



ISSN Print: 2664-844X
 ISSN Online: 2664-8458
 NAAS Rating (2026): 4.97
 IJAFS 2026; 8(10): 404-410
www.agriculturaljournals.com
 Received: 13-08-2026
 Accepted: 01-10-2026
 Published: 12-10-2026

Shivani Gupta

M.Sc. Final Year, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur (C.G.), India

TD Pandey

Professor, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur (C.G.), India

Dinesh Pandey

Principal Scientist, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur (C.G.), India

PK Keshry

Principal Scientist, Dept. of Soil Science & Agri. Chemistry, BTC College of Agriculture and Research Station, Bilaspur (C.G.), India

NK Chaure

Principal Scientist, Dept. of Agricultural Statistics, BTC College of Agriculture and Research Station, Bilaspur (C.G.), India

Hemant Patel

M.Sc. Final Year, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur (C.G.), India

Shweta Tirkey

Dept. of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwavidyalaya Jabalpur (M.P.), India

Corresponding Author: Shivani Gupta

M.Sc. Final Year, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur (C.G.), India

Effect of integrated nutrient management on growth and yield of horsegram [*Macrotyloma uniflorum* (L.) Verdc.]

Shivani Gupta¹, TD Pandey², Dinesh Pandey³, PK Keshry⁴, NK Chaure⁵, Hemant Patel⁶, Shweta Tirkey⁷

DOI: <https://www.doi.org/10.33545/2664844X.2026.v8.i10f.2044>

ABSTRACT

A field experiment entitled “Effect of integrated nutrient management on growth and yield of horsegram [*Macrotyloma uniflorum* (L.) Verdc.]” was conducted during post-kharif season 2024 at the Instructional Farm of BTC College of Agriculture and Research Station, Sarkanda, Bilaspur. The investigation was carried out in a randomized block design wherein eleven treatment combinations in three replications i.e., T1 - Control plot, T2 - Control plot + Rhizobium (5 g kg⁻¹ seed), T3 - Control plot + PSB (5 g kg⁻¹ seed), T4 - 125 % RDF, T5 - 100 % RDF (20:50:20 Kg N, P₂O₅ and K₂O ha⁻¹), T6 - 100 % RDF + Rhizobium (5 g kg⁻¹ seed), T7 - 100 % RDF + PSB (5 g kg⁻¹ seed), T8 - 100 % RDF + Rhizobium (5 g kg⁻¹ seed) + PSB (5 g kg⁻¹ seed), T9 - 75 % RDF + Rhizobium (5 g kg⁻¹ seed), T10 - 75 % RDF + PSB (5 g kg⁻¹ seed) and T11 - 75 % RDF + Rhizobium (5 g kg⁻¹ seed) + PSB (5 g kg⁻¹ seed) were chosen for study purpose. The soil of the experimental plot was sandy clay loam in texture, neutral in reaction, medium in organic carbon, low in available nitrogen, medium in available phosphorus and high in available potassium. The horsegram variety Chhattisgarh kulthi – 3 was sown on 2nd September 2024 and harvested on 1st December 2024. The results revealed that all integrated nutrient management treatments showed superiority over the control with respect to growth parameters viz., plant height, number of primary branches and plant dry weight of horsegram. T8 (100% RDF + Rhizobium @ 5 g kg⁻¹ seed + PSB @ 5 g kg⁻¹ seed) recorded significantly higher growth attributes under study. Treatment T1 (Control) recorded the lowest values for all growth parameters. Similarly, T8 (100% RDF + Rhizobium + PSB) recorded significantly higher yield attributes viz., number of pods plant⁻¹, pod length, number of seeds pod⁻¹, test weight, grain yield, stover yield and harvest index of horsegram. All integrated nutrient management treatments performed better than the control (T1), which recorded the lowest values for all yield attributes and yields. The economic analysis revealed that the highest cost of cultivation (₹ 21137.15 ha⁻¹) was incurred under (T4) 125% RDF. However, the highest gross return (₹ 74637.02 ha⁻¹), net return (₹ 56496.02 ha⁻¹) and B:C ratio (3.11) were recorded under (T8) 100% RDF + Rhizobium + PSB. Treatment T1 (Control) recorded the lowest gross return, net return and B:C ratio. Post-harvest soil properties viz., EC, pH and organic carbon, as well as nutrient contents (N, P and K) in grain and stover, were not significantly influenced by the treatments.

