Original Research Article

EFFECT OF SPACING AND BIOFERTILIZER ON YIELD AND ECONOMIC OF BLACK GRAM (Vigna mungo L.)

Abstract – A field experiment was carried out during *zaid* season of 2021 at crop research farm of SHUATS, Prayagraj to study about the Effect of Spacing and Biofertilizer on growth and yield of Black gram (*Vigna mungo* L.) The experiment was laid out in randomized block design by keeping three spacing levels, *i.e.* S - (20 x 10 cm), S2 – (25 x 10 cm) and S3 – (30 x 10 cm) and Biofertilizers *i.e.* PSB and Rhizobium and which was replicated three. Results revealed that spacing of 30 x 10 cm + Rhizobium , PSB recorded significantly higher in plant height (43.88 cm), number of branches per plant (6.81), number of nodules per plant (25.84), number of pods per plant (37.30), number of seeds per pod (7.51) test weight (37.73 g), grain yield (836 kg/ha) and stover yield (2144 kg/ha) and plant dry weight (6.77 g/plant), crop growth rate results are showed in 20 x 10 cm + Rhizobium + PSB. However, net returns (54550.00 INR/ha) and B:C ratio (2.62) was also obtained with the application of spacing 30 x 10 cm + Rhizobium + PSB. Therefore I concluded that spacing of 30 cm x 10 cm + Rhizobium + PSB was produced more grains (836 kg/ha) and economic effect (2.62).

Keywords: Black gram, Economics, growth, Yield.

1.INTRODUCTION

Blackgram (*Vigna mungo*) is one of important pulse crop. The food legumes, particularly the grain or pulses are important food stuff in all tropical and subtropical countries. It is grown throughout India. Blackgram is widely grown grain legume and belongs to the family "*leguminoseae*" and genus "*vigna*" and assumes considerable importance from the point of food and nutritional security in the world. It is also known as urdbean, udad dal, urad dal or urad. It also acts as 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.

Blackgram is grown well in moisture retentive light soil, but loamy and clay loam are suitable for the cultivation of Blackgram. Loam to clay loam with neutral PH are best suited for Blackgram cultivation. It is susceptible to waterlogged conditions of the soil. It is popular because of its nutritional quality having rich protein (22-24%), carbohydrates (56.6-59.6%), fat (1.2-1.4%), Minerals (3.2%), phosphorous (385 mg/100g) and it is rich source of calcium and iron. It defers from other pulses in its peculiarity of attaining a somewhat mucilaginous pasty character, giving additional body to the mass due to long polymer chain of polysaccharide chain of carbohydrates. Tamil Nadu leads first in productivity with an average yield of 775 kg/ha. It contained 24.7 % protein, 0.6 % fat, 0.9 % fibre and 3.7 % ash as well as sufficient quantity of calcium, phosphorus and important vitamins. Due to cheaper protein source it is designated as "poor man's meat" **[1]** (Aslam *et al.,* 2010).

"Plant density can have a major effect on the final yield of most of the legumes and the general response of yield to increasing population is well documented. To realize the maximum yield potential of blackgram during summer and rainy season, maintenance of optimum space made available to individual plant is of prime importance. Row and plant spacing has to be worked out to get desired spacing. The spacing requirement depends upon the growth behaviour of genotype. So it is required to maintain spacing for obtaining higher yield" [15] (Veeramani, 2019).

The phosphate solubalising Bacteria (PSB), dissolving inter locked phosphates appear to have an important implication in Indian agriculture.The role of microorganisms in solubilizing inorganic phosphates in soil and making them available to plants is well known these microorganisms bring about solubilization by the production of organic acid and phosphate enzyme activity. As regards phosphate only about 15-20 per cent of the applied phosphorous is utilized by first crop.

