DOI: 10.15740/HAS/AU/12.TECHSEAR(6)2017/1514-1519 *Agriculture Update*
Volume **12** | TECHSEAR-6 | 2017 | 1514-1519
Visit us : *www.researchjournal.co.in*

RESEARCH ARTICLE :

Effect of carrier and liquid biofertilizer on growth of mungbean using different method of application

K. BHAVYA, R. SUBHASHREDDY, S. TRIVENI, K. DAMODHARA CHARI, G. THIRUMAL AND Y. NAGARAJU

ARTICLE CHRONICLE :
Received :
17.07.2017;
Accepted :
01.08.2017]

SUMMARY : In the present study different carrier and liquid biofertilizers are brought from different production centres. The field experiment was conducted following Complete Randomized Design with control and 12 treatments. The plant growth parameters *viz.,* plant height, root length, nodule number per plant, nodule dry weight (g per plant), dry matter accumulation (g per plant), were observed at different crop growth stages.

How to cite this article : Bhavya, K., Subhashreddy, R., Triveni, S., Chari, K. Damodhara, Thirumal, G. and Nagaraju, Y. (2017). Effect of carrier and liquid biofertilizer on growth of mungbean using different method of application. *Agric. Update,* **12**(TECHSEAR-6) : 1514-1519; **DOI: 10.15740/HAS/AU/12.TECHSEAR(6)2017/ 1514-1519.**

KEY WORDS :
Rhizobium, Phosphate solubilizing bacteria, Pot culture experiment, Carrier based biofertilizers, Liquid based biofertilizers

Author for correspondence :

K. BHAVYA
Department of Agricultural Microbiology and Bioenergy, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, HYDERABAD (TELANGANA) INDIA
Email: bhavyaraj55@gmail.com

See end of the article for authors' affiliations

BACKGROUND AND OBJECTIVES

Biofertilizer or microbial inoculants can be generally defined as latent cells of efficient strains of a phosphate solubilizing and nitrogen fixing micro-organism used for treatment of soil. Biofertilizer are organic products of living cells containing different types of micro-organisms, which have the ability to convert important elements from unavailable sources to available sources through ecological processes. They are composting the area with the objective of increasing the number of such micro-organisms and accelerate microbial process to augment to extent of the availability of the nutrient in a form which can easily assimilated by plant (Subba Rao,1999).

Organic farming has emerged as an important priority area globally as well in our country India. Due to this there is a growing demand for safe and healthy food. Hence, there are concerns for the long term sustainability as well as environmental pollution associated due to use of agro-chemicals indiscriminately. Biofertilizers has an important role to play in improving soil fertility by fixing atmospheric nitrogen. Hence, the use of biofertilizers for harvesting of the naturally available, biological system of nutrient mobilization (Venkatashwarlu, 2008). The importance and role of biofertilizers in sustainable crop production has been studied by several authors. But their progress in the field of technology production always remained below satisfaction in Asia and Europe due to various constraints, either economically or politically and in some cases even ecologically.

Pulse crops have unique properties of nodulation through rhizobium bacteria. These bacteria, through biological nitrogen fixation, meet about 80% to 90% of total N requirements of legumes (Verma, 1993). Likewise, phosphate solubilizing bacteria have the capability to solubilize the residual or fixed soil P, increase the availability of P in the soil (Singh *et al*., 2008), produce growth promoting substances (Selvakumar *et al*., 2012), and there by increase the overall P-use efficiency of the crops. Thus, application of biofertilizers to leguminous crops may help in sustainable crop production.

RESOURCES AND METHODS

Different types of carrier and liquid based biofertilizerswere collected from followingdifferent firms and stored at 4°C in refrigerator and evaluated the shelf-life of those biofertilizers

Carrier based biofertilizers		
1.	*Rhizobium*	Agri Biotech Foundation, K.N Biosciences(India).pvt.ltd, pratista Biofertilizers, Agriculture Research Station.
2.	PSB	Agri Biotech Foundation, K.N Biosciences(India).pvt.ltd, pratista Biofertilizers, Agriculture Research Station.
Liquid based biofertilizers		
1.	*Rhizobium*	K.N Biosciences(India).pvt.ltd, pratista Biofertilizers, Agriculture Research Station.
2.	PSB	K.N Biosciences(India).pvt.ltd, pratista Biofertilizers, Agriculture Research Station.