Keywords: Kodo millet, Panicle, Organic carbon, Tillers, Fertility and soil

Introduction

Pulses play important role in agriculture next to cereals. These are the major source of dietary protein, along with minerals and vitamins. It is the second rich source of dietary protein in vegetarian diet in our country and also in other developing countries. Among the pulses, horsegram is an important post *kharif* season crop of the country commonly known as “Kulthi” belongs to the family Fabaceae. It has diploid chromosome numbers of $2n = 20$. Crop is an underutilized and unexplored arid tropical food legume. Horsegram as a legume, it maintains soil fertility through biological nitrogen fixation in soil via root nodules and act as organic manure as well. It is suitable as a cover crop, soil and water conservation and an excellent drought and salinity tolerant as well as heavy metal stress tolerant contingent crop (Ram *et al.*, 2001). Crop is popular at maximum extent is Southern Indian states while to some extent in North Indian states. Horsegram known as a poor man's pulse crop and it is used for human consumption in India and Africa. Its centre of origin is South West India. In India, as a pulse crop horsegram contributing about 0.33 per cent of the total food grain production (Singh *et al.*, 2003). It is multiplied by seed. In India, horsegram is usually sown as a sole crop, but sometimes it is intercropped with ground nut, castor, niger and maize.

The crop duration of horsegram is 100 – 110 days. The average yield is about 350-800 kg ha⁻¹. It is known for its medicinal use and nutritional quality. It is consumed as a whole seed and as sprouts in India. Horsegram used traditionally as a medicinal crop famous for its medicinal uses because different parts of the

plant are used for the treatment of asthma, bronchitis, urinary disorder, lowering cholesterol levels and kidney stones. Its seed comprises 57.0 per cent carbohydrate, 22.0 per cent protein and 2.5 per cent fat (Meena *et al.*, 2018). It is also an excellent source of iron, calcium and molybdenum. In India, horsegram occupies an area of 460.40 (000 ha) with a production of 181.29 (000 tonnes) with an average national productivity of 394 kg ha⁻¹ in the year 2020 (Anonymous, 2020) [1]. It is important pulse crop mostly grown in Karnataka, Odisha, Chhattisgarh, Andhra Pradesh, Tamil Nadu and Maharashtra which together contributes about 89.23 per cent area and 86.10 per cent production in 2020. Horsegram is cultivated both as a sole crop and in various combinations with other crops. Its wide adaptability extends its cultivation across almost all states of India. However, the majority of its cultivation, approximately 90-95%, is concentrated in five major states: Orissa, Tamil Nadu, Karnataka, Maharashtra, and Andhra Pradesh. In specific regions like the Northern hill zone and Bastar plateau of Chhattisgarh, horsegram cultivation is significant, particularly among tribal farmers. In Chhattisgarh, for instance, the total cultivated area, crop production, and productivity of horsegram are reported to be 0.026 million hectares, 0.010 million tones and 3.90 quintals ha⁻¹, respectively (Anonymous, 2021) [2].

Integrated nutrient management (INM) is the adjustment of plant nutrients supply in balanced quantities for sustaining the desired crop productivity. It involves proper combination of chemical fertilizers, organic manure, crop residues, N₂-fixing crops and biofertilizers suitable to the system of land use and ecological, social and economic conditions. INM helps to maintain soil productivity, ensures productive and sustainable agriculture, reduce expenditure on costs of purchased inputs by using farm manure and crop residue etc., utilizing the potential benefits of green manures, leguminous crops and biofertilizers, prevent degradation of the environment and helps to meet the social and economic aspirations of the farmers without harming the natural resource base of the agricultural production (Sharma *et al.*, 2004). The efficiency of nutrients applied by soil application is frequently reduced as a result of leaching and volatilization losses. The availability of nutrients will also be impacted by problematic soils, insufficient moisture, waterlogging conditions, etc. Due to the availability of water-soluble fertilizers and the climatic changing conditions in rainfed areas, foliar fertilization has become more significant in recent years. Many research studies found that on oilseed and pulse crops were improved in terms of crop output and quality. Nutrient supplement to the leaves by foliar application method is one of the significant turning points in the development of agricultural produce. The growth of all living things depends on the availability of nutrients and out of this nitrogen is very important one, which is needed in large quantities as an essential component of proteins, nucleic acids and other cell components, including enzymes. Nitrogen is converted to amino acids, the building blocks for proteins. These amino acids are then used in formation of the protoplasm, which is used in cell division. Nitrogen is also a component of chlorophyll, which is responsible for photosynthesis. It assists plants with rapid growth, increase seed and fruit production and improves the quality of leaf and transplant crops. It is necessary for the full growth of the seeds. Phosphorous is involved in many important plant processes. It is widely found as part of the formation present mainly as a structural component of the nucleic acids, deoxyribonucleic acid (DNA), ribose nucleic acid (RNA) and as well as the role of fat phospholipids. Potassium does not enter into the composition of any of the important plant nutrients involved in body (Krishnaprabu, S., 2018) [3], but occur in all parts of plants in large quantities. It seems to be very importance for leaves and at growing areas. Potassium is essential for controlling the opening and closing of stomata, which plays a key role in water management for plants. By facilitating potassium ion movement, it helps to minimize water loss from leaves and increases drought resistance. When plants lack of potassium, their seeds tend to be small, shrivelled and more vulnerable to diseases. Utilizing various organic nutrient sources can enhance these benefits. Furthermore, combining organic and chemical fertilizers can signifi-

