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Khushbu Yogi
Department of Agronomy,
Rajasthan College of Agriculture,
MPUAT, Udaipur, Rajasthan,
India

Dr. KC Nagar
Dryland Farming Research Station
Arjia, Bhilwara, Maharana Pratap
University of Agriculture and
Technology, Udaipur, Rajasthan,
India

Dr. J Choudhary
Department of Agronomy,
Rajasthan College of Agriculture,
MPUAT, Udaipur, Rajasthan,
India

Dr. RK Sharma
Department of Soil Science and
Agricultural Chemistry, RCA,
MPUAT, Udaipur, Rajasthan,
India

Dr. HL Bairwa
Department of Horticulture RCA,
MPUAT, Udaipur, Rajasthan,
India

Manish Kumar
Ph.D. Scholar, Department of
Agronomy, Rajasthan College of
Agriculture, MPUAT, Udaipur,
Rajasthan, India

Corresponding Author:
Khushbu Yogi
Department of Agronomy,
Rajasthan College of Agriculture,
MPUAT, Udaipur, Rajasthan,
India

Effect of fertility levels and liquid bio-fertilizers on growth dynamics of Black gram (*Vigna mungo* L. Hepper)

Khushbu Yogi, KC Nagar, J Choudhary, RK Sharma, HL Bairwa and Manish Kumar

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Abstract

A field experiment was conducted during *kharif*, 2025 at the Dryland Farming Research Station, Arjia, Bhilwara, to study the effect of fertility levels and liquid bio-fertilizers on growth dynamics of black gram (*Vigna mungo* L. Hepper). The experiment was laid out in a factorial randomized block design with four fertility levels, namely control, 50% RDF, 75% RDF and 100% RDF and four liquid bio-fertilizers, namely control, *Rhizobium*, NPK consortium and *Rhizobium* + NPK consortium, replicated three times. The recommended dose of fertilizer was 20:40 NP kg ha⁻¹. The experimental results showed that application of 100% RDF recorded significantly higher values of growth parameters viz., plant height (53.33cm) and dry matter accumulation (18.60g plant⁻¹) at harvest in black gram which was superior to lower fertility levels and was at par with 75% RDF. Among the liquid bio-fertilizers, application of *Rhizobium* + NPK consortium recorded significantly higher values of plant height (53.80 cm) and dry matter accumulation (18.52g plant⁻¹) at harvest which was found superior over control. The results indicated that application of 100% RDF in combination with *Rhizobium* + NPK consortium had a positive effect on the growth.

Keywords: Black gram, fertility levels, liquid bio-fertilizers, *Rhizobium*, NPK consortium, growth parameters

Introduction

Black gram (*Vigna mungo* L. Hepper) commonly known as “Urd” belongs to family leguminosae is one of the important *kharif* pulse crops. It is commonly grown in summer and rainy seasons in Northern India. Black gram is highly nutritious, contain 24 per cent protein, 1.3 per cent fat, 0.9 per cent fiber, 60 per cent carbohydrates, several vitamins and essential amino acids. Black gram is adaptable to various soil types, including those with low and high pH, acidic and alkaline or sodic soil (Yadav *et al.*, 2024) [21].

Black gram is consumed in the form of ‘dal’ (whole or split, husked and un-husked) or perched. It differs from other pulses in its peculiarity of attaining mucilaginous pasty character when soaked in water. In the South, it is consumed in variety of ways across the form North to South in preparation of different regular and popular dishes like vada, idli, dosa, halwa, imarti in combination with other food seeds and also used as a nutritive fodder for milch cattle. It helps to controls soil erosions and competes with weeds effectively due to its deep root system and foliage dense cover. Additionally it fixes atmospheric nitrogen into the soil, thereby improving the soil fertility. Pulse plays a vital role in the Indian agriculture after cereals and oilseed crops because it is the second important constituent of diet after cereals. Pulses are essential with regards to its contribution to human nutrition and also in respect of their contribution to farmer’s income. They also contribute significantly through enriching the soil with nitrogen fixation. India is the largest grower and consumer of pulses in the world.

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) [5]. Among the states, Rajasthan, Madhya Pradesh, Maharashtra, Andhra Pradesh, Uttar Pradesh, Tamil Nadu and Gujarat are the major black gram producing states. In Rajasthan, black gram is predominantly grown in *kharif* season under rainfed conditions. In the Rajasthan state, black gram occupies 3.21 lakh ha area with production of 1.35 lakh tonnes and the average

productivity was 420 kg ha⁻¹ (Department of Agriculture, Government of Rajasthan, 2022-23)^[3]. In Rajasthan, it is mainly cultivated in Chittorgarh, Udaipur, Ajmer, Jhalawar, Kota, Bundi and Baran districts.

