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RESEARCH PAPER

To study the effect of different fertilizer and biofertizer levels on growth and yield of summer greengram

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Abstract : The field experiment was conducted in Factorial Randomized Block Design during summer 2010 at Research Farm, College of Agriculture, Latur (Maharashtra). The treatments were comprised of nine combinations with three fertilizer levels *viz.*, 50 per cent RDF (F_1), 75 per cent RDF (F_2), 100 per cent RDF (F_3), along with seed inoculation of *Rhizobium* (B_1), seed inoculation of PSB (B_2) and dual seed inoculation of *Rhizobium* + PSB (B_3). Each experimental unit was replicated thrice with the plot size of 5.4 m × 4.2 m and 4.2 m × 3.6 m as the gross and net plot, respectively. The variety GOLD-9 SHANESHWAR was sown by dibbling method on 28th January 2010 at spacing of 30 cm × 10 cm. The recommended cultural practices and plant protection measures were undertaken. The recommended dose of fertilizer (25:50:00 kg NPK ha^{-1}) was applied at the time of sowing through ammonium sulphate and SSP. The results revealed that application of 100 per cent RDF (F_3) and dual seed inoculation of *Rhizobium* + PSB (B_3) recorded significantly higher growth, yield and quality contributing characters followed by application of 75 per cent RDF (F_2), 50 per cent RDF (F_1) in combination with seed inoculation of PSB (B_2) and seed inoculation of *Rhizobium* (B_1). But dual seed inoculation of *Rhizobium* + PSB (B_3) recorded significantly higher growth contributing characters followed by seed inoculation of *Rhizobium* (B_1) and seed inoculation of PSB (B_2) except number of pods per plant.

Key Words : Biofertilizer, Fertilizer levels, Growth, Summer greengram, Yield

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INTRODUCTION

Pulses are important not only for their value as human food, but also because of high protein content for livestock. It has been important component of Indian agriculture enabling the land to restore fertility by fixing atmospheric nitrogen, so as to produce reasonable yields of succeeding crops and to meet out the demand of dietary requirement regarding proteins, carbohydrates and other nutrient sources. On an average, pulses contain 22-24 per cent protein as against 8-10 per cent in cereals. A good amount of lysine is present in the pulses. Pulses vary in maturity periods, hence, are useful in different cropping systems. Greengram locally called as moog or mug [*Vigna radiata* (L.) Wilczek] belongs to the family Leguminoceae, which fixes atmospheric nitrogen and improves soil fertility by adding 20-25 kg N ha^{-1}. Being a short duration crop and having wider adaptability, it can be grown in summer as well as in *Kharif* season. It is an important ruling crop in summer season, locally known

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as 'Vaishakhi Mug'. The yield of summer greengram is comparatively more than that of *Kharif* crop, mainly because the controlled moisture conditions through irrigation, abundant sunshine and less pest and disease infestation. The greengram foliage left over after picking of mature pods can either be fed to livestock or it may ploughed *in situ* as a green manure to enrich soil with organic matter. Employment is provided to the farmers and the agricultural labours during off season. Mungbean is a very short duration crop so it can be grown as catch crop.

In India mungbean occupies 3.0 million hectares and contribute to 1.3 million tonnes in pulse production (Anonymous, 2010a). In Maharashtra, area under mungbean is 4.13 lakh hectares and its production and productivity is 1.23 lakh tonnes and 297 kg ha^{-1} (Anonymous, 2010b). Greengram [*Vigna radiata* (L.) Wilczek] gives low seed yield and poor growth performance mainly due to poor management and low soil fertility. Nitrogen due to leaching and volatization and phosphorus due to fixation may not be available adequately at flowering and pod formation stages of crop and result in shading of flowers and pods. The crop needs more nitrogen at the reproductive phase, and the nutrient uptake after flowering either becomes slow or stops due to inactivation of roots. The optimum supply of nitrogen and phosphorus significantly influenced on growth and yield of greengram. Yield of summer greengram increases with the application of nitrogenous and phosphatic fertilization. Usually grain legumes are grown on marginal land and poor yield in such soils are partly due to lack of effective and specific strains of *Rhizobium* in rhizosphere. The uptake of phosphorus by plant is also influenced by use of PSB. Hence, to evaluate correct levels of fertilizer and biofertizer on growth and yield of summer greengram the present investigation was undertaken.

