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Effect of phosphate rich organic manure (prom) and bio-inoculants on growth attributes of *Rabi* blackgram (*Vigna mungo* L.)

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Abstract
The present study was conducted at College farm, Agriculture College Palem, during the *Rabi* season of 2024-25, to study the effect of phosphate rich organic manure and bio-inoculants on growth parameters of *rabi* blackgram (*Vigna mungo* L.). The experiment was laid out according to factorial randomized block design comprised of three replications. The experiment comprised four fertility levels of (control:100% RDP through RDF, 50% RDP through RDF and 50% RDP through PROM, 25% RDP through RDF and 75% RDP through PROM and 100% RDP through PROM) and three biofertilizers levels (seed treatment with PSB at 10 ml kg^{-1} seed, soil application of PSB at 1 lit ha^{-1}, soil application of PSB at 1.5 lit ha^{-1}) were applied to blackgram variety MBG-1070. The results revealed that application of 25% RDP through RDF and 75% RDP through PROM along with PSB at 1.5 lit ha^{-1} showed highest plant height, number of branches and dry matter production. However there is no significant difference between the treatments regarding number of leaves, leaf area.

Keywords: Blackgam, phosphate rich organic manure, phosphate solubilizing bacteria, growth parameters

1. Introduction

Pulses serve as a vital source of nutrition for billions of people globally. While the terms "legumes" and "pulses" are often used interchangeably, it is important to note that although all pulses are classified as legumes, not all legumes are considered pulses. Pulses belong to the *Leguminosae* family and include species that are primarily consumed by humans and domestic animals, typically in the form of dry grains. However, groundnut (*Arachis hypogaea*) and soybean (*Glycine max*) are excluded from this classification, as they are primarily cultivated for edible oil production. Pulses are an excellent source of protein, carbohydrates, dietary fiber, vitamins, minerals, and phytochemicals. A significant proportion of the global population consumes pulses as a staple food, often in combination with cereals, to fulfill their protein requirements. Pulses contain approximately 21–25% protein; however, they have limited amounts of essential amino acids such as methionine, tryptophan, and cystine (Tiwari & Singh, 2012) [16].

Among all pulse crops, black gram (*Vigna mungo* L.) is one of the most important, accounting for approximately 10% of India's total pulse production and holding significant value as a *Kharif* crop (Marimuthu *et al.*, 2024) [7]. In addition to its nutritional benefits, black gram plays a vital role in soil conservation by preventing erosion and effectively suppressing weed growth, owing to its deep root system and dense foliage cover. Furthermore, it enhances soil fertility by converting atmospheric nitrogen into a plant-available form.

India is the world's leading producer of black gram, contributing 70% of global production, followed by Myanmar and Pakistan. India produces approximately 2.7 million tonnes of black gram from an estimated cultivation area of 32.11 lakh hectares, with an average yield of 598 kg per hectare (Indiastat, 2024). The major black gram-producing states in India include Madhya Pradesh (8.04 lakh ha), Uttar Pradesh (7.11 lakh ha), Rajasthan (2.95 lakh ha), and Telangana (0.119 lakh ha) (Indiastat, 2024). In Telangana, the area sown under black gram during *Vanakalam* (*Kharif*) 2023–24 was 6,587 hectares, with major growing districts being Vikarabad

(2,263 ha) and Sangareddy (2,045 ha). During the *Rabi* season, the total sown area increased to 18,348 hectares, with Wanaparthy (8,629 ha) and Nagarkurnool (5,673 ha) being the leading districts in black gram cultivation (Government of Telangana, Department of Agriculture, 2023) [3].

Phosphorus is a vital mineral that significantly influences plant growth and metabolism. It plays a crucial role in energy storage and transfer, photosynthesis, sugar metabolism, cell division, root development, nodulation, and nitrogen fixation in legumes (Jangir *et al*., 2016) [5]. Phosphorus is essential for forming energy-rich ATP molecules, nucleoproteins, and phospholipids. However, approximately 80% of Indian soils require phosphorus application at recommended rates (Motsara, 2002) [8]. The challenges with phosphorus availability are threefold: it is present in limited quantities, only 16–18% of soil phosphorus is readily available, and it has a high fixation capacity after application. To sustain high crop yields, applying phosphorus fertilizers is necessary to prevent soil depletion. Proper phosphorus management enhances root biomass, nodulation, and grain yield, particularly in modern black gram cultivars.

