Original Research Article

EffectofspacingandbiofertilizerongrowthandyieldofGreengram *(Vignaradiata)*

ABSTRACT

The present investigation entitled **"Effect of spacing and biofertilizer on growth andyield of greengram*(Vigna radiata)*"**, was conducted during *Kharif* season of 2022 at theCrop Research Farm of the Department of Agronomy, Sam Higginbottom University ofAgriculture,TechnologyandSciences,Prayagraj.Theexperimentwithninetreatmentsandthreereplicationswaslaiddowninfactorialrandomizedblockdesign.Theresultsshowedthat pre harvest observations like plant height (42.04cm), dry weight (6.79 g), number ofbranches (6.18) of plant were higher in T3 i.e. Application of Rhizobium and PSB alongwiththespacingof30x10cm,Numberofnodulesperplant(6.62)washigherintreatment2 i.e. Application of PSB along with the spacing of 30x10 cm and the value of thetreatment.Post-harvestdataindicatedthatnumberofpods/plant(23.74),numberofseeds/pod (7.72), test weight (41.30 g), seed yield (1.69 t/ha), biological yield (5.61 t/ha),stoveryield(3.83t/ha)andharvestindex(33.37%)werehigher intreatment3i.e.Application of Rhizobium and PSB along with the spacing of 30x10 cm. The maximumcostofproductionandgrossreturnwasrecordedhigherundertreatment3i.e.Applicationof Rhizobium and PSB along with the spacing of 30x10 cm is INR. 36500/ha and INR.88500/ha, respectively. The net return (INR. 12500/ha) and B:C Ratio (2:4) was recordedhigherundertreatment3i.e.ApplicationofRhizobiumandPSBalongwiththespacingof30x10cm.

Key words:- Spacing, biofertilizers, growth, yield, economics, greengram

INTRODUCTION

Green gram generally called as moong bean and it belongs to the family *leguminaceae*. InIndia, it is one of the most important pulse crop. It alone accounts for 65% of its worldacreage and 54% of production and it is grown on about 3.50 mha in our country mainlyin the state of Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Orissa and Bihar.From1964-65ithascontinuouslyincreaseditsarea,productionandproductivityfrom 0.50 mt to1.81mt. In India, it is mainly utilized in making *dal* and also for curries, soup,sweets and snacks. The sprouts are rich in thiamine, niacin and ascorbic acid, thus moongbean sprouts are increasingly becoming popular in certain vegetarian diets **(Anonymous,2016).** Mungbean contributes 14% in total pulse area and 7% in total pulse production inIndia.Thelowproductivityofmungbeanmaybeduetonutritionaldeficiencyinsoiland imbalanced external fertilization (**Awomi*et al.*, 2012**). Pulses plays very important rolenot only for humans but also for animal feed and their dried straw is used as hay. Inpulses, mungbean is a vital crop **(Khattak *et al*., 2004).** This warm season legume is anativeofIndiaandisstillgrownona largeacreageduetoallregionsitiscalledasgoldengram in international publications. There are many constraints like appropriate varietiesand inter-row spacing are the most important, which contribute yield and yield attributesofmungbean**(IsmailandHall,2000,Khan*etal.*,2001**).Greengramcrophascompensatory behavior in respect of biofertilizer to economic yield. Biofertilizers areapparently environment friendly, low cost, non-bulky agricultural inputswhich couldplay a significant role in plant nutrition as a supplementary and complementary factor tomineral nutrition. *Rhizobium* population in the soil depends on the presence of legumecropsin thefield.Inabsenceoflegumes,thepopulationdecreases.Artificialseedinoculation is often needed to restore the population of effective strain of the *Rhizobium*near the rhizosphere to hasten N- fixation. The strain of*Bradyrhizobium japonicum*species is specific to legume crop (**Dorle** *et al.,* 2015). Biofertilizers being essentialcomponents of organic farming play a vital role in maintaining long term soil fertility andsustainability by fixing atmospheric di-nitrogen, (N = N) mobilizing fixed macro andmicro nutrients or convert insoluble P in the soil into forms available to plants, therebyincreasestheirefficiencyandavailability.Under*Rhizobium*inoculation,plantssynthesize more photosynthesis and enhances the protein content in grain and nodulationin plants. Increase nodulation in legumes, helps in promoting free- living nitrogen fixingbacteria. The use of phosphate solubulizing bacteria (PSB) as inoculants simultaneouslyincreases uptake by the plantand crop yield.Strainsfrom the genera *Pseudomonas*,*Bacillus*and*Rhizobium*areamongthemostpowerfulphosphatesolubilizers.Biofertilizers are the preparations which contain living cells of efficient strains of variousmicroorganisms that enhance uptake of nutrients by their interaction in the rhizospherewhen applied through soil or seed treatment. There are various types of Biofertilizers likeRhizobium, Azospirillum, Azotobacter, Blue green algae and Azolla. Biofertilizers addnutrientsinsoilthroughthenaturalprocessesofnitrogenfixation,solubilizingphosphorus,andstimulatingplantgrowth through the synthesis of growth promotingsubstances. Biofertilizers play an important role in the plant growth as well as they bringdown thecost of chemicalfertilizers.

