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Assessment of yield attributes in mungbean with carrier and liquid bio fertilizer using different method of application

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Abstract
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. Treatments consisted of 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 application at 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 application at 40 DAS,T_{11}: 75% RDF +25% CBF-Liquid culture(soil application at the time of sowing soil application at 40DAS)T_{12}: 75% RDF +25%LBF- Liquid culture (Soil application before sowing) + soil application at 40 DAS. The yield attributes viz., number of seeds per pod, test weight of seeds, seed yield were taken at harvest and nutrient uptake was estimated at harvest stage. Also available soil N, P and K were recorded at initial and at harvesting stage.

Keywords: Biofertilizers, *Rhizobium*, phosphate solubilizing bacteria, pot culture experiment

Introduction
Biofertilizer is a substance which contains living microorganisms which, when applied to seed, plant surfaces or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Bio-fertilizers add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth-promoting substances. The microorganisms in bio-fertilizers restore the soils natural nutrient cycle and build soil organic matter. Through the use of bio-fertliizers, healthy plants can be grown, while enhancing the sustainability and the health of the soil. Since they play several roles, a preferred scientific term for such beneficial bacteria is Plant-Growth Promoting Rhizobacteria (PGPR). Therefore, they are extremely advantageous in enriching soil fertility and fulfilling plant nutrient requirements by supplying the organic nutrients through microorganism and their byproducts.

Carrier based biofertilizers (CBF) are not so tolerant to the temperature which is mostly unpredictable and uncertain in the crop fields while temperature tolerance is the other advantage of the liquid biofertilizers. The range of possible contamination is very high as bulk sterilization does not provide the desirable results in the case of carrier based biofertilizers, whereas the contamination can be controlled constructively by means of proper sterilization techniques and maintenance of intensive hygiene conditions by appropriate quality control measures in the case of liquid based biofertilizer. Moisture retaining capacity of the carrier based biofertilizers is very low, which does not allow the organism viable for longer period and the liquid based biofertilizer (LBF) facilitates the enhanced viability of the organism. The administration of liquid based biofertilizers in the fields is comparatively easier than carrier based biofertilizers **(**Singleton *et al.* 2002 and Deaker *et al.* 2004) [1]. LBF are believed to be the best alternative for the conventional carrier based biofertilizers in the modern agriculture which help in the enhanced crop yields, regaining soil health and sustainable global food production.

Materials and Methods
Different types of carrier and liquid based bio fertilizers were collected from following

different firms and stored at 4°C in refrigerator and evaluated the shelf life of those bio fertilizers

Carrier based bio fertilizers		
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.

Location of the experiment

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 application at 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 application at 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. All the plants from one m^2 were harvested at maturity to record data on yield attributes i.e. number of seeds pod^{-1}, weight of 100 seeds. The total number of pods from ten randomly selected plants in each net plot was counted, averaged and expressed as number of pods per plant. Twenty pods were picked at random from the produce of each treatment and their total number of seeds were counted, averaged and expressed as number of seeds per pod. 100 seeds were selected at random from each treatment, their weights were recorded and expressed in grams. Seed yield obtained from each net plot was sun dried thoroughly, weighed and expressed in kg ha^{-1}.

Soil analysis

Organic carbon content of the soil was estimated by the wet digestion method (Walkley and Black, 1934), Available nitrogen content of the soil was estimated by alkaline permanganate method (Subbaiah and Asija, 1956), The phosphorus content in the extract was determined by ascorbic acid method (Watanabe and Olsen, 1965), Available potassium was extracted from the soil using neutral normal ammonium acetate in 1:5 ratio and the readings were recorded using flame photometer.

Result and Discussion

Number of pods per plant

Influence of application of liquid and carrier based biofertilizers on the number of Number of pods per plant at harvest stage in mungbean presented in the table 1.1.