Organic inputs provide a cost-effective, low-capital, and environmentally friendly approach to enhancing farm productivity by facilitating nutrient mobilization. They have a unique ability to fix atmospheric nitrogen, either symbiotically or non-symbiotically, and convert native soil nutrients, such as phosphorus, from an unavailable to an available form through biological processes. The rising cost of conventional fertilizers like Single Super Phosphate (SSP) and Diammonium Phosphate (DAP) has limited their accessibility for many farmers. However, the development of technology for producing Phosphate Rich Organic Manure (PROM) has provided a more affordable, eco-friendly, and equally effective alternative to water-soluble phosphorus fertilizers, regardless of soil type.

PROM is prepared from high grade rock phosphate and organic matter. The organic matter releases organic acids, which converts unavailable phosphate into available phosphate. It also known as a “green chemistry phosphatic fertilizer,” an efficient and cost-effective alternative to conventional chemical phosphatic fertilizers, providing a sustainable source of phosphorus (Sekhar *et al*., 2012) [12]. It is composed of well-composted organic manure combined with finely ground high-grade rock phosphate. PROM performs as effectively as Diammonium Phosphate (DAP) and exhibits a strong residual effect, benefiting subsequent crops. Its composition includes 55–60% organic manure, 11–14% P_2O_5, a carbon-to-nitrogen (C: N) ratio less than 15:1, and a pH of 7.0–7.5 (Pushpika udawat, 2023) [17] Additionally, PROM is highly effective in saline soils, where conventional phosphatic fertilizers often fail to supply adequate phosphorus.

Soil microorganisms play a crucial role in plant nutrient uptake and are involved in various biological processes. Insoluble soil phosphorus is mineralized by some of these microorganisms, making it available for plant absorption. Aside from chemical fertilization, microbial phosphate solubilization and mineralization are considered the only viable methods to enhance the availability of phosphorus for plants. Numerous microorganisms present in the soil and rhizosphere have been identified as effective in releasing phosphorus through solubilization and mineralization, and they are referred to as phosphate-solubilizing microorganisms (Timofeeva *et al*., 2022) [15].

2. Materials and Methods

2.1 Experimental Site

The field experiment was carried out at college farm, Agricultural College Palem, during the *rabi* season of 2024-25. The farm, is situated at a geographical location of 16°51′ N latitude and 78°25′ E longitude. During the entire crop growth duration the weekly mean maximum and minimum temperatures averaged 31.5 °C and 19.08 °C, respectively. Total rainfall was minimal at 2 mm with no rainy days, indicating predominantly dry conditions. Morning relative humidity ranged from 76% to 91.42% (avg. 88.23%), while afternoon humidity varied between 13.14% and 61.14% (avg. 33.66%). Sunshine hours averaged 7.61 hr day^{-1} (range: 3.1–19.08 hr), and pan evaporation ranged from 5.2 to 9.68 mm day^{-1}, averaging 7.6 mm day^{-1}. The soil of the experimental field was sandy loam with a neutral pH (7.27), EC (0.14dS m^{-1}), low in organic carbon (1.2 g kg^{-1}) and available N (128 kg ha^{-1}), high in available P_2O_5 (28.14 kg ha^{-1}) and medium in available K_2O (276 kg ha^{-1}).

