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Effect of Phosphate Rich Organic Manure (PROM) on growth, yield and quality of blackgram [*Vigna mungo* (L.) hepper]

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Abstract
A field investigation entitled "Effect of phosphate rich organic manure (PROM) on growth, yield and quality of blackgram" was conducted in *kharif* 2024 at Post Graduate Institute Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahilyanagar (M.S.). The experiment consisted of seven treatments *viz*., T_1: Absolute control; T_2: Control (No P_2O_5); T_3: 100% P_2O_5 through SSP; T_4: 100% P_2O_5 through Phosphate Rich Organic Manure (PROM); T_5: 75% P_2O_5 through Phosphate Rich Organic Manure (PROM) + 25% P_2O_5 through SSP; T_6: 50% P_2O_5 through Phosphate Rich Organic Manure (PROM) + 50% P_2O_5 through SSP and T_7: 25% P_2O_5 through Phosphate Rich Organic Manure (PROM) + 75% P_2O_5 through SSP. Nitrogen was applied through Urea. The experiment was laid out in randomized block design (RBD) with three replications. The soil was clayey in texture, low in available nitrogen (195.35 kg ha^{-1}), medium in available phosphorus (17.03 kg ha^{-1}) and high in potassium (367.22 kg ha^{-1}). The soil was slightly alkaline in reaction (pH 8.18) with medium in organic carbon content (0.51%). The sowing was done manually by dibbling. The spacing was 30 cm x 10 cm. The results revealed that application of 100% P_2O_5 through SSP recorded significantly higher plant height (61.27 cm), number of functional leaves $plant^{-1}$ (12.63), leaf area $plant^{-1}$ (10.43 dm^2), dry matter $plant^{-1}$ (32.10 g) and number of root nodules $plant^{-1}$ (29.92). However, it was at par with the application of 25% P_2O_5 through Phosphate Rich Organic Manure (PROM) + 75% P_2O_5 through SSP in case of plant height, number of functional leaves $plant^{-1}$, leaf area $plant^{-1}$, dry matter $plant^{-1}$ and number of root nodule $plant^{-1}$. Similarly significantly higher biological yield (seed + straw) and harvest index (3003 kg ha^{-1} and 36.76% respectively) were obtained with application of 100% P_2O_5 through SSP which was at par with application of 25% P_2O_5 through Phosphate Rich Organic Manure (PROM) + 75% P_2O_5 through SSP. The significantly higher gross and net monetary returns (₹ 84545 and ₹ 35653 ha^{-1}) and numerically higher B:C ratio (1.73) was obtained with application of 100% P_2O_5 through SSP as compared to other treatments.

Keywords: PROM, SSP, blackgram, phosphorus

Introduction
Pulses, often termed food legumes, hold a vital position in Indian agriculture, ranking next to cereals in both area and production. They are an indispensable component of the predominantly vegetarian diet of the Indian population, providing essential proteins, energy, vitamins and minerals required for growth and maintenance of health. Pulses contain 17 - 25% protein, significantly higher than cereals which contain 6 - 10% protein and are rich in dietary fiber, potassium, magnesium, zinc and iron, while their fat content remains low. In recent years, pulse production in India has shown only modest improvement compared to cereals which have advanced considerably due to modern technologies and intensive input use. According to the Ministry of Agriculture and Farmers Welfare (2024), India produced about 27.5 million tonnes of pulses in 2022 -23, with a slight increase projected for 2023 - 24.

Phosphorus is one of the major essential plant nutrients, second only to nitrogen, required for optimal crop growth and development. It plays a pivotal role in energy transfer as a component of ATP, ADP and NADP, which are essential for photosynthesis and respiration processes (Troch and Thompson, 1993) [9]. Adequate phosphorus fertilization stimulates root development, enhances nodulation in legumes, promotes flowering and seed formation and hastens crop maturity (Munir *et al.*, 2004) [6].