MATERIALSANDMETHODS

The present investigation was conducted during the *Kharif season* 2022, at the CropResearchFarm,DepartmentofAgronomy,NainiAgriculturalInstitute,SamHigginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj(U.P.) to study the effect of **Effect of spacing and biofertilizer on growth and yield ofgreengram (*Vigna radiata)*** which is located at 25^{o} 39’ 42’’N latitude, 81^{o} 67’ 56” Elongitude and 98 m altitude above the mean sea level (MSL). This area is situated on theright side of the Yamuna River by the side of Prayagraj-Rewa road about 12 km from thecity. The soil of the experimental field constituting a part ofcentralGangeticalluvial isneutral anddeep.Pre- sowingsoilsamplesweretakenfrom 5 different places with adepthof15 cm withthehelpofanauger. Thecompositesampleswereusedforthechemicalandmechanicalanalysis.
Thesoilwassandyloam intexture , low inorganic carbon and medium inavailable nitrogen, phosphorousandlowin

potassium.Theexperimentwaslaidoutwithrandomizedblockdesignconsisting9treatment combination which are as follows: T_{1}: Rhizobium+75% RDF+ 25x10cm, T_{2}:PSB + 75%RDF+ 25 x 10cm, T_{3}: (Rhizobium + PSB) + 100% RDF+25 x 10cm, T_{4}:Rhizobium + 75%RDF+30x10cm,T_{5}:PSB+75%RDF+30x10cm,T_{6}: (Rhizobium+PSB) +100%RDF+30x10cm,T_{7}:Rhizobium+75%RDF+40x10cm,T_{8}:PSB+75%RDF+40 x10cmandT_{9}:(Rhizobium+PSB)+100%RDF+40x10cm,eachreplicatedthrice.Treatments were randomly arranged in each replication, divided into twenty seven plots.Anetplotsizeof3mx3m=9m^2waskept.Sowingdatewason23-07-2022byhand.The observations on growth, yield and yield attributes and economics viz.,viz., Plantheight(cm),Plantdryweight(g/plant),Branches/plant(No.),Nodules/plant(No.),Pods/plant(No.),Seeds/pod(No.), Testweight(g), Seedyield(kg/ha),Stoveryield(t/ha),Biological yield (t/ha), Harvest index (%), Cost of cultivation (INR/ha), Gross return(INR/ha),Netreturn(INR/ha)andBenefitcostratio(B:C).Thedatarecordedfordifferent characteristics were subjected to statistical analysis by adopting the method ofanalysisof variance(ANOVA)as describedby**Gomezand Gomez(1984).**