2.2 Experimental Details

The experiment was conducted in a Factorial Randomized Block Design (FRBD) during the *rabi* season of 2024-25, consisting of twelve treatments with replicated thrice, having a net plot size of 5 x 4.8 m^2. Blackgram variety MBG-1070 was sown in sandy loam soil at a spacing of 30 cm×10 cm on 5th November 2024. Nitrogen was supplied through urea as per the treatment specifications; Phosphorus was applied as a basal dose using Di ammonium phosphate (DAP) and Phosphate rich organic manure (PROM). All standard agronomic practices as per recommendations and necessary plant protection measures were followed as required. The recommended dose of fertilizers: 20 kg N, 50 kg P_2O_5 and 0 kg K_2O ha^{-1}. The seed was treated with biofertilizers (PSB at 10 ml kg^{-1} seed) as per treatments and PROM was broadcasted to the soil before sowing as per treatments. Immediately after sowing, irrigation was given to each plot to bring the soil to field capacity to induce germination. Gap filling was done 8-10 days after sowing wherever it was necessary in order to maintain optimum plant population.

Hand-weeding twice at 30 and 45 DAS were carried out in order to keep the plots free from weed competition and there by soil moisture and nutrient depletion by weeds are minimized. In each net plot, five representative plants were randomly selected and tagged. All the successive biometric observations during the crop growth period were recorded periodically on the selected plants. Growth characters like initial and final plant stand, plant height, no of leaves, leaf area, leaf area index, no of branches $plant^{-1}$ and dry matter $plant^{-1}$ were recorded at 30, 60 DAS and at harvest in blackgram. Data were subjected to analysis of variance (ANOVA) using online statistical analysis package (OPSTAT) at 5% level of significance (p=0.05).

Treatment details of the experiment

Treatment	Symbol
PROM levels (p)	
RDF (Control)	P_0
50% RDP + 50% RDP through PROM	P_1
25% RDP + 75% RDP through PROM	P2
0% RDP + 100% RDP through PROM	P3
Bio-inoculant	
Seed treatment with PSB @ 10 ml kg^{-1} seed	B_0
Soil application of PSB @ 1.0 lit ha^{-1}	B_1
Soil application of PSB @ 1.5 lit ha^{-1}	B_2

3. Results and Discussion

Application of PROM and bio-inoculants significantly influenced growth parameters of blackgram.

Growth parameters

1. Plant height (cm)

Plant height was significantly influenced by PROM and bio-inoculants at all stages except at 30 DAS.

PROM levels

The data in Table 2 indicate that the integrated application of 25% RDP through RDF and 75% RDP through PROM resulted in the highest plant heights, measuring (29.3 38.8 cm) both at 60 DAS and harvest respectively. This treatment outperformed other combinations, such as 100% RDP through PROM (27.6, 36.5 cm), 50% RDP through RDF+50% through PROM (26.9, 35.7 cm) both at 60 DAS and harvest respectively, lowest plant height recorded in treatment supplied with control (RDF) with values (23.9, 33.8 cm) both at 60 DAS and harvest respectively. Similar findings were reported by Udawat (2023) [17] and Rabari *et al*. (2020) [10].

Plant height was significantly higher when PSB was applied to the soil at 1.5 lit ha^{-1}. This treatment resulted in the tallest plants, with a height of (27.8, 37.4 cm) both at 60 DAS and harvest respectively and it is on par with applying PSB to the soil at 1 lit ha^{-1} resulting in (26.7, 36.3 cm) plant height at 60 DAS and harvest respectively. The lowest plant heights (26.3, 34.8 cm) at 60 DAS and harvest respectively were observed when PSB was applied to the seed at 10 ml kg^{-1} of seed. The results are aligning with the findings of Khandelwal *et al*., (2012) [6] and Soumya *et al*., (2024).

The interaction effect of PROM and bio-inoculants was found to be non-significant.

2. Number of leaves

There was no significant difference between the treatments, based on the data in Table 2 regarding the impact of PROM and bio-inoculants on the number of leaves per plant at various stages of crop growth. At 30 and 60 DAS, the treatment that resulted in the highest number of leaves among the PROM levels was 25% RDP through recommended fertilizer +75% RDP through PROM, yielding 15.3 and 36.0 leaves, respectively. Conversely, the treatment with 100% RDP through RDF (control) had the fewest leaves at these same stages, with counts of 14.0 and 34.3. Among the different levels of bio-inoculants, soil treated with Phosphate Solubilizing Bacteria (PSB) at a rate of 1.5 lit ha^{-1} produced the most leaves, with counts of 15 and 35.6 at 30 and 60 DAS, respectively. The seed treatment with PSB at 10 ml kg^{-1} of seed had the fewest leaves, totaling 14.1 and 34.3 at 30 and 60 DAS respectively. The interaction effect of PROM and bio-inoculants also found to be non-significant.