A pot culture experiment was carried out at College of Agriculture, Rajendranagar, Hyderabad. Soil was red soil and neutral in reaction (pH 7.8). It was medium in available nitrogen.The pot culture experiment was conducted by following Complete Randomized Block Design (CRD) with 13 treatments with three replicates. Variety used was LGG 407 and biofertilizers used are *Rhizobium* and phosphate solubilizing bacteria of Agriculture research station as there was more viable count.

Treatments :

Control : 100% RDF, T_1 : 75% RDF + 25%CBF (Seed treatment) at the time of sowing, T_2 : 75% RDF + 25% CBF (Soil application) before sowing, T_3 : 75% RDF +25% CBF- Liquid culture (soil application) at the time of sowing, T_4 :75% RDF + 25%LBF-Liquid culture (Soil application) before sowing, T_5 : 75% RDF + 25% LBF (Seed treatment) at the time of sowing, T_6: 75% RDF+ 25% LBF (Soil application) before sowing. T_7 : 75% RDF + 25% CBF (Seed treatment at the time of sowing) + soil application at 40DAS, T_8 : 75% RDF + 25% CBF (Soil application before sowing) + soil applicationat 40 DAS, T_9 : 75% RDF+25% LBF (Seed treatment at the time of sowing) + soil application at 40 DAS, T_{10} : 75% RDF+25%LBF (Soil application before sowing) + soil applicationat 40 DAS, T_{11}: 75% RDF +25% CBF-Liquid culture(soil application at the time sowing soil application at 40 DAS), T_{12}: 75% RDF +25% LBF- Liquid culture (Soil application before sowing) + soil application at 40 DAS.

Seed treatment and soil application of biofertilizers:

The seeds were soaked for 10 minutes and drained off the water. Jaggery solution was prepared by dissolving 120 g guar in one litre water and was boiled for ½ h and cooled to room temperature. Carrier based Biofertilizers of *Rhizobium* and PSB @ 250 g each per 10 kg seed were transferred to the cooled jaggery solution to make a slurry. The soaked seeds were thoroughly mixed with cultures slurry so as to obtain a uniform coating of the cultures on the seeds. The seeds thus, inoculated were spread on a clean gunny bag in shade and dried. These dried seeds were used for sowing. Seed treatment with liquid based culture of *Rhizobium* @ 10 ml for 1 kg seed and PSB @ 300 – 500 ml per acre. Soil application of biofertilizers, mixed 3 to 5 kg biofertilizer with 50kg finely powdered FYM and broadcasted in experimental pot.

Growth attributes :

Plant height (*cm*):

The plant height was measured with meter scale from the cotyledonary node upto the growing tip of the stem at 25 and 50 DAS. Mean of five values were worked out from five plants, which were selected at random in each treatment and expressed in centimetres.

Root length (*cm*) :

Root length was recorded by uprooting five plants from each plots of all replications at 25 and 50 days after sowing of crop and expressed in cm.

Number of nodules per plant:

Number of root nodules were counted carefully after uprooting munbean plants from the field, followed by dipping them in water to remove soil clods without losing the nodules and counted by detaching the nodules from the root.

Dry weight of nodules per plant:

Dry weight of the nodules was recorded after drying the nodules to constant weight at 65^0C and expressed as g plant^{-1}.

Dry matter accumulation:

Five plants per treatment were collected from the sampling rows selected next to border rows at flowering. The plant samples after sun drying were dried at 60-65^{o}C for 48 h in hot air oven till constant weights were obtained and weight was recorded and expressed as dry matter accumulation in g plant^{-1}.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Plant growth parameters :

Plant height (cm):

Plant height of greengram at 25 and 50 DAS differed significantly as influenced byapplication of liquid and carrier based biofertilizers presented in the Table 1 and Fig 1.

Table 1 : Influence of application of carrier and liquid based biofertilizers on plant height of mungbean

Treatments	Plant height (cm)	
	25DAS	50DAS
Control	11.62	15.51
T_1	14.05	18.11
T_2	13.24	17.74
T_3	13.40	18.08
T_4	13.33	17.39
T_5	15.34	22.96
T_6	14.20	18.23
T_7	14.53	18.56
T_8	13.57	17.74
T_9	15.24	21.68
T_{10}	13.75	19.32
T_{11}	13.24	17.22
T_{12}	13.16	17.16
S.E.±	0.94	1.607
C.D.(P=0.05)	1.142	4.697

