E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(8): 755-758
Received: 20-05-2024
Accepted: 22-06-2024

Dr. Prabhat Kumar Chaturvedi
Head, Department of Agronomy, National Post Graduate College, Barhalganj, Gorakhpur, Uttar Pradesh, India

Dr. Dileep Kumar Sharma
Assistant Professor, Department of Agricultural Chemistry, B. R. D. P. G. College, Deoria, Uttar Pradesh, India

Dr. Akhilesh Chandra Singh
Associate Professor, Kulbhaskar P.G. College, Prayagraj, Uttar Pradesh, India

Rakesh Kumar
Ph.D. Scholar, Department of Agronomy, National Post Graduate College, Barhalganj, Gorakhpur, Uttar Pradesh, India

Corresponding Author:
Dr. Prabhat Kumar Chaturvedi
Head, Department of Agronomy, National Post Graduate College, Barhalganj, Gorakhpur, Uttar Pradesh, India

Response of phosphorus and biofertilizers on growth and yield of black gram (*Vigna mungo* L.)

Dr. Prabhat Kumar Chaturvedi, Dr. Dileep Kumar Sharma, Dr. Akhilesh Chandra Singh and Rakesh Kumar

DOI: https://doi.org/10.33545/2618060X.2024.v7.i8Sj.1368

Abstract
Phosphorus and Bio fertilizer (VAM + PSB) are a key element involved in various functions in growth and metabolism of Blackgram. It is frequently a major limiting nutrient for plant growth in most Indian soils Pulses have been in focus in recent times due to the continuous upswing in their prices. The low productivity of blackgram is due to intensive farming practices and use of exhaustive and high yield cultivars and imbalanced external fertilization. Therefore, proper fertilization (site specific and balanced fertilization) is needed to increase the production and productivity of blackgram. Blackgram is very much responsive to phosphorus and biofertilizers.

The present investigation entitled " Response of Phosphorus and Biofertilizers on Growth and Yield of Black Gram (*Vigna mungo* L.) " was carried out at Crop Research Farm of National Post Graduate College, Barhalganj, Gorakhpur, (U P.) during zaid season on 2022 - 23 with the objective to study the effect of Phosphorus and Biofertilizers (VAM + PSB) on growth, yield and quality of Black Gram (*Vigna mungo* L.). The soil of the experimental field was a silty loam in texture with low, medium and high in N, P and K respectively. The experimental site is situated in a subtropical zone in indo gangetic planes. The experiment was laid out in Randomized Block Design with 9 treatment combinations and 3 replications. Black gram was sown on 20th February 2023 with treatment combinations *viz*. T_1 - 30 kg P + VYM, T_2 - 40 kg P + VAM, T_3 - 50 kg P + VAM, T_4 - 30 kg P + PSB, T_5 - 40 kg P + PSB, T_6 - 50 kg P + PSB, T_7 - 30 kg P + VAM + PSB, T_8 - 40 kg P + VAM + PSB and T_9 - 50 kg P + VAM + PSB, respectively. The crop was harvested on 5th May 2023. Most of the results revealed that different levels of Phosphorus and Biofertilizers (VAM + PSB) had a significant effect on growth parameters, yield parameters and yield of Black gram. The conjoint application up to 40 kg P + VAM + PSB i.e. T_8 was registered significantly superior in growth attributes *viz*. plant height (Cm), number of branches per plant, leaf area index, number of nodules per plant and dry weight (g) and yield attributes *viz*. number of pods per plant, number of grains per pod, test weight (g) and grain yield and economic feasibility *viz*. gross return (Rs/ha), net return (Rs/ ha.) and benefit: cost ratio, respectively over the rest of the treatments except treatment combination T_9 i.e. 50 kg P + VAM + PSB which were at par to each other. The present paper is a critical review from research findings of eminent scientists on Phosphorus and Biofertilizer effect over black gram.