MATERIAL AND METHODS

A field experiment was conducted during summer 2010 at College of Agriculture, Latur (Maharashtra). The Latur falls under the subtropical climate of NARP and is situated on an elevation of 633.85 meters above the mean sea level on 18° 5' to 18° 24' North latitude and 77° 36' East longitude The soil of experimental plot was medium black clay (Vertisol) with good drainage. The experiment was laid out in Factorial Randomized Block Design with three replications. There were nine treatment combinations with three inorganic fertilizer levels (F_1- 50% RDF, F_2- 75% RDF, F_3-100%RDF) and three biofertilizer levels (B_1-*Rhizobium*, B_2-PSB, B_3-*Rhizobium*+PSB). Each experimental unit was replicated thrice with the plot size of 5.4 m × 4.2 m and 4.2 m × 3.6 m as the gross and net plot, respectively. The variety GOLD-9 SHANESHWAR was sown 28th January 2010 by dibbling at a distance of 30 cm × 10 cm at about 2.5 cm depth. Application of N and P as per RDF 25:50:00 NPK kg ha^{-1}. The complete dose of nitrogen and phosphorus as per treatment was drilled at sowing uniformly in the plots. The fertilizers used were ammonium sulphate (20.6% N) and single super phosphate (16% P). The seeds were treated with thirum 80 WP @ 3 g kg^{-1} of seeds for controlling seed borne diseases. Also the seeds were inoculated with culture of *Rhizobium* and phosphorus solubilizing bacteria (PSB) before sowing. The biometric observations for growth/ yield attributing characters were taken at 60 and at harvest stage of crop by randomly selecting five plants per plot. The nitrogen content in seed analysed by micro-kjeldhal method (AOAC, 1975) was utilized to work out protein content using factor 5.71 (Sadasivam and Manickam, 1976). Data obtained on various variables were analyzed by analysis of variance method (Panse and Sukhatme, 1967).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of inorganic fertilizer levels on growth, yield and quality parameters of greengram :

The beneficial effect of different levels of fertilizers on plant height, number of functional leaves, leaf area, number of branches, number of pods per plant and total dry matter of greengram were evident during active growth and maturity (Table 1).

The effect of different levels of fertilizers on plant height was found to be significant and the higher plant height was observed by the application of 100 per cent RDF (32.42 cm) as compared to other levels of fertilizers. Similar result was obtained by Uddin *et al.* (2009). Mean number of branches were influenced significantly by various treatments under study. The application of 100 per cent RDF was found to be at par with 75 per cent RDF and found to be significantly superior over 50 per

cent RDF. Differences were at par between the treatments of 75 and 50 per cent RDF at all the growth stages. The application of 100 per cent RDF recorded higher mean number of functional leaves (19.88) and leaf area per plant (487.83 cm^2) followed by the application of 75 per cent RDF (18.68, 453.32 cm^2) and 50 per cent RDF (17.51, 424.91 cm^2), respectively. Similar result was obtained by Singh *et al.* (2005). The application of 100 per cent RDF recorded the higher dry matter accumulation (19.89 g) followed by the application of 75 per cent RDF (18.59 g) and 50 per cent RDF (17.42 g) at harvest stage. Similar result was reported by Yakadri *et al.* (2004), Saxena *et al.* (1996) and Badole and Umale (1994). The application of 100 per cent RDF recorded higher mean number of pods per plant (16.69) followed by the application of 75 per cent RDF (15.57) and 50 per cent RDF (14.59). Same result was reported by Sadeghipour *et al.* (2010); Uddin *et al.* (2009); Dixit *et al.* (2008); Suman *et al.* (2007); Karwasra *et al.* (2006); Khan *et al.* (2002) and Patel and Patel (1994).

Data on yield and yield contributing characters *viz.*, weight of pods $plant^{-1}$(g), weight of grain $plant^{-1}$(g), test weight (g), grain yield (kg ha^{-1}), straw yield (kg ha^{-1}), harvest index (%) and protein content (%) as influenced by different levels of fertilizers was found to be significant are presented in Table 2. Application of 100 per cent RDF (8.61 g $plant^{-1}$) was found to be at par with 75 per cent RDF (7.88 g $plant^{-1}$) and found to be significantly superior over 50 per cent RDF (7.44 g $plant^{-1}$) in influencing pod yield g $plant^{-1}$. Application of 100 per cent RDF (4.62 g $plant^{-1}$) was found to be at par with 75 per cent RDF (4.21 g $plant^{-1}$) and found to be significantly superior over 50 per cent RDF (4.04 g $plant^{-1}$) in influencing grain yield g $plant^{-1}$. Application of 100 per cent RDF (33.63 g) was found to be at par with 75 per cent RDF (31.01 g) and found to be significantly superior over 50 per cent RDF (29.47 g) in influencing test weight (g). The application of 100 per cent RDF recorded significantly higher mean grain yield kg ha^{-1} (1056 kg ha^{-1}) followed by the application of 75 per cent RDF (974 kg ha^{-1}) and 50 per cent RDF (926 kg ha^{-1}). Same result was reported by Sadeghipour *et al.* (2010); Singh (2008); Chesti and Tahir (2007); Siag and Prakash (2007); Sekhon *et al.* (2006); Mitra *et al.* (2006); Mandal *et al.* (2005); Ganeshamurthy *et al.* (2005) and Yakadri *et al.* (2004). Straw yield kg ha^{-1} as influenced by different levels of fertilizers was found to be significant. The application of 100 per cent RDF recorded significantly higher mean straw yield kg ha^{-1} (2323 kg ha^{-1}) followed by the application of 75 per cent RDF

