The Pharma Innovation Journal 2023; 12(9): 2968-2972

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 2968-2972

www.thepharmajournal.com
Received: 01-07-2023
Accepted: 05-08-2023

Shikha Rao
Master Research Scholar, Soil Science, MGCGV, Madhya Pradesh, India

Pawan Sirothia
Associate Professor, Faculty of Agriculture, MGCGV, Madhya Pradesh, India

Sujeet Gautam
Master Research Scholar, Soil Science, MGCGV, Madhya Pradesh, India

Harsh Gupta
Master Research Scholar, Soil Science, MGCGV, Madhya Pradesh, India

Corresponding Author:
Shikha Rao
Master Research Scholar, Soil Science, MGCGV, Madhya Pradesh, India

The effect of rhizobium and phosphate solubilizing bacteria (PSB) along with inorganic fertilizers on growth and yield attributes of black gram (*Vigna mungo*)

Shikha Rao, Pawan Sirothia, Sujeet Gautam and Harsh Gupta

Abstract
The effect of various treatments incorporated with Rhizobium and PSB along with inorganic fertilizers for growth and yield attributes was studied on "IPU-2-43" variety of Black gram through a field experiment which was conducted at the Agricultural research farm, Rajaula, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.) during the kharif season of 2021-22. The core importance of the study is the requirement for shifting from orthodox agriculture practice to organic and sustainable agriculture. Experiment was conducted to determine the effect of bio-fertilizers in dryland area of Chitrakoot. The experiment comprised of thirteen treatments including control treatment and treatments with recommended dose of fertilizers with nine treatments incorporated with Rhizobium and PSB. The experiment was laid out in randomized block design (RBD) with three replications. Half kilogram rhizobium was enough for 20 kg seeds and 3 Kg of PSB inoculant was given with soil application along with 50 kg finely powdered FYM. Results indicated that the treatment incorporated with rhizobium and PSB along with 100% recommended doses of fertilizers recorded higher plant growth (45.73 cm plant height, 20.27 branches per plant), and higher grain yield (1741.33 kg/hectare), and maximum number of nodulation (36.50 nodules per plant). Due to the continuous rise in the population of the country, the demand for food security by increasing production from the same limited land along with the perspective of sustainable agriculture the presented study can contribute to the cause.

Keywords: Black gram, PSB, rhizobium, bio-fertilizers, growth, yield, nodulation

Introduction
Black gram or commonly known as urad is one of the most important source of protein in India. Not only for humans but this is also used as nutritive fodder for the milch breed animals also. It is rich in protein content with 24% of protein content. During the twelfth Plan (2012-2015) the total production was 18.29 lakh tonnes on an area of 31.29 lakh hectares. As regards the total contribution from states, Madhya Pradesh stand first in respect of area (19.40%) followed by U.P. (17.88%) and Andhra Pradesh (11.69%), whereas in production U.P. stands first (16.98%) followed by Andhra Pradesh (16.75%) and Madhya Pradesh (15.07%). The highest yield was recorded by the state of Bihar (898 kg/ha) followed by Sikkim (895 kg/ha) and Jharkhand (890 kg/ha) the National yield average was (585 kg/ha). The lowest yield was recorded in the state of C.G. (309 kg/ha) followed by Odisha (326 kg/ha) and J&K (385 kg/ha) (DES, 2015-16). (htt). As the population of the country is continuously increasing the production must be increased from the same limited land and the perspective of sustainable agriculture should also be kept in mind. This the reason why this experiment was carried out taking Bio-inoculants and inorganic fertilizers both in the picture. The inorganic fertilizers as we already know increases the yield significantly but the recommended dose of fertilizers was reduced to 75% and 50% to check how much of the yield was compensated by the use of bio-inoculants namely Rhizobium and Phosphate solubilizing bacteria (PSB). In India, the survey conducted on Rhizobium showed poor nodulation in about half the area for one reason or the other, though the legumes are grown in the area for a long time. The nitrogen fixing process and its contribution to total nitrogen can be enhanced by selection and use of efficient strains of N2 fixing micro-organism suited to the local environmental conditions coupled with proper amendments (Agnihotri, 2005) [2]. Phosphorus (P) is a vital and major nutrient for plants and microorganisms next only to nitrogen. Phosphorus is essential for plant growth. It accounts for about 0.1% of the terrestrial matter. Phosphorus plays a critical role in the life cycle of plants.

It is an essential component of deoxy ribonucleic acid (DNA), the seat of genetic inheritance in plants as well as animals and of the various forms of ribonucleic acid (RNA) needed for protein synthesis (Watts, 2003) [5].

