Plant Archives Vol. 25, No. 2, 2025 pp. 2714-2717 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.2.392

EVALUATION OF EFFECTIVENESS OF INTEGRATED NUTRIENT MANAGEMENT ON PLANT GROWTH, QUALITY AND QUANTITY OF *SUMMER* BLACK GRAM (*VIGNA MUNGO* L. HEPPER)

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(Date of Receiving-04-06-2025; Date of Acceptance-14-08-2025)

ABSTRACT

A field experiment on black gram was carried out at the Instruction Farm of Invertis University Bareilly, Uttar Pradesh, India during *summer* season 2024. The soil of the experimental field was sandy loam in texture, low in organic carbon and available nitrogen, but medium in available phosphorus and available potassium having slightly alkali pH (7.35) with an electrical conductivity of 0.312. The experiment was arranged in a randomized block design having 8 treatments *viz;* T_1- Control, T_2- 100 % RDF (20: 60: 20 kg NPK/ha) + *Rhizobium*, T_3- FYM @3 t/ha, T_4- 100 % RDF + FYM @2.5 t/ha + *Rhizobium*, T_5 – 50 % RDF + FYM @2.5 t/ha + *Rhizobium*, T_6- Vermicompost @1.5 t/ha + *Rhizobium*, T_7- 100 % RDF + Vermicompost @1.5 t/ha + *Rhizobium*, T_8- 50 % RDF + VC @1.5 t/ha + *Rhizobium* with three replications. The application results noted that among the nutrient management practices, application of 100 % RDF + Vermicompost @1.5 t/ha + *Rhizobium* had maximum plant height (50.8 cm), Number of branches/plants (6.1) and dry matter accumulation (18.7 g/plant) at harvest stage. However, significantly maximum pods/plant (32.6), pod length (7.7 cm), grains/pod (11.4), test weight (37.3 g), grain yield (11.1 q/ha), straw yield (21.7 q/ha), biological yield (32.8 q/ha) was recorded under the application of 100 % RDF + Vermicompost @1.5 t/ha + *Rhizobium*

***Key words*:** Farm yard manure (FYM), *Rhizobium*, Vermicompost (VC) and Nutrient management,

Introduction

Black gram (*Vigna mungo* L.) is one of the important pulse crops, grown throughout the country. The crop is resistant to adverse climatic condition and improves the soil fertility by fixing atmospheric nitrogen in the soil. Black gram is a perfect combination of all nutrients, which includes proteins (25-26%), carbohydrates (60%), fat (1.5%), minerals, amino acids and vitamins. India is the largest producer of pulses in the world, accounting for about 25% global share. The total black gram production in India was 2.84 million tonnes from an area of 3.56 million hectare (Ministry of Agriculture and Farmer's welfare annual report 2021-22). In Uttar Pradesh, total area was 6.99 lakh hectare with total production of 4.5 lakh tonnes. There are numerous reasons for low yield of black gram in the country. These reasons are non-availability of quality seed of improved and short duration varieties, growing under marginal and less fertile soil with low inputs and without pest and disease management, growing under moisture stress conditions, unscientific postharvest practices and storage under unfavorable condition. There is immense scope for improving the production potential of this crop by use of organic manures, inorganic manures and biofertilizers (Verma *et al.*, 2017). Although, chemical fertilizers are playing a crucial role to meet the nutrient requirement of the crop, persistent nutrient depletion is posing a greater threat to the sustainable agriculture. Therefore, there is an urgent need to reduce the usage of chemical fertilizer and in turn, increase in the usage of organics which is needed to check the yield and quality levels. Use of organics alone does not result in spectacular increase in crop yield. Therefore, the foresaid consequences have paved way to grow pulses like black gram using organic and inorganic manures along with biofertilizers. The existing blanket recommendation for crops does not ensure efficient and economic use of

Table 1: Evaluation of different nutrient management practices on plant height (cm), number of branches/plant and dry matter accumulation (g/plant) of *summer* black gram at successive stage of crop growth.

Treatment	Plant Height (cm) at			No. of branches/plants at			Dry matter accumulation (g/plant) at		
	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	Harvest
T_1	10.4	36.5	43.4	1.4	2.3	3.3	3.3	10.4	11.7
T_2	13.3	38.9	45.7	2.5	3.3	4.1	4.1	12	12
T_3	12.6	37.3	44.5	3.2	4.3	5.4	4.9	11.3	14.2
T_4	14.5	40.7	48.0	2.5	3.7	4.9	5.9	13.5	18.2
T_5	13.2	36.2	46.2	2.4	3.6	4.8	3.9	11.2	13.9
T_6	12.9	39.9	45.3	2.4	3.8	5.2	5.2	13.3	18
T_7	14.9	46.2	50.8	3.9	5.0	6.1	6.5	13.9	18.7
T_8	12.6	38.5	47.6	2.2	3.6	5	5.0	13.2	18.0
SEm±	0.5	1.8	1.4	0.25	0.28	0.60	0.17	0.49	0.66
CD(P=0.05)	1.7	5.9	4.4	0.8	0.9	1.9	0.6	1.5	2.1