3. Leaf Area (cm^2)

There was no significant difference in leaf area due to PROM and bio-inoculants between 30 and 60 DAS across the various treatments. Interaction effect of PROM and bio-inoculants also found non-significant. Among the different PROM levels, the highest leaf area was observed with application of 25% recommended dose of phosphorus RDP through RDF and 75% RDP through PROM, recording values of 33.4 cm^2 at 30 DAS and 320.8 cm^2 at 60 DAS. Conversely, the lowest leaf area was noted with the application of 100% RDP through RDF alone, which recorded 30.6 cm^2 at 30 DAS and 296.0 cm^2 at 60 DAS. Similarly, regarding bio-inoculant treatments, the soil application of PSB at 1.5 lit ha^{-1} to the seed resulted in the highest leaf area, with values of 33.1 cm^2 at 30 DAS and 307.7 cm^2 at 60 DAS. The lowest values were observed with seed treatment using PSB at 10 ml kg^{-1} seed, which recorded 30.5 cm^2 at 30 DAS and 302.2 cm^2 at 60 DAS.

4. Number of branches $plant^{-1}$

The number of branches $plant^{-1}$ in blackgram at 60 DAS was significantly higher with the application of 25% RDP through RDF + 75% RDP through PROM (5.7), compared to the application of 100% RDP through PROM alone (5.2). Application of 50% RDP through RDF + 50% RDP through PROM (4.7) was statistically on par with application of 100% RDP through RDF (control) (4.7). At harvest, the highest number of branches $plant^{-1}$ was observed in the treatment supplied with 25% RDP through RDF + 75% RDP through PROM (7.2), followed by the application of PROM alone as a source of RDP (6.9) and 50% RDP through RDF + 50% RDP through PROM (6.1). The lowest number of branches was recorded in the treatment supplied with 100% RDP through RDF alone (5.4) Similar results were observed by Rabari *et al*., (2020) [10].

Soil application of PSB at 1.5 lit ha^{-1} resulted in the highest number of branches (5.3, 6.7) at 60 DAS and harvest respectively. This was followed by the soil application of PSB at 1.0 lit ha^{-1}, which recorded values of (5.1, 6.5) at 60 DAS and harvest. The lowest number of branches was observed with seed treatment using PSB at 10 ml kg^{-1} of seed (4.9, 6.0) at 60 DAS and harvest. These results are conformed to Wang *et al*., 2021 [18], Prajapati *et al*., 2017 [9].

5. Dry matter production (kg ha^{-1})

PROM and Bio-inoculants significantly influenced the DMP (kg ha^{-1}) at all stages except, at 30 DAS. The interaction was found to be non-significant at all stages. At 30 DAS mean values of PROM levels ranged from 669.8 to 726.1 and bio-inoculants levels mean data ranged from 692.1 to 726.5. DMP (kg ha^{-1}) was significantly higher in treatment supplied with 5% RDP through RDF + 75% RDP through PROM (1983.8, 2206.7) than in 100% RDP through PROM alone (1884.9, 2128), 50% RDP through RDF + 50% RDP through PROM (1869.6, 2116.7) and least DMP was observed in treatment supplied with 100% RDP through RDF (1798.9, 1852.8) at 60 DAS and harvest respectively. Similar results were reported by Ramakrishna 2015 [11], Singh *et al*., 2022 [13] and Devi *et al*., (2022) [2]

Significantly higher dry matter production (DMP) was observed with soil application of PSB at 1.5 lit ha^{-1} (1905.4, 2114.2) compared to seed treatment with PSB at 10 ml kg^{-1} seed (1864.2, 2031.3) at 60 DAS and harvest, respectively. The DMP achieved with soil application of PSB at 1.5 lit ha^{-1} was also on par with the soil application of PSB at 1 lit ha^{-1} (1883.2, 2083.3) at the same stages. These findings are consistent with previous reports by Gummadala *et al*., 2022 [4].