RESULTSANDDISCUSSION

The response of spacing and biofertilizer on growth attributes of *kharif* green gram. Datapertaining growth parameters at harvest 60 DAS of greengram there was a significantinfluence on plant height (cm), dry weight (g), number of branches per plant, and numberof nodules per plant at 60 DAS as seen in table 1. At 60 DAS, there was significantdifference between the treatments and higher plant height (42.04cm) was recorded alongwith the application of Rhizobium and PSB along with the spacing of 25x10cm.However,treatment Rhizobium and PSB along with the spacing of25x10cm (42.04 cm) wasrecordedstatisticallyatparwiththetreatmentofRhizobiumalongwithspacingof40x10cm. At 60 DAS, there was significant difference between the treatments and higherdryweight (6.69 g) was recorded with the application of Rhizobium and PSB along withthespacingof25x10cm.However,treatmentRhizobiumandPSBalongwiththespacing of 25x10cm (6.69 g) was recorded statistically at par with the treatment of PSBalong with the spacing of 30x10cm. Dry weight were significantly more with treatment ofrecommended dose of fertilizer(25: 50N:P_2O_5kg/ha) in the findings of **Singh *et al*.(2016).** At 60 DAS, there was a significant difference found between the treatments andhighernumberofbranchesperplant(5.42)wasrecordedwiththeapplicationofRhizobium and PSB along with the spacing of 25x10cm. However, treatment Rhizobiumand PSB along with the spacing of 25x10cm (5.42) was recorded statistically at par withthe treatment of PSB along with the spacing of 25x10cm. The number of branches is agenetically controlled factor so it differed significantly among three factors under study.The inter-row spacing affected the branches, which might be due to better availability oflight, moisture nutrients, *etc.* in case of varying spacing. These results are in agreementwith those of **Kokani*et al.* (2015)** who stated significant differences for this characteramonginter rowspacing.At60DAS,therewassignificantdifferencebetweenthetreatments and higher number nodules per plant (6.62) was recorded with the applicationsofRhizobiumandPSBalongwiththespacingof30x10cm.However,treatmentRhizobium and PSB along with the spacing of 30x10cm (6.62) was recorded statisticallyat par with the treatment of PSB along with the spacing of 40x10cm. The yield and yieldattributesrecordedatharvestispresentedinTable2.Thedatashowsthattherewasa significanteffectofdifferenttreatmentsonthepods/plant (no.),seeds/pod (no.),testweight (g),seed yield (kg/ha),stover yield (t/ha), biological yield (t/ha) and harvest index(%)ofgreengram.At harvest,therewassignificantdifferencebetweenthetreatmentsandhigher number of pods /plant (23.74) was recorded with Rhizobium and PSB along withthe spacing of 25x10cm. However, treatment Rhizobium and PSB along with the spacingof 25x10cm (23.74) was recorded statistically at par with the treatment of Rhizobiumalong with the spacing 30x10cm. At harvest, there was significant difference between thetreatmentsandhighernumberofseeds/pods(7.72)wasrecordedintreatmentofRhizobium and PSB along with the spacing of 25x10cm. However, treatment Rhizobiumand PSB along with the spacing of 25x10cm (7.72) was recorded statistically at par withthe treatment of PSB along with the spacing of 25x10cm. Maximum number of seeds/pod(7.80) was found to be maximum in treatment combination with 30×10 cm along with 40kg/haofphosphorusascomparedtorestofthetreatmentswhichisbeneficialforGreengram production in the findings of **Rashmitha *et al*. (2021).** At harvest, there wassignificantdifferencebetweenthetreatmentsandhighertestweight(41.30g)wasrecorded with the treatment of Rhizobium and PSB along with the spacing of 25x10cm .However, treatmentRhizobiumand PSBalong withthe spacingof 25x10cm(41.30g)wasrecordedstatisticallyatparwiththetreatmentofPSBalongwiththespacin g30x10cm. Test weight was higher in application of 60 kg P and 45 kg/ha S in greengramin the findings of **Neeraj *e t a l* .(2015).** At harvest, there was significant differencebetween the treatments and higher number of grain yield (1.69 t/ha) was recorded intreatmentofRhizobiumandPSBalongwiththespacingof25x10cm.However,treatmentRhiz obiumandPSBalongwiththespacingof25x10cm(1.69t/ha)wasrecordedstatisticallyatparwith thetreatmentofPSBalongwiththespacingof25x10cm.Applicationof 60kg/ha P_2O_5recordedgrainyield(8q/ha) andphosphorus(0.365%), sulphur (0.253%) and protein content of grain (22.64%) as compared to lowerlevels.ApplicationofSulphur@40kg/harecordedgrainyield(7.92t/ha)andphosphorus (0.295%), sulphur (0.281%) and protein content (21.79%). Inoculation ofgreengram seeds with phosphorus solubilizing bacteria recorded slightly higher grainyield (7.49 t/ha) as compared to no inoculation (7.39 t/ha) were reported by **Mir *et al*.(2013)**CombinedapplicationofPandShadsignificanteffectsstoveryieldofblackgram. The optimum stover yield (39.20 g/pod) were recorded with combined applicationof 60 mg/kg soil and 30 mg/kg soil, respectively which was statistically at par withcombined application of 80 mg/kg soil and 40 mg/kg soil were reported by **Tamang *et al.*(2017).** The data on biological yield was recorded highest (5.61 t/ha) with Rhizobium andPSB along with the spacing of 25x10cm which found a significant difference between thetreatments. However, treatment Rhizobium and PSB along with the spacing of 25x10cmwasrecordedstatisticallyatparwiththetreatmentofRhizobiumalongwiththespacing 40x10cm.There was a significant difference between the treatments and data onstover yield (3.83q/ha) was recorded higher with PSB along with the spacing of 25x10cmand Rhizobium and PSB along with the spacing of 25x10cm. However, treatment PSBalong with the spacing of 25x10cm and Rhizobium and PSB along with the spacing of25x10cm (3.83q/ha) was recorded statistically at par with the treatment PSB along withthe spacing of 30x10cm. There was significant difference between the treatments and thehigher harvest index (33.37%) was recorded with Rhizobium and PSB along with thespacingof25x10cm.However,treatmentRhizobiumandPSBalongwiththespacingof

