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Effect of Liquid and Carrier based Rhizobium And PSB on Growth, Yield And Economics of Green Gram [*Vigna radiata* (L.) Wilczek].

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ABSTRACT
An experiment was conducted to study the effect of liquid and carrier based Rhizobium on growth and yield of green gram. The treatments include 10 treatments ***viz.,*** T_1 *- Carrier based Rhizobium,* T_2 *- Carrier based Rhizobium + PSB,* T_3 *- Rhizobium + PSB(CB)* T_4 *- Liquid based Rhizobium @ 50 ml/10 kg,* T_5 *- Liquid based Rhizobium @ 100 ml/10 kg,* T_6 *- Liquid based PSB @ 50 ml/10 kg,* T_7 *- Liquid based PSB @ 100 ml/10 kg,* T_8 *- Liquid based Rhizobium + PSB @ 50 ml/10 kg,* T_9 *- Liquid based Rhizobium + PSB @ 100 ml/10 kg,* T_{10} *- Absolute control. The results indicated that application of Liquid based Rhizobium + PSB @ 100 ml/10 kg registered significantly highest growth attributes viz., plant height, number of branches plant^{-1} , number of leaves plant^{-1} , leaf area of plant^{-1} and dry matter plant^{-1}. Similarly, Liquid based Rhizobium + PSB @ 100 ml/10 kg recorded significantly maximum yield contributing characters viz., number of pod plant^{-1}(10.34), number of seed pod^{-1}(13), weight of pod^{-1}(4.57g), seed yield plant^{-1}(4.16g), seed yield ha^{-1}(1174 kg ha^{-1}) and straw yield ha^{-1}(2996 kg ha^{-1}).*
Keywords *Green gram, Rhizobium, PSB, Growth and Yield*

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INTRODUCTION

Green gram (*Vigna radiata*) is commonly known as moong, golden gram or mung. It belongs to *leguminaceae* family. It's origin is from India and central Asia. Mungbean is one of the important pulse crop and rank third in area and production after piegeon pea and chick pea. It contains about 25 percent protein of high digestability. Vit. C is synthesized in sprouted seeds of mungbean and the amount of riboflavin and thiamines are also get increased. Green gram being a leguminous crop it has the capacity to fix the atmospheric nitrogen. It is used as green manuring crop. It also helps in preventing soil erosion. It is a short duration crop, Hence it fits well in many intensive crop rotations. Green gram gives low seed yield and poor growth performance mainly due to poor management and low soil fertility. Nitrogen due to leaching and volatilization and phosphorus due to fixation may not be available adequately at flowering and pod formation stages of crop and result in shedding of flowers and pods. The only way to improve the yield of pulse crop lies in the use of biofertilizers. The rhizosphere bacteria secretes growth substances and secondary metabolic, which contribute to seed germination and plant growth. Therefore, the application of bacterial culture inoculating to seeds for increasing the pulse crop yield now a days is standard practice. With advancement or research the biofertilizers are now formulated in a clear liquid based medium of whose efficiency is supposed to be higher as compared to the charcoal based biofertilizers. Since the literature on the these aspects is meager, so far the present investigation was carried out to evaluate the effect of carrier and liquid *Rhizobium* on growth and yield of green gram.

MATERIAL AND METHODS

The field experiment was conducted at farms, Department of Agronomy, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S.) during *kharif* 2014. The soil of experimental plot was clayey in texture. It was low in nitrogen(235.0 kg ha-1), medium in organic carbon (0.24%), medium in available phosphorus(15 kg ha-1) and high in available potash(408.60 kg ha-1) and slightly alkaline in reaction(pH-7.20). The experiment was laid out in Randomised Block Design comprising of ten treatments replicated three times. The treatments were allotted randomly to each replication by keeping

the gross plot size of 5.4 m x 4.5 m and net plot size of 4.8 m x 3.9 m. The experiment includes 10 treatments *viz*., T_1 - Carrier based *Rhizobium*, T_2 - Carrier based PSB, T_3 - Carrier based *Rhizobium* + PSB, T_4 - Liquid based *Rhizobium* @ 50 ml/10 kg, T_5 - Liquid based *Rhizobium* @ 100 ml/10 kg, T_6 -Liquid based PSB @ 50 ml/10 kg, T_7 - Liquid based PSB @ 100 ml/10 kg, T_8 - Liquid based *Rhizobium* + PSB @ 50 ml/10 kg, T_9 - Liquid based *Rhizobium* + PSB @ 100 ml/10 kg, T_{10} - Absolute control (No fertilizer was applied).