Table 2: Effect of PROM and bio-inoculants on plant height, number of leaves and number of branches of Blackgram

Treatments	Plant height (cm)			No of leaves		No of branches		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	30 DAS	60 DAS	At harvest
PROM levels (P)								
P_0:RDF	20.9	23.9	33.8	14.0	34.3	2.9	4.7	5.4
P_1: 50% RDP through RDF + 50% RDP through PROM	20.6	26.9	35.7	14.5	34.5	3.0	4.7	6.1
P_2: 25% RDP through RDF + 75% RDP through PROM	21.4	29.3	38.8	15.3	36.0	3.3	5.7	7.2
P_3:0% RDP through RDF + 100% RDP through PROM	20.4	27.6	36.5	14.6	35.3	3.2	5.2	6.9
S.Em±	0.4	0.43	0.44	0.39	0.86	0.13	0.11	0.14
CD (P=0.05)	NS	1.26	1.28	NS	NS	NS	0.32	0.40
PSB strains (B)								
B_0: Seed treatment with PSB @ 10 ml kg seed^{-1}	20.6	26.3	34.8	14.1	34.3	3.0	4.9	6.0
B_1:Soil application of PSB @ 1 lit ha^{-1}	20.6	26.7	36.3	14.9	35.1	3.1	5.1	6.5
B_2:Soil application of PSB @ 1.5 lit ha^{-1}	21.3	27.8	37.4	15.0	35.6	3.2	5.3	6.7
S.Em±	0.3	0.37	0.38	0.34	0.74	0.1	0.09	0.12
CD (P=0.05)	NS	1.09	1.11	NS	NS	NS	0.27	0.35
Interaction (P*B)								
S.Em±	0.6	0.74	0.76	0.68	1.49	0.23	0.19	0.24
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Effect of PROM and bio- inoculants on leaf area and dry matter production of blackgram

Treatments	Leaf area (cm^2)		Dry matter production (kg ha^{-1})		
	30 DAS	60 DAS	30 DAS	60 DAS	At harvest
PROM levels (P)					
P_0:RDF	30.6	296.0	669.8	1798.9	1852
P_1: 50% RDP through RDF + 50% RDP through PROM	31.4	299.0	712.4	1869.9	2116.7
P_2: 25% RDP through RDF + 75% RDP through PROM	33.4	320.8	726.1	1983.8	2206.7
P_3:0% RDP through RDF + 100% RDP through PROM	32.0	301.7	724.8	1884.9	2128.9
S.Em±	0.89	22.74	21.38	11.99	23.95
CD (P=0.05)	NS	NS	NS	35.16	70.23
PSB strains (B)					
B_0: Seed treatment with PSB @ 10 ml kg seed^{-1}	30.5	302.2	692.1	18642	2031.3
B_1:Soil application of PSB @ 1 lit ha^{-1}	31.9	303.2	706.2	1883.2	2083.3
B_2:Soil application of PSB @ 1.5 lit ha^{-1}	33.1	307.7	726.5	1905.4	2114.2
S.Em±	0.77	19.69	18.52	10.38	20.74
CD (P=0.05)	NS	NS	NS	30.45	60.82
Interaction (P*B)					
S.Em±	1.55	39.39	37.04	20.77	41.47
CD (P=0.05)	NS	NS	NS	NS	NS

Conclusion

The superior growth performance of blackgram observed under the integrated application of 25% RDP through RDF and 75% through PROM, coupled with soil application of PSB at 1.5 lit ha^{-1}, can be attributed to the synergistic role of organic, inorganic, and microbial inputs. The partial substitution of chemical phosphorus with PROM not only ensured a sustained supply of available phosphorus but also improved soil structure and microbial dynamics. The addition of PSB further enhanced solubilization of native and applied phosphorus, thereby improving its availability in the rhizosphere. Enhanced phosphorus availability is known to stimulate root growth, enhance photosynthetic activity, and promote efficient translocation of assimilates, which in turn contribute to greater plant height, increased leaf area, higher branching, and dry matter production.