cantly boost productivity, leading to healthier crops and more sustainable agricultural methods. This integrated strategy optimizes nutrient availability while promoting long-term soil health.

Materials and methods

A field experiment was carried out at instructional farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (Chhattisgarh) during *post-kharif* season 2024, to study the “Effect of integrated nutrient management on growth and yield of horsegram [*Macrotyloma uniflorum* (L.) Verdc.]” An investigation was planned with following objectives: The investigation was carried out in a randomized block design wherein eleven treatment combinations in three replications i.e., T₁ - Control plot, T₂ - Control plot + Rhizobium (5 g kg⁻¹ seed), T₃ - Control plot + PSB (5 g kg⁻¹ seed), T₄ - 125 % RDF, T₅ - 100 % RDF (20:50:20 Kg N, P₂O₅ and K₂O ha⁻¹), T₆ - 100 % RDF + Rhizobium (5 g kg⁻¹ seed), T₇ - 100 % RDF + PSB (5 g kg⁻¹ seed), T₈ - 100 % RDF + Rhizobium (5 g kg⁻¹ seed) + PSB (5 g kg⁻¹ seed), T₉ - 75 % RDF + Rhizobium (5 g kg⁻¹ seed), T₁₀ - 75 % RDF + PSB (5 g kg⁻¹ seed) and T₁₁ - 75 % RDF + Rhizobium (5 g kg⁻¹ seed) + PSB (5 g kg⁻¹ seed) were chosen for study purpose. The soil of the experimental plot was sandy clay loam in texture, neutral in reaction, medium in organic carbon, low in available nitrogen, medium in available phosphorus and high in available potassium. The horsegram variety Chhattisgarh kulthi - 3 was sown on 2nd September 2024 and harvested on 1st December 2024. The weather condition during crop season was favourable for normal growth and development of horsegram.

Results and discussions

1. Growth parameters of horsegram recorded at 20 DAS, 40 DAS, 60 DAS and at harvest showed significant variation among the integrated nutrient management treatments, whereas plant population remained non-significant. Results revealed that under (T₈) 100% RDF + Rhizobium (5 g kg⁻¹ seed) + PSB (5 g kg⁻¹ seed), the highest plant height of 19.84, 41.08, 62.14 and 78.05 cm, highest number of primary branches of 2.70, 6.02, 9.01 and 9.03 plant⁻¹, and highest plant dry weight of 3.11, 11.24, 28.25 and 38.72 g plant⁻¹ at 20 DAS, 40 DAS, 60 DAS and harvest, respectively, were recorded. This treatment was followed by (T₁₁) 75% RDF + Rhizobium + PSB, whereas the lowest values for all growth parameters were recorded under (T₁) Control plot.
2. Yield attributes of horsegram *viz.*, number of pods per plant, pod length, number of seeds per pod and test weight were significantly influenced by integrated nutrient management practices. The maximum number of pods (28.07 plant⁻¹), pod length (6.38 cm), number of seeds (6.26 pod⁻¹) and test weight (31.05 g) were recorded under (T₈) 100% RDF + Rhizobium + PSB. The lowest values for all yield attributes were recorded under (T₁) Control plot.
3. Grain yield, stover yield and harvest index differed significantly among the treatments. The highest grain yield (1045.03 kg ha⁻¹), stover yield (1484.92 kg ha⁻¹) and harvest index (41.42%) were recorded under (T₈) 100% RDF + Rhizobium + PSB, followed by (T₁₁) 75% RDF + Rhizobium + PSB with 955.15 kg ha⁻¹ grain yield, 1351.06 kg ha⁻¹ stover yield and 41.31% harvest index. The lowest grain yield (517.92 kg ha⁻¹), stover yield (855.83 kg ha⁻¹) and harvest index (37.70%) were recorded under (T₁) Control plot.
4. Economic analysis revealed that the highest cost of cultivation (₹ 18,233.00 ha⁻¹) was incurred under (T₄) 125% RDF. However, the highest gross return (₹ 74,637.02 ha⁻¹), net return (₹ 56,496.02 ha⁻¹) and B:C ratio (3.11) were recorded under (T₈) 100% RDF + Rhizobium + PSB. The minimum gross return (₹ 32,308.44 ha⁻¹), net return (₹ 16,550.44 ha⁻¹) and B:C ratio (1.05) were obtained under (T₃) Control plot + PSB.