Table 1 : Growth and development parameter as influenced by different fertilizer levels and biofertilizer treatments

Treatments	Plant height at harvest (cm)	Number of functional leaves $plant^{-1}$ at 50 DAS	Leaf area $plant^{-1}$ at 50 DAS (cm^2)	Number of branches $plant^{-1}$ at harvest	Number of pods $plant^{-1}$ at harvest	Total dry matter $plant^{-1}$ at harvest (g)
Fertilizer levels (F)						
F_1 : 50%RDF	28.22	17.51	424.91	4.65	14.59	17.42
F_2 : 75%RDF	30.12	18.68	453.32	4.96	15.57	18.59
F_3 : 100%RDF	32.42	19.88	487.83	5.31	16.69	19.89
S.E. ±	1.06	0.62	16.07	0.17	0.54	0.63
C.D. (P=0.05)	3.19	1.85	48.17	0.50	1.61	1.90
Biofertilizers (B)						
B_1 : *Rhizobium*	30.57	18.96	460.10	5.03	14.41	18.86
B_2 : PSB	27.99	17.36	421.25	4.62	15.79	17.28
B_3 : *Rhizobium*+PSB	32.21	19.75	484.71	5.27	16.64	19.76
S.E. ±	1.06	0.62	16.07	0.17	0.54	0.63
C.D. (P=0.05)	3.19	1.85	48.17	0.50	1.61	1.90
Interaction (F × B)						
S.E. ±	1.84	1.07	27.83	0.29	0.93	1.10
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS
General mean	30.26	18.69	455.36	4.98	15.62	18.63

NS=Non-significant

(2132 kg ha^{-1}) and 50 per cent RDF (2026 kg ha^{-1}). Same result was reported by Karwasra *et al*. (2006); Yakadri *et al*. (2004); Khan *et al*. (2002); Srinivas and Shaik (2002) and Singh *et al*. (2000). Data on harvest index showed that there was no any significant effect by the application of different levels of fertilizers on harvest index. The highest harvest index was observed (31.37) by the application of 50 per cent RDF but differences between the harvest index were nearly same at all the treatments. Same result was reported by Singh *et al*. (2000) and Saxena *et al*. (1996). The effect of different levels of fertilizers on mean protein content was found to be significant. The application of 100 per cent RDF recorded significantly higher mean protein content (23.10%) followed by the application of 75 per cent RDF (21.10%) and 50 per cent RDF (20.05%). Similar result was reported by Singh (2008); Mitra *et al*. (2006) and Ahmad *et al*. (2003).

Effect of biofertilizer levels on growth, yield and quality parameters of greengram :

The beneficial effect of biofertilizer treatments on plant height, number of functional leaves, leaf area, number of branches, number of pods per plant and total dry matter of greengram were evident during active growth and maturity (Table 1).

The application of biofertilizers on mean plant height was found to be significant at harvest stage of crop. The application of dual seed inoculation of *Rhizobium* + PSB observed significantly the highest mean plant height (32.21 cm) followed by the alone seed inoculation of *Rhizobium* (30.57 cm) and alone seed inoculation of PSB (27.99 cm). Similar result was reported by Uddin *et al.* (2009) and Dost Muhammad *et al*. (2004). The data on mean number of branches per plant, functional leaves per plant, leaf area per plant (cm^2) and total dry matter per plant (g) revealed that the dual seed inoculation of *Rhizobium* + PSB recorded significantly higher mean number of branches per plant (5.27), functional leaves per plant (19.75), leaf area per plant (484.71 cm^2) and total dry matter per plant (19.76 g) as compared to the alone seed inoculation of *Rhizobium* and PSB at 50 and at harvest stage of crop growth. Similar result was reported by Uddin *et al.* (2009); Ghosh and Joseph (2007) and Goud and Reddy (2007b). The data on mean number of pods per plant revealed that the dual seed inoculation of *Rhizobium* + PSB recorded highest mean number of pods per plant (16.64) followed by the alone seed inoculation of PSB (15.79) and alone seed inoculation of *Rhizobium* (14.41). Similar result was reported by Uddin *et al.* (2009); Goud and Reddy (2007a and b); Srivastava *et al*. (2006) and Dost Muhammad *et al*. (2004).