Keywords: Black gram, phosphorus, bio-fertilizer, VAM, PSB, growth attributing characters, yield attributing characters, yield, straw yield

Introduction
Black gram (*Vigna mungo* L.) has originated from the Indian subcontinent, belongs to the family " Leguminosae", subfamily " Fabaceae " and genus " Vigna " Center of genetic diversity for black gram is found in India (Zeven *et al*., 1982) [14]. Being an important pulse crop, the food legumes, particularly the grain or pulses are important food stuff in all tropical and subtropical countries. Black gram is also known as urd bean, urad dal or urad acts as a cover crop and its deep root system protects the soil from erosion. The crop also improves soil fertility by symbiotic fixation of atmospheric nitrogen in root nodules. Black Gram is a self-pollinated leguminous crop and seeds are highly nutritious containing 24% protein, 60% carbohydrate, 1.3% fat and is richest in phosphoric acid among the pulses being five to ten times richer than in others. Besides this, potassium, phosphorus, calcium and sodium. It also contains sufficient amounts of vitamins like A, B1 and B3 (Anonymous, 2010) [1].

Black gram also possesses some medicinal and curative properties. India is the largest producer of pulses, producing about 25% of the world's production. Because of their vital role in nutritional protection and soil development, pulses have been an integral part of sustainable agriculture since ancient times. The world's pulse crops occupy 93.54 million hectares of land and produce 92.13 million tonnes of yield at an average rate of 985 kg per hectare. India is one of the major producers of pulses, with an area of 287.83 lakh hectares, a production of 254.63 lakh tonnes and a productivity of 885 kg per hectare. Biofertilizers are defined as live and latent cells of microorganisms which have potential to benefit crops and soil through different modes ranging from nitrogen fixation to phosphorus solubilisation (Khanna *et al*., 2019) [5]. Phosphorus is a universally deficient plant nutrient in most of the soils, particularly in light textured soils. Application of phosphorus to pulse crop has been found very effective and called as master key element for increasing yield. its play a vital role in growth and development of roots and also necessary for growth of Rhizobium bacteria responsible for biological fixation of N to increase the efficiency of pulses as soil renovator and serves the dual purpose of increasing yield of main as well as succeeding crop. An adequate supply of phosphorus has been reported good for better growth, yield, quality and enormous nodule formation in legumes (Sammauria *et al*., 2009) [10]. About 93-99 per cent of the total phosphorus is insoluble and hence directly not available to plants. Inoculation of P solubilizing microorganisms in the rhizosphere of crop and soil increases the availability of P from insoluble sources of phosphate, desorption of fixed phosphates and also increases the efficiency of phosphatic fertilizers through secreting acidic substances (Gaur, 1991) [3]. Symbiosis between plant roots and certain soil fungi e.g. Vesicular Arbuscular Mycorrhiza (VAM) plays an important role in phosphorus cycling and its uptake by plants (Biswas *et al*., (2001) [2]. These symbiotic micro-organisms have an extensive mycelial network and can increase the transport of other mineral elements such as zinc and copper. VAM fungi can play an important role in enhancing P availability to plants in deficient soils and can save P- fertilizer by 25-30% (Somani *et al*., 1990) [12]. Hence, keeping in view all above mentioned aspects, present study was formulated to access the most suitable combination of phosphorus and Biofertilizer for enhancing the growth parameters and yield of Black Gram.

Materials and Methods

Research Site

The field experiment was carried out at the Crop Research Farm of National Post Graduate College, Barhalganj, Gorakhpur, U.P. during Zaid season 2022-23. The experimental site is situated in a subtropical zone in Indo - gangetic plains and lies between 260471 North latitude, 820101 East longitude and 1130m above sea level.

Experimental Design

The experiment was laid out in Randomized Block Design, keeping 9 treatment combinations *viz*. T_1 - VAM + 30 Kg P/ ha., T_2 - VAM + 40 Kg P per ha., T_3 - VAM + 50 Kg P per ha., T_4 - PSB + 30 Kg P/ ha., T_5 - PSB + 40 Kg P per ha., T_6 - VAM + 50 Kg P per ha., T_7 - VAM + PSB + 30 Kg P/ ha., T_8 - VAM + PSB + 40 Kg P per ha. And T_9 - PSB + VAM + 50 Kg P per ha., respectively and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design.