5. Post-harvest soil properties *viz.*, EC, soil pH and organic carbon were not significantly influenced by integrated nutrient management treatments. However, the highest EC (0.41 dS m^{-1}), soil pH (7.3) and organic carbon (0.52%) were recorded under (T_8) 100% RDF + Rhizobium + PSB. The lowest EC (0.36 dS m^{-1}), soil pH (6.9) and organic carbon (0.45%) were recorded under (T_1) Control plot.

6. Nutrient content and nutrient uptake in horsegram were influenced by integrated nutrient management. Although nitrogen, phosphorus and potassium contents in grain and stover did not differ significantly, the highest numerical values of 3.59 and 0.39% N, 0.53 and 0.31% P and 0.84 and 0.94% K in grain and stover, respectively, were recorded under (T_8) 100% RDF + Rhizobium + PSB. The same treatment also recorded the highest nitrogen uptake (37.52 , 5.79 and 43.31 kg ha^{-1}), phosphorus uptake (5.54 , 4.60 and 10.14 kg ha^{-1}) and potassium uptake (8.78 , 13.97 and 22.75 kg ha^{-1}) in grain, stover and total plant, respectively. The lowest nutrient contents and nutrient uptake were recorded under (T_1) Control plot.

Table 1. Effect of integrated nutrient management on plant height, number of primary branches and plant dry weight of horsegram.

Treatments	Plant height (cm)				Number of primary branches plant ⁻¹				Plant dry weight (g plant ⁻¹)			
	20 DAS	40 DAS	60 DAS	At harvest	20 DAS	40 DAS	60 DAS	At harvest	20 DAS	40 DAS	60 DAS	At harvest
T_1 - Control plot	12.53	20.64	40.68	45.08	1.13	3.13	5.22	5.03	1.09	3.14	11.28	14.21
T_2 - Control plot + Rhizobium (5 g kg ⁻¹ seed)	12.84	24.11	41.88	46.97	1.24	3.64	5.85	5.64	1.09	3.68	15.25	18.71
T_3 - Control plot + PSB (5 g kg ⁻¹ seed)	12.76	24.76	40.35	45.14	1.22	3.55	5.74	5.54	1.03	3.46	14.81	17.95
T_4 - 125 % RDF	18.63	39.57	60.03	74.12	2.49	5.62	8.48	8.21	2.58	9.05	23.71	31.64
T_5 - 100 % RDF (20:50:20 Kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	18.34	39.07	59.89	73.06	2.41	5.42	8.11	7.87	2.39	7.97	21.93	28.25
T_6 - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed)	18.47	39.25	59.14	72.43	2.44	5.48	8.29	8.04	2.47	8.12	22.56	29.47
T_7 - 100 % RDF + PSB (5 g kg ⁻¹ seed)	18.56	39.38	58.63	72.19	2.47	5.55	8.37	8.12	2.51	8.69	23.11	30.62
T_8 - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	19.84	41.08	62.14	78.05	2.70	6.02	9.01	9.03	3.11	11.24	28.25	38.72
T_9 - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed)	17.65	37.34	56.97	69.32	2.33	5.05	7.61	7.38	2.02	6.46	19.38	23.24
T_{10} - 75 % RDF + PSB (5 g kg ⁻¹ seed)	17.54	37.05	56.23	68.03	2.31	4.92	7.27	7.05	1.96	6.13	18.12	22.53
T_{11} - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	19.34	40.83	61.82	76.34	2.62	5.91	8.94	8.67	2.95	10.73	26.37	35.93
SEm (±)	0.24	0.29	0.46	0.73	0.04	0.07	0.14	0.13	0.11	0.42	0.84	1.26
CD (5%)	0.69	0.87	1.35	2.16	0.13	0.22	0.40	0.39	0.33	1.25	2.48	3.71
CV (%)	10.26	10.34	10.37	10.79	10.14	10.49	10.02	10.05	10.65	10.01	10.12	10.23

(continued on next page)

Table 2. Effect of integrated nutrient management on number of pods, pod length, number of seeds, test weight, grain yield, stover yield and harvest index of horsegram.

