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Effect of phosphorus and molybdenum on nutrient content of black gram

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Abstract

A field experiment entitled “Effect of Phosphorus and Molybdenum on Growth, Yield and Productivity of Black gram (*Vigna mungo* L.)” was conducted during *khari* season of 2025-26. The experiment was laid out at the Instructional Farm, Rajasthan College of Agriculture, Udaipur. The treatment consisted of one variety (Kota Urd-4), four phosphorus levels (Control, 20, 40 and 60 kg ha⁻¹) and four molybdenum levels (control, 0.25, 0.50 and 1.0 kg ha⁻¹), thereby making 16 treatments combinations replicated thrice in Factorial Randomised Block Design (FRBD). On the basis of results emanated from the present investigation, it can be concluded that under prevailing agro-climatic condition of zone IVa of Rajasthan it was observed that application of 60 Kg P₂O₅ ha⁻¹ significantly increased nutrient content in seed and haulm over application of 40, 20 and control, respectively and application of 1.0 Kg Mo ha⁻¹ significantly increased nutrient content in seed and haulm over application of 0.50, 0.25 and control.

Keywords: Black gram, phosphorus, molybdenum

Introduction

Black gram [*Vigna mungo* (L.) Hepper] is one of the most imperative pulse crop and it cultivated in tropical and sub-tropical regions of the world. This crop is known by many of names in various areas of the globe and in Hindi it is popularly known as “Urd bean”. This pulse crop belongs to sub-family *Papilionaceae* and family *Fabaceae* or *Leguminosae*. Black gram crop is richest in phosphoric acid amongst all pulses. It is a rich source of protein (24%), starch (67%), fiber (3.5%), fat (1.74%), and lysine, making it especially valuable in vegetarian diets. It is consumed in the form of “dal” (whole or split, husked and un-husked) or perched and in a variety of ways across from North to South in preparation of different regular and popular dishes like vada, idli, dosa, halwa and imarti in combination with other food grains. Recognizing their nutritional significance, the United Nations designated 2016 as the “International Year of Pulses” to raise awareness about their role in sustainable food production for improved food security and nutrition. It differs from other pulses in its peculiarity of attaining a mucilaginous pasty character when soaked in water. This crop can grow in adverse climatic conditions and show resistant to many ways. It has wide adaptability and can be grown round the year in different agro-ecological regions of the country. It is well established fact that being pulse crop it improves the soil fertility through biological nitrogen fixation as well as conserving and improving the physical properties of soil by virtue of their nodulated root system and leaf fall (Chaudharya *et al.*, 2020)^[2].

India is the world's largest producer as well as consumer of black gram. In India, during the year 2022-23, black gram occupied on 4.4 million ha area with production of 1.84 million tonnes and the average productivity was 598 kg ha⁻¹ (Directorate of Economics and Statistics, 2022-23)^[4]. The soil application of phosphorus and molybdenum is more advantageous and gives better yield when compared to single nutrient application. The phenomenal increase in growth and yield of black gram was due to mutual benefit of these nutrients in improving absorption and utilization of nutrients.

The synergetic interaction of phosphorus and molybdenum also influences the availability of certain essential nutrients that result in better uptake and maintain source and sink relationship (Awomi *et al.*, 2012)^[1].

Materials and Methods

A field experiment entitled “Effect of Phosphorus and Molybdenum on Growth, Yield and Productivity of Black gram (*Vigna mungo* L.)” was conducted during *kharif* season 26. The experiment was laid out at the Instructional Farm, Rajasthan College of Agriculture, Udaipur which is situated at 24°35' North latitude, 73°42' East longitude and at an altitude of 582.17 metres above mean sea level. It falls under agro climatic zone IVa “Sub-Humid Southern Plain and Aravali Hills” of Rajasthan. The treatment consisted of one variety (Kota Urd-4), four phosphorus levels (Control, 20, 40 and 60 kg ha⁻¹) and four molybdenum levels (control, 0.25, 0.50 and 1.0 kg ha⁻¹), thereby making 16 treatments combinations replicated thrice in FRBD. The data show that soil of experimental field was clay-loam in texture, slightly alkaline in reaction (pH 7.8), medium in available nitrogen (272.43 kg ha⁻¹) and phosphorus (22.08 kg ha⁻¹) while high in available potassium status (323.45 kg ha⁻¹) and available molybdenum (0.21 mg kg⁻¹). The total quantity of nitrogen, phosphorus and molybdenum were drilled in furrows before sowing of seed. DAP and Ammonium molybdate were used as a source of nitrogen, phosphorus and molybdenum, respectively.