In the recent years, continuous and imbalance application of chemical fertilizers with little or no use of organic manure is leading to poor nutrient use efficiency, low yield of crop, poor physical and biological property of soil. At the same time increasing cost of production due to more and more use of costly nutrient sources is becoming unaffordable to the most of farmers. Hence, it has become imperative to search for other complementary and alternative sources of nutrients, among which use of bio-fertilizers of biological origin in black gram is an important avenue. In this approach, microbial fertilization with *Rhizobium* well as NPK consortium has been found promising to improve soil health and crop production there has been understandable concern about decline in the per capita availability of pulses. Nitrogen plays important role in synthesis of chlorophyll, amino acids and other organic compounds of physiological significance in plant system. Nitrogen is the most frequently deficient nutrient in crop production, and most non-legume systems require nitrogen inputs. Phosphorus is second important nutrient for crop after nitrogen. Phosphorus is referred to as the “kingpin” in Indian agriculture and also as the “energy currency” of plants (Dey *et al.*, 2017)^[4]. Its role in root development, nodule formation and plays important role in energy transfer in the living cells by means of high energy phosphate bond of ATP. Phosphorus is an important for formation and translocation of carbohydrate, fatty acids, glycerolides and other essential intermediate compounds. *Rhizobium* plays an important role in increasing the availability of nitrogen to the plants and helps in boosting the production through nitrogen fixation. Bio-fertilizers are compounds that contribute nutrients the natural process of fix atmospheric nitrogen, solubilizing phosphorous and aid for plant development through the manufacture of growth encouraging material (Suhag *et al.*, 2016)^[19].

Economic success of these legumes depends upon symbiotic nitrogen fixation, so seed inoculation with appropriate strains of *Rhizobium* is important to improve symbiotic nitrogen fixation which requires survival and establishment of inoculated *rhizobium* in the soil environment (Da and Deng, 2003)^[2]. However, many biotic and abiotic factors affect the persistence of symbiotically effective introduced *rhizobial* strain in soil (Sessitschet *et al.*, 2002; Lebrazi and Benbrahim 2014)^[16, 11]. It has been observed that the properly screened local strains are more effective for a particular agro-climatic region than the strains imported from other places in general (Gupta *et al.*, 2000)^[7].

Materials and Methods

A field experiment was conducted at block F₂, Dryland Farming Research Station, Arjia, Bhilwara (Rajasthan) during *kharif*, 2025. The experimental soil was clay-loam in texture, slightly alkaline in reaction (pH 7.32), low in organic carbon and available nitrogen, medium in available phosphorus and high in available potassium. The experiment was laid out in a factorial randomized block design with three replications, comprising four fertility levels viz. control, 50% RDF, 75% RDF and 100% RDF and four liquid bio-fertilizers viz. control, *Rhizobium* @ 5ml kg⁻¹, NPK consortium @ 5 ml kg⁻¹ and *Rhizobium* + NPK consortium. The test crop was black gram variety KU-4, sown at a spacing of 30 cm × 10 cm with a seed rate of 15 kg ha⁻¹. The recommended dose of fertilizer was 20:40 NP kg ha⁻¹ and half

nitrogen and full dose of phosphorus were applied at sowing through urea and DAP. The crop was managed through gap filling, pre-emergence atrazine, post-emergence metsulfuron-methyl and hand weeding at critical stages. Observations were recorded on plant height and dry matter accumulation using standard procedures and the data were analyzed by ANOVA as per factorial randomized block design (Panse and Sukhantme, 1985)^[12].

Results and Discussion

Fertility levels: During *kharif* 2025, fertility levels had a significant effect on all growth parameters of black gram including plant height and dry matter accumulation. Plant height remained non-significant at 30 DAS, possibly because seedlings mainly depend upon seed reserves during the early growth stages. Application of 100% RDF recorded the tallest plants at 60 DAS and at harvest with 45.86 and 53.33 cm, respectively which was statistically at par with 75% RDF (45.02 and 53.30 cm) but higher than 50% RDF and control. However, significant improvement at later stages might be due to improved nutritional status of the plant, which enhanced the synthesis of amino acids, proteins and growth-promoting substances, there by stimulating meristematic activity, cell division and cell elongation. Similar findings were reported by Singh *et al.* (2014)^[17], Jaiswal *et al.* (2019)^[8], Sarkeret *et al.* (2020)^[14]. A similar trend was observed for dry matter accumulation, where 100% RDF recorded the highest values of 2.13, 13.40 and 18.60 g plant⁻¹ at 30, 60 DAS and at harvest, respectively followed by 75% RDF with 17.98, 13.16 and 2.08 g plant⁻¹. This enhancement might be attributed to improved morphological growth of plants, which facilitated greater interception and efficient utilization of solar radiation, there by promoting higher photosynthetic activity. Adequate fertilizer supply also enhanced the plants ability to utilize favourable environmental conditions for increased synthesis and accumulation of photosynthates, ultimately resulting in higher biomass production. Singh *et al.* (2020)^[18] and Parashar and Tripathi (2020)^[13].

