Original Research Article

Performance of graded doses of fertilizers and varieties on growth, yield and quality of Black gram (*Vigna mungo* L.)

Comment [RR1]: customized writing format

Abstract

A study was conducted during the *kharif* season of 2022 at the Research plot, Department of Agronomy, AKS University, Madhya Pradesh to investigate the impact of graded doses of fertilizers*viz*., Control (F_0), NPK @ 18:18:18 kg/ha (F_1), NPK @ 19:19:19 kg/ha (F_2), and NPK @ 20:20:20 kg/ha (F_3) and three varieties*i.e*.,IPU-2-43 (V_1), PU-31 (V_2), Indira-1 (V_3) on black gram.The experimental design employed was a Randomized Complete Block Design, with the 12treatment combinations replicated three times.Results revealed thattreatment F_3(NPK @ 20:20:20kg/ha) significantly enhanced plant height (40.73 cm), number of branches per plant (4.49), number of leaves per plant (27.09) and number of root nodules (30.89). This grade also resulted in maximum yield attributes such as the number of pods per plant (22.00), grains per pod (4.89), test weight (36.98 g), grain (9.31 q/ha) and stover yield (18.10 q/ha). Additionally, the highest protein content (21.71 %) in black gram grain was observed with the application of F_3(NPK @ 20:20:20 kg/ha).Regarding varieties, Indira-1 displayed superior growth parameters and yield-contributing characters compared to IPU-2-43 and PU-31. Notably, Indira-1 exhibited higher protein content in seeds.The results suggest that the application of NPK @ 20:20:20 kg/ha and cultivation of the Indira-1 variety hold promise for enhancing black gram productivity.

Comment [RR2]: Consistent unit writing$kg.ha^{-1}$

Keywords: Black gram, fertilizer grade, urd, varieties

1. Introduction

Black gram (*Vigna mungo* L.) plays a crucial role in preserving and enhancing soil fertility by harnessing atmospheric nitrogen through root nodules containing Rhizobium bacteria. With a composition of 60% carbohydrates, 24% proteins, and 1.3% fats, it stands out for its phosphorus richness, surpassing other pulses by 5-10 times [1]. The suboptimal productivity of black gram can be attributed to factors such as inadequate fertility management and the cultivation of outdated traditional varieties, both contributing

significantly to diminished yields. In 2018-19, pulse cultivation covered 29.03 million hectares, yielding 23.40 million tonnes at a rate of 806 kg/ha [2]. In Madhya Pradesh, black gram is cultivated across 1788.80 thousand ha, producing 1744.35 thousand MT with a productivity of 975 kg/ha.

Among various cultivation practices, fertility management emerges as a crucial agronomic aspect for elevating crop yield and sustaining soil fertility. Nitrogen fertilizer, essential for enhancing soil fertility and crop productivity, boosts grain yield and biomass. This vital nutrient plays a pivotal role in the growth, development, and protein content of pulses [3]. The scarcity of phosphorus poses a significant challenge in realizing the maximum yield potential [4]. Phosphorus influences root growth, nodulation, energy storage, and transport. It is acrucial component of nucleic acids and several enzymes which are crucial for energy conversion in carbohydrate metabolism and plant respiration.

Comment [RR3]: Add references to research results on the influence of inorganic fertilizer

Modern varieties of black gram generally exhibit higher grain yields, with yield components significantly influenced by fertilizer levels. However, farmers often cultivate black gram without optimal fertilizer doses, hesitating to adopt higher amounts. Utilizing new varieties with the appropriate fertilizer dosage has the potential to increase yields. Variations in yield-related parameters persist among varieties from different parental origins, with these characteristics being genetically controlled. Despite the availability of various black gram varieties, information regarding their suitability for cultivation in diverse altitudinal ranges is lacking.

Comment [RR4]: Add references to research results on the influence of varieties

The cultivation aspects of black gram, especially in the Vindhya region, have been relatively underexplored. There exists a potential to significantly influence productivity per unit area through the judicious application of fertilizers and the selection of suitable varieties. Consequently, the present study was undertaken toassess the performance of graded doses of fertilizers and varieties on growth, yield and quality of black gram.

2. Materials and Methods

Comment [RR5]: Writing adapted to the template, consisting of:
Location
Design experiments
Procedure
Parameter observation
Data analysis

During the *kharif* season of 2022, an experiment was conducted at the Research plot, Department of Agronomy, AKS University, Satna M.P. which is located in the north-eastern part of Madhya Pradesh the latitude of $23^0$58' to $25^0$12' N and longitude of $80^0$21' to $81^0$23' east in Rewa division of M.P.The soil of the experimental site hada pH (7.30) and an electrical conductivity of 0.18dS m^{-1}. The soil had a low organic carbon content (0.45 %) and contained only 178.2 kg ha^{-1} of available nitrogen, 14.4 kg ha^{-1} of available phosphorus and

