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National Academy of Agricultural Science (NAAS) Rating : 3. 03

Yield and Economics of Black gram as influenced by Carrier and Liquid Based *Rhizobium* and *PSB*

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Abstract: *A field experiment was conducted at Department of Agronomy, College of Agriculture, VNMKV, Parbhani (Maharashtra) India, during Kharif season of 2014 to study the effect of carrier and liquid based Rhizobium and PSB on yield and economics of black gram (vigna mungo l. hepper). Results revealed that application of Recommended Dose of Fertilizers + Rhizobium (Liquid Based) + PSB (Liquid Based) was found more productive and profitable as compared to other treatments except the application of RDF + Rhizobium (Carrier Based) + PSB (Carrier Based).*

Key words: *Black gram,Carrier based and Liquid based bio inoculants yield and economics.*

INTRODUCTION

Nutrients play a vital role in increasing the seed yield in pulses. In legume, nitrogen (N) is more useful because it is the main component of amino acid as well as protein. Mineral nitrogen fertilizers are costly and detrimental to the environment. Blackgram can obtain Nitrogen (N) by atmospheric fixation in their root nodules in symbiosis with soil *rhizobia* and thus has a potential to yield well in nitrogen deficit soils. To reduce the production cost with application of mineral fertilization and provide environment protection, more pulse production can be achieved through seed inoculation with *Rhizobium* biofertilizer. They are known to influence nodulation, symbiotic nitrogen fixation and growth and yield of pulses (Vijayalakshmi and Swarajyalakshmi, 2005).

Phosphorus is the second most critical plant nutrient but for pulses, it assumes primary importance, owing to its important role in root proliferation and thereby atmospheric nitrogen fixation. Majority of the phosphorus gets fixed in the soil due to various factors. The yield and nutritional quality of pulses is greatly influenced by application of phosphorus and biofertilizer. Phosphorus solubilizing bacteria helps in increasing crop productivity by way of helping in solubilization of insoluble phosphorus, stimulating growth by providing hormones, vitamins and other growth factors (Singh *et al.,* 2013).

The availability of phosphorus to legume crop is a key constraint for its production. The soil microorganisms are responsible for transfer of the immobilized soil phosphorus into available form through which phosphorus becomes easily available to these legume crops (Singh *et al.,* 2008). Hence, the use of biofertilizers is economical & environment friendly. The programatic approach will be to develop a supply system involving combination of biofertilizers.

Under *Rhizobium* inoculation, plants synthesize more photosynthates and enhances the protein content in grain and nodulation in plants. Increase nodulation in legumes, helps in promoting free-living nitrogen fixing bacteria. The use of phosphate solubilizing bacteria (PSB) as inoculants simultaneously increases P uptake by the plant and crop yield. Strains from the genera *Pseudomonas*, *Bacillus* and *Rhizobium* are among the most powerful phosphate solubilizers. The principal mechanism for mineral phosphate solubilization is the production of organic acids, and acid phosphates play a major role in the mineralization of organic phosphorous in soil (Balachandran and Nagarajan 2002).

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The objective of any agricultural research programme is to increase the level of crop productivity. The strategy to boost the level of crop productivity would be through the adoption of package of practices comprising use of seeds of high yielding varieties, adequate doses of *Rhizobium* and phosphorus solubilizing bacteria (PSB) in powder or liquid form etc. Application of biofertilizer is an acceptable approach for yield with good quality food for human consumption.

In order to increase the yield of black gram, the experiment was undertaken to e study the performance of carrier and liquid based *Rhizobium* and PSB on yield and economics of Blackgram (*Vigna mungo* L. Hepper)".

MATERIALS AND METHODS

The field experiment was conducted at experimental farm, Department of Agronomy, VNMKV, Parbhani (M.S.) during *Kharif* season 2014. The experiment was laid out in a Randomized Block Design with seven treatments. The treatments were RDF+ *Rhizobium* (CB) (T_1), RDF + PSB (CB) (T_2), RDF + *Rhizobium* (CB) + PSB (CB) (T_3), RDF + *Rhizobium* (LB) (T_4), RDF + PSB (LB) (T_5), RDF + *Rhizobium* (LB) + PSB (LB) (T_6) and RDF Only (25:50:00 NPK kg ha^{-1}) (T_7). Sowing was done on 14th July, 2014 at the spacing of 30 cm × 10 cm. Recommended dose of fertilizer for black gram 25:50:00 N P K kg ha^{-1} was applied as basal dose. The bio inoculants were applied through seed treatment at the time of sowing. The recommended plant protection schedule was followed for the crop. (CB: Carrier based, LB: Liquid based, RDF: Recommended Dose of Fertilizers)

RESULT AND DISCUSSION

Yield Attributes

The data on yield attributes was influenced significantly due to various treatments. The application of RDF + *Rhizobium* (LB) + PSB (LB) produced maximum pod yield plant^{-1} (6.86 g) which was at par with application of RDF + *Rhizobium* (CB) + PSB (CB) (6.26 g). Lowest pod yield plant^{-1} among all the treatments was recorded with treatment (RDF only 25:50:00 NPK kg ha^{-1}). Similar trend was observed as regards to seed yield plant^{-1}(g) and number of seeds pod^{-1}. The treatment differences in case of test weight (g) were recorded to be non-significant. The application of bio fertilizers might have also provided more nitrogen resulting in increased number of seeds and higher uptake of nutrients by the plant consequently might have increased yield contributing characters *i.e* number of seeds pod^{-1}. The results are in line with those reported by Karthikeyan *et al*., 2008.