Treatments	Number of pods plant ⁻¹	Pod length (cm)	Number of seeds pod ⁻¹	Test weight (g)	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Harvest index (%)
T ₁ - Control plot	13.34	4.41	4.11	28.93	431.92	755.83	36.36
T ₂ - Control plot + Rhizobium (5 g kg ⁻¹ seed)	16.15	4.82	4.78	29.02	459.93	789.73	36.80
T ₃ - Control plot + PSB (5 g kg ⁻¹ seed)	15.87	4.75	4.69	30.15	450.34	784.64	36.47
T ₄ - 125 % RDF	23.92	5.83	5.73	30.88	834.52	1212.17	40.77
T ₅ - 100 % RDF (20:50:20 Kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	21.76	5.66	5.58	30.69	793.98	1163.95	40.55
T ₆ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed)	22.91	5.72	5.56	30.76	805.84	1172.72	40.73
T ₇ - 100 % RDF + PSB (5 g kg ⁻¹ seed)	23.18	5.78	5.61	30.81	817.56	1191.83	40.69
T ₈ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	28.07	6.38	6.26	31.05	1045.03	1484.92	41.31
T ₉ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed)	19.05	5.28	5.25	30.52	783.91	1132.85	40.90
T ₁₀ - 75 % RDF + PSB (5 g kg ⁻¹ seed)	18.76	5.19	5.17	30.43	776.16	1124.41	40.84
T ₁₁ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	26.53	6.16	6.04	30.95	955.15	1361.06	41.24
SEm (±)	0.85	0.12	0.09	0.49	36.68	54.06	0.56
CD (5%)	2.49	0.36	0.28	1.44	108.21	159.47	1.65
CV (%)	11.02	10.85	10.03	10.78	10.08	10.14	9.40

Table 3. Effect of integrated nutrient management on cost of cultivation of horsegram.

Treatments	Cost of cultivation (₹ ha ⁻¹)	Gross return (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	B:C ratio
T ₁ - Control plot	15460.00	30990.23	15530.23	1.00
T ₂ - Control plot + Rhizobium (5 g kg ⁻¹ seed)	15665.00	32984.83	17319.83	1.11
T ₃ - Control plot + PSB (5 g kg ⁻¹ seed)	15758.00	32308.44	16550.44	1.05
T ₄ - 125 % RDF	18233.00	59628.57	41395.57	2.27
T ₅ - 100 % RDF (20:50:20 Kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	17706.00	56742.55	39036.55	2.20
T ₆ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed)	17911.00	57581.52	39670.52	2.21
T ₇ - 100 % RDF + PSB (5 g kg ⁻¹ seed)	17936.00	58421.03	40485.03	2.26
T ₈ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	18141.00	74637.02	56496.02	3.11
T ₉ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed)	17315.00	56006.55	38691.55	2.23
T ₁₀ - 75 % RDF + PSB (5 g kg ⁻¹ seed)	17340.00	55455.61	38115.61	2.20
T ₁₁ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	17545.00	68221.56	50676.56	2.89

(continued on next page)

Table 4. Effect of integrated nutrient management on EC, pH and organic carbon of soil after harvest of horsegram.

Treatments	EC (dS m ⁻¹)	Soil pH	Organic carbon
T ₁ - Control plot	0.36	6.9	0.45
T ₂ - Control plot + Rhizobium (5 g kg ⁻¹ seed)	0.37	7.1	0.47
T ₃ - Control plot + PSB (5 g kg ⁻¹ seed)	0.37	7.0	0.46
T ₄ - 125 % RDF	0.39	7.2	0.50
T ₅ - 100 % RDF (20:50:20 Kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	0.38	7.1	0.49
T ₆ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed)	0.38	7.1	0.49
T ₇ - 100 % RDF + PSB (5 g kg ⁻¹ seed)	0.39	7.2	0.50
T ₈ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	0.41	7.3	0.52
T ₉ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed)	0.38	7.0	0.48
T ₁₀ - 75 % RDF + PSB (5 g kg ⁻¹ seed)	0.37	7.0	0.48
T ₁₁ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	0.4	7.2	0.51
SEm (±)	0.02	0.44	0.03
CD (5%)	NS	NS	NS
CV (%)	10.13	10.74	10.45

Table 5. Effect of integrated nutrient management on nutrient contents in horsegram.