196.0 kg ha^{-1} of available potassium.The experimental design employed was a Randomized Complete Block Design, with the 12treatment combinations repeated three times.The treatments combinations applied in the experiment were drawn from four graded doses of fertilizers *i.e.*, Control (F_0), NPK @ 18:18:18 kg/ha (F_1), NPK @ 19:19:19 kg/ha (F_2), and NPK @ 20:20:20 kg/ha(F_3) and three varieties *viz*., IPU-2-43 (V_1), PU-31 (V_2), Indira-1 (V_3). The fertilizer application was done as per the treatments. The sowing took place on July 21, 2022. Thinning was performed at 20 DAS when plants attained a height of 10 cm. Five plants were randomly chosen from each net plot and specifically identified for biometric observations throughout various growth stages. These plants were individually harvested to facilitate comprehensive post-harvest studies. The analytical approach employed involved the use of analysis of variance to assess the significance of the experimental outcomes. In instances where the F-test yielded significance at a 5% level, the critical difference (C.D.) for treatment means was calculated.

Comment [RR6]: Consistent unit writing$kg.ha^{-1}$

Comment [RR7]: How are the research procedures?

Comment [RR8]: add observed parameters

3. Results and Discussion

3.1 Effect of different fertilizer grades

A perusal of the data in Table 1 and Fig. 1 manifests thatapplication of F_3(NPK @ 20: 20: 20 kg/ha) recorded significantly higher values for plant height (40.73 cm), number of branches per plant (4.49), number of leaves per plant (27.09) and root nodules per plant (30.89) followed by F_2 (NPK @ 19: 19: 19kg/ha). While values for these parameters were lowest in Control (F_0).This increase in plant growth of black gram might be due to better availability of nutrients throughout the crop growth stages, where the chemical fertilizer supplied the NPK at the initial growth stages of the crop and later stages of nutrients. The number of branches and trifoliate leaves per plant is an important indicator of the total source available to the plant for photosynthesis production. This could be attributed to an augmented provision of multi-nutrients, complemented by exceptionally favourable conditions concerning the physicochemical and biological attributes of the soil. These results also corroborate the findings of Sekhar *et al*. (2020) [5] and Sahu *et al*. (2022) [6].

Comment [RR9]: Consistent unit writing$kg.ha^{-1}$

The application of F_3(NPK @ 20: 20: 20 kg/ha) resulted insignificant maximum yield attributing parameters *viz*., number of pods per plant (22.00), number of grains per pod (4.89), test weight (36.98 g), grain yield (9.31 q/ha), stover yield (18.10 q/ha) and harvest index (33.55 %) followed by F_2(NPK @ 19: 19: 19kg/ha). While values for these parameters were lowest in Control (F_0). The superior yield attributes and overall productivity observed in

this treatment can be attributed to heightened growth parameters resulting from an enhanced supply of essential plant nutrients. Additionally, the improved physicochemical and biological properties of the soil played a crucial role. These favourable conditions likely contributed to an increased accumulation of carbohydrates and their efficient translocation from source to sink (reproductive organs). Consequently, this mechanism led to a substantial increase in the number of yield-attributing parameters. These results pertain in close agreement with numerous researcherslikeVakeswaran*et al*. (2016) [7], Singh *et al*. (2018) [8] and Sahu *et al*. (2021) [9].

Comment [RR10]: How effective is NPK fertilizer?

Fertilizer grade had a significant impact on protein content in black gram grain. The maximum protein content (21.71 %) in black gram grain was recorded under the application F_3(NPK @ 20: 20: 20 kg/ha) while the least protein content was in control (F_0). The augmented qualitative parameters can be ascribed to the pivotal role of applied nutrients in governing photosynthesis, coupled with improved microbial activities fostered by favourable soil conditions, ultimately contributing to enhanced protein content. Comparable findings were documented by Thiyageshwari et al. (2018) [10].

Comment [RR11]: What is the role of NPK in protein formation

3.2 Effect of varieties

Black gram varieties differed significantly with respect to growth parameters like plant height, number of leaves, number of branches and root nodules, almost at all the growth stages. Variety Indra-1 recorded significantly higher plant height (38.61 cm) and branches per plant (4.48), number of leaves per plant (24.72) as well as higher root nodules (31.22) as compared to variety IPU- 2-43and PU- 31. This might be due to the fast growth habit of variety Indra-1 which increased plant height, dry matter accumulation branching and nodules.

The results regarding yield contributing characters *viz*., number of pods per plant (20.23), number of seeds per pod (4.77), test weight (37.13 g), grain yield (9.71 q/ha), stover yield (18.59 q/ha) and harvest index (33.83 %) showed that variety Indra-1 was superior as compared to IPU- 2-43 and PU- 3 which might be because of synthesis of more photosynthates due to increased source capacity and efficient translocation of photosynthates to the sink (seed). Dash and Rautary (2017) [11],Mondal and Sengupta (2019) [12] and Pareek*et al*. (2022) [13] also observed differences in yield attributing characters under different varieties of black gram.