25x10cm (33.37%) was recorded statistically at par with the treatment Rhizobium alongwith the spacing 25x10cm. Observations on economics of treatments viz., total cost ofcultivation, gross return, net return, and benefit cost ratio was calculated and has beenpresented in Table 3. The maximum cost of production i.e. INR. 36500/ha was recordedunder treatment of Rhizobium and PSB along with the spacing of 25x10cm whereasminimum INR. 34100/ha was recorded in control with Rhizobium along with the spacingof 30x10cm. The maximum gross return ie. INR.125000/ha was found in treatment ofRhizobium and PSB along with the spacing of 25x10cm and lowest ie. INR.104390/hawas found in treatment of Rhizobium along with the spacing of 25x10cm. The maximumnet return ie. INR.88500/ha was recorded under treatmentRhizobium and PSB alongwith the spacing of 25x10cm whereas minimum ie. INR.70955/ha recorded in Rhizobiumalong with the spacing of 30x10cm. Higher B:C Ratio ie. 2:4 was recorded treatment ofRhizobium and PSB along with the spacing of 25x10cm meanwhile minimum B:C Ratioie.2:1 recorded in control of Rhizobium along withthe spacing of30x10cm.

CONCLUSION

It is concluded that for obtaining highest growth and yield and yield attributes in Greengram during *kharif* season, application of treatment 3 ie. Application of Rhizobium andPSBalongwiththespacingof25x10cmrecordedPlantheight(cm),Numberofbranchesperplant,Dryweight(g)perplant,,Numberofnodules/plant'Testweight(gm), Seed yield (t/ha), Stover yield (kg/ha), Biological yield (kg/ha) and Harvestindex (%). It has also recorded the maximum gross return, net return and benefit costratio.

