# Response of Blackgram Varieties to Various NPK Doses in the Bundelkhand Region


## Abstract

Pulses play a pivotal role in contemporary agriculture, influencing food security and climate change mitigation. Blackgram (*Vigna mungo* L.), with its nutritional richness and adaptability, addresses malnutrition and contributes to soil fertility. This study focuses on enhancing blackgram productivity in Bundelkhand, Uttar Pradesh, addressing challenges through tailored variety selection and balanced nutrient management. The experiment, conducted in 2022, evaluates three varieties (Azad-3, IPU 10-26, IPU 11-2) and three NPK doses (75% RDF, 100% RDF, 125% RDF) to comprehensively analyze growth, yield, and economic parameters of blackgram. Findings revealed that variety IPU 10-26 and NPK dose 100% RDF ~~demonstrates~~ exhibited superior growth, yield, and economic performance, ~~emphasizing~~ indicating its ~~competitiveness~~competitive and comparative advantage over the other varieties and nutrient management treatments. The study ~~concludes~~ demonstrates that optimal blackgram production in Bundelkhand necessitates location-specific variety choices and a ~~delicate~~ prudent balanced nutrient management strategy that could be exploited for increased productivity of the crop~~balance~~, as exemplified by IPU 10-26 and 100% RDF.



**Keywords:** Blackgram, Bundelkhand, crop growth, economics, nutrient management, productivity, variety, *Vigna mungo*


## Introduction:

Pulses play an integral role in modern agriculture, extending their influence beyond soil health enhancement to encompass vital dimensions of food security and climate change mitigation. This significance is particularly pronounced in regions where animal protein is scarce or economically challenging to obtain. Blackgram (*Vigna mungo* L.) is in proteins, fats, minerals, and vitamins.~~, with its~~ It exhibits 20% to 25% protein content~~ranging from 20% to 25%~~, which makes it ~~stands out as~~ a crucial component of dietary plans (Ref???). Its amino acid profile is essential for combat~~t~~ing malnutrition and food insecurity, especially in vulnerable communities (Ref??). ~~Beyond~~ Besides, its nutritional benefits, blackgram thrives in diverse agro-climatic conditions, contributing significantly to soil fertility and livestock fodder (Ref??). ~~Rich in proteins, fats, minerals, and vitamins, blackgram~~ Blackgram also plays a vital role in traditional medicine and culinary practices in India, offering a myriad of health advantages.

However, despite Despite its nutritional and agronomic potential, blackgram faces productivity challenges, especially in regions like Bundelkhand in Uttar Pradesh (UP). Factors such as the non-availability of quality seeds, imbalanced fertilizer application, moisture stress, and inadequate pest and disease management contribute to lower yields (Sharma and Sisodia, 2018, ; Kumar *et al.*, 2017). These challenges can be addressed, specifically in U.P. Bundelkhand, by exploring the impact of different NPK doses on the growth and yield of blackgram varieties (Kumar *et al.*, 2022; Mishra *et al.*, 2017; Rajiv and Singh, 2014). The study delves into the economic aspects of cultivation, providing insights and recommendations for optimizing blackgram production and productivity in the region, ultimately contributing to food security and the economic well-being of farmers. The findings have the potential to guide future interventions, bridging technological and extension gaps while promoting sustainable agricultural practices in Bundelkhand.

Comments

The objective of the study has not being state.

The authors did not use the manuscript template of this journal and did not follow the sequential numerical ordering of this journal throughout the write-up. Please refer to the authors guidelines for this journal.