Results and Discussion

The estimate of nitrogen, phosphorus, potassium and molybdenum content in seed as well as in haulm under the influence of various treatments are presented in Table 1.

Nitrogen content in seed

Phosphorus: As shown in Table 1 indicate that nitrogen content in seed was significantly altered by different phosphorus levels. The highest nitrogen content in seed was recorded with application of 60 kg P₂O₅ (3.936%) which did not differ significantly from 40 kg P₂O₅ (3.894%) but significantly superior over 20 kg P₂O₅ (3.687%) and control (3.491%). The increase with 60 kg P₂O₅ was 12.74 per cent over control.

Molybdenum: Table 1 shows that molybdenum levels, application of 1 kg Mo recorded the highest nitrogen content in seed (3.910%) which was found at par with 0.5 kg Mo (3.822%) and 0.25 kg Mo (3.657%) but statistically superior to control (3.620%). The increase with 1 kg Mo was 8.01 per cent over control.

Nitrogen content in haulm

Phosphorus: It is observed from data given in Table 1 that nitrogen content in haulm increased progressively with increasing phosphorus levels. The highest value was recorded with application of 60 kg P₂O₅ (1.619%) which was significantly superior over 40 kg P₂O₅ (1.541%), 20 kg P₂O₅ (1.405%) and control (1.250%) with an extent of 29.52 per cent increase over the control.

Molybdenum: It can be inferred from data (Table 1) that application of 1 kg Mo recorded the highest nitrogen content in haulm (1.524%) which was at par with 0.5 kg Mo (1.476%) and 0.25 kg Mo (1.436%) but significantly superior over control (1.380%) with an increase of 10.43 per cent over the control.

Phosphorus content in seed

Phosphorus: A comprehensive assessment of the data presented in Table 1 reveals that phosphorus content in seed was significantly impacted by different phosphorus levels. The highest phosphorus content in seed was recorded with application of 60 kg P₂O₅ (0.444%) which remained statistically equivalent

to 40 kg P₂O₅ (0.430%) but significantly superior over 20 kg P₂O₅ (0.320%) and control (0.317%) which outperformed the control by 40.06 per cent.

Molybdenum: Data recorded in Table 1 suggest that different molybdenum levels did not show any significant effect on phosphorus content in seed.

Phosphorus content in haulm

Phosphorus: A critical evaluation of the data given in Table 1 suggest that phosphorus content in haulm was significantly influenced by phosphorus levels. The maximum phosphorus content in haulm was recorded with application of 60 kg P₂O₅ (0.220%) which was performed significantly better than 40 kg P₂O₅ (0.210%), 20 kg P₂O₅ (0.180%) and control (0.168%) which resulted in a 30.95 per cent increase over the control.

Molybdenum: Data recorded in Table 1 suggest that different molybdenum levels did not show any significant effect on phosphorus content in haulm.

Potassium content in seed

Phosphorus: A study of the data Table 1, potassium content in seed was significantly influenced by phosphorus levels. The highest potassium content in seed was recorded with application of 60 kg P₂O₅ (0.890%) which showed similarity with 40 kg P₂O₅ (0.864%) but significantly superior over 20 kg P₂O₅ (0.813%) and control (0.798%) demonstrating a 11.52 per cent enhancement over the control treatment.

Molybdenum: It is depicted from data Table 1 that different molybdenum levels did not show any significant effect on potassium content in seed.

Potassium content in haulm

Phosphorus: The data summarized in the Table 1 provide evidence that potassium content in haulm was significantly governed by phosphorus levels. The maximum potassium content in haulm was recorded with application of 60 kg P₂O₅ (1.828%) which aligned closely with 40 kg P₂O₅ (1.772%) but significantly superior over 20 kg P₂O₅ (1.698%) and control (1.665%) indicating a 9.78 per cent increment in comparison to the control.

Molybdenum: It is clear from data (Table 1) that different molybdenum levels did not show any significant effect on potassium content in haulm.