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Table1:EffectofspacingandbiofertilizerongrowthparametersofGreengram

S.No.	Treatments	GrowthParameters			
		Plantheight (cm)at60 DAS	Dry weight (g)at60DAS	Numberof Branches at 60DAS	Nodules per plantat60DAS
1	Rhizobium+75%RDF+ 25 x10cm	37.88	6.65	4.78	5.52
2	PSB+75%RDF+25 x 10cm	40.27	6.30	5.30	6.09
3	(Rhizobium+ PSB) +100%RDF+25 x 10cm	42.04	6.79	5.42	5.36
4	Rhizobium+ 75%RDF+30 x10 cm	38.88	6.32	4.74	5.24
5	PSB+75%RDF+30x10cm	41.51	6.69	4.76	5.31
6	(Rhizobium+PSB)+100%RDF+30x10cm	39.63	5.47	4.98	6.62
7	Rhizobium+ 75%RDF+40x 10cm	41.90	6.18	5.07	5.71
8	PSB+75% RDF+40 x 10cm	40.14	6.17	5.01	6.40
9	(Rhizobium+PSB) +100%RDF+40x10cm	40.86	6.31	5.03	6.00
	Ftest	**S**	**S**	**S**	**S**
	S.Ed(±)	**1.05**	**0.26**	**0.23**	**0.45**
	CD(P=0.05)	**0.52**	**0.13**	**0.12**	**0.22**

Table2:Effectofspacingandbiofertilizeron yieldandyieldattributesofGreengram

S.No.	Treatments	Yieldandyieldattributes						
		Numberof Pods/plant	Numberof seeds/pods	Testw eight(g)	Seed yield (t/ha)	Biological yield(t/ha)	Stover yield(t /ha)	Harvesti ndex(%)
1	Rhizobium+75%RDF+ 25 x10cm	18.10	6.71	36.04	1.51	4.68	3.18	32.00
2	PSB+75%RDF+25 x 10cm	19.10	7.51	34.15	1.54	5.37	3.83	28.69
3	(Rhizobium+ PSB) +100%RDF+25 x 10cm	23.74	7.72	41.30	1.69	5.61	3.83	33.37
4	Rhizobium+ 75%RDF+30 x10 cm	23.62	6.65	35.53	1.27	4.77	3.5	26.67
5	PSB+75%RDF+30x10cm	23.11	6.29	40.09	1.39	4.99	3.81	27.82
6	(Rhizobium+PSB)+100%RDF+30x10cm	22.31	5.48	32.56	1.29	4.8	3.52	26.76
7	Rhizobium+ 75%RDF+40x 10cm	23.54	6.48	30.31	1.41	5.51	4.09	25.75
8	PSB+75%RDF+40 x 10cm	18.43	7.15	36.35	1.42	4.73	3.31	29.94
9	(Rhizobium+PSB) +100%RDF+40x10cm	20.85	5.52	39.17	1.14	4.98	3.54	28.91
	Ftest	S	S	**S**	S	S	**S**	**S**
	S.Ed(±)	**0.23**	**0.42**	**0.79**	**0.31**	**0.21**	**0.31**	**2.63**
	CD(P=0.05)	**0.12**	**0.21**	**0.40**	**0.16**	**0.11**	**0.15**	**1.41**

Table3:EffectofdifferentlevelsofspacingandbiofertilizeronGreenGram

S.No.	Treatments	Total Cost ofCultivation (INR/ha)	NetReturn (INR/ha)	Gross Return(INR/ha)	Benefit CostRatio
1	Rhizobium+75%RDF+ 25 x10cm	34130	79725	113855	2.3
2	PSB+75%RDF+25 x 10cm	34130	76780	110910	2.2
3	(Rhizobium+ PSB) +100%RDF+25x10cm	36500	88500	125000	2.4
4	Rhizobium+ 75%RDF+30 x10 cm	34100	70955	105055	2.1
5	PSB+75%RDF+30x10cm	34130	78445	112575	2.3
6	(Rhizobium+PSB)+100%RDF+30x10cm	34130	75055	109190	2.2
7	Rhizobium+ 75%RDF+40x 10cm	34160	78395	112555	2.3
8	PSB+75%RDF+40 x 10cm	35600	76385	111985	2.1
9	(Rhizobium+PSB)+100%RDF+40x10cm	34160	76455	110615	2.2