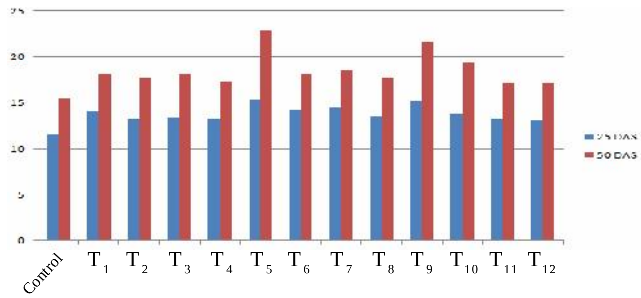

Fig. 1 : Influence of application of carrier and liquid based biofertilizers on plant height of mungbean

At 25 DAS, T_5- Seed treatment with LBF at the time of sowinghas recorded significantly higher plant height (15.34 cm) as compared to all other treatments and was on par with treatment T_9 - LBFSeed treatment at the time of sowing + soil application at 40 DAS,T_7 - Seed treatment with CBFat the time of sowing + soil application at 40 DAS(14.53cm) and T_6 - LBF Soil application before sowing (14.20) . The significantly lowest plant height (13.16 cm) was recorded withT_{12} – LBF Liquid culture as Soil application before sowing + soil application at 40 DAS among the treatments. Compared to control (11.62cm) in all other treatments plant height was significantly higher.

At 50 DAS, T_5 - seed treatment with LBF at the time of sowing has recorded significantly higher plant height (22.96cm) and was on par with T_9 -LBF Seed treatment at the time of sowing + soil application at 40 DAS which has recorded as (21.68 cm),T_{10} LBF as Soil application before sowing + soil application at 40 DAS (19.32 cm) and T_7 - Seed treatment with CBF at the time of sowing + soil application at 40 DAS (18.56cm). The significantly lowest plant height (17.16 cm) was recorded in T_{12} - LBF Liquid culture as Soil application before sowing + soil application at 40 DAS among the treatments. Compared to control (15.51cm) in all other treatments plant height was significantly higher.

The significant increase in plant height in T_5 treatment at 25 DAS and 50 DAS might be due to seed treatment at the time of sowing with liquid based biofertilizers. More nitrogen supply to the crop through nitrogen fixation because of Rhizobium might be another reason for increase in plant height. These results are in the line with the findings of Nazir Hussain *et al.* (2011) who reported that biofertilizers had significant effect on plant height of the blackgram with the inoculation of *Rhizobium* and PSB.

Root length (*cm*) :

Root length of greengram at 25 and 50 DAS differed significantly as influenced by application of liquid and carrier based biofertilizers presented in the.

At 25 DAS T_9 - Seed treatment with LBF at the time of sowing + soil application at 40 DAS has recorded significantly higher root length (6.97cm) as compared to all other treatments and was on par with T_5 -LBF Seed treatment at the time of sowing (6.84cm) and T_{10} LBF as Soil application before sowing + soil application at 40 DAS (6.58 cm). The significantly lowest root length was recorded in T_{11}LBF- Liquid culture as Soil application before sowing + soil application at 40 DAS (5.78 cm).Compared to control (4.86cm) in all other treatments root length was significantly higher.

At 50 DAS, T_9 - Seed treatment with LBF at the time of sowing + soil application at 40 DAS has recorded significantly higher root length (9.23cm) as compared to all other treatments and was on par with T_{10} LBF as Soil application before sowing + soil application at 40 DAS (8.29 cm) and T_5 - LBF Seed treatment at the time of sowing (8.20cm) followed by T_6 - LBF Soil application before sowing (7.32cm).The significantly lowest root length was observed in T_2 - CBF as Soil application before sowing (6.53). Compared to control (6.23cm) in all other treatments root length was significantly higher.

The significant increase in root length in T_9 - might be due to seed treatment of liquid based biofertilizer at sowing and soil application at 40 DAS. These results are in the line with findings of Asad *et al.*(2004) who reported that biofertilizers, had significant effect on root length of the greengram plants with the inoculation of *Rhizobium* and phosphobacteria.

Table 2: Influence of application of carrier and liquid based biofertilizers on plant height of mungbean

Treatments	Root length (cm)	
	25 DAS	50 DAS
Control	4.86	6.23
T_1	6.18	7.24
T_2	4.95	6.53
T_3	5.23	6.92
T_4	4.98	7.10
T_5	6.84	8.20
T_6	6.27	7.32
T_7	6.23	8.33
T_8	5.82	7.93
T_9	6.97	9.23
T_{10}	6.58	8.29
T_{11}	5.78	6.92
T_{12}	5.65	6.97
S.E.±	0.13	0.912
C.D.(P=0.05)	0.415	1.886

