

## Effect of Phosphorus Level and Variety on Growth, Yield and Quality of Black Gram (*Vigna mungo* L.)

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### ABSTRACT

Field experiment was conducted at the student instructional Farm, Department of Agronomy, AKS University, Satna, (M.P.) during the kharif season of 2020- 21 to study the effect of phosphorus levels and varieties on growth, yield parameters, yield and quality of black gram. The experiment was laid out in factorial randomized block design with four phosphorus levels viz., P<sub>0</sub>- 0 kg P<sub>2</sub>O<sub>5</sub>/ha (control), P<sub>1</sub>- 25 kg P<sub>2</sub>O<sub>5</sub>/ha, P<sub>2</sub>- 35 kg P<sub>2</sub>O<sub>5</sub>/ha and P<sub>3</sub>- 45 kg P<sub>2</sub>O<sub>5</sub>/ha, while three black gram varieties were tested are V<sub>1</sub>- PRATAP-1, V<sub>2</sub>- PU-31 and V<sub>3</sub>- IPU-2-43. Application of 45 kg P<sub>2</sub>O<sub>5</sub>/ha registered significantly higher plant height (41.43 cm) and number of branches per plant (13.47) at 60 DAS, number of pods per plant (26.67), number of seeds/pod (7.00), 1000- seed weight (34.22 g), grain yield (12.78 q/ha), stover yield (17.40 q/ha) and protein content (22.25 %) of black gram were observed under the application of phosphorus @ 45 kg/ha with black gram variety of IPU- 2-43.

**Keywords:** Black gram, Phosphorus, Grain yield, Varieties, Protein content.

### INTRODUCTION

Black gram (*Vigna mungo* L.) is one of the important kharif pulse crop. It is commonly grown in summer and rainy seasons in northern India. It is a protein rich (25 per cent) staple food containing almost three times that of cereals. India is the largest producer as well as consumer of black gram. It produces about 15 to 19 lakh tones black gram annually from about 35 lakh ha of area, with an average productivity of 500 kg/ha (Ministry of Agriculture, GOI 2014-15).

There exists a vast gap between potential productivity and actual productivity of black gram being realized at present. Apart from other agronomical management practices, imbalanced plant nutrition is the major constraint to higher productivity of the crop. Proper fertilization is essential to improve the productivity of black gram. It can meet its nitrogen requirements by symbiotic fixation of atmospheric nitrogen. The nutrients which need attention are phosphorus fertilization.

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Black gram being a leguminous crop, requires adequate amount of phosphorus as well as apart from other nutrients these are directly involved in growth and development of plant.

Phosphorus is an integral component of virtually all the biochemical compounds that make plant life possible. Its response is known in presently available black gram varieties. Nitrogen as well as phosphorus (Singh et al., 2008) is essential for normal growth and development of black gram. Phosphorus application to black gram increases plant growth, yield attributes and grain yield. Phosphorus promotes early root formation and the formation of lateral, fibrous and healthy roots which is very important for nodule formation and to fix atmospheric nitrogen. Different varieties of black gram have varying nutrient demand and climate adaptability. Therefore, selection of appropriate adoptable variety requires immediate and large efforts in the direction of an improved varieties for a particular tract and its distribution.

Keeping all these points in view, field study was conducted to find out the effect of different phosphorus levels and varieties on growth, yield attributes, yield and economics of black gram during *kharif* season of 2019.

## MATERIALS AND METHODS

A field experiment was conducted at the student instructional Farm, Department of Agronomy, AKS University, Satna, (M.P.) during the *kharif* season of 2020- 21. The experiment was laid out in randomized block design in factorial concept with four phosphorus levels viz., P<sub>0</sub>- 0 kg P<sub>2</sub>O<sub>5</sub>/ha (control), P<sub>1</sub>- 25 kg P<sub>2</sub>O<sub>5</sub>/ha, P<sub>2</sub>- 35 kg P<sub>2</sub>O<sub>5</sub>/ha and P<sub>3</sub>- 45 kg P<sub>2</sub>O<sub>5</sub>/ha, while three black gram varieties were tested are V<sub>1</sub>- PRATAP-1, V<sub>2</sub>- PU-31 and V<sub>3</sub>- IPU-2-43. The recommended dose of N 20 kg/ha through urea and 60 Kg K<sub>2</sub>O /ha through MOP was applied at the time of sowing. The phosphorus was applied as per treatments through single super phosphate.