**Materials and Methods:**

The field experiment took was conducted place during the kharif season of 2022 at the IFS Farm, Banda University of Agriculture and Technology, India. The region's agro-climatic conditions, characterized by a hot and semi-humid climate with occasional droughts, present unique challenges to crop cultivation. The experimental field, located between latitude 24° 53' and 25° 55'N and longitudes 80° 07' and 81° 34'E, at an altitude of 168 meters above sea level, falls under agro-climatic zone-8 (Central Plateaus & Hills Region) in India. Composite soil samples were collected from each plot at depths of 0 to 30 cm before sowing and subjected to laboratory analysis to determine physical and chemical characteristics crucial for understanding soil fertility. The experimental field had a history of pigeon pea and mustard crops sown during the previous kharif and rabi seasons, respectively. The field experiment, laid out in a Split-plot design with three replications, involved three blackgram varieties (Azad-3, IPU 10-26, and IPU 11-2) as main plot treatments and three nutrient doses (75% RDF, 100% RDF, and 125% RDF, where RDF is 25:50:30 kg of NPK /ha$^{-1}$) as sub-plot treatments. Recommended rates of nitrogen, phosphorous, and potassium were applied using DAP, Urea, and MOP, respectively, with specific timings and methods. Manual sowing of blackgram seeds took place on July 31st, 2022, with specific spacing and depth.

Various growth parameters, including plant population, height, dry matter accumulation, leaf area, and number of branches, were assessed at different stages. Additional parameters such as the

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number of pods, length of pod, number of seeds per pod, test weight, biological yield, and economical yield were determined to comprehensively assess crop productivity. Seed protein content was calculated by multiplying Nitrogen % in grain by the conversion factor 6.25. Soil parameters, including pH, EC, organic carbon, available nitrogen, phosphorus, potassium, sulphur, bulk density, and particle density, were analyzed to understand the soil's properties. The economic viability of different treatments was evaluated by calculating the cost of cultivation, gross returns, and net profit. Data on growth, yield, and soil parameters were subjected to analysis of variance according to Gomez and Gomez (1984) with a 5% probability level. The "F" test was performed to determine statistical significance, and critical differences were calculated.

Comments

How and when were the various parameters collected?? You might reference established protocols of previous authors utilized in your work.

What guided the nutrient doses utilized? Why were 0, 25 and 50% RDF omitted in your study??

This study did not capture nutrient release pattern and this aspect might be considered in future studies.

The active ingredients of the various fertilizers were not also captured.

Which statistical package did you utilize for your analysis??

**Results and Discussion:**

***Effect of variety and nutrient management on growth of blackgram:***

Varieties did not significantly affect emergence count or final plant population, though numerically higher counts were observed in IPU 10-26. NPK doses showed no significant impact on emergence count or final plant population, with 125% RDF numerically higher. Plant height at 30 and 45 days after sowing (DAS) did not significantly differ among varieties, but IPU 10-26 exhibited taller plants at 60 DAS and at harvest (X DAS). NPK doses showed no significant impact on plant height at 30 and 45 DAS, but 125% RDF produced taller plants at 60 DAS and at harvest.

Varieties did not significantly affect Leaf Area Index (LAI), but numerically higher LAI was observed in IPU 10-26. NPK dose did not significantly impact LAI, but the maximum LAI was observed in 125% RDF. Variety IPU 10-26 exhibited significantly more branches at 60 DAS and harvest. NPK dose had non-significant effects at 30 and 45 DAS, but significantly influenced branches at 60 DAS and at harvest, with the maximum under 125% RDF. Variety effect on root nodulation was non-significant at 30 and 60 DAS, but was significant at 45 DAS, with the highest nodules observed under 125% RDF, which was statistically at par with 100% RDF. Variety IPU 10-26 recorded significantly higher dry matter accumulation at 60 DAS. NPK dose did not significantly

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influence dry matter at 30 DAS, but at 45 and 60 DAS, 125% RDF recorded significantly higher dry matter compared to 75% RDF.