Liquid Bio-fertilizers

Among the liquid bio-fertilizers, *Rhizobium* + NPK consortium recorded the best growth performance as it produced the highest plant height at 60 DAS and at harvest with 46.34 and 53.80 cm, respectively and these values were statistically at par with NPK consortia @ 5ml kg⁻¹ but superior to *Rhizobium* and control. *Rhizobium* + NPK consortium also recorded the highest dry matter accumulation of 2.14, 13.50 and 18.52 g plant⁻¹ at 30, 60 DAS and at harvest, respectively. The superior growth performance under *Rhizobium* + NPK consortium might be attributed to enhanced symbiotic nitrogen fixation, solubilization of insoluble phosphorus and potassium, production of organic acids, chelating compounds in the rhizosphere, and synthesis of plant growth-promoting substances. Similar findings were reported by Selvakumaret *et al.* (2012)^[15], Bhutadiya *et al.* (2019)^[1], Gohil *et al.* (2021)^[6] and Verma *et al.* (2025)^[20]. NPK consortia remained statistically at par with *Rhizobium* + NPK consortium for most growth parameters, likely due to enhanced nutrient availability through nitrogen fixation, phosphorus solubilization and potassium mobilization by beneficial microorganisms, as also reported by Jangir *et al.* (2016)^[9] and Kant *et al.* (2016)^[10].

Conclusion

Based on findings, it is proposed that application of 100% RDF recorded the best growth performance in black gram, with the

highest plant height and dry matter accumulation. Among the liquid bio-fertilizers, *Rhizobium* + NPK consortium performed best and was better than NPK consortia, *Rhizobium* and control. Overall, the combined use of 100% RDF and *Rhizobium* + NPK consortium was most effective for improving growth of black gram.

Treatments	Plant height (cm)		
	30 DAS	60 DAS	At harvest
Fertility levels			
F ₀ :Control	10.66	42.86	49.80
F ₁ :50% RDF	11.03	43.78	52.13
F ₂ :75% RDF	11.23	45.02	53.30
F ₃ :100% RDF	11.38	45.86	53.33
S.E.m.±	0.195	0.696	0.881
C.D. (P= 0.05)	NS	2.010	2.544
Liquid bio-fertilizers			
B ₀ :Control	10.68	42.41	49.96
B ₁ : <i>Rhizobium</i>	10.95	43.73	51.73
B ₂ :NPK Consortium	11.23	45.02	53.07
B ₃ : <i>Rhizobium</i> + NPK consortia (5.0 l ha ⁻¹)	11.42	46.34	53.80
S.E.m.±	0.195	0.696	0.881
C.D. (P= 0.05)	NS	2.010	2.544

Treatments	Dry matter accumulation (g plant ⁻¹)		
	30 DAS	60 DAS	At harvest
Fertility levels (N:P)			
Control	1.96	12.03	17.03
50% RDF	2.02	12.66	17.68
75% RDF	2.08	13.16	17.98
100% RDF	2.13	13.40	18.60
S.E.m.±	0.039	0.261	0.355
C.D. (P= 0.05)	0.112	0.754	1.025
Liquid Bio-fertilizers (Seed Treatment)			
Control	1.94	11.91	16.83
<i>Rhizobium</i>	2.02	12.66	17.70
NPK Consortium	2.08	13.18	18.23
<i>Rhizobium</i> + NPK Consortium	2.14	13.50	18.52
S.E.m.±	0.038	0.261	0.355
C.D. (P= 0.05)	0.109	0.754	1.025