All the statements presented above built the foundation of this experiment to assess the extent to which bio-inoculants increase the yield attributes along with the change in growth attributes.

Materials and Methods

A field experiment was conducted at the agricultural research farm of Rajaula, MGCGV, Chitrakoot, satna (M.P.) to study the effects of Rhizobium and PSB along with inorganic fertilizers on growth and yield attributes of Black gram (Vigna mungo). The soil of the experimental site was light textured sandy loam with a pH of 7.62, medium in available nitrogen, medium in available phosphorus and medium in available potassium. There were thirteen treatment combinations comprising of 50%, 75% and 100% levels of recommended dose of fertilizers along with rhizobium and PSB were present which is given in Table-1. Rhizobium treatment was half kg rhizobium for 20 Kg seeds and 3 Kg of PSB inoculant was given with soil application along with 50 kg finely powdered FYM. The plot size was 5m x 3m. The variety that was used here was IPU 2-43 of Black gram. All the desired cultural practices were followed during experiment and the recording for growth attributes was taken at 20, 40 and at harvest days after sowing and the recordings for yield attributes was taken post-harvest. The experiment was laid out in randomized block design (RBD). All the obtained data from experiment were statistically analyzed by analysis of variance (ANOVA) according to randomized block design as prescribed by (Panse and Sukhtame, 1978). Standard error of mean in each case and critical difference only for significant cases were calculated at 5% levels of probability.

Table 1: Treatment Combinations

S. No.	Symbols	Treatments
1.	T_0	0% RDF + No bio-fertilizers
2.	T_1	100% RDF + No bio-fertilizers
3.	T_2	75% RDF + No bio-fertilizers
4.	T_3	50% RDF + No bio-fertilizers
5.	T_4	0% RDF + PSB (Soil application)
6.	T_5	100% RDF + PSB (Soil application)
7.	T_6	75% RDF + PSB (Soil application)
8.	T_7	50% RDF + PSB (Soil application)
9.	T_8	0% RDF + Rhizobium
10.	T_9	100% RDF + Rhizobium
11.	T_{10}	75% RDF + Rhizobium
12.	T_{11}	50% RDF + Rhizobium
13.	T_{12}	100% RDF + Rhizobium + PSB

Results and Discussion

Effect on growth attributes of Black gram

The treatments having inoculation of rhizobium along with inorganic fertilizers showed better plant height and number of branches as compared to other treatments. The plant height was in the range of 12.00 cm to 45.73 cm. Results from the data showed that the maximum plant height at harvest was of treatment T_{12} – 100% RDF + rhizobium + PSB which was 45.73 cm. The results for branches were different from that of plant height, plant branches were in the range of 3.60 to 20.27 and the maximum number of branches was present in the treatment T_{11} – 50% RDF + rhizobium, which in itself is a quite different result without any plausible explanation. Phosphorus increases the metabolic activities and amount of naturally occurring phyto-hormones. PSB strains released greater amount of available P and this enable the plant to absorb more P resulting in improved growth attributes. Similar results were founded by (Agnihotri, 2005) [2].

Effect on nodulation of Black gram

Rhizobium inoculated treatments as expected previously gave way better results than the un-inoculated ones. The data for root nodules was taken at 45 DAS and nodules were in the range of 24.30 to 36.50. The maximum number of nodules were present in treatment T_{12} – 100% RDF + Rhizobium + PSB. Control treatment and treatments with sole application of inorganic fertilizers showed less satisfactory results. The findings were coincided with the findings of (Agnihotri, 2005) [2]. The treatment of seed and soil with Bacillus species of PSB increased growth (root length, shoot length, number of Branches, biomass and root nodules) was reported by (Durgapal, 2016) [3].

Effect on grain yield of Black gram

The grain yield per hectare was in the range of 1110.00 kg per hectare to 1741.33 kg per hectare. The maximum grain yield was found to be in treatment T_{12} – 100% RDF + Rhizobium + PSB which was 1741.33 kg per hectare. Nutrients play a pivotal role in increasing the seed yield in pulses. The PSB like pseudomonas and bacillus also enhance the availability of phosphorus to plant by converting insoluble phosphorus to soluble form. The better nodulation and improvement of yield attributes due to seed inoculation with efficient Rhizobium isolates. The increase in yields might have resulted due to improvement in growth and yield attributing characters through better supply of nutrient as a result of Rhizobium inoculation reported by (Agnihotri, 2005) [2]. The results were also in accordance with (Durgapal, 2016) [3]. PSB inoculation + 40 kg P205 ha'1 brought highly significant differences regarding yield attributing parameters *viz.* number of pods plants'1, length of pod, number of grains pod'1, 1000 - grain weight, grain yield, straw yield and harvest index in the both years. A perusal of data indicated that PSB inoculation with increasing rates of phosphorus fertilization increased the yield attributing parameters reported by (Rai, 2002) [4].