Properties of the Experimental Area of Soil

The soil of the experimental field was silty loam in texture and slightly alkaline in reaction with PH, 7.6, EC 0.20 dsm^{-1} organic carbon 0.40 % and available Nitrogen 196 kg ha^{-1}, Phosphorus 18.9 kg ha^{-1} and Potassium 260.50 kg ha^{-1} at 0 $^{-1}$5 cm soil depth.

Cultural Practices

The experimental field was prepared by cross cultivation followed by planking. The field was demarcated (Lay-out) by experimental design rules. The sowing was done dated on 20/ 02/ 2023 with seed-rate 20 Kg per ha. Phosphorus, VAM and PSB were used to the crops as per treatment of experiment. The other agronomical cultural practices such as use of Nitrogen, irrigation, weeding and plant protection measures have been performed uniformly in all treatments. The Black Gram was harvested manually at the maturity dated on 05/ 05/ 2023.

Growth Parameters of Crops

From germination to harvesting of the crops several crop growth attributes *viz*. plant height (cm), number of branches per plant, leaf area index, number of nodules per plant and dry weight (g) were recorded at defined intervals.

Yield Parameters of Crops

The yield attributes *viz*. number of pods per plant, number of grains per pod, test weight (g), grain yield and straw yield were recorded.

Economics

To examine the economic feasibility and viability of different treatments under investigation, economics of Black gram production in terms of gross return (Rs. per ha), net return (Rs. per ha) and B C ratio were calculated for different treatments and the outcome is presented.

Results and Discussion

Growth Parameters

An experiment was conducted to observe the influence of Phosphorus and Biofertilizer on growth and yield of Black gram. The data pertaining to growth, yield and quality along with statistical interpretations are presented and discussed.

Different combinations of Phosphorus and Biofertilizer had a significant effect on plant growth characters. Growth attributes *viz*. plant height (cm), number of branches per plant, leaf area index, number of nodules per plant and dry weight (g) during the year of study given in Table 1 clearly indicates that the maximum plant height (cm), number of branches per plant, leaf area index, number of nodules per plant and dry weight (g) (36.90 cm, 5.89, 1.04, 23.56 and 9.11 g, respectively) were recorded with the Treatment T_8 i.e. P - 40 kg per ha. + VAM + PSB which were significantly superior over the rest of the treatment except the treatment T_9 i.e. P - 50 kg per ha + VAM + PSB which were at par to each other, while the lowest values were observed (plant height - 33.67 cm, number of branches per plant - 4.09, and number of root nodules 21.37 respectively) with the Treatment T_1 i.e. P - 30 kg per ha + VAM. This could be attributed due to better root proliferation, higher root development, increased availability and uptake of nutrients, energy transformation and metabolic processes in plants. Biofertilizers also improve the nutrient absorption (Naserirad *et al*., 2011) [8].

Phosphate Solubilizing Bacteria are key microorganisms which help in solubilization of fixed phosphorus through release of various organic acids such as formic acid, butyric acid etc. and make it available to plants (Gaur, 1991) [3]. The stimulatory

effect of biofertilizers was in accordance with the findings of Selvakumar *et al*., 2012, Kachave *et al*., 2018; Kumari *et al*., 2020) [11, 4, 6]. Application of higher doses of phosphorus along with PSB resulted in improved phosphorus uptake by the plants and ultimately improved plant growth was reported (Kachave *et al*., 2018) [4].