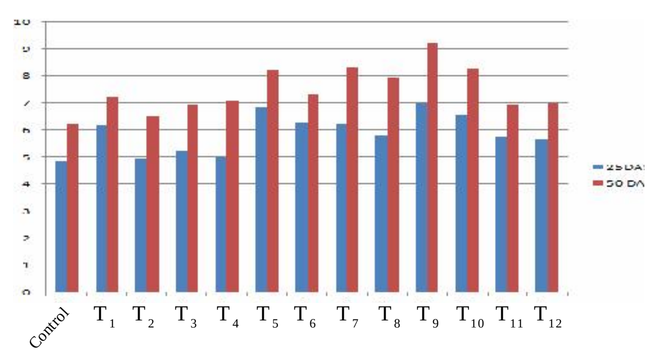

Fig. 2 : Influence of application of carrier and liquid based biofertilizers on root length of mungbean

Nodulation :

Number of root nodule, fresh weight and dry weight of root nodule of greengram at peak flowering stage differed significantly as influenced by application of liquid and carrier based biofertilizers and presented in the.

Number of root nodules per plant :

At maximum vegetative stage, maximum root

Table 3 : Influence of application of carrier and liquid based biofertilizers on nodulation of mungbean

Treatments	Nodule number	Nodule dry weight (g)
Control	6	3.40
T_1	9	5.86
T_2	10	6.24
T_3	7	3.35
T_4	10	6.82
T_5	13	10.48
T_6	12	8.96
T_7	10	6.29
T_8	11	7.96
T_9	14	11.32
T_{10}	13	10.62
T_{11}	8	3.92
T_{12}	10	6.02
S.E.±	1.05	0.025
C.D.(P=0.05)	3.093	0.073

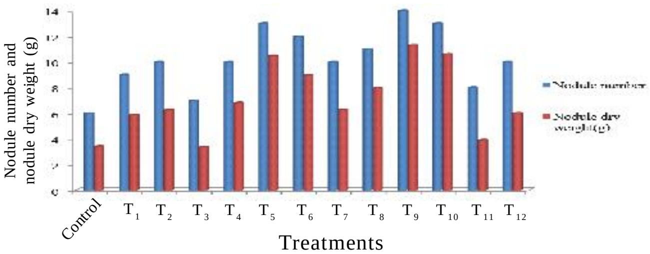

Fig. 3 : Influence of application of carrier and liquid based biofertilizers on nodulation of mungbean

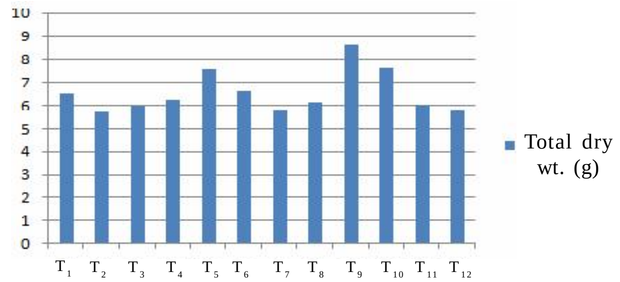

Fig. 4 : Influence of application of carrier and liquid based biofertilizers on total dry wt. (g) of mungbean

nodules (14.0) was observed in response to T_9 - Seed treatment with LBF at the time of sowing + soil application at 40 DAS was on par with T_{10}- LBF as soil application before sowing + soil application at 40 DAS (13.0), T_5 - LBF Seed treatment at the time of sowing (13.0)) and T_6 - LBF Soil application before sowing (12.0). The significantly lowest nodule number (7.0) was recorded by treatmentT_3 – CBF liquid culture as Soil application before sowing.Compared to control (6.0) in all other treatments root length was significantly higher.

Nodule dry weight per plant (*g plant* $^{-1}$) :

At flowering stage, maximum dry weight of root nodule (11.32g) was observed in response to T_9 Seed treatment with LBF at the time of sowing + soil application at 40 DAS and was significantly higher dry weight of root nodule compared to all treatments. Second highest dry weight of root nodule was observed in T_{10} – LBF as soil application before sowing + soil application at 40 DAS (10.62g) followed by T_5 Seed treatment with LBF at the time of sowing(10.48g) . The significantly lowest nodule number (3.35) was recorded in treatment T_3 – CBF liquid culture as Soil application before sowing.