Among all the treatments, significantly maximum number of pods (62.00) per plant was recorded in T_9 - Seed treatment with LBF at the time of sowing + soil application at 40 DAS. The second best treatment was T_{10} - LBF as Soil application before sowing + soil application at 40 DAS (54.00). The significantly lowest number of pods (37.00) per plant was observed in T_2 – CBF soil application before sowing. Compared to control (27.00) in all other treatments no of pods per plant was significantly higher. These result is in agreement with the findings of Solaiman (1999) who conducted experiment with chickpea and reported that *Rhizobium* inoculants significantly increased number of pods compared to uninoculated control.

Number of seeds per pod

Influence of application of liquid and carrier based biofertilizers on the number of seeds per pod at harvest stage in mungbean presented shows the data in the Table 1.1

Among all the treatments, significantly maximum number of seeds (12.00) per pod was recorded in T_9 - Seed treatment with LBF at the time of sowing + soil application at 40 DAS and was on par with T_{10} - LBF as Soil application before sowing + soil application at 40 DAS (11.25), T_5 - Seed treatment with LBF at the time of sowing (10.48) and T_7 - Seed treatment with CBF at the time of sowing + soil application at 40DAS (9.78). The significantly lowest Number of seeds per pod (7.62) was observed in T_2 - CBF soil application before sowing. Compared to control (7.18) in all other treatments no of seeds per pod was significantly higher.

Test weight of seeds (g)

Test weight of seeds at harvest stage differed significantly as influenced by application of liquid and carrier based biofertilizers. The data is shown in the table 1.1.

Among all the treatments, significantly maximum Test weight of seeds (13.40g) was recorded in T_9 - Seed treatment with LBF at the time of sowing + soil application at 40 DAS and was on par with T_5 - Seed treatment with LBF at the time of sowing (11.56g) followed by T_{10} – LBF as soil application before sowing + soil application at 40 DAS (10.29g). The significantly lowest test weight was observed in T_7 - Seed treatment with CBF at the time of sowing + soil application at

40DAS (7.64g). Compared to control (6.77g) in all other treatments test weight of seeds was significantly higher.

Seed yield per palnt (g)

Seed yield per palnt (g) at harvesting stage was significantly as influenced by application of carrier and liquid based biofertilizers. The data is shown in the table 1.1.

Among all the treatments, significantly highest seed yield per plant (14.51g) was recorded in T_9 - Seed treatment with LBF at the time of sowing + soil application at 40 DAS. The second best treatment is T_{10} – LBF as soil application before sowing + soil application at 40 DAS (14.27g) followed by T_8 - CBF as soil application before sowing + soil application at 40 DAS(14.06g). The significantly lowest seed yield per plant was observed in T_2 - CBF soil application before sowing (10.84g). Compared to control (10.26g) in all other treatments seed yield per plant was significantly higher.

Seed yield per hectare (kg ha^{-1})

Seed yield per hectare at harvesting stage was significantly influenced by application of carrier and liquid based biofertilizers. The data is shown in the table 1.1.

Among all the treatments, significantly highest seed yield calculated per hectare (645.85kg ha^{-1}) was recorded in T_9 - seed treatment with LBF at the time of sowing + soil application at 40 DAS and was on par with T_{10} – LBF as Soil application before sowing + soil application at 40 DAS (643.84 kg ha^{-1}) followed by treatment T_5 – seed treatment with LBF at the time of sowing (625.20 kg ha^{-1}). The significantly lowest seed yield per plant was observed in T_2 - CBF soil application before sowing (500.00 kg ha^{-1}). Compared to control (471.81 kg ha^{-1}) in all other treatments seed yield was significantly higher.

Treatment T_9 (75% RDF + 25% LBF Seed treatment at the time of sowing + soil application at 40 DAS) recorded higher yield attributing characters and yield. This might be due to seed treatment of liquid based biofertilizer at the time of sowing and soil application at 40 DAS increases no of pods, no of seeds per pod, inturn seed yield. The highest yield and yield attributing characters could be attributed because of enhanced supply of N and P, production of several phytohormones and mobilization of reserve food material to developing seed which act as sink for carbohydrate and nitrogenous compounds present in plant. Nearly equal yield was observed in T_{10} - LBF Soil application before sowing + soil application at 40 DAS. Biswas and Bhowmick (2007) reported that seed yield was high using liquid inoculants which is followed by carrier inoculants in black gram. Similar results were observed by Bhattacharya and Kumar (2002) [1], Brahmaprakash *et al*., (2004) [2] in soyabean, Gupta (2005) [3] in chickpea.