The choice of location-specific, appropriate varieties plays a crucial role in crop productivity, contributing to a 20-30% increase in productivity. The impact of varieties on growth and yield attributes was assessed, revealing significant differences. IPU 10-26 demonstrated superiority in plant height, number of branches, and dry matter accumulation over IPU 11-02 and Azad-03. Variations in plant height and root nodulation may be attributed to genetic differences, environmental factors, and the interaction between host plants and *Rhizobium* spp. The impact of different NPK doses on blackgram varieties was statistically non-significant, ~~emphasizing~~ indicating the importance of balanced fertilizer application for optimal crop output and soil health. NPK doses influenced root nodulation, plant height, and dry matter accumulation. A balanced dose, particularly 125% RDF, positively affected these attributes, indicating improved soil fertility and nutrient availability, aligning with the findings of previous studies. Aher *et al*. (2006) and Arpita and Singh (2022) also ~~has been~~ reported the effect of nutrient management ~~variation~~ on growth characters blackgram genotypes. ~~according~~ Accordingly, ~~to the genotypes in blackgram, where~~ genetic potential of varieties is among factors ~~deciding~~ that influence the growth performance of the crop ~~in relation~~ as well as ~~to~~ several interactions ~~with~~ among factors such as climate and edaphic ~~factors~~ parameters of the region. The height of a plant is an important morphological trait which determines the yield potential of the crop through the development of a greater photosynthetic area. In general, the application of 100% RDF along with biofertilizers ~~inputs~~ was found to have a positive effect on this trait.

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The increase in plant height, dry matter, nodulation, LAI might be due to the supply of essential micro and macro nutrients to the plants caused by ~~when decomposed increasing both nutrients in the soil as well as enhancing~~ the nutrient enhancement of the physical, chemical, and biological processes of soil. This could have led to its high vegetative growth. Production of plant hormone-like auxin and gibberellin has been described as the major reason for increasing plant growth due to the presence of Rhizobium bacteria. The results are in line with the findings of Rathod and Gawande (2014) and Amutha *et al*.~~,~~ (2012) who found that ……..??.

***Effect of variety and nutrient management on yield and ~~attributing~~ attribute characters ~~and yield~~ of blackgram~~:~~***

Variety IPU 10-26 significantly produced ~~significantly more~~ the highest number of pods per plant, whereas Azad-3 produced the lowest. Application of 125% RDF recorded the maximum pods per plant, significantly higher than 100% RDF and 75% RDF. Varieties did not significantly affect pod length, but IPU 10-26 exhibited numerically higher pod length. NPK dose did not significantly affect pod length, but numerically, 125% RDF was superior. IPU 10-26 produced significantly higher seed pod$^{-1}$. Nutrient management practices did not significantly affect the number of seed pod$^{-1}$.

IPU 10-26 significantly outperformed in yield attributes, showing higher seed and biological yields. The close correlation between seed yield and various yield components highlighted the genetic influence on overall yield. The increased biological yield with varieties suggested improvements in vegetative and reproductive growth. Economic analysis revealed that IPU 11-02 yielded the highest net returns, gross returns, and benefit-cost ratio. However, economic performance varied among varieties, with IPU 10-26 demonstrating competitiveness. This outcome was attributed to the genetic potential and climatic adaptability of the varieties. Variety IPU 10-26 exhibited higher seed protein content compared to IPU 11-02, emphasizing the impact of genetic makeup on nutrient uptake. Nitrogen concentration, which is crucial for protein synthesis, was potentially increased in IPU 10-26, aligning with the findings of previous studies. The number of pods per plant and subsequent biological and seed yields significantly increased under 125% RDF, ~~emphasizing~~ indicating the role of balanced fertilization in enhancing crop yield. This aligns with research highlighting the positive impact of phosphorus on seed and stover yield in blackgram. The growth performance of the different varieties ~~has been directly~~ is ~~reflected~~ reflective ~~into~~ of the view that further translocation of assimilates may have occurred ~~for~~ leading to improved yield characters and higher yield in variety IPM 10-26. Choudhary *et al*. (2017) and Singh *et al*. (2017) also ~~has been~~found ~~correlated~~ the impact of cultivars on growth and yield of blackgram due to the biotic and abiotic factors interacting with crop growth and yield potential as per the specific local conditions. The response of blackgram yield observed in 100 and 125% RDF ~~percent~~ nutrient doses might be due to photosynthesis results and an adequate supply of nutrients from higher inorganic fertilizer which have a better effect on the number of pods per plant due to improvement in the soil fertility. It also releases the nutrients for the benefit of crops during the entire crop growth period. These findings agree with Tyagi and Singh. (2019) and Sachin *et al*. (2019).