Effect on Soil Fertility

The fertility of post-harvest soil was evaluated in the form of organic carbon and Available N, P, K status of the soil. Results revealed that all the parameters under consideration were increased due to rhizobium and PSB inoculation. On the basis of the result obtained, it can be concluded that the maximum organic carbon was present in the treatment T_9- 20 kg N/ha + 40 kg P/ha + 20 kg K/ha which was 3.55 gm/kg, the maximum amount of available nitrogen was present in T_{12}- 20 kg N/ha + 40 kg P/ha + 20 kg K/ha + Rhizobium which was 338.5 kg/ha, maximum available phosphorus was maximum in T_9 and potassium were also obtained in the same treatment T_{12} which was 33.6 kg/ha and 132.90 kg/ha respectively. Similar results were obtained by (Agnihotri, 2005) [2].

Table 2: Effect of rhizobium and PSB along with inorganic fertilizers on growth and yield attributes of Black gram

S. No.	Treatments	Plant height	No. of Branches	No. of nodules	Grain yield (kg per ha)
1.	T_0- 0% RDF + No bio-fertilizers	41.03	11.67	24.30	1110.33
2.	T_1- 100% RDF + No bio-fertilizers	40.27	11.47	25.70	1315.67
3.	T_2- 75% RDF + No bio-fertilizers	42.03	17.13	25.30	1463.67
4.	T_3- 50% RDF + No bio-fertilizers	41.43	9.73	25.10	888.67
5.	T_4- 0% RDF + PSB (Soil application)	33.67	10.87	28.70	824.33
6.	T_5- 100% RDF + PSB (Soil application)	41.70	10.73	30.50	1230.33
7.	T_6- 75% RDF + PSB (Soil application)	44.10	9.87	28.90	1427.00
8.	T_7- 50% RDF + PSB (Soil application)	34.60	10.67	28.70	1093.33
9.	T_8- 0% RDF + Rhizobium	42.07	17.73	32.30	849.00
10.	T_9- 100% RDF + Rhizobium	42.27	17.80	35.90	1487.67
11.	T_{10}- 75% RDF + Rhizobium	33.70	11.73	34.30	1420.00
12.	T_{11}- 50% RDF + Rhizobium	43.53	21.33	33.70	1492.67
13.	T_{12}-100% RDF + Rhizobium + PSB	45.73	20.27	36.70	1741.33
	$CD_{5\%}$ =	5.11	1.62	0.67	124.08
	SE± =	1.75	0.55	0.23	42.51

Table 3: Effect of rhizobium and PSB on Soil fertility

S. No.	Symbols	Treatments	Organic carbon (gm/kg)	Available nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potassium (kg/ha)
1.	T_0	0% RDF + No bio-fertilizers	3.53	290.50	24.50	132.90
2.	T_1	100% RDF + No bio-fertilizers	3.53	322.65	31.58	190.90
3.	T_2	75% RDF + No bio-fertilizers	3.53	315.12	29.78	188.00
4.	T_3	50% RDF + No bio-fertilizers	3.54	310.22	28.68	156.27
5.	T_4	0% RDF + PSB (Soil application)	3.53	308.22	25.60	142.00
6.	T_5	100% RDF + PSB (Soil application)	3.54	325.70	32.80	186.00
7.	T_6	75% RDF + PSB (Soil application)	3.54	324.00	30.40	178.00
8.	T_7	50% RDF + PSB (Soil application)	3.53	323.00	28.70	175.20
9.	T_8	0% RDF + Rhizobium	3.53	305.60	28.60	49.20
10.	T_9	100% RDF + Rhizobium	3.54	335.23	34.86	205.54
11.	T_{10}	75% RDF + Rhizobium	3.54	322.60	32.90	195.30
12.	T_{11}	50% RDF + Rhizobium	3.55	320.60	29.38	167.40
13.	T_{12}	100% RDF + Rhizobium + PSB	3.55	338.50	33.60	220.60