Treatments	N (%)		P (%)		K (%)	
	Grain	Stover	Grain	Stover	Grain	Stover
T ₁ - Control plot	3.37	0.32	0.44	0.24	0.73	0.82
T ₂ - Control plot + Rhizobium (5 g kg ⁻¹ seed)	3.42	0.34	0.46	0.25	0.76	0.85
T ₃ - Control plot + PSB (5 g kg ⁻¹ seed)	3.40	0.34	0.45	0.25	0.75	0.84
T ₄ - 125 % RDF	3.54	0.36	0.51	0.28	0.78	0.87
T ₅ - 100 % RDF (20:50:20 Kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	3.50	0.38	0.48	0.27	0.80	0.90
T ₆ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed)	3.56	0.38	0.51	0.29	0.81	0.91
T ₇ - 100 % RDF + PSB (5 g kg ⁻¹ seed)	3.52	0.37	0.49	0.28	0.79	0.88
T ₈ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	3.59	0.39	0.53	0.31	0.84	0.94
T ₉ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed)	3.47	0.35	0.47	0.26	0.77	0.86
T ₁₀ - 75 % RDF + PSB (5 g kg ⁻¹ seed)	3.45	0.35	0.47	0.26	0.77	0.86
T ₁₁ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	3.51	0.36	0.48	0.27	0.78	0.87
SEm (±)	0.22	0.03	0.03	0.02	0.05	0.05
CD (5%)	NS	NS	NS	NS	NS	NS
CV (%)	10.82	12.55	11.28	10.63	10.02	10.45

(continued on next page)

Table 6. Effect of integrated nutrient management on nutrient uptake by horsegram.

Treatments	Nitrogen uptake (kg ha ⁻¹)			Phosphorus uptake (kg ha ⁻¹)			Potassium uptake (kg ha ⁻¹)		
	Grain	Stover	Total	Grain	Stover	Total	Grain	Stover	Total
T ₁ - Control plot	15.23	2.42	17.65	1.99	1.81	3.80	3.30	6.18	9.48
T ₂ - Control plot + Rhizobium (5 g kg ⁻¹ seed)	15.73	2.69	18.41	2.12	1.97	4.09	3.50	6.72	10.22
T ₃ - Control plot + PSB (5 g kg ⁻¹ seed)	15.31	2.67	17.98	2.03	1.96	3.99	3.38	6.59	9.97
T ₄ - 125 % RDF	29.54	4.36	33.91	4.26	3.39	7.65	6.51	10.59	17.10
T ₅ - 100 % RDF (20:50:20 Kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	27.95	4.31	32.25	3.89	3.26	7.15	6.27	10.30	16.57
T ₆ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed)	28.69	4.46	33.14	4.11	3.40	7.51	6.53	10.64	17.17
T ₇ - 100 % RDF + PSB (5 g kg ⁻¹ seed)	28.61	4.53	33.14	3.92	3.22	7.14	6.54	10.68	17.22
T ₈ - 100 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	37.52	5.79	43.31	5.54	4.60	10.14	8.78	13.97	22.75
T ₉ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed)	27.20	3.96	31.17	3.68	2.95	6.63	6.04	9.77	15.81
T ₁₀ - 75 % RDF + PSB (5 g kg ⁻¹ seed)	26.78	3.94	30.71	3.65	2.92	6.57	5.98	9.70	15.67
T ₁₁ - 75 % RDF + Rhizobium (5 g kg ⁻¹ seed) + PSB (5 g kg ⁻¹ seed)	33.53	4.86	38.39	4.58	3.65	8.23	7.45	11.80	19.25
SEm (±)	1.77	0.26	2.12	0.24	0.20	0.46	0.38	0.63	1.03
CD (5%)	5.22	0.76	6.26	0.71	0.59	1.37	1.13	1.84	3.05
CV (%)	10.41	10.23	10.88	10.12	10.54	10.89	10.07	10.24	10.41