Comment [RR12]: add, How is the ability to adapt to the environment

It was further observed that variety Indra-1 showed significantly higher protein content (21.85 %) in seed over others. The results of the present investigation regarding the

differential behaviour of black gram varieties with respect to protein content are in close conformity with the findings of other workers like Patidar and Singh (2018) [14], Adhithya*et al*. (2022) [15] and Pareek*et al*. (2022) [13].

4. Conclusion

Based on the experimentation, it may be concluded that among graded doses of fertilizers, the application of NPK @ 20:20:20 kg/ha was found to be most effective in obtaining better yield and yield attributes of black gram. Similarly, among three varieties tested under the investigation, 'Indira-1'gave the highest yield, therefore, application of NPK @ 20:20:20 kg/ha and variety 'Indira-1' should be opted for better outcomes.

Acknowledgement

The authors are thankful to the Department of Agronomy, AKS University, Satna (M.P.) for providing the necessary facilities, inputs and support throughout the investigation.

References

Comment [RR13]: Reference to add related to varieties and inorganic fertilizers

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Table 1. Effect of graded doses of fertilizers and varieties on growth, yield and quality of Black gram.

Treatments	Plant height (cm)	Number of branches per plant	Number of leaves per plant	Number of root nodules	Number of pods per plant	Number of seeds per pod	Test weight (g)	Grain yield (q/ha)	Stover yield (q/ha)	Harvest index (%)	Protein content (%)
Graded dose of fertilizers											
F_0	20.32	2.56	12.73	29.16	7.60	1.40	32.11	4.57	11.06	29.05	19.15
F_1	37.77	4.11	25.27	29.89	20.42	4.29	35.35	7.73	15.67	32.95	20.75
F_2	39.77	4.27	26.29	30.78	21.29	4.71	36.32	8.53	17.27	32.59	20.94
F_3	40.73	4.49	27.09	30.89	22.00	4.89	36.98	9.31	18.10	33.55	21.71
S.Em ±	**0.36**	**0.09**	**0.22**	**0.25**	**0.22**	**0.10**	**0.18**	**0.19**	**0.29**	**0.72**	**0.25**
C.D. (*p*=0.05)	**1.05**	**0.27**	**0.66**	**0.72**	**0.65**	**0.28**	**0.54**	**0.55**	**0.85**	**2.11**	**0.74**
Varieties											
V_1	33.78	3.92	22.67	29.85	17.23	3.60	34.99	7.39	15.08	32.64	20.49
V_2	31.55	3.17	21.15	29.47	16.02	3.10	33.44	5.51	12.89	29.65	19.56
V_3	38.61	4.48	24.72	31.22	20.23	4.77	37.13	9.71	18.59	33.83	21.85
S.Em ±	**0.31**	**0.08**	**0.19**	**0.21**	**0.19**	**0.08**	**0.16**	**0.16**	**0.25**	**0.62**	**0.22**
C.D. (*p*=0.05)	**0.91**	**0.23**	**0.57**	**0.63**	**0.56**	**0.25**	**0.46**	**0.48**	**0.73**	**1.83**	**0.64**

Fig. 1 Effect of graded doses of fertilizers and varieties on growth attributesofBlack gram.

Comment [RR14]: Figure can be classified with the same units

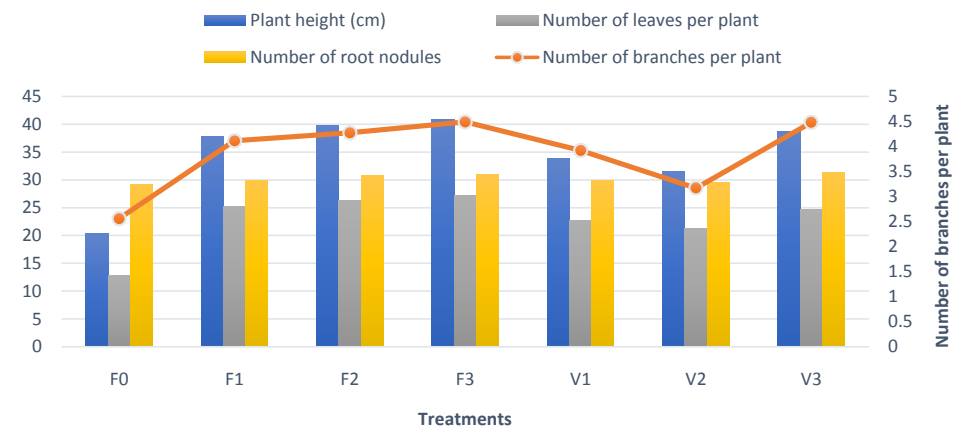

Fig. 2 Effect of graded doses of fertilizers and varieties on yield attributes and yield ofBlack gram.