fertilizers, as it does not take into account of the fertility variations resulting in imbalanced use of fertilizer nutrients (Singh, 2018). The integrated nutrient management ensures higher productivity, minimizes expenditure on costly fertilizer inputs, improves physical properties of soil, efficiency of added nutrients and at the same time ensures good soil health and is also an environment-friendly approach (Kumpawat, 2010, Singh and Singh, 2017). It comprises of application of organic manures, green manures, bio-fertilizer and crop rotation with legumes along with minimum use of chemical fertilizer to produce optimum crop yields without deteriorating the soil health. Use of biofertilizers with organic manures may prove a viable option for sustaining crop production. But the information on use of organic, inorganic and biofertilizers in Vertisol is lacking in many crops including Black gram. Hence, the present investigation was carried out to study the effect of integrated nutrient management practices on growth, yield, and nutrient uptake of summer Black gram.

Material and Method

The field experiment was conducted at the Instruction Farm (at a latitude of 28° 29' North and longitude of 79° 49' East with an elevation of 652 m above mean sea level) of Invertis University Bareilly, Uttar Pradesh, India during *summer* season 2024 on sandy loam soil. The soil of the experimental field was low in organic carbon (0.45 %) and available nitrogen (189.3 kg/ha), but medium in available phosphorus (18.5 kg/ha) and potassium (198.85.6 kg/ha) having slightly alkali pH (7.5) with an electric conductivity of 0.309. Experimental field was moist, well- drained with uniform topography. The experiment was arranged in a randomized block design having 10 treatments *viz;* T_1- Control, T_2- 100 % RDF (20: 60: 20 kg NPK/ha) + *Rhizobium*, T_3- FYM @3 t/ha, T_4- 100 % RDF + FYM @2.5 t/ha + *Rhizobium*, T_5 – 50 % RDF + FYM @2.5 t/ha + *Rhizobium*, T_6- Vermicompost @1.5 t/ha + *Rhizobium*, T_7- 100 % RDF + Vermicompost @1.5 t/ha + *Rhizobium*, T_8- 50 % RDF + VC @1.5 t/ha + *Rhizobium* with three replications. Plant height was recorded with the help of a meter scale, dry matter accumulation was recorded in each plot, two plants form the sample rows (second row from both north and west side of the plot) was cut from the ground surface with the help of sickle at all the stages of crop growth and sun dried for 2-3 days. After sun drying, these plants were dried at 65±5^{0}C temperature at until a constant

Table 2: Evaluation of different nutrient management practices on yield attributes, yield and quality of *summer* black gram.

Treatments	Pods/ plant	Pod length (cm)	Grains/ pod	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)
T_1	21.3	6.3	10.1	35.6	6.1	14.1	20.2
T_2	29.5	7.4	10.7	35.9	9.3	20.5	29.8
T_3	28.7	7.0	10.6	35.7	8.7	18.3	27
T_4	32.4	7.6	11.3	37.1	10.9	21.3	32.2
T_5	27.7	6.7	10.4	35.7	8.2	18.2	26.4
T_6	32.3	7.6	11.2	36.7	10.6	21.0	31.6
T_7	32.6	7.7	11.4	37.3	11.1	21.7	32.8
T_8	30.3	7.5	11.0	36.2	9.7	20.3	30
SEm±	1.12	0.15	0.25	1.42	0.66	1.43	2.1
CD(P=0.05)	3.4	0.47	0.76	NS	2.1	4.4	6.4

weight was achieved and the average weight was expressed in gram per plant. The yield attributes viz; Pods/plant, Pod length (cm) and Grains/pod were recorded according to standard procedure. After the harvesting of border rows, the grain yield, stover yield and biological yield were recorded in kg/plot in each net plot and express as q/ha.

The mean of data was analyzed through Analysis of Variance (ANOVA) techniques for randomized block design and presented at 5 % level of significance (<P = 0.05).