Conclusion

The present investigation concluded that integrated nutrient management significantly improved the growth, yield, nutrient uptake and economic returns of horsegram. Among the different nutrient management treatments, T₈ (100% RDF + Rhizobium @ 5 g kg⁻¹ seed + PSB @ 5 g kg⁻¹ seed) proved to be the most effective treatment, recording the highest plant height, number of primary branches, plant dry weight, crop growth rate, yield attributes, grain yield (1045.03 kg ha⁻¹), stover yield (1484.92 kg ha⁻¹), harvest index (41.42%), nutrient uptake and profitability with the maximum gross return (₹ 74,637.02 ha⁻¹) and net return (₹ 56,496.02 ha⁻¹) and B:C ratio (3.11). Although post-harvest soil EC, pH, organic carbon and nutrient contents in grain and stover did not differ significantly among treatments. Therefore, the integrated application of 100% RDF along with Rhizobium and PSB is recommended for achieving higher productivity, improved nutrient uptake and greater economic returns in horsegram under the agro-climatic conditions of Chhattisgarh.

References

1. Anonymous. Directorate of Economics and Statistics (DES): Based on 3rd Advance Estimates for 2021. Commodity Profile for Pulses July. agricoop.nic. 2022.
2. Anonymous. Directorate of Agriculture, Chhattisgarh Government, Raipur. 2021.
3. Krishnaprabhu S. Integrated nutrient management for sustaining the Productivity of irrigated blackgram. *Jetir*. 2018;5(8).
4. Aravinthkumar P, Gokul D, Kamaleswaran R, Vijai AA, Manikandan K, Manibharathi S, Sridharan S. Residual and cumulative effect of ipns practices of Horsegram (*Macrotyloma uniflorum* Lam.) on growth and yield of Finger Millet-Horsegram Cropping Sequence. *Legume Research- An International Journal*. 2024;10(7):1-8.
5. Balachandran Sripriya Deotale RD, Hatmode CN, Thakre KG, Archana Thorat. Effect of bio fertilizers (pressmud, Rhizobium and PSB) and nutrients (NPK) on chemical and biochemical parameters of green gram. *Journal of Soils and Crops*. 2006;16(1):176-179.
6. Chandrakar K, Verma SK, Dubey S, Kesari R. Yield gap analysis of blackgram through front line demonstration under rainfed condition. *International Journal of Chemical Studies*. 2018;6(4):3173-3176.
7. Chaudhary N, Purib C, Jaisib PN, Basnet S. Effect of integrated nutrient management on yield and yield attributing characters of blackgram in lamahi, Dang. *Sustainability in Food and Agriculture*. 2020;1(2):106-108.
8. Deva Sahaza, Reddy B, Sahadeva B, Durgaprasad AVS. Effect of Integrated Nutrient Management on Growth, Yield and Economics of Horsegram (*Macrotyloma uniflorum*). *Mysore Journal of Agricultural Sciences*. 2026;60(1):276-279.
9. Desai NA, Chaudhary MG, Solanki KR, Chaudhary MG S. Effect of nutrient management on growth, yield attributes and yield of horsegram (*Macrotyloma uniflorum* L.). *The Pharma Innovation Journal*. 2022;11(4):2039-2043.
10. Gogai A, Hazarika JR, Deka AM, Chakrabarty R, Deka N, Borah HK. Effect of integrated nutrient management on growth, yield and soil fertility of horse gram (*Macrotyloma uniflorum* L.) in Assam India. *Plant Archives*. 2026;26(1):954-959.
11. Hanif N, Ramasamy AKA, Davidson R, Pandiyan M. Popularization of horsegram (*Macrotyloma uniflorum*) in Vellore District of Tamil Nadu. *Journal of Krishi Vigyan*. 2017;6(1):148-150.
12. Kala TC, Christi RM, Bai NR. Effect of rhizobium inoculation on the growth and yield of Horsegram (*Dolichos biflorus* Linn). *Plant archives*. 2011;11(1):97-99.
13. Khatoon R, Ali MN, Alam MP, Mahapatra P. Effect of organic nutrient sources on nutrient uptake, yield, and protein content of horse gram (*Macrotyloma uniflorum*) in upland soil of Jharkhand. *Agriculture association of Textile Chemical and Critical Review*. 2025;13(2):309-313.
14. Keshava BS, Halepyati AS, Pujari BT, Desai BK. Yield and economics of horse gram (*Macrotyloma uniflorum* Lam. Verdc.) as influenced by genotypes, plant densities and phosphorus levels. *Karnataka Journal of Agricultural Sciences*. 2007;20:589-591.
15. Kumar S, Kumar V, Kumar T, Bhaskar OP. Effect of Organic and Inorganic Nutrient Combinations on Yield and Economics of Black Gram (*Vigna mungo* L.). *Int.J.Curr.Microbiol.App.Sci*. 2020;9(8):3366-3371.
16. Mukeshkumar VT, Sudhakar P, Arivukkarasu K, Kamaraj A. Studies on influence of INM practices on growth and economics of Blackgram. *The Pharma Innovation Journal*. 2022;11(10):1653-1655.