The experimental plots were fertilized with 25 kg N ha^{-1} and 50 kg P_2O_5 ha^{-1}, as per the recommendation by using fertilizer viz. urea for nitrogen and SSP for P_2O_5. Urea and SSP were mixed thoroughly in required proportion and drilled in field before dibbling the seeds. RDF is common for all the treatments except Absolute control. Sowing was done by dibbling two seeds per hill keeping spacing of 30 × 10 cm on flat bed. Before sowing the seeds were treated with biofertilizers *viz*., *Rhizobium* and PSB culture. Irrigation was given immediately after sowing. All the agronomic practices and plant protection measures were adopted as per recommendations. Observations on growth and yield parameters were recorded from five randomly sampled plants from each treatment.

Table 1: Growth attributes of green gram as influenced by various treatments.

Treatment	Plant height(cm)	No. of branches plant^{-1}	No. of leaves plant^{-1}	Leaf area plant-1(dm^2)	Dry matter plant^{-1}(g)
T_1- *Rhizobium*(CB)	45.33	4.90	5.23	40.87	13.07
T_2- PSB(CB)	44.41	4.67	5.00	40.20	12.98
T_3- *Rhizobium* + PSB(CB)	49.04	6.07	6.53	46.93	14.94
T_4- *Rhizobium* @50ml/10kg (LB)	47.97	5.40	5.57	43.83	14.02
T_5- *Rhizobium* @100ml/10kg (LB)	48.17	5.60	6.00	44.67	14.37
T_6- PSB @50ml/10kg (LB)	45.93	5.00	5.27	42.00	13.40
T_7- PSB @100ml/10kg (LB)	46.43	5.17	5.53	42.77	13.67
T_8- *Rhizobium* + PSB @50ml/10kg (LB)	50.55	6.43	6.60	47.43	15.97
T_9- *Rhizobium* + SB@100ml/10kg (LB)	52.74	6.93	7.40	49.43	15.97
T_{10}- Absolute control	41.67	4.28	4.90	40.00	11.77
SE±	1.46	0.36	0.36	1.51	0.48
C.D. at 5%	4.36	1.09	1.07	4.49	1.43

RESULT AND DISCUSSION

A reference to data (Table 1) on growth attributes *viz*., plant height, number of branches plant^{-1}, number of leaves plant^{-1}, leaf area plant^{-1} and dry matter plant^{-1} were significantly influenced by different treatments. Among the treatment combinations, the application of Liquid based *Rhizobium* + PSB @ 100 ml/10 kg recorded the significantly maximum plant height (52.74 cm), number of branches plant^{-1} (6.93), number of leaves plant^{-1} (7.40), leaf area plant^{-1} (49.43 dm^2) and dry matter plant^{-1} (15.97 g) over rest of the treatments followed by *Rhizobium* + PSB @ 50 ml/10 kg and treatment *Rhizobium* + PSB (CB) @ 250 gm / 10 kg. Significantly lowest values of these parameters were observed in absolute control treatment where no fertilizers were applied. The increased plant height might be due to combine application of *Rhizobium* and PSB. Microorganisum secrete certain organic substances, such as auxins, gibberellins, cytokinins, ethylene and abscisic acid that function as plant growth regulators and influence physiological process resulting better growth and reflected in more dry matter. The results are conformity to the findings of by Sindhu *et al*. (1997), Kumar *et al*. (2000), Sindhu *et al*. (2001), Beg and Singh (2008), Uddin *et al.* (2009), Ravikumar (2012), Rajesh et al. (2013), Lalitha and Immanuel (2013).

Significant effect was observed on yield *viz*., number of pods plant^{-1}, number of seeds pod^{-1}, weight of pod plant^{-1}, seed yield plant^{-1}, seed yield ha^{-1} and straw yield ha^{-1} of green gram by different treatments (Table 2). Among the treatment combinations, application of liquid based *Rhizobium* + PSB @ 100 ml/10 kg registered significantly maximum number of pods plant-1 (10.34), number of seeds pod^{-1} (13.00), weight of pods plant^{-1}(4.57 g), seed yield plant^{-1}(4.16 g), seed yield ha^{-1}(1174 kg ha^{-1}) and straw yield ha^{-1} (2996 kg ha^{-1}) of green gram as compared to other treatments followed by the treatments *Rhizobium* + PSB @ 50 ml/10 kg and *Rhizobium* + PSB (CB) @ 250 gm/10 kg. while the lowest of these values were recorded

in the absolute control treatment. This might be due to better nodulation, nitrogen fixation and maximum yield and yield attributes noticed under liquid based biofertilizers. The results are in conformity with the findings of Gupta *et al*. (2005), Anjum *et al*. (2006), Ahmed *et al.* (2007), Ghosh and Joseph (2008), Khandelwal *et at*. (2011).