Rhizobium culture to different legumes is common agronomic practice for enhance pulse production [2] (Bhatt *et al.,* 2014). Rhizobium inoculation is essential for all the pulse crops to increase the yield of pulses. It is a biofertilizer which increases symbiotic nitrogen fixation and ultimately it increases the yield. Thus, the response of nitrogen to legumes is more important than phosphorus as later is being fixed by the symbiosis. Increasing in the number of such microorganisms accelerates the microbial process to augment to the extent availability of nutrient in the form which can be easily assimilated by the plant. The techniques involving optimization of fertilizer inputs with aim to productivity.

2.MATERIALS & METHODS

The experiment was conducted during the *Zaid* season 2021, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at 25^0 30' 42''N latitude, 81^0 60' 56" E longitude and 98 m altitude above the mean sea level. Soil having nearly neutral in soil reaction (pH 7.7), organic carbon (0.44), available nitrogen (171.48 kg/ha K), available phosphorus (27 kg/ha) and available potassium (291.2 kg/ha). The climate of the region is semi- arid subtropical. Treatments comprised of T_1– 20 x 10 cm + Rhizobium, T_2 – 20 x 10 cm + PSB, T_3 – 20 x 10 cm + Rhizobium + PSB, T_4 – 25 x 10 cm + Rhizobium, T_5 - 25 x 10 cm + PSB, T_6 – 25 x 10 cm + Rhizobium + PSB, T_7 – 30 x 10 cm + Rhizobium, T_8– 30 x 10 cm + PSB and T_9 – 30 x 10 cm + Rhizobium + PSB. These were replicated thrice in Randomized Block Design. The recommended dose of fertilizer is 20-40-20 kg/ha NPK. Recommended dose of fertilizer was applied at the time of sowing in the form of Urea, DAP and MOP.

2.1 Chemical analysis of soil

Composite soil samples are collected before layout of the experiment to determine the initial soil properties. The soil samples are collected from 0-15 cm depth and were dried under shade, powdered with wooden pestle and mortar, passed through 2 mm sieve and were analyzed for organic carbon by rapid titration method by [6] Nelson (1975). Available nitrogen was estimated by alkaline permanganate method by[12] Subbiah and Asija (1956), available phosphorus by [7] Olsen,S.H., Cole,V.V(1954**)** method as outlined by Jackson (1967), available potassium was determined by using the flame photometer normal ammonium acetate solution and estimating by using flame photometer (ELICO Model) as outlined by [5] Jackson **(1973)** and available $ZnSO_4$ was estimated by Atomic Absorption Spectrophotometer method as outlined by Lindsay and Norvell (1978).

2.2 Statistical analysis

The data recorded were different characteristics were subjected to statistical analysis by adopting Fishers the method of analysis of varianc (ANOVA) as described by [4] Gomez and Gomez

(2010). Critical difference (CD) values were calculated the ‘F’ test was found significant at 5% level.

3 Results and Discussion

3.1 Plant height (cm)

“There was an increasing in crop age plant height was progressively increased with the advancement during the experimentation. The analysis on plant height was significantly higher in all the different growth intervals with the levels of spacing and biofertilizers. At harvest, maximum plant height (43.88 cm) was recorded with application of 30×10 cm + Rhizobium +PSB which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + Rhizobium +PSB (43.31 cm) and spacing 20 x 10 cm + Rhizobium +PSB (43.10cm). It might be due to in case of dry matter production kg ha^{-1} and leaf area index of growth attributing characters, grain, bhusa and haulm yield kg ha^{-1} were recorded higher with crop geometry of 30 × 10 cm with foliar spray of TNAU Pulse Wonder at 1.125%. Similar observation was reported by” [8] Rajeshkumar *et al.* (2017).