17. Nalawde AA, Bharao SA. Response of black gram (*Vigna mungo* L. Hepper) to biofertilizer. International Journal of Life Sciences. 2015;3:81-84.
18. Neelam S, Kumar V, Natrajans, Venkateshwaran K, Pandravada SR. Evaluation and diversity observed in horsegram (*Macrotyloma uniflorum* L.). India plant. 2014;4(1):17-22.
19. Patre S, Shukla RK, Pandey D, Keshry PK, Chaure NK. Studies on integrated nutrient management on yield of blackgram (*Vigna mungo* L.) in Chhattisgarh plain. The Pharma Innovation Journal. 2022;11(7):3072-3077.
20. Purushotham S, Sharma KMS, Kulkarni KR. Response of horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.] to combinations of nitrogen, phosphorus and potassium on farmers field in Tumur district Bangalore, India. Mysore J. of Agricultural Science. 1988;22(4):444-451.
21. Siddappa R, Hegde NK. Effect of foliar spray of vermiwash and nutritional treatments on growth and yield performance of curry leaf var. Suvasini. The Asian Journal of Horticulture. 2011;6(1):68-70.
22. Sinclair TR, Vadez V. Physiological traits for crop yield improvement in low N and P environments. Plant Soil. 2002;245:1-15.
23. Singh B, Pareek RG. Studies on phosphorus and bio-inoculants on biological nitrogen fixation, concentration, uptake, quality and productivity of mung bean. Annals of Agricultural Research. 2003;24(3):537-541.
24. Singh B, Singh CP, Parihar SS. Growth and yield enhancement of mungbean by sources and levels of phosphorus and phosphate solubilizing microbes. Annals of Agricultural Research (New Series). 2006;27(1):210-212.
25. Singh AK, Tripathi PN, Singh R. Effect of Rhizobium inoculation, nitrogen and phosphorus levels on growth, yield and quality of kharif cowpea (*Vigna unguiculata*). Crop Research. 2007;33(1, 2 & 3):71-73.
26. Singh RP, Gupta SC, Yadav AS. Effect of levels and sources of phosphorus and PSB on growth and yield of blackgram (*Vigna mungo* L.). Legume Research. 2008;31(2):139-141.
27. Singh P, Agrawal HP, Patel JR, Keshry PK, Chaure NK, Agrawal AP, Sharma G, Patel CR, Rawate D, Hetram, Mitasha M. Performance of Integrated nutrient management on growth and yield of horsegram (*Macrotyloma uniflorum* L.) in Chhattisgarh plain. The Pharma Innovation Journal. 2022;11(9):1430-1434.
28. Sivasubramanian K, Kavitha B, Kanchana S, Hemalatha G. Evaluation of some selected black gram varieties for preparation of fermented idli. Research gate. 2015;Doi:10-15.
29. Sivakumar R, Vijayakumar M, Tamilselvan N. Impact of foliar spray of PGR nutrient consortium on growth, photosynthesis and yield of horsegram (*Macrotyloma uniflorum* Lam) under rainfed condition. Legume Research. 2023;46(8):981-987.
30. Subramanian KS, Klimaraswamy K. Effect of continuous cropping and fertilization on the response of finger millet to P. J. Indian Soc. Soil Sci. 1989;37:328-332.
31. Verma NK, Agrawal HP, Dhruve R. Effect of integrated nutrient management on yield and yield attribute of horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.] in Chhattisgarh plain. The Pharma Innovation Journal. 2023;12(7):2015-2016.
32. Verma NK, Manisha, Ramnath. Effect of Integrated Nutrient Management for Environmental Sustainability on Yield and Economics of Horsegram [*Macrotyloma Uniflorum* (Lam.) Verdc.]. Archives of Current Research International. 2025;25(9):60-67.

How to cite this article: Gupta S, Pandey T, Pandey D, Keshry P, Chaure N, Patel H, et al. Effect of integrated nutrient management on growth and yield of horsegram [*Macrotyloma uniflorum* (L.) Verdc.]. *International Journal of Agriculture and Food Science*. 2026;8(10):404-410. doi: <https://www.doi.org/10.33545/2664844X.2026.v8.i10f.2044>