Table 1
Pod yield plant^{-1}, seed yield plant^{-1}, number of seeds pod^{-1} and test weight of Black gram as influenced by various treatments.

Treatments	*Pod yield plant^{-1} (g)*	*Seed yield plant^{-1}(g)*	*No. of Seeds pod^{-1}*	*Test weight (g)*
T_1-RDF + *Rhizobium* (CB)	5.88	3.45	5.15	50.33
T_2-RDF + PSB (CB)	5.81	3.41	5.09	50.33
T_3-RDF + *Rhizobium* (CB) + PSB (CB)	6.26	3.67	5.48	54.33
T_4-RDF + *Rhizobium* (LB)	6.07	3.56	5.31	53.00
T_5- RDF + PSB (LB)	5.85	3.44	5.13	51.33
T_6- RDF + *Rhizobium* (LB) + PSB (LB)	6.86	4.03	6.01	54.67
T_7-RDF Only (25:50:00 NPK kg ha^{-1})	4.98	2.93	4.36	50.33
SE ±	0.31	0.18	0.27	1.14
C.D. at 5%	0.94	0.55	0.82	NS
General Mean	5.96	3.50	5.22	52.05

Table 2
Seed, straw yield (kg ha^{-1}) and biological yield (kg ha^{-1}) of Black gram as influenced by various treatments.

Treatments	*Seed yield (kg ha^{-1})*	*Straw yield (kg ha^{-1})*	*Biological yield (kg ha^{-1})*
T_1-RDF + *Rhizobium* (CB)	979	2084	3064
T_2-RDF + PSB (CB)	934	1929	2863
T_3-RDF + *Rhizobium* (CB) + PSB (CB)	1079	2132	3211
T_4-RDF + *Rhizobium* (LB)	1035	2117	3151
T_5-RDF + PSB (LB)	952	1963	2915
T_6-RDF + *Rhizobium* (LB) + PSB (LB)	1210	2248	3458
T_7-RDF Only (25:50:00 NPK kg ha^{-1})	781	1775	2556
SE ±	74	87	119
C.D. at 5%	223	263	359
General Mean	996	2035	3031

Yield Studies

Seed yield was significantly influenced by different treatments. Significantly higher seed yield was recorded with the application of RDF + *Rhizobium* (LB) + PSB (LB) than rest of the treatments but it was found at par with the application of RDF + *Rhizobium* (CB) + PSB (CB) and RDF + *Rhizobium* (LB). Similar trend was observed in respect of straw yield and biological yield. This might to be combination of both *Rhizobium* and PSB biofertilizers which result in the cumulative effect in increasing growth and yield contributing characters which have been contributed to increased yield. Similar trend of results was reported by Vijayalakshmi and Swarajyalakshmi (2005) and Selvakumar *et al*., (2009) who stated that combined inoculation of phosphobacteria and *Rhizobium* overcome the single inoculation.

Table 3
Gross monetary return, net monetary return and Benefit: Cost Ratio of Black gram as influenced by various treatments.

Treatments	*GMR (Rs. ha^{-1})*	*NMR (Rs. ha^{-1})*	*B:C Ratio*
T_1-RDF + *Rhizobium* (CB)	45980	28640	2.65
T_2-RDF + PSB (CB)	43750	26410	2.52
T_3-RDF + *Rhizobium* (CB) + PSB (CB)	50390	33030	2.90
T_4-RDF + *Rhizobium* (LB)	48440	31060	2.79
T_5-RDF + PSB (LB)	44590	27220	2.57
T_6-RDF + *Rhizobium* (LB) + PSB (LB)	56260	38830	3.23
T_7-RDF Only (25:50:00 NPK kg ha^{-1})	36860	19530	2.13
SE ±	3220	3220	0.19
C.D. at 5%	9740	9740	0.56
General Mean	46610	29240	2.68

Economics

Gross monetary return, net monetary return and benefit: cost ratio were differed significantly due to different biofertilizer treatments.

The data revealed that the application of RDF + *Rhizobium* (LB) + PSB (LB) recorded higher gross monetary returns and net monetary returns over rest of the treatments and it was found at par with the application of RDF + *Rhizobium* (CB) + PSB (CB) and RDF + *Rhizobium* (LB). The highest Benefit:Cost ratio was recorded with treatments *i.e.* RDF + *Rhizobium* (LB) + PSB (LB) whereas the lowest Benefit:Cost ratio was recorded with control treatment *i.e.* and (RDF only 25:50:00 NPK kg ha^{-1}). The results are in line with those reported by Kumawat *et al.,* (2013).

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