At flowering stage, treatment T_9 recorded significantly higher number of root nodules and nodule dry weight. It may be due to seed treatment of liquid based biofertilizer - *Rhizobium* and PSB rather than carrier based biofertilizers. These results are in conformity with the findings of Tagore *et al*. (2013) who stated that among microbial inoculants, the Rhizobium + PSB was found most effective in terms of nodule number (27.66 nodules plant^{-1}), nodule fresh weight (144.90 mg plant^{-1}), nodule dry weight (74.30 mg plant^{-1}) and leghemoglobin content (2.29 mg g^{-1} of fresh nodule) and also showed its positive effect in enhancing all the yield attributing parameters, grain and straw yield. Similar results were obtained by Poonam *et al.* (2006) reported the efficacy of liquid and carrier based *Rhizobium* inoculants with respect to nodulation, leghaemoglobin contents and grain yield in mungbean, urdbean and pigeonpea during *Kharif* 2003. All the inoculants significantly increased nodule number as compared to uninoculated control in all the three pulse crops (13-66%)

Table 4 : Influence of application of carrier and liquid based biofertilizers on dry matter accumulation of mungbean

Treatments	Shoot dry weight (g)	Root dry weight (g)	Total dry weight (g)
Control	4.37	1.24	5.56
T_1	4.99	1.72	6.52
T_2	4.40	1.36	5.71
T_3	4.53	1.52	6.00
T_4	4.61	1.68	6.22
T_5	5.59	2.03	7.55
T_6	5.02	2.01	6.59
T_7	4.43	1.41	5.79
T_8	4.59	1.62	6.14
T_9	6.32	2.36	8.60
T_{10}	5.57	2.13	7.61
T_{11}	4.58	1.49	6.01
T_{12}	4.41	1.39	5.75
S.E.±	0.032	0.203	0.669
C.D. (P=0.05)	0.094	0.594	1.955

Authors' affiliations :

R. SUBHASHREDDY, S. TRIVENI, K. DAMODHARA CHARI, G. THIRUMAL AND Y. NAGARAJU, Department of Agricultural Microbiology and Bioenergy, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, HYDERABAD (TELANGANA) INDIA

REFERENCES

Asad, S.A., Asghari, B., Farooq, M., Aslam, M. and Afzal,A. (2004).Comparative Study of the effects of biofertilizers on nodulation and yield characteristics of mungbean (*Phaseolus vulgaris* L.) *Internat. J. Agric. & Biol.*, 1560–8530/2004/06–5–837–843 *http://www.ijab.org.*

Hossain,E.M., Imtiaz Faruk,C., Hasanuzzaman, Md., Sujan,M., Abdul Matin, Md. and Rahima, J. (2014). Effect of nitrogen and bradyrhizobium on growth and yield of mungbean. *J. Bioscience & Agric. Res.*, **1** (2): 79-84, 2014.*http://gopher.colostate.edu/Depts/Coopext/PUBS/CROPS/00305.html.*

Kachhave, K.G., Dhage, S.J. and Adsul, R.B. (2009). Associative effect of *Rhizobium*, PSB and fertilizers on nodulation and yield of blackgram (*Vigna mungo*) in vertisol. *J. Maharashtra Agric. Univ.*, **34**: 186-188.

Koushal, S. and Singh, P. (2011). Effect of integrated use of fertilizer, fym and biofertilizer on growth and yield performance on soybean [*Glycine max* (L.) Merill]. *Res. J. Agric. Sci*., **43** (3): 193-197.

Poonam, S., Gupta, R.P. and Veena, K. (2006). Evaluation of liquid Rhizobium inoculants in mungbean, urdbean and pigeonpea under field conditions. *Indian J. Pulses Res.,* **19**: 208-209.

Selvakumar, G., Reetha, S. and Thamizhiniyan, P. (2012). Response of biofertilizers on growth and yield attributes and associate protein profiling changes of blackgram [*Vigna mungo* (L.) Hepper]. *World Appl. Sci J.,* **16** : 1368 – 1374.

Singh, R.P., Gupta, S.C. and Yadav, A.S. (2008). Effect of levels and sources of phosphorous and PSB on growth and yield of blackgram [*Vigna mungo* (L.) Hepper]. *Legume Res.,* **31**: 139 – 141.

Subba Rao, N.S. (1999). The rhizosphere and the phyllosphere, In: Soil Microbiology, 4th Ed., p: 85. *Science Publishers*, Inc., Enfield, New Hampshire, UK.

Uma Maheswari, N. and Elakkiya, T. (2014). Effect of liquid biofertilizers on growth and yield of *Vigna mungo* L. *Internat. J. Pharm. Sci.*, **29** (2): 42-45.

Verma, L.N. (1993). Biofertiliser in agriculture. In: *Organics in soil health and crop production*. (Ed. P K Thampan), Peekay Tree Crops Development foundation, Cochin, India, pp. 152-183.