The experimental plot size was 5.0 m 3.5 m. The crop was sown on July, 20<sup>th</sup> 2020. The line to line spacing was kept 30 cm using seed rate of 20 kg/ha. A distance of 10 cm was maintained between plant to plant in rows. Hand weeding was done at 25 days after sowing. The observations on five randomly selected plants from each treatment were recorded at maturity. The crop was harvested on 10<sup>th</sup> October, 2020.

## RESULTS AND DISCUSSION

### EFFECT OF PHOSPHORUS LEVELS

Varying levels of phosphorus significantly influenced the plant height (39.73 cm) and number of branches per plant (12.22) at 60 DAS, number of pods per plant (23.16), number of seeds/pod (5.69), 1000- seed weight (32.15 g), grain yield (10.87 q/ha), stover yield (15.55 q/ha) and protein content (21.36 %) (Table-1). They're occurred significant increase with each increase in phosphorus levels up to 45 kg P<sub>2</sub>O<sub>5</sub>/ha. The results are in conformity with those of Yadav et al. (2007). The positive effect of phosphorus application on number of pods per plant might be due to better enzymatic activities which controlled flowering and pod formation. Application of varying levels of phosphorus significantly improved the seed yield of black gram over control (Table- 1). The higher seed yield with higher phosphorus rates was attributable to better nodulation and efficient functioning of nodule bacteria for fixation of N to be utilized by plants during grain development stage in the synthesis of protein as reflected in N uptake which in turn led to increase in seed yield. Similar findings were observed by Singh et al. (2011) and Das (2017). The grain yield is known to have positive association with these characters. However, higher levels of phosphorus i.e. 45 kg P<sub>2</sub>O<sub>5</sub> /ha were at par with respect to nutrient uptake. The increase in yield and yield attributes with increased phosphorus application rates was perhaps due to efficient and effective role of N fixing

bacteria. These results are in accordance with the findings of Duhan (2014).

### EFFECT OF VARIETIES

Black gram variety IPU- 2-43 registered highest plant height (38.57 cm) and number of branches per plant (11.73) at 60 DAS, number of pods per plant (22.43), number of seeds/pod (5.42), 1000- seed weight (31.86 g), grain yield (10.33q/ha), stover yield (14.89 q/ha) and protein content (21.07 %) (Table-1). Similar type of variations in yield attributing parameters of various genotypes has been reported by Kumar et al. (2007). This may be due to its better growth and yield attributing characters to cv. PU- 31 and Pratap- 1. The superiority of cv. IPU- 2-43 was owing to its better source to sink supply than in other varieties. Similar findings have also been reported by Rajput and Rajput (2017). Variable response of black gram varieties in respect of growth and yield was also reported by Ganeshamurthy et al. (2007).

### INTERACTION EFFECT BETWEEN PHOSPHORUS LEVELS AND VARIETIES

The effect of interaction between phosphorus levels and varieties was found to be significant for variation in growth, yield attributes, yield and quality characters of black gram. The treatment combination consisting of the application of phosphorus @ 45 kg/ha with black gram variety of IPU- 2-43 produced significantly highest plant height (41.43 cm) and number of branches per plant (13.47) at 60 DAS, number of pods per plant (26.67), number of seeds/pod (7.00), 1000- seed weight (34.22 g), grain yield (12.78 q/ha), stover yield (17.40 q/ha) and protein content (22.25 %) (Table-1). While, the minimum values were noticed under the without application of phosphorus with the black gram variety of PU- 31 (treatment combination).

The better growth of plant in terms of height and leaf number might have helped in improving yield parameters and yield of black gram through better translocation of food

reserves to sink. The levels of phosphorus regulate the starch/sucrose ratio in the source levels and the reproductive organs. Thus, the stimulatory effect of plant nutrients with increasing rates of phosphorus on growth and partitioning of photosynthates to sink development has led to increased number of pods per plant, pod length, number of seeds/pod and test weight. The corresponding lower values of these parameters at lower doses further lend support to the above statement. With increase in photosynthetic products, coupled with efficient translocation, plant produced more pods/ plant with a greater number of seeds per pod. Significant increase in grain and straw yields appeared to be on account of beneficial effects of phosphorus on growth and yield attributes. Similar findings have also been reported by Ashutosh and Amit (2017), Vinod et al. (2017) and Faizan et al. (2020). The application of adequate amount of phosphorus influenced the vigour of plants which has possibly accelerated the nitrogen fixing power of plants by increasing the activity of nodule bacteria, proliferation of root growth resulting in more build up to nitrogen content in seed and straw ultimately produce higher concentration of protein. Similar results found by Ram et al. (2017).