3.2 Number of branches per plant

There was a steady increase in the number of branches /plants from 30 to 60 DAS differed significantly as influenced by Spacing and Biofertilizers. At harvest, maximum number of branches/plant (6.81) was recorded with application of 30×10 cm + Rhizobium +PSB which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + Rhizobium +PSB (6.78). “It might be due to Increase of plant density, decreased the number of branches/plant due to plants at higher densities accumulate less carbon which is not sufficient to support more branching. Similar observations have been reported by” **[3] Gama *et al.* (2007).**

3.3 Number of nodules per plant

There was steady increase in root nodules from 15 to 45 DAS and 45 to at harvest root nodules decrease. At harvest, maximum number of nodules/plant (25.84) was recorded with application of 30×10 cm + Rhizobium +PSB which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + Rhizobium +PSB (25.80). "It might me due to the inoculation of rhizobium and PSB enhance the microbial population in legume crop and form higher number of nodule per plant. The activity of microorganism increased in legumes crop due to rhizobium and PSB and this inoculation of Rhizobium and PSB increased the number of nodule per plant. The increase in nodulation was highest with the T_8 (Rhizobium, PSB and RDF 100%). Similar results are also reported by" [14] Tagore *et al.* 2014**.**

3.4 Plant dry weight (g/plant)

The Plant dry weight of Black gram recorded at 15, 30, 45 DAS and at harvest differed significantly as influenced by Spacing and Biofertilizers. At harvest, maximum plant dry weight (6.77) was recorded with application of 20×10 cm + Rhizobium, PSB which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + PSB (6.68). It might be due to the inoculation of Rhizobium and PSB increases the availability of enzymes and vitamins in soil and due to this enzyme activity the number of microbial population increases and this increased population of bacteria, and actinomycetes recharge the soil with conditioner. The inoculation of Rhizobium and PSB works as a soil conditioner which enhance the nutrient availability. PSB helps in nodule formation because PSB increases the phosphorus availability and this available phosphorus ha direct role in biological nitrogen fixation in legumes which ultimately increase the activity of microorganism and this increased microorganism which help in nodule formation. Sufficient amount of nodule formation increases the weight of nodule. The increases in fresh and dry weight of root nodule were highest in treatment Rhizobium and PSB . Similar results are also reported by [11] Singh *et al.,* (2007).

3.5 Crop growth rate ((g/day/m^2)

At harvest, maximum crop growth rate (9.44 g/day/m^2) was recorded with application of 20×10 cm + Rhizobium +PSB which was significantly superior over all other treatments. "It might me due to the crop growth rate makes the assessment of crop productivity/unit land. The CGR was significantly higher with closer crop geometry of 20 × 10 cm^2 all the growth stages, which was mainly due to more population per unit area. Similar findings were also reported by" [10] Sathyamoorthi *et al.* (2008).

3.6 Yield attributes and Yield

Observations regarding the response of spacing 20 × 10 cm^2, 25 × 10 cm^2 and 30 × 10 cm^2 cm's and biofertilizer on yield and yield attributes of black gram. The observation showed that the yield and yield attributes there was significant difference between treatments.

3.6.1 Number of pods/plant

Treatment with application of spacing 30 x10 cm + PSB + Rhizobium was recorded maximum number of pods/plant (37.30) which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + PSB + Rhizobium (36.50).

3.6.2 Number of seeds/pod

Treatment with application of spacing 30 x10 cm + PSB + Rhizobium was recorded maximum number of seeds/pods (7.51) which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + PSB + Rhizobium (7.39). "It might be due to the findings revealed that crop geometry (cm) 30×10 recorded significantly yield attributing characters, yield, gross return and net return. Variety Indira Urd-1 produced to significant higher growth parameters, yield attributing characters and net return and return per rupee invested as compared to Pratap Urd-1". [13] Suraj Kumar and Dr. AS Rajput (2020).

3.6.3 Test weight (g)

Treatment with application of spacing 30 x10 cm + PSB + Rhizobium was recorded maximum number of test weight (37.73) which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + PSB + Rhizobium (37.02). It might be due to the prospect further revealed that the inoculation of Rhizobium and PSB increase the test weight significantly improved the test weight of grain as comparison to rest of the treatment. The increases in test weight were highest with the treatment T_8 (RDF 100%, Rhizobium, PSB and azotobacter) Similar results are also reported by [16] Yasari *et al.* 2007.