Result and Discussion

Growth and development of black gram

The data is presenting Table 1. The effect of different nutrient management practices on various growth parameter *viz*; Plant height, number of branches/plant and dry matter accumulation (g/plant) at 30, 60 days after sowing (DAS) and at harvest stage. The maximum plant height of 14.9, 46.2 and 50.8 cm noted that with the application of 100 % RDF + Vermicompost @1.5 t/ha + *Rhizobium* at 30, 60 and at harvest stage, respectively. Which being *at par* with T_2, T_4 and T_5 at 30 DAS and T_4 at 50 DAS and at harvest stage. While, the lowest plant height 10.4, 36.5 and 43.4 was recorded under control at 30, 60 DAS and at harvest stage, respectively. Number of branches/plants was significantly affected by different nutrient management practices. The result presented in table 1 showed that the minimum to maximum branches/plant of 1.4, 2.3 and 3.3 to 3.9, 6.1 and 6.5 under control and 100 % RDF + Vermicompost @1.5 t/ha + *Rhizobium* (T_7), respectively. Which being statically *at par* with T_3 at 30 and 60 DAS, T_3, T_4, T_5, T_6 and T_8 at harvest. The result presented in table 1 showed that the minimum to maximum dry matter accumulation (g/plant) varies from 3.3, 10.4 and 11.7 to 6.5, 13.9 and 18.7 (g/plant) was recorded under control (T_1) and (T_7) which being *at par* with T_4 at 30 DAS and T_4, T_6 and T_8 at 60 DAS and at harvest. The remarkable improvement in growth character under integrated nutrient management practices can be attributed to the synergistic effects of inorganic, organic and biological nutrient sources. Inorganic fertilizer (RDF) supplied immediate and balanced amounts of essential macronutrients which are critical for early vegetative development, cell division and elongation. Organic manures (VC and FYM) enriched the soil with micronutrients and organic matter, improving soil physical properties like porosity, moisture retention and aeration. These factor collectively enhanced root development and nutrient absorption and Rhizobium facilitated atmospheric nitrogen fixation, making additional nitrogen available in the rhizosphere. The combined nutrient availability from these sources increased cell division and elongation, photosynthetic efficiency and biomass accumulation due to improves nutrient uptake and chlorophyll formation. The similar findings also reported by Omar and Bhatnagar., 2023, Kavya *et al.*, 2021 and Patel *et al.*, 2017

Yield attributes, yield and quality

The data is presenting in Table 2. The Impact of different INM practices on various yield attributes *viz.*, pods/plant, pod length, grains/pod, test weight (g), grain yield (q/ha), straw yield (q/ha) and biological yield (q/ha) have significant different. The significantly maximum pods/plant (32.6) and pod length (7.7 cm) were noted under T_7, which being statically *at par* with T_2, T_4, T_6 and T_8. While, the minimum pods/plant (21.3) and Pod length (6.3 cm) recorded under control. The maximum grains/pod (11.4) recorded under T_7 was statically *at par* with T_2, T_3, T_4, T_6 and T_8. The minimum grains/pod (10.1) noted under control. The maximum test weight (37.3 g) noted with the application of 100 % RDF + Vermicompost @1.5 t/ha + *Rhizobium* (T_7) while, the minimum test weight (35.6 g) noted under control. The increase in yield attributes by INM, was due to Integrated use of organic, inorganic and biofertilizer resulted in better growth of plants associated with increased availability of nutrients might have resulted in greater translocation of photosynthates from source to sink site that resulted higher yield contributing characters (Barik *et al.*, 2008) under these treatments. The favorable effect of integration of organic manures, inorganic fertilizers and *Rhizobium* on yield attributes of Black gram was reported by Kumpawat (2010) and Verma *et al.*, (2017). The significantly maximum grain yield of 11.1 q/ha, straw yield of 21.7 q/ha and biological yield of 32.8 q/ha were recorded under T_7. Grain yield *at par* with T_4 and T_6. While, straw and biological yield *at par* with all the treatment except unfertilized treatment. The minimum grain yield (6.1 q/ha), straw yield (14.1 q/ha) and biological yield (20.2 q/ha) received under control. This might be due to the benefits accruing from the integrated use of organic with inorganic fertilizers might be attributed to better supply of nutrients along with conducive physical environment leading to better root activity and higher nutrient absorption, which resulted better plant growth and superior yield attributes responsible for high yield (Thakur *et al.*, 2011 and Tyagi *et al.*, 2014). The positive impact of availability of individual plant nutrients and humic substances from manure and balanced supplement of nitrogen through inorganic fertilizers might have induced cell division, expansion of cell wall, meristematic activity,

photosynthetic efficiency and regulation of water intake into the cells, resulting in the enhancement of yield parameters. Improvement in yield due to combined application of inorganic fertilizer and organic manure might be attributed to control release of nutrients in the soil through mineralization of organic manure which might have facilitated better crop growth and yield (Verma *et al.*, 2017).

Conclusion

On the basis of experiment, it may be concluded that with the application of 100 % RDF + Vermicompost @1.5 t/ha + *Rhizobium* in black gram seems to be best as they improved the growth, yield attributes, yield and quality of black gram and provides a reliable, short- term and sustainable approach for increasing the yield in black gram.

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