Table 2 : Yield and quality parameter as influenced by different fertilizer levels and biofertilizer treatments

Treatments	Weight of pods plant^{-1} (g)	Weight of grains plant^{-1} (g)	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)	Protein content (%)
Fertilizer levels (F)							
F_1 : 50%RDF	7.44	4.04	29.47	926	2026	31.37	20.05
F_2 : 75%RDF	7.88	4.21	31.01	974	2132	31.36	21.10
F_3 : 100%RDF	8.61	4.62	33.63	1056	2323	31.25	23.10
S.E. ±	0.30	0.16	1.18	34	48	-	0.68
C.D. (P=0.05)	0.90	0.47	NS	103	143	-	2.02
Biofertilizers (B)							
B_1 : *Rhizobium*	7.38	3.98	29.23	919	2010	31.38	19.89
B_2 : PSB	7.99	4.22	31.45	989	2163	31.39	21.40
B_3 : *Rhizobium*+PSB	8.57	4.68	33.43	1050	2308	31.28	22.95
S.E. ±	0.30	0.16	1.18	34	48	-	0.68
C.D. (P=0.05)	0.90	0.47	NS	103	143	-	2.02
Interaction (F × B)							
S.E. ±	0.52	0.27	2.04	59	82	-	1.17
C.D. (P=0.05)	NS	NS	NS	NS	NS	-	NS
General mean	7.98	4.29	31.37	986	2160	31.34	21.42

NS=Non-significant

Data on yield and yield contributing characters *viz.*, weight of pods plant^{-1}(g), weight of grain plant^{-1}(g), test weight (g), grain yield (kg ha^{-1}), straw yield (kg ha^{-1}), harvest index (%) and protein content (%) as influenced by biofertilizer treatments were found to be significant (Table 2). The mean pod yield (g) per plant was significantly influenced by the various treatments and it was revealed that the dual seed inoculation of *Rhizobium* + PSB recorded highest mean pod yield (g) per plant (8.57 g) followed by the alone seed inoculation of PSB (7.99 g) and alone seed inoculation of *Rhizobium* (7.38 g). The effect of biofertilizers on mean grain yield (g plant^{-1}) was found to be significant. The dual seed inoculation of *Rhizobium* + PSB recorded highest mean grain yield (4.68 g) followed by the alone seed inoculation of PSB (4.22 g) and alone seed inoculation of *Rhizobium* (3.98 g). The effect of biofertilizers on mean number of grain per plant was found to be significant. The effect of biofertilizers on mean test weight (1000 seeds) was found to be non-significant. But the highest test weight was observed by the dual seed inoculation of *Rhizobium* + PSB (33.43 g) followed by the alone seed inoculation of PSB (31.45) and alone seed inoculation of *Rhizobium* (29.23). Similar result was reported by Uddin *et al.* (2009) and Ghosh and Joseph (2007). The data on mean grain yield kg ha^{-1} and straw yield kg ha^{-1} revealed that the dual seed inoculation of *Rhizobium* + PSB recorded significantly higher mean grain yield (1050 kg ha^{-1}) and straw yield (2308 kg ha^{-1}) followed by the alone seed inoculation of PSB (989 and 2163 kg ha^{-1}, respectively) and alone seed inoculation of *Rhizobium* (919 and 2010 kg ha^{-1}, respectively). Similar result was reported by Singh *et al.* (2009); Ghosh and Joseph (2007) and Srivastava *et al.* (2006). Data on harvest index showed that there was no any significant effect by the application of different levels of fertilizers on harvest index. The highest harvest index was observed (31.39) by the alone seed inoculation of PSB but differences between the harvest index was nearly more and less same at all the treatments. Similar result was reported by Bhat *et al.* (2005). The data on mean protein content (%) revealed that the dual seed inoculation of *Rhizobium* + PSB recorded significantly higher mean protein content (22.95 %) followed by the alone seed inoculation of PSB (21.40 %) and alone seed inoculation of *Rhizobium* (19.89 %). Similar result was reported by Goud and Reddy (2007a).

Interaction effect on growth, yield and quality parameters of greengram :

The data on mean plant height, branches per plant, functional leaves per plant, leaf area per plant and total dry matter per plant revealed that the interaction effect of different levels of fertilizers and biofertilizers on all above growth attributing parameters was found to be non-significant (Table 1). Similar result was reported by Uddin *et al.* (2009). The data (Table 2) on mean pod yield per plant (g), grain yield per plant (g) and test weight (g) (1000 seeds) revealed that the interaction effect of different levels of fertilizers and biofertilizers on above yield attributing parameters was found to be non-significant. Similar result was reported by Uddin *et al.* (2009). The data (Table 2) on mean grain yield kg ha^{-1} and straw yield kg ha^{-1} revealed that the interaction effect of different levels of fertilizers and biofertilizers on above yield and yield attributes was found to be non-significant. Similar result was reported by Uddin *et al.* (2009). The data (Table 2) on mean protein content revealed that the interaction effect of different levels of fertilizers and biofertilizers on mean protein content was found to be non-significant.

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