***Effect of variety and nutrient management on economic parameters of blackgram~~:~~***

The cost of production was not significantly affected by blackgram varieties. The maximum cost was incurred at 125% RDF, and the minimum at 75% RDF. IPU 10-26 produced the highest gross returns, followed by IPU 11-02 and Azad-03. 125% RDF produced the maximum gross returns, significantly over 100% RDF and 75% RDF. IPU 10-26 produced the maximum net returns. The application of 125% RDF produced the maximum net return. The interaction effect on net income was statistically non-significant. IPU 10-26 recorded significantly higher benefit-cost ratio. The highest benefit-cost ratio was observed with 100% RDF, while the remaining nutrient treatments were statistically at par with 125% RDF.

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Economic analysis revealed that 100% RDF produced the highest gross returns, net returns, and benefit-cost ratio, surpassing the 125% RDF treatment. This suggests that balanced nutrient management, particularly at 100% RDF, resulted in optimal economic returns. The application of 125% RDF positively influenced seed protein content, indicating a direct relationship between fertilizer dose and nutrient concentration in seeds. The increment in yield with application of equivalent amount of inputs in IPM 10-26 and 100% RDF is reflected into higher gross& , net return and B:C ratio. Similar results have been reported by Kokani *et al*. (2014) in blackgram.

**Conclusion:**

This study emphasizes the critical role of tailored variety selection and balanced nutrient management in optimizing blackgram cultivation. Variety IPU 10-26 emerged as a competitive variety, exhibiting superior growth and yield attributes. Economic analysis revealed optimal returns with 100% RDF, emphasizing the delicate balance required for sustainable and economically viable blackgram production in Bundelkhand region of Uttar Pradesh.

Comments

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**References**

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Aher, S.R., Mate, S.N., and Tagad, L.N., (2006). Effect of morpho-physiological parameters on yield and yield contributing characters in germplasm of Blackgram (*Phaseolus mungo* L.). *Legume Research*, 29: 154-156.

Amutha R., S. Nithila and Sivakumar, T., (2012). Management of source limitation by foliar spray of nutrients and growth regulators in Blackgram. *International Journal of Plant Sciences*, 7(1):65-68.

Arpita Pandey and Rajesh Singh., (2022). Effect of Spacing on Yield and Economics of Varieties of Blackgram (*Vigna mungo* L.) *International Journal of Plant & Soil Science*, 34(15): 37-42.

Choudhary, P., Singh, G., Reddy, G.L. and Jat, B.L., (2017). Effect of Bio-fertilizer on different varieties of Blackgram (*Vigna mungo* L). *International Journal of Current Microbiology and Applied Sciences*, 6(2): 302-316.

Gomez, K.A. and Gomez, A. (1984) Statistical Procedure for Agricultural Research—Hand Book. John Wiley & Sons, New York.

Kokani, J.M., Shah, K.A., Tandel, B.M. and Nayaka, P., (2014). Growth, yield attributes and yield of summer Blackgram (*Vigna mungo* L.) as influenced by FYM, phosphorus and sulphur. *The Ecoscan*, 6: 429-433.

Kumar, P., Handral, A.R., Mondal, B., Yadav, R.K., Anbukkani, P., (2022). Economics of Pulse Production in Bundelkhand Region of Uttar Pradesh, India: An Empirical Analysis. *Research on World Agricultural Economy*. 3(3): 560.

Kumar, R., Singh, S.K. and Sah, U., (2017). Multidimensional study of pulse production in Bundelkhand region of India. *Legume Research*, 40(5): 1046-52.