Furthermore, PROM improves soil health by increasing organic matter content, enhancing microbial activity and improving soil physical properties such as texture, structure, aeration and water retention. It's ideal C:N ratio of 20:1 ensures effective decomposition without immobilizing nutrients or causing adverse effects like termite infestation (Aechra *et al.*, 2017) [1]. PROM application has been shown to enhance root growth, crop establishment, flowering and pod formation, increase yield and quality of produce and supply residual phosphorus to subsequent crops, enhancing long-term soil fertility (Basak and Gajbhiye, 2018) [3].

Materials and Methods

The field experiment entitled "Effect of phosphate rich organic manure (PROM) on growth, yield and quality of blackgram" was conducted at Post Graduate Institute Farm, MPKV, Rahuri during *kharif* 2024-25.

The experiment consisted of seven treatments replicated three times. Nitrogen was applied through Urea and phosphorus through SSP and PROM.

Results and Discussion

Growth studies

The plant height, number of functional leaves and dry matter was found significant at 60 DAS and at harvest. The significantly higher plant height (61.00 cm and 61.27 cm), number of functional leaves (24.61 and 12.63) and dry matter (22.57 g and 32.10 g) respectively recorded by treatment (T_3) 100% P_2O_5 through single super phosphate (SSP) at 60 DAS and at harvest and it was at par with treatment (T_7) 25% P_2O_5 through phosphate rich organic manure (PROM) + 75% P_2O_5 through single super phosphate (SSP) (Table 1). On the other hand, the significantly lowest plant height, number of functional leaves and dry matter was consistently observed under the absolute control (T_1) treatment. Whereas, significantly higher leaf area plant^{-1} at 45 and 60 DAS was (5.28 and 10.43 dm^2) recorded by (T_3) treatment and it was at par with treatment (T_7) 25% P_2O_5 through phosphate rich organic manure (PROM) + 75% P_2O_5 through single super phosphate (SSP).

These findings are in conformity with Vyas *et al.* (2013) [10] and Majeed *et al.* (2014) [5] who reported significant improvement in plant height in response to phosphorus fertilization.

Yield studies

The data related seed, straw, biological yield and harvest index is presented in Table 2. The significantly higher seed, straw, biological yield and harvest index was (1104, 1899, 3003 kg ha^{-1} and 36.76%) was recorded by treatment (T_3) 100% P_2O_5 through single super phosphate (SSP) and it was at par with treatment (T_7) 25% P_2O_5 through PROM and 75% P_2O_5 through SSP. Whereas, significantly minimum seed, straw, biological yield and harvest index was recorded by treatment (T_1) *i.e.* Absolute control (621, 1199, 1820 kg ha^{-1} and 34.13%).

These findings are in agreement with those reported by Bairwa *et al.* (2019) [2], Sanaye *et al.* (2015) [8], and Phogat (2016) [7], who demonstrated that integrated or adequate phosphorus application significantly improved seed yield in blackgram and other legume crops.

Economics

Table 3 indicate that the gross, net monetary returns, cost of cultivation and B:C ratio. The significantly higher gross and net monetary returns and B:C ratio registered by T_3 treatment 100% P_2O_5 through SSP was ₹ 84545 ha^{-1} and ₹ 35653 ha^{-1} and 1.73 it was at par with the T_7 treatment 25% P_2O_5 through PROM and 75% P_2O_5 through SSP. Whereas significantly lowest gross and net monetary returns (₹ 47553 ha^{-1} and ₹ 14784 ha^{-1}) and lowest B:C ratio (1.45) registered by treatment T_1 (Absolute control). The numerically higher cost of cultivation was ₹ 50532 ha^{-1} recorded by T_4 treatment 100% P_2O_5 through PROM and it was numerically followed by T_5 treatment 75% P_2O_5 through PROM and 25% P_2O_5 through SSP. Similarly numerically minimum cost of cultivation was recorded by treatment (T_1) Absolute control (32969 ha^{-1}). These results are in conformity with Majeed *et al.* (2014) [5] and Majeed *et al.* (2018) [4].