Table 1: Growth attributes of black gram as affected by different combinations of phosphorus and biofertilizers

Treatment	Plant height(cm)	Number of branches per plant	Leaf area index	Number of Nodules per plant	Dry Weight (g)
T_1	33.67	4.09	0.76	21.37	7.32
T_2	33.76	4.17	0.78	22.04	7.81
T_3	34.20	4.20	0.86	22.78	7.65
T_4	34.09	4.16	0.75	21.83	7.30
T_5	33.90	4.13	0.79	22.43	7.90
T_6	34.45	4.25	0.89	22.96	7.85
T_7	35.24	4.65	0.83	23.10	8.01
T_8	36.90	5.89	1.04	23.56	9.11
T_9	36.04	5.75	0.94	23.29	8.90
SEm	0.60	0.24	0.01	0.47	0.40
CD	1.27	0.50	0.02	0.99	0.84

Yield Parameters

Yield attributes *viz*. number of pods per plant, number of grains per pod, test weight (g) grain yield (q ha^{-1}) and stover yield (q ha^{-1}) as influenced by different combinations of Phosphorus and Biofertilizer have been shown in Table - 2 clearly indicates that as yield attributes *viz*. number of pods per plant, number of grains per pod, test weight (g) grain yield (q ha^{-1}) and stover yield (q ha^{-1}) as (12.72, 6.90, 36.99 g, 8.42 q ha^{-1}, and 16.85 q ha^{-1}, respectively) were recorded highest with the Treatment T 8 i.e. P - 40 kg per ha. + VAM + PSB, while the lowest values were observed (11.22, 5.09, 34.45 g, 7.18 q ha^{-1}, and 15.51 q ha^{-1} %, respectively) with the Treatment T 1 - i.e. P - 30 kg per ha. + VAM. When the new Plant comes out of the seed, they do not have well root development and they need nutrients soon, which is obtained from chemical fertilizers instantly. Whereas, the organic manures are gradually decomposed, so that new plants do not have nutrients as needed, this is the main reason that the chemical fertilizers apply have higher nutrients in plants in the growth stage.

Greater availability of metabolites (photosynthates) and nutrients to developing reproductive structures seems to have resulted in an increase in all the yield attributing characters which ultimately improved the yield of the crop. The higher crop growth with more supply of phosphorus might regulate starch/sucrose ratio in source leaves and reproductive organs. The beneficial effect of phosphorus on fruiting of plants and better translocation of desired metabolites to the yield contributing parts of the plant might be attributed to more grain yield. The improvement in straw yield might be due to the fact that phosphorus tends to increase growth and development in terms of plant height, branches and dry matter by improving the nutritional environment of the rhizosphere and plant system leading to higher plant metabolism and photosynthetic activity. These findings corroborate the results of Tanwar *et al*., (2003) [13], Rathore *et al*., (2010) [9] and Kumawat *et al*., (2013) [7] in urd bean. Sink capacity of a plant depends mainly on vegetative growth that is affected positively by application of Nitrogen fertilizers and supply of photosynthesis for the formation of yield components.

Table 2: Yield attributes of black gram as affected by different combinations of phosphorus and black gram

Treatment	Number of pod per plant	Number of grains per pod	Test weight (g)	Grain Yield (q/ha)	Straw yield (q/ha)
T_1	11.22	5.09	34.45	7.18	15.51
T_2	11.45	5.15	34.55	7.20	15.75
T_3	11.50	5.22	34.92	7.61	16.05
T_4	11.53	5.45	34.72	7.22	15.70
T_5	11.34	5.30	34.50	7.29	15.85
T_6	11.85	5.90	34.82	7.75	15.90
T_7	11.90	5.85	34.49	7.85	16.30
T_8	12.72	6.90	36.99	8.42	16.85
T_9	12.56	6.55	35.82	7.83	16.82
SEm	0.18	0.16	0.26	0.76	15.22
CD	0.39	0.34	0.56	1.61	32.27

Economic Feasibility

To examine the economic feasibility and viability of different treatments under investigation, economics of Black gram production in terms of gross return (Rs per ha), net return (Rs per ha) and B C ratio were calculated for different treatments and the outcome is presented in Table 3.