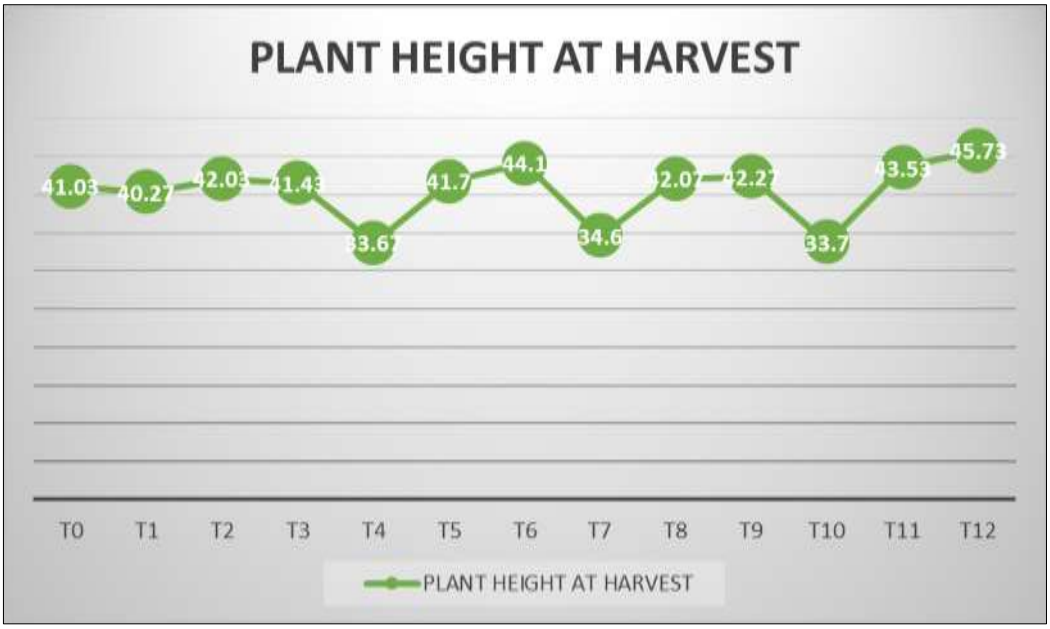

Fig 1: Plant height at harvest

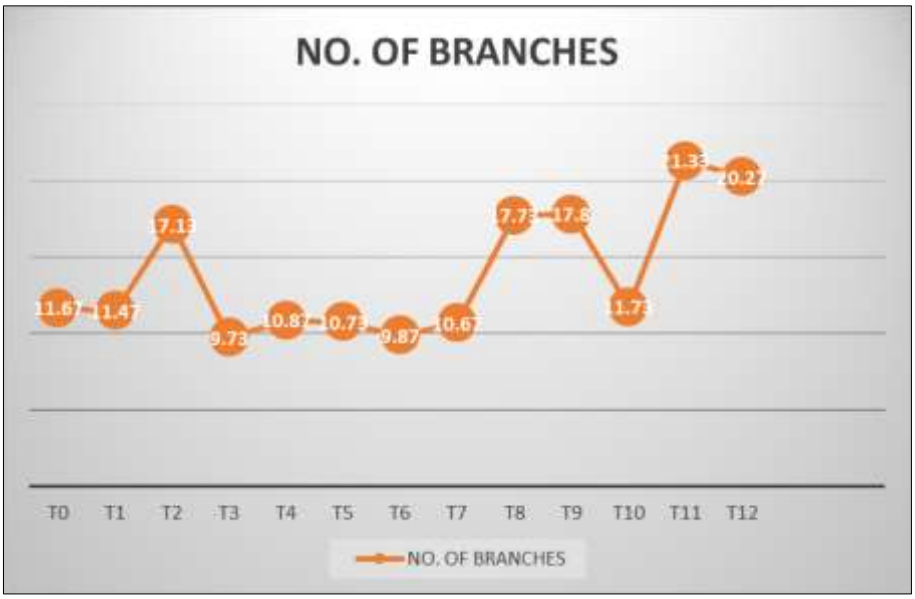

Fig 2: Number of branches

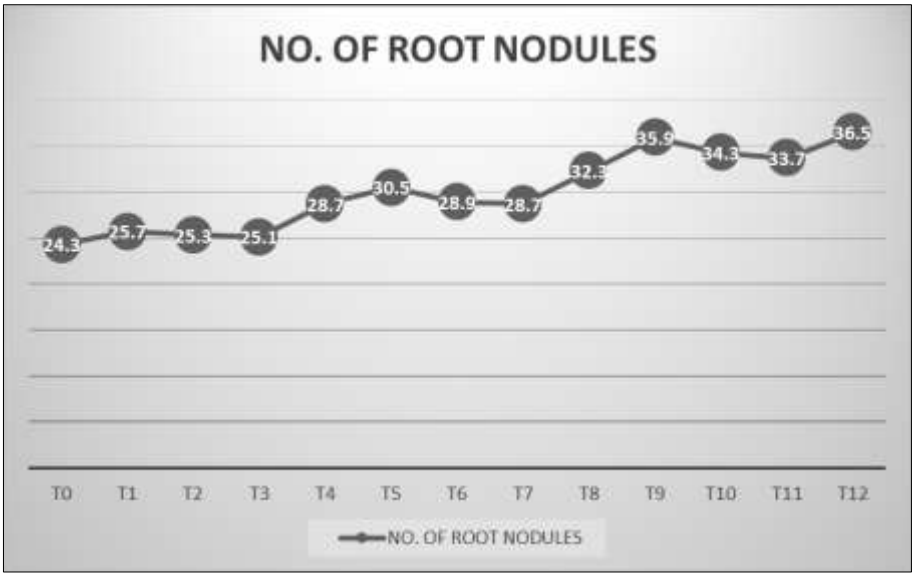

Fig 3: Number of Nodules

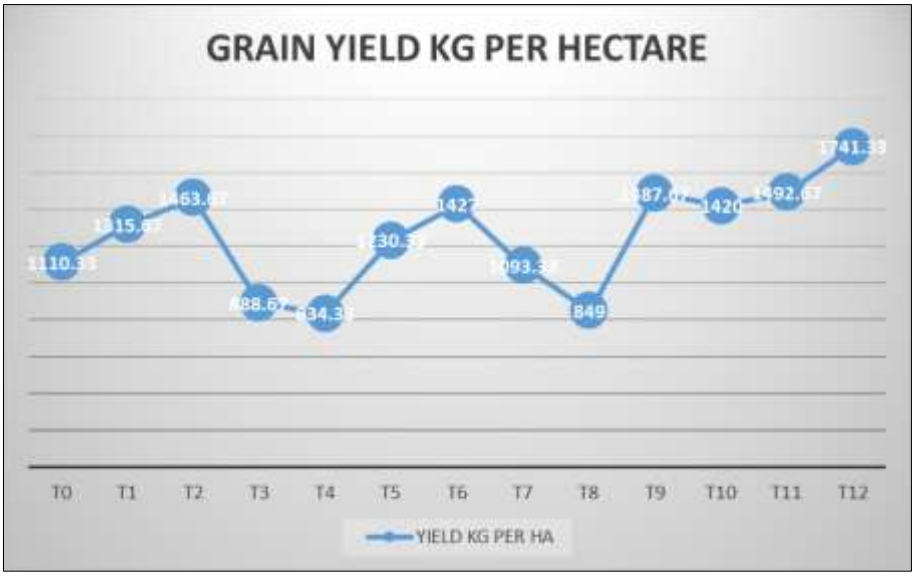

Fig 4: Grain yield kg per hectare

Conclusion

The research findings of this research put a clear light on the importance of bio-fertilizers on both growth and yield attributes of black gram. The study shows that even in dryland conditions the bio-fertilizers perform significantly and changes the whole production scenario. By the virtue of the data, it can be concluded that the treatment with 100% RDF along with rhizobium and PSB was the most effective amongst all the treatments and the treatments with sole inorganic fertilizers were less effective. Bio-fertilizer incorporated treatments increased growth, nodulation and yield in the black gram crop efficiently. However, to get more accurate results some more experiments like this must be conducted repeatedly in the same agro-climatic regions.

References

1. (n.d.). Retrieved from https://dpd.gov.in/Urdbean.pdf
2. Agnihotri P. Effect of rhizobium phosphorus and sulphur on yield and quality of black gram *Vigna Mungo* L. Jaunpur; c2005. http://hdl.handle.net/10603/166767.
3. Durgapal A. Effect of N2 Fixing and Phosphate Solubilizing Rhizobacteria on Germination Growth and Nutrient Uptake of Macrotyloma Uniflorum Lam Verdc and Setaria Italica LP Beauv. Kumaun University; c2016. http://hdl.handle.net/10603/214681.
4. Rai SK. Response of mungbean Vigna radiata L Witzcek to Rhizobium and PSB inoculation with phosphorus and sulphur fertilisation. Jaunpur; c2002. http://hdl.handle.net/10603/167152.
5. Watts J. Phosphate solubilizing bacteria in soils. Chauka; c2003. http://hdl.handle.net/10603/6898.