Table 1: Effect of Phosphate Rich Organic Manure (PROM) on growth contributing characters of blackgram as influenced by different treatment

Tr. No.	Treatment	Growth studies							
		Plant Height (cm)		Number of functional leaves plant^{-1}		Leaf area plant^{-1} (dm^2)		Dry matter of plant^{-1} (g)	
		60 DAS	At harvest	60 DAS	At harvest	45 DAS	60 DAS	60 DAS	At harvest
T_1	Absolute control	46.17	46.22	17.08	8.77	3.68	7.23	17.40	24.74
T_2	Control (No P2O5)	52.51	52.57	17.92	9.20	3.85	7.61	18.23	25.92
T_3	100% P through Single Super Phosphate (SSP)	61.00	61.27	24.61	12.63	5.28	10.43	22.57	32.10
T_4	100% P through Phosphate Rich Organic Manure (PROM)	52.90	53.00	19.19	9.85	4.12	8.11	18.69	26.59
T_5	75% P through Phosphate Rich Organic Manure (PROM) and 25% P through Single Super Phosphate (SSP)	54.74	53.48	19.82	10.18	4.26	8.37	20.07	28.55
T_6	50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP)	55.42	55.46	20.79	10.67	4.50	8.76	20.38	28.99
T_7	25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP)	58.98	59.11	23.16	11.89	4.97	9.79	21.88	31.12
	SE m±	1.64	1.68	1.03	0.53	0.23	0.43	1.05	1.49
	CD (P=0.05)	5.06	5.18	3.18	1.63	0.70	1.34	3.23	4.59
	General mean	54.53	54.58	20.37	10.46	4.38	8.61	19.89	28.29

Table 2: Effect of Phosphate Rich Organic Manure (PROM) on seed yield (kg ha^{-1}), straw yield (kg ha^{-1}), biological yield (kg ha^{-1}) and harvest index (%) of blackgram as influenced by different treatment.

Tr. No.	Treatment	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)
T_1	Absolute control	621	1199	1820	34.13
T_2	Control (No P2O5)	842	1558	2400	35.09
T_3	100% P through Single Super Phosphate (SSP)	1104	1899	3003	36.76
T_4	100% P through Phosphate Rich Organic Manure (PROM)	965	1756	2721	35.46
T_5	75% P through Phosphate Rich Organic Manure (PROM) and 25% P through Single Super Phosphate (SSP)	994	1779	2773	35.84
T_6	50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP)	1023	1800	2823	36.23
T_7	25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP)	1050	1838	2888	36.36
	SE m±	24.74	28.76	54.63	-
	CD (P=0.05)	76.24	88.63	168.34	-
	General mean	942.78	1689.93	2632.71	35.70

Table 3: Effect of Phosphate Rich Organic Manure (PROM) on gross monetary return (₹ ha^{-1}), net monetary return (₹ ha^{-1}), cost of cultivation (₹ ha^{-1}) and B:C ratio of blackgram as influenced by different treatment.

Tr. No.	Treatment	Gross monetary return (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net monetary return (₹ ha^{-1})	B: C ratio
T_1	Absolute control	47553	32969	14784	1.45
T_2	Control (No P2O5)	64644	44244	20399	1.46
T_3	100% P through Single Super Phosphate (SSP)	84545	48892	35653	1.73
T_4	100% P through Phosphate Rich Organic Manure (PROM)	74044	50532	23513	1.47
T_5	75% P through Phosphate Rich Organic Manure (PROM) and 25% P through Single Super Phosphate (SSP)	76225	50112	26112	1.52
T_6	50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP)	78404	49682	28722	1.58
T_7	25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP)	80457	49245	31212	1.63
	SE m±	1465.14	-	1465.14	-
	CD (P=0.05)	4514.54	-	4514.54	-
	General mean	72267	-	25771	-

Conclusion

The cultivation of blackgram with 100% P_2O_5 through single super phosphate (SSP) or 25% P_2O_5 through phosphate rich organic manure (PROM) and 75% P_2O_5 through single super phosphate (SSP) along with recommended dose of nitrogen be applied for higher yield, nutrient uptake and net monetary returns.

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Conflict of Interest

The authors declare there are no conflict of interest relevant to this article

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