Mishra, D.K., Singh, K.K., Roy, N. and Kumar, V., (2017). Impact of front line demonstrations (FLDs) on yield of pulses in NICRA villages of Bundelkhand region of U.P. *International Journal of Plant Sciences*, 12(2): 169-172.

Rajeev and Singh, L., (2014). Performance of pulses demonstrations in Bundelkhand zone of Uttar Pradesh. *Indian Journal of Applied Research*, 4(3): 1-2.

Rathod, S. L. and Gawande, M. B., (2014). Response of green gram varieties to different fertilizer grades. *The International Journal of Science and Research*, 3: 1313-15.

Sachin, A.S., T. Sivakumar, K. KrishnaSurendar, Senthivelu, M., (2019). Influence of plant growth regulators and nutrients on biometric, growth and yield attributes in Blackgram (*Vigna mungo* L.). *Journal of Agriculture and Ecology*, 1(7): 55-63.

Sharma, M. K., & Sisodia, B. V. S., (2018). Pulses area out of reach-a regional study of Uttar Pradesh. *International Journal of Agriculture Sciences*, 10(5): 5335-5342.

Singh Kumar Ritesh, Dawson Joy, and Srivastava Nishant., (2017). Effect of sources of nutrient on growth and yield of blackgram (*Vigna mungo* L.) varieties in NEPZ of India. *Journal of Pharmacognosy and Phytochemistry*, 6(4): 1064-1066.

Tyagi, P. K and Singh V. K., (2019). Effect of integrated nutrient management on growth, yield, and nutrients uptake of summer Blackgram (*Vigna mungo*). *Annals of Plant and Soil Research*, 21(1): 30-35.

**Table 1: Influence of Varieties and Nutrient doses on growth of blackgram**

| Treatment | Plant height (cm) | | | | No. of Branches | | | | Leaf Area Index | | | No. of root nodules plant$^{-1}$ | | | Plant Dry Matter (g. plant$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 45 DAS | 60 DAS | At harvest | 30 DAS | 45 DAS | 60 DAS | At harvest | 30 DAS | 45 DAS | 60 DAS | 30 DAS | 45 DAS | 60 DAS | 30 DAS | 45 DAS | 60 DAS |
| **$V_1$** | 29.47 | 36.97 | 44.00 | 48.93 | 1.72 | 4.10 | 5.71 | 7.71 | 0.268 | 1.60 | 2.54 | 23.159 | 24.56 | 12.14 | 1.65 | 4.30 | 7.27 |
| **$V_2$** | 30.11 | 37.91 | 45.94 | 50.76 | 1.77 | 4.29 | 6.46 | 8.47 | 0.269 | 1.66 | 2.73 | 23.409 | 26.52 | 12.37 | 1.64 | 4.47 | 7.89 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$V_3$** | 29.09 | 37.75 | 43.65 | 47.31 | 1.73 | 4.09 | 6.20 | 8.20 | 0.262 | 1.64 | 2.54 | 22.868 | 24.77 | 11.89 | 1.67 | 4.41 | 7.18 |
| **SEm±** | 0.30 | 0.27 | 0.16 | 0.42 | 0.01 | 0.05 | 0.05 | 0.05 | 0.03 | 0.01 | 0.03 | 0.182 | 0.14 | 0.15 | 0.02 | 0.05 | 0.03 |
| **CD (P=0.05)** | NS | NS | 0.65 | 1.68 | NS | NS | 0.19 | 0.19 | NS | NS | NS | NS | 0.56 | NS | NS | NS | 0.11 |
| **$N_1$** | 29.20 | 37.14 | 41.18 | 45.99 | 1.73 | 4.12 | 5.65 | 7.65 | 0.263 | 1.47 | 2.25 | 22.829 | 24.41 | 11.96 | 1.62 | 4.04 | 6.17 |
| **$N_2$** | 29.68 | 37.44 | 45.53 | 49.68 | 1.74 | 4.18 | 6.36 | 8.36 | 0.266 | 1.68 | 2.77 | 23.088 | 25.52 | 12.07 | 1.67 | 4.53 | 8.04 |
| **$N_3$** | 29.79 | 38.04 | 46.57 | 50.82 | 1.75 | 4.18 | 6.38 | 8.38 | 0.271 | 1.75 | 2.78 | 23.519 | 25.91 | 12.37 | 1.67 | 4.62 | 8.12 |
| **SEm±** | 0.20 | 0.33 | 0.34 | 0.39 | 0.02 | 0.04 | 0.04 | 0.04 | 0.03 | 0.01 | 0.03 | 0.252 | 0.13 | 0.13 | 0.02 | 0.03 | 0.05 |
| **CD (P= 0.05)** | NS | NS | 1.04 | 1.22 | NS | NS | 0.12 | 0.12 | NS | 0.04 | 0.09 | NS | 0.40 | NS | NS | 0.10 | 0.14 |