Table 3: Green Return, Net Return and Benefit Cost Ration of Black Gram as Affected by Different Combination of Phosphorus and Biofertilizer

Treatment	Gross Return	Net Return	Benefit: Cost Ration
T_1	69847.50	36232.50	1.07
T_2	72975.00	38965.00	1.14
T_3	74573.50	40293.50	1.17
T_4	70890.00	37150.00	1.10
T_5	77840.00	43595.00	1.28
T_6	79925.00	45770.00	1.34
T_7	80967.50	46812.50	1.37
T_8	104250.00	69615.00	2.00
T_9	85902.00	51267.00	1.49

It is obvious from the above table that the Treatment T_8 i.e. P - 40 kg per ha + VAM + PSB was registered with the highest gross return (Rs 104250.00), net return (Rs. 69615.00) and benefit cost ratio (2.00) per ha., this might be due to higher yield in the treatment compared to other treatments.

Conclusion

Based on the experimental findings, it may be concluded that P - 40 kg per ha. + VAM + PSB has been proved to be an ideal to exploit the maximum yield.

References

1. Anonymous. https://wik.onse.conr; c2010.
2. Biswas BC, Das S, Subhash KP. Crop response to bio-fertilizers. Fertil News. 2001;46:15-24.
3. Gaur AC. Phosphate solubilizing microorganisms and biofertilizers. New Delhi: Omega Scientific Publishers; c1991. p. 176.
4. Kachave RR, Indulkar BS, Vaidya PH, Ingole AJ, Patil NM. Effect of phosphorus and PSB on growth, yield and quality of black gram (*Vigna mungo* L.) in inceptisol. Int J Curr Microbiol App Sci. 2018;7:3359-65.
5. Khanna R, Pawar J, Gupta S, Verma H, Trivedi H, Kumar P, *et al*. Efficiency of biofertilizers in increasing the production potential of cereals and pulses: A review. J Pharmacogn Phytochem. 2019;8:183-188.
6. Kumari K, Poonia S, Purushottam, Tomar A, Kumar R, Dhyani BP, *et al*. Effect of phosphate solubilizing bacteria and Rhizobium on growth and yield of legume plants (*Vigna radiata* L. and *Vigna mungo* L.). Int J Curr Microbiol App Sci. 2020;9:332-341.
7. Kumawat PK, Tiwari RC, Golada SL, Godara AS, Garhwal RS, Choudhary R. Effect of phosphorus sources, levels and biofertilizers on yield attributes, yield, and economics of black gram (*Phaseolus mungo* L.). Legume Res. 2013;36:70-73.
8. Naserirad H, Soleymanifard A, Naseri R. Effect of integrated application of bio-fertilizers on grain yield, yield components, and associated traits of maize cultivars. Am-Euras J Agric Environ Sci. 2011;10:271-277.
9. Rathore DS, Purohit HS, Yadav BL. Integrated phosphorus management on yield and nutrient uptake of urdbean under rainfed conditions of Southern Rajasthan. J Food Legumes. 2010;23(2):128-137.
10. Sammauria R, Yadav RS, Nagar KC. Performance of cluster bean (*Cyamopsis tetragonoloba*) as influenced by nitrogen and phosphorus fertilization and biofertilizers in Western Rajasthan. Indian J Agron. 2009;54(3):319-323.
11. Selvakumar G, Reetha S, Thamizhiniyan P. Response of biofertilizers on growth, yield attributes and associated protein profiling changes of black gram (*Vigna mungo* L.). World Appl Sci J. 2012;16:1368-1374.
12. Somani LL, Bhandari SC, Saxena SN, Vyas KK, editors. Bio-fertilizers. Jodhpur: Scientific Publication; c1990. p. 142-145.
13. Tanwar S, Sharma G, Chahar M. Effect of phosphorus and biofertilizers on yield, nutrient content and uptake by black gram [*Vigna mungo* (L.) Hepper]. Legume Res.: An Int J. 2003;26(1):39-41.
14. Zeven AC, De Wet JM. Dictionary of cultivated plants and their regions of diversity. Wageningen: Center for Agricultural Publishing and Documentation; c1982.