References:

1. Department of Agriculture & Farmers Welfare, Government of India. Agricultural Statistics at a Glance 2022. New Delhi: Govt. of India. Available from: www.indiastat.com
2. Devi RP, Gnanachitra M, Marimuthu S. Studies on combined application of bacterial and fungal bioinoculants on growth and yield of blackgram. J Food Legumes. 2022;35(4):305-308.
3. Government of Telangana, Department of Agriculture. Season and crop coverage report Yasangi-2023-24. Available from: https://agri.telangana.gov.in
4. Gummadala KR, Tomar SS, Perli VH, Kaushik M. Agronomical performance of black gram (*Vigna mungo* L.) in the presence of organic manures and bio-fertilizers in typic haplustalf. Pharma Innov. 2022;11(6):1927-1931.
5. Jangir CK, Singh D, Kumar S. Yield and economic response of biofertilizer and fertility levels on black gram (*Vigna mungo* L.). Prog Res Int J. 2016;11(8):5252-5254.
6. Khandelwal R, Choudhary SK, Khangarot SS, Jat MK, Singh P. Effect of inorganic and bio-fertilizers on productivity and nutrients uptake in cowpea (*Vigna unguiculata* L.). Legume Res Int J. 2012;35(3):235-238.
7. Marimuthu S, Surendran U. Effect of nutrients and plant growth regulators on growth and yield of black gram in sandy loam soils of Cauvery new delta zone, India. Cogent Food Agric. 2015;1(1):1010415.
8. Motsara MR. Promoting balanced fertilization in India–Policies and economic issues. Fertilizer News. 2002;47:15-21.
9. Prajapati BJ, Gudadhe N, Gamit VR, Chhaganiya HJ. Effect of integrated phosphorus management on growth, yield attributes and yield of chickpea. Farming Manage. 2017;2(1):36-40.

10. Rabari KV. Effect of phosphorus and biofertilizers on yield and economics of blackgram. Int J Agric Sci. 2022;14(4):0975-3710.
11. Ramakrishna K, Devi KS, Vani KP, Sailaja V, Umamaheshwari T. Growth, yield and economics of groundnut as influenced by organic nutrient management. Prog Res Int J. 2015;10(3):1686-1690.
12. Sekhar DMR, Katewa MK, Shaktawat MS. PROM Khad an efficient source of P to replace the costly chemical phosphatic fertilizer. Nature Preceding. 2012;7:1-5.
13. Singh J, Bhatt R, Sidhu DS, Dhillon BS, Al-Huqail AA, Alfagham A, Siddiqui MH, Ali HM, Khan F, Kumar R. Integrated use of phosphorus, farmyard manure and biofertilizer improves the yield and phosphorus uptake of black gram in silt loam soil. PLoS One. 2022;17(4):266753.
14. Sowmya NSL, Rupesh P, Rajeev LS, Upadhyay H. Effect of different bio-inoculants with varied levels of phosphorus on growth and yield attributes of chickpea (*Cicer arietinum* L.). Ann Agri-Bio Res. 2024;29(1):76-82.
15. Timofeeva A, Galyamova M, Sedykh S. Prospects for using phosphate-solubilizing microorganisms as natural fertilizers in agriculture. Plants. 2022;11(16):2119.
16. Tiwari B, Singh N. Pulse chemistry and technology. London: Royal Society of Chemistry; 2015.
17. Udawat P. Phosphate rich organic manure (PROM)–A novel organic fertilizer. Indian J Agric Sci. 2023;93(2):214-216.
18. Wang L, Zheng J, You J, Li J, Qian C, Leng S, Yang G, Zuo Q. Effects of phosphorus supply on the leaf photosynthesis, and biomass and phosphorus accumulation and partitioning of canola (*Brassica napus* L.) in saline environment. Agronomy. 2021;11(10):1918.