References

- Bhutadiya JP, Chaudhary MG, Damor RP, Patel AJ. Effect of different organic sources on growth, yield, yield attributes and economics of summer groundnut (*Arachishypogaea* L.) under organic farming. *Journal of Pharmacognosy and Phytochemistry*. 2019;8(2):846-849.
- Da HN, Deng SP. Survival and persistence of genetically modified *Sinorhizobiummeliloti* in soil. *Applied Soil Ecology*. 2003;22:1-14.
- Department of Agriculture, Government of Rajasthan. Raj Kisan Portal. 2022-23. <https://rajkisan.rajasthan.gov.in/>
- Dey P, Santhi R, Maragatham S, Sellamuthu KM. Status of phosphorus and potassium in the Indian soils vis-à-vis world soils. *Indian Journal of Fertilisers*. 2017;13(4):44-59.
- Directorate of Economics and Statistics. Government of Rajasthan. 2022-23. <https://statistics.rajasthan.gov.in/home/dptHome/>
- Gohil NB, Ramani VP, Kadivala VH, Kacha RP. Effects of bio-NPK consortium on growth, yield and nutrient uptake by rice under clay-loam textured soil. *Journal of the Indian Society of Soil Science*. 2021;69(2):179-186.
- Gupta S, Bhushan B, Hoondal GS. Isolation, purification and characterization of xylanase from *Staphylococcus* SG-13 and its application in bio-bleaching of kraft pulp. *Journal of Applied Microbiology*. 2000;88:325-334.
- Jaiswal JS, Kashyap Y, Bharve V. Response of black gram (*Vigna mungo* L.) to graded doses of sulphur under rainfed conditions. *Journal of Pharmacognosy and Phytochemistry*. 2019;8(2):124-127.
- Jangir CK, Singh D, Kumar S. Yield and economic response of biofertilizers and fertility level on black gram (*Vigna mungo* L.). *Progressive Research*. 2016;11(8):5252-5254.
- Kant S, Kumar A, Kumar S, Kumar V, Pal Y, Shukla AK. Effect of *Rhizobium*, PSB and phosphorus levels on growth, yield attributes and yield of black gram (*Vigna mungo* L.). *Journal of Pure and Applied Microbiology*. 2016;10:3093-3099.
- Lebrazi S, Benbrahim KF. Environmental stress conditions affecting the N₂-fixing *Rhizobium*-legume symbiosis and adaptation mechanisms. *African Journal of Microbiology Research*. 2014;8(53):4053-4061.
- Panse VG, Sukhatme PV. *Statistical Methods for Agricultural Workers*. New Delhi: Indian Council of Agricultural Research; 1985.
- Parashar A, Tripathi L. Effect of phosphorus and sulphur on the growth and yield of black gram (*Vigna mungo* L.). *Journal of Pharmacognosy and Phytochemistry*. 2020;9(5):2585-2588.
- Sarker BC, Das MK, Ray J, Biswas A. Yield response of black gram to nitrogen, phosphorus and potassium combinations grown in Khulna district of south-western coastal Bangladesh. *Journal of Emerging Technologies and Innovative Research*. 2020;7(9):2349-5162.
- Selvakumar G, Reetha S, Thamizhiniyan P. Response of bio-fertilizers on growth, yield attributes and associated protein profiling changes of black gram (*Vigna mungo* L.). *World Applied Sciences Journal*. 2012;16(10):1368-1374.
- Sessitsch A, Howieson JG, Perret X, Antoun H, Martínez-Romero E. Advances in *Rhizobium* research. *Critical Reviews in Plant Sciences*. 2002;21(4):323-378.
- Singh A, Jat NL, Singh R, Pal S, Singh AK, Gudade BA. Effect of fertility levels and bio-inoculants on growth, productivity and economics of cluster bean (*Cyamopsistetragonoloba*L.). *Indian Journal of Agricultural Sciences*. 2014;84(6):784-786.
- Singh RE, Singh V, Tiwari D, Masih A. Effect of levels of phosphorus and sulphur on growth and yield of black gram (*Vigna mungo* L.). *International Journal of Current Microbiology*. 2020;9(10):2784-2791.
- Suhag M. Potential of bio-fertilizers to replace chemical fertilizers. *International Advanced Research Journal in Science, Engineering and Technology*. 2016;3(5):163-167.
- Verma AK, Singh AK, Singh A, Verma R, Kumar A, Singh A, Singh U. Productivity of black gram (*Vigna mungo* L.) influenced by bio-fertilizers and variable sources of nutrients. *Legume Research*. 2025;48(10):1766-1770.
- Yadav R, Pal RK, Maurya DK, Yadav P, Yadav A, Singh R, Kumar N. Effect of different liquid bio-fertilizer on economics, yield and yield attributes. *International Journal of Research in Agronomy*. 2024;7(5):602-606.