3.6.4 Seed yield (kg/ha)

Treatment with application of spacing 30 x10 cm + PSB + Rhozobium was recorded maximum seed yield (836 kg/ha) which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + PSB + Rhizobium (768 kg/ha).

3.6.5 Straw yield (kg/ha)

Treatment with application of spacing 30 x10 cm + PSB + Rhozobium was recorded maximum straw yield (2144 kg/ha) which was significantly superior over all other treatments and statistically at par with treatment of spacing 25 x 10 cm + PSB + Rhizobium (2098).

"It might be due to the result revealed that among all the treatments, *Rhizobium* + PSB + *Azotobacter* (T_8) treatment recorded maximum growth attributes, yield and yield attributes which is closely followed by T_5 (*Rhizobium* + PSB). Application of *Rhizobium* + PSB+ *Azotobacter* also exhibited maximum values of gross return, net returns and benefit cost ratio. Similar findings were reported by" [9] Yadav *et al.* (2021).

3.6.6 Harvest index (%)

Treatment with application of spacing 25 x10 cm + Rhizobium was recorded maximum harvest index (29.58 %) which was significantly superior over all other treatments and statistically at par with treatment of spacing 20 x 10 cm + PSB + Rhizobium (28.38 %), 30 x 10 + PSB + Rhizobium (28.08 %), 30 x 10 cm + Rhizobium (27.84 %) and 25 x 10 cm + PSB, Rhizobium (26.98 %). It might be due to the result revealed that among all the treatments, *Rhizobium*, PSB treatment T8 recorded maximum growth attributes, yield and yield attributes which is closely followed by T_5 (*Rhizobium*, PSB). Application of *Rhizobium*, PSB also exhibited maximum values of gross return, net returns and benefit cost ratio.

3.6.7 Economics

Higher net returns were obtained with application of spacing 30 x 10 cm + PSB + Rhizobium (Rs.54550.00), which was significantly superior over all other treatments which was closely followed by 25 x 10 cm + Rhizobium, PSB(Rs.48300.00).

Higher benefit cost ratio were obtained with application of spacing 30 x 10 cm + PSB + Rhizobium (2.62), which was significantly superior over all other treatments which was closely followed by 25 x 10 cm + Rhizobium, PSB. (2.26).

4.CONCLUSION

It is concluded that the treatment T9 30 x 10 cm spacing, Rhizobium, PSB was found significantly more productive (836 kg/ha). It is also recorded that maximum Benefit cost ratio (2.62) as compared to other treatment combinations.

5. References

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Table 1 Effect of spacing and biofertilizer on yield attributes, yield and economics of Black gram

Treatments	Yield attributes			Yield			Economics	
	No. of effective tillers/ m^2	No. of grains/ earhead	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)	Net return (INR/ha)	B:C ratio
20x10 cm + Rhizobium	33.87	4.93	30.96	544	1521	26.33	27200	1.24
20x10cm + PSB	30.12	5.94	33.59	447	1280	25.88	19320	0.91
20x10cm + Rhizobium + PSB	36.02	7.11	36.18	712	1797	28.38	41950	1.89
25 x10 cm + Rhizobium	34.85	5.32	32.20	583	1387	29.58	31570	1.50
25 x10cm + PSB	32.00	6.47	34.81	480	1584	23.39	23180	1.15
25 x10cm + Rhizobium + PSB	36.50	7.39	37.02	774	2098	26.98	48300	2.26
30x10 cm + Rhizobium	35.35	5.49	32.79	632	1636	27.84	36560	1.79
30x10 cm +PSB	33.16	6.89	35.74	492	1404	25.91	24840	1.27
30x10 cm + Rhizobium + PSB	37.30	7.51	37.73	836	2144	28.05	54550	2.62
SEm(±)	0.312	0.103	0.277	23.091	36.84	0.965		
CD (=0.05)	0.927	0.306	0.823	68.607	109.47	2.869		