The probable reason for enhanced plant growth, grain yield and protein content may be due to cumulative effects of varietal characters and sufficient quantity of nutrient on vegetative growth which ultimately lead to more photosynthetic activities while, application of nutrient levels enhances carbohydrate and nitrogen metabolism of pectic substances, as well as improve the water metabolism and water relation in the plants. The variation in yield attributes of IPU- 2-43 variety may be due to genetic characteristics among different genotypes under present investigation. These findings are in agreement with the findings of Mondal and Sengupta (2019).

**Table1: Effect of Different Levels of Phosphorus and Varieties on Growth, Yield and Quality of Black Gram**

Treatment	Plant height (cm)	Number of branches/plant	Number of pods per plant	Number of grains per pod	Test weight (g)	Grain yield (q/ha)	Stover yield (q/ha)	Protein content (%)
<b>Effect of phosphorus</b>								
P <sub>0</sub>	37.66	7.73	18.40	3.31	29.00	5.83	10.26	19.01
P <sub>1</sub>	38.96	10.20	20.24	4.56	30.52	8.66	13.35	20.15
P <sub>2</sub>	39.73	11.58	21.24	5.04	31.25	9.79	14.73	21.02
P <sub>3</sub>	0.90	12.22	23.16	5.69	32.15	10.87	15.55	21.36
S. Em±	2.63	1.45	1.16	0.36	0.61	0.49	0.43	0.30
C.D.	37.66	4.25	3.40	1.07	1.79	1.45	1.26	0.87
<b>Effect of varieties</b>								
V <sub>1</sub>	36.72	10.25	20.30	4.53	30.44	8.64	13.32	20.30
V <sub>2</sub>	34.68	9.32	19.55	4.00	29.89	7.40	12.21	19.79
V <sub>3</sub>	38.57	11.73	22.43	5.42	31.86	10.33	14.89	21.07
S. Em±	1.04	1.67	1.34	0.42	0.71	0.57	0.49	0.34
C.D.	3.04	4.90	3.93	1.23	2.07	1.67	1.45	1.01
<b>Interaction effect between different levels of phosphorus and varieties</b>								
P <sub>0</sub> V <sub>1</sub>	30.95	7.60	18.40	3.53	28.88	5.99	10.52	18.98
P <sub>0</sub> V <sub>2</sub>	37.27	9.67	19.80	4.33	30.34	8.18	12.94	19.94
P <sub>0</sub> V <sub>3</sub>	38.88	11.47	21.07	4.93	30.92	9.45	14.50	20.98
P <sub>1</sub> V <sub>1</sub>	39.77	12.27	21.93	5.33	31.64	10.94	15.33	21.31
P <sub>1</sub> V <sub>2</sub>	26.83	6.73	17.73	2.53	28.54	4.72	9.16	18.77
P <sub>1</sub> V <sub>3</sub>	36.34	9.27	19.33	4.13	29.92	7.49	12.27	19.49
P <sub>2</sub> V <sub>1</sub>	37.54	10.33	20.27	4.60	30.49	8.48	13.47	20.36
P <sub>2</sub> V <sub>2</sub>	38.00	10.93	20.87	4.73	30.60	8.91	13.93	20.52
P <sub>2</sub> V <sub>3</sub>	33.03	8.87	19.07	3.87	29.59	6.77	11.08	19.27
P <sub>3</sub> V <sub>1</sub>	39.36	11.67	21.60	5.20	31.31	10.32	14.84	21.03
P <sub>3</sub> V <sub>2</sub>	40.47	12.93	22.40	5.60	32.33	11.46	16.23	21.73
P <sub>3</sub> V <sub>3</sub>	41.43	13.47	26.67	7.00	34.22	12.78	17.40	22.25
S. Em±	0.52	0.84	0.67	0.21	0.35	0.29	0.25	0.17
C.D.	1.08	NS	1.39	0.44	0.73	0.59	0.51	0.36

## CONCLUSION

Based upon this experiment it is concluded that application of higher level of phosphorus at the rate of 45 kg/ ha with the black gram variety on IPU- 2-43 recorded the maximum growth, grain yield and quality of black gram.

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## Conflict of Interest

The author(s) declares no conflict of interest.

## Author Contributions

Lokesh Burade was involved in data collection, analysis, interpretation and writing

first draft of the manuscript. A.S. Tiwari was involved in revision and final compilation of the manuscript.

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