Table 1: Effect of phosphorus and molybdenum on nutrient content of black gram

Treatments	Nutrient content (%)							
	Nitrogen		Phosphorus		Potassium		Molybdenum	
	Seed	Haulm	Seed	Haulm	Seed	Haulm	Seed	Haulm
Phosphorus levels (kg ha⁻¹)								
P0: Control	3.491	1.250	0.317	0.168	0.798	1.665	0.227	1.784
P1: 20	3.687	1.405	0.320	0.180	0.813	1.698	0.228	1.785
P2: 40	3.894	1.541	0.430	0.210	0.864	1.772	0.233	1.787
P3: 60	3.936	1.619	0.444	0.220	0.890	1.828	0.236	1.791
S.E.m.±	0.030	0.030	0.006	0.002	0.009	0.020	0.003	0.035
C.D. (P=0.05)	0.088	0.088	0.016	0.007	0.026	0.058	NS	NS
Molybdenum levels (kg ha⁻¹)								
M0: Control	3.620	1.380	0.369	0.191	0.838	1.734	0.192	1.721
M1: 0.25	3.657	1.436	0.377	0.193	0.840	1.738	0.215	1.765
M2: 0.50	3.822	1.476	0.380	0.196	0.842	1.745	0.256	1.794
M3: 1.00	3.910	1.524	0.385	0.197	0.844	1.746	0.262	1.867
S.E.m.±	0.030	0.030	0.006	0.002	0.009	0.020	0.003	0.035
C.D. (P=0.05)	0.088	0.088	NS	NS	NS	NS	0.007	0.100

Molybdenum content in seed

Phosphorus: It is revealed from data Table 1 that different phosphorus levels did not show any significant effect on molybdenum content in seed.

Molybdenum: The tabulated observations suggest that application of 1 kg Mo recorded the highest molybdenum content in seed (0.262%) which was found at par with 0.5 kg Mo (0.256%) and 0.25 kg Mo (0.215%) but significantly superior over control (0.192%) which showed an improvement of 34.45 per cent over the control.

Molybdenum content in haulm

Phosphorus: It is revealed from data Table 1 that different phosphorus levels did not show any significant effect on molybdenum content in haulm.

Molybdenum: The tabulated data (Table 1) disclose that application of 1 kg Mo recorded the highest molybdenum content in haulm (1.867%) which was found at par with 0.5 kg Mo (1.794%) and 0.25 kg Mo (1.765%) but significantly superior over control (1.721%) which was 8.48 per cent greater than that of the control.

It was observed that application of phosphorus up to 60 kg ha⁻¹ significantly increased N, P and K content in seed and haulm. In general, improvement in nutritional status of plant under phosphorus fertilization seems to be primarily on account of better growth of roots, which might have increased the absorption and efficient translocation of these towards plant system. Secondly, the possibly increased nodules with addition of phosphorus might have resulted in higher biological nitrogen fixation. In many leguminous crops, phosphorus application enhances root formation and increase the capacity of nodules for fixation of higher atmospheric nitrogen thereby improves nitrogen content in seed and haulm. In case of potassium, experimental soil was found sufficient in potassium content before sowing the crop, but variation in potassium content in seed and haulm due to direct correlation of P with K, which means increasing level of phosphorus also increased the availability of fixed soil potassium and thus reflected in seed and haulm. These results corroborate the earlier reports of Srivastav *et al.* (2018)^[7] and Choudhary *et al.* (2025)^[3].

The application of molybdenum up to 1 kg ha⁻¹ was found to significantly increase the content of N and Mo in both seed and haulm. The increase in nitrogen content by seed and haulm with molybdenum application may be attributed to the pivotal role of molybdenum in biological nitrogen fixation and nitrogen metabolism. The increased nitrogen fixation ensures a continuous and synchronized supply of nitrogen throughout the crop growth period. These results are in conformity with findings of Singh *et al.* (2008)^[6], Tejaswini and Singh (2023)^[8] and Patel *et al.* (2025)^[5].

Conclusion

On the basis of results emanated from the present investigation, it can be concluded that under prevailing agro-climatic condition of zone IVa of Rajasthan it was observed that application of 60 Kg P₂O₅ ha⁻¹ significantly increased nutrient content in seed and haulm over application of 40, 20 and control, respectively and application of 1.0 Kg MO ha⁻¹ significantly increased nutrient content in seed and haulm over application of 0.50, 0.25 and control.

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