly higher nutrient content than the control, with N (4.116% seed, 0.865% haulm), P (0.479% seed, 0.249% haulm), and K (1.099% seed, 1.609% haulm), due to enhanced nutrient solubilization and microbial stimulation.

Nutrient Uptake

The treatment 100% RDF + Zn + Mo also recorded the maximum nutrient uptake (Table 4 and 5): N (41.44 kg ha⁻¹ seed, 20.19 kg ha⁻¹ haulm), P (4.86 and 6.92 kg ha⁻¹) and K (11.46 and 37.12 kg ha⁻¹), significantly surpassing other fertility levels. This confirms the positive effect of micronutrient supplementation on nutrient absorption and partitioning.

Vermicompost @ 2 t ha⁻¹ further enhanced nutrient uptake: N (41.14 and 18.20 kg ha⁻¹), P (4.82 and 5.50 kg ha⁻¹), and K (11.05 and 33.75 kg ha⁻¹) by seed and haulm, respectively. The improvement is likely due to better root proliferation and nutrient retention in the root zone. Biofertilizer application with NPK liquid consortia recorded N uptake (41.42 and 17.91 kg ha⁻¹), P uptake (4.82 and 5.20 kg ha⁻¹), and K uptake (11.10 and 33.15 kg ha⁻¹), significantly higher than the control. This highlights the role of microbial consortia in improving nutrient mobilization and plant uptake.

IV. CONCLUSION

The study revealed that integrated nutrient management significantly improved nitrogen, phosphorus, and potassium content and uptake in blackgram. The

combined application of 100% RDF + Zn + Mo + vermicompost @ 2 t ha^{-1} + NPK liquid consortia recorded the highest nutrient content and uptake in both seed and haulm. These results highlight the synergistic benefits of integrating chemical fertilizers with micronutrients, organic manures, and biofertilizers, which enhanced nutrient availability, microbial activity, and root efficiency. Therefore, INM practices offer a sustainable approach to improving nutrient use efficiency and crop nutrition in blackgram under rainfed conditions.

ACKNOWLEDGMENT

The authors sincerely acknowledge the Dr. J. Choudhary (Head and Professor) and Dr. Arvind Verma (Professor), Department of Agronomy, along with Dr. R.B. Dubey, Dean of Rajasthan College of Agriculture, Udaipur, for their valuable support, provision of research facilities and scientific guidance, which were instrumental in the successful completion of this study.

REFERENCES

[1] Acharya N. G. Ranga Agricultural University. (ANGRAU). Official website. Retrieved March 23, 2025, from https://angrau.ac.in.

[2] Chhatwani, M., David, A. A., Thomas, T., Reddy, I. S. and Barthwal, A. 2022. Effect of integrated nutrient management on soil health, growth and yield of blackgram (*Vigna mungo* L.) var. Indra Urad-1. *The Pharma Innovation Journal* **11**(5): 2022-2025.

[3] Kannan, P., Arunachlam, P., Prabukumar, G. and Prabhaharan, J. 2014. Response of blackgram (*Vigna mungo* L.) to multi-micronutrient mixtures under rainfed Alfisol. *Journal of the Indian Society of Soil Science* **62**(2): 154-160.

[4] Richards, L. A. 1968. Diagnosis and improvement of saline and alkaline soils. USDA Handbook No. 60, Oxford and IBH Publishing Company, New Delhi.

[5] Snell, F. D. and Snell, C. P. 1949. Colorimetric Methods of Analysis. **2**(3): 1-19.

[6] Vavilov, N. I. 1951. The origin, variation, immunity and breeding of cultivated plants (K. S. Chester, Trans.). *Chronica Botanica.*

Table: 2 Effect of integrated nutrient management on NPK content in seed of blackgram

Treatments	Content (%)		
	Nitrogen	Phosphorus	Potassium
Fertility Levels			
100% RDF	3.983	0.468	1.000
100% RDF + Zn	4.107	0.466	1.048
100% RDF + Zn + Mo	4.189	0.490	1.146
SEm±	0.020	0.003	0.006
CD (P = 0.05)	0.058	0.009	0.018
Organic Manure			
Control	4.023	0.466	1.030
Vermicompost 1 t ha^{-1}	4.122	0.474	1.060
Vermicompost 2 t ha^{-1}	4.132	0.485	1.104
SEm±	0.020	0.003	0.006
CD (P = 0.05)	0.058	0.009	0.018
Biofertilizer			
Control	4.069	0.471	1.031
NPK liquid consortia	4.116	0.479	1.099
SEm±	0.017	0.002	0.005
CD (P = 0.05)	0.048	0.007	0.014

Table: 3 Effect of integrated nutrient management on NPK content in haulm of blackgram

Treatments	Content (%)		
	Nitrogen	Phosphorus	Potassium
Fertility Levels			
100% RDF	0.804	0.235	1.556
100% RDF + Zn	0.854	0.237	1.567
100% RDF + Zn + Mo	0.863	0.270	1.595
SEm±	0.006	0.001	0.006
CD (P = 0.05)	0.017	0.002	0.018
Organic Manure			
Control	0.820	0.241	1.556
Vermicompost 1 t ha^{-1}	0.849	0.244	1.570
Vermicompost 2 t ha^{-1}	0.851	0.257	1.592
SEm±	0.006	0.001	0.006
CD (P = 0.05)	0.017	0.002	0.018
Biofertilizer			
Control	0.815	0.246	1.536
NPK liquid consortia	0.865	0.249	1.609
SEm±	0.005	0.001	0.005
CD (P = 0.05)	0.014	0.002	0.015

Table: 4 Effect of integrated nutrient management on NPK uptake by seed of blackgram

Treatments	Nutrient uptake (kg ha^{-1})		
	Nitrogen	Phosphorus	Potassium
Fertility Levels			
100% RDF	34.23	4.04	8.65
100% RDF + Zn	38.06	4.31	9.71
100% RDF + Zn + Mo	41.44	4.86	11.46
SEm±	0.90	0.11	0.24
CD (P = 0.05)	2.58	0.31	0.69
Organic Manure			
Control	33.86	3.94	8.80
Vermicompost 1 t ha^{-1}	38.74	4.45	9.97
Vermicompost 2 t ha^{-1}	41.14	4.82	11.05
SEm±	0.90	0.11	0.24
CD (P = 0.05)	2.58	0.31	0.69
Biofertilizer			
Control	34.41	3.98	8.78
NPK liquid consortia	41.42	4.82	11.10
SEm±	0.73	0.09	0.19
CD (P = 0.05)	2.11	0.25	0.56

Table: 5 Effect of integrated nutrient management on NPK uptake by haulm of blackgram

Treatments	Nutrient uptake (kg ha^{-1})		
	Nitrogen	**Phosphorus**	**Potassium**
Fertility Levels			
100% RDF	12.64	3.67	24.44
100% RDF + Zn	17.15	4.78	31.50
100% RDF + Zn + Mo	20.19	6.29	37.12
SEm±	0.41	0.11	0.72
CD (P = 0.05)	1.18	0.32	2.08
Organic Manure			
Control	15.07	4.44	28.56
Vermicompost 1 t ha^{-1}	16.70	4.81	30.75
Vermicompost 2 t ha^{-1}	18.20	5.50	33.75
SEm±	0.41	0.11	0.72
CD (P = 0.05)	1.18	0.32	2.08
Biofertilizer			
Control	15.41	4.63	28.89
NPK liquid consortia	17.91	5.20	33.15
SEm±	0.34	0.09	0.59
CD (P = 0.05)	0.97	0.26	1.70