($V_1$: Azad-3; $V_2$: IPU 10-26; $V_3$: IPU 11-2; $N_1$: 75% RDF; $N_2$: 100% RDF; $N_3$: 125% RDF; RDF is 25:50:30 kg of NPK /ha$^{-1}$)

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**Table 2: Influence of Varieties and Nutrient doses on yield attributing characters, yield and economics of blackgram**

| Treatment | No. of Pod plant$^{-1}$ | No. of seed pod$^{-1}$ | Pod length (cm) | Seed Yield (q./ha$^{-1}$) | Biological Yield (q./ha$^{-1}$) | Harvest Index | Test weight (g) | Cost of Cultivation (Rs./ha$^{-1}$) | Gross return (Rs./ha$^{-1}$) | Net Income (Rs./ha$^{-1}$) | B:C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **$V_1$** | 16.77 | 4.04 | 4.16 | 11.47 | 34.39 | 33.65 | 37.28 | 34771 | 92705 | 54770 | 1.45 |
| **$V_2$** | 17.77 | 4.62 | 4.22 | 12.39 | 36.46 | 34.70 | 37.71 | 34771 | 98199 | 60263 | 1.59 |
| **$V_3$** | 17.38 | 4.52 | 4.14 | 11.39 | 34.28 | 33.96 | 37.07 | 34771 | 92873 | 54938 | 1.45 |
| **SEm±** | 0.15 | 0.03 | 0.04 | 0.10 | 0.10 | 0.19 | 0.09 | - | 713 | 543 | 0.01 |
| **CD (P=0.05)** | 0.59 | 0.11 | NS | 0.38 | 0.39 | NS | NS | - | 2799 | 2131 | 0.06 |
| **$N_1$** | 16.39 | 3.78 | 4.14 | 10.54 | 32.92 | 34.10 | 37.13 | 37205 | 88477 | 51272 | 1.38 |
| **$N_2$** | 17.54 | 4.63 | 4.14 | 12.28 | 35.84 | 34.16 | 37.34 | 37935 | 97083 | 59147 | 1.57 |
| **$N_3$** | 17.98 | 4.78 | 4.23 | 12.43 | 36.38 | 34.82 | 37.59 | 38664 | 98217 | 59552 | 1.54 |
| **SEm±** | 0.19 | 0.05 | 0.03 | 0.13 | 0.21 | 0.26 | 0.17 | - | 664 | 619 | 0.02 |
| **CD (P= 0.05)** | 0.59 | 0.15 | NS | 0.40 | 0.64 | NS | NS | - | 1999 | 1907 | 0.05 |

($V_1$: Azad-3; $V_2$: IPU 10-26; $V_3$: IPU 11-2; $N_1$: 75% RDF; $N_2$: 100% RDF; $N_3$: 125% RDF; RDF is 25:50:30 kg ~~of~~ NPK/ha$^{-1}$)