Table 2: Yield attributes and yield of green gram as influenced by various treatment

Treatment	N0. Of pods plant^{-1}	No. of seeds pod^{-1}	Weight of pods plant^{-1}	Seed weight plant^{-1}(g)	Seed yield (kg ha^{-1})	Straw yield Kg ha^{-1})
T_1- *Rhizobium*(CB)	8.37	10.67	3.40	3.07	832	2378
T_2- PSB(CB)	8.31	10.52	3.31	2.97	798	2325
T_3- *Rhizobium* + PSB(CB)	9.60	12.51	4.40	3.97	1096	2755
T_4- *Rhizobium* @50ml/10kg (LB)	9.00	11.47	4.03	3.44	945	2494
T_5- *Rhizobium* @100ml/10kg (LB)	9.21	11.56	4.13	3.55	974	2603
T_6- PSB @50ml/10kg (LB)	8.34	10.69	3.53	3.07	832	2403
T_7- PSB @100ml/10kg (LB)	8.44	10.79	3.73	3.20	868	2450
T_8- *Rhizobium* + PSB @50ml/10kg (LB)	10.00	12.65	4.43	4.10	1145	2949
T_9- *Rhizobium* + SB@100ml/10kg (LB)	10.34	13.00	4.57	4.16	1174	2996
T_{10}- Absolute control	8.07	10.27	3.23	2.93	767	2163
SE±	0.37	0.42	0.14	0.20	65.53	128.18
C.D. at 5%	1.11	1.25	0.41	0.60	194.71	380.85

Table 3: Economics of various treatments in green gram

Treatment	Cost of cultivation (Rs ha^{-1})	Gross Returns (Rs ha^{-1})	Net Returns (Rs ha^{-1})	B:C ratio
T_1- *Rhizobium*(CB)	18498	39460	20962	2.13
T_2- PSB(CB)	18498	37901	19403	2.05
$_3$- *Rhizobium* + PSB(CB)	18518	51808	33290	2.79
T_4- *Rhizobium* @50ml/10kg (LB)	18505	44732	26227	2.41
T_5- *Rhizobium* @100ml/10kg (LB)	18531	46136	27605	2.46
PSB @50ml/10kg (LB)	18505	39473	20968	2.11
T_7- PSB @100ml/10kg (LB)	18531	41167	22636	2.22
T_8- *Rhizobium* + PSB @50ml/10kg (LB)	18531	54144	35613	2.92
T_9- *Rhizobium* + SB@100ml/10kg (LB)	18584	55532	36948	2.98
T_{10}- Absolute control	16535	36363	19828	2.20
SE±	-	3020	3020	-
C.D. at 5%	-	8975	8975	-
G. Mean	**18323**	**44671**	**26348**	**2.42**

The maximum and minimum values of cost of cultivation of green gram cultivation were recorded with treatments T_9 (Rs.18584) and T_{10} (Rs.16535),respectively (Table 3). The gross monetary returns were

highest for treatment *Rhizobium* (LB) + PSB(LB) @ 100 ml 10 kg^{-1} (T_9), which was at par with treatments *Rhizobium* (LB) + PSB (LB) @ 50 ml 10 kg^{-1}(T_8) and treatment *Rhizobium* (CB) + PSB (CB) @ 250 gm 10 kg^{-1}(T_3) and found significantly superior over rest of the treatments. The net monetary returns were highest for *Rhizobium* (LB) + PSB(LB) @ 100 ml 10 kg^{-1} (T_9) followed by treatment *Rhizobium* (LB) + PSB (LB) @ 50 ml 10 kg^{-1}(T_8) and treatment *Rhizobium* (CB) + PSB (CB) @ 250 gm 10 kg^{-1}(T_3) which was at par with each other but found significantly superior over rest of the treatments. Absolute control (T_{10}) recorded lowest net monetary returns among all the treatments.

Similarly the highest B:C ratio(Table 3) of 2.98 was recorded by treatment *Rhizobium* (LB) + PSB(LB) @ 100 ml 10 kg^{-1} (T_9) while lowest B: C ratio was in the treatment PSB(CB) 250gm 10 kg^{-1}[T_2] (2.05). These results are in lines with those reported by Dhage *et al*. (2008), Sahu and Singh (2009), Mohite *et al*. (2011), Patel *et al.* (2012).

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