Soil nutrient status

The available major nutrients viz., nitrogen, phosphorous and potassium in the soil samples collected from pot culture at different intervals of Mungbean crop in pot culture and are presented in Table 1.2.

Organic carbon

Effect of application liquid and carrier based biofertilizers on organic carbon in soil with mungbean crop was determined at harvesting stage. (Table 1.2)

The initial organic carbon in the soil was 0.30%. At harvesting stage, treatment T_9 - Seed treatment with LBF at the time of sowing + soil application at 40 DAS was recorded highest followed with T_{10} –LBF as Soil application before sowing + soil application at 40 DAS and T_8 - CBF as Soil application before sowing + soil application at 40 DAS. Compared to control (0.28%) in all other treatments organic carbon was significantly higher.

Available nitrogen (kg ha^{-1})

Data pertaining to the available nitrogen in the soil showed significant differences as influenced by application of liquid and carrier based biofertilizers after harvesting. (Table 1.2)

The basal nitrogen level in the soil was 221 kg ha^{-1}. Available nitrogen in the soil after the crop harvest was significantly highest in T_9 - LBF Seed treatment at the time of sowing + soil application at 40 DAS (298.15) followed with T_{10} – LBF as Soil application before sowing + soil application at 40 DAS (293.78). The significantly lowest available nitrogen was observed in T_1 - Seed treatment with CBF at the time of sowing (230.04) among treatments. Compared to control (215.28) in all other treatments available nitrogen was significantly higher.

Available phosphorous (kg ha^{-1})

Effect of application liquid and carrier based biofertilizers on available phosphorous in soil with mungbean crop was determined at harvesting stage. (Table 1.2)

Initial phosphorous level in the soil was 30.77 kg ha^{-1}. Available phosphorous in soil after the crop harvest was significantly highest in T_9 - Seed treatment with LBF at the time of sowing + soil application at 40 DAS (55.87) and was on par with T_{10} - LBF as soil application before sowing + soil application at 40 DAS (52.70) followed by T_{12} – LBF Liquid culture as soil application before sowing + soil application at 40 DAS (50.88). The significantly lowest available phosphorous was observed in T_1 - Seed treatment with CBF at the time of sowing (34.37) among treatments. Compared to control (29.46) in all other treatments available phosphorous was significantly higher.

Available potassium (kg ha^{-1})

Soil available potassium status differed significantly as influenced by application of liquid and carrier biofertilizers. Soil analysis was carried out at harvest stage and depicted in Table 1.2.

The basal potassium level in the soil was 242.6 kg ha^{-1}. At harvest stage T_9 - LBF as Seed treatment at the time of sowing + soil application at 40 DAS (292.45) as compared to all other treatments. The second highest available potassium was observed in T_6 - LBF as Soil application before sowing (284.26) followed by T_{12} – LBF Liquid culture as Soil application before sowing + soil application at 40 DAS (279.45). The significantly lowest available potassium was observed in T_1 - Seed treatment with CBF at the time of sowing (34.37) among treatments. Compared to control (219.63) in all other treatments available potassium was significantly higher.

Table 1: Influence of application of carrier and liquid based bio fertilizers on yield attributing characters of mungbean.

Treatments	Seeds per pod	No. of pods per plant	Test weight of seeds (g)	seed yield per plant(g)	seed yield (kg ha^{-1})
Control	7.18	27	6.77	10.26	471.81
T1	8.21	39	9.41	10.95	533.18
T2	7.62	37	7.78	10.84	500.00
T3	9.46	39	7.93	12.09	528.15
T4	9.52	45	8.55	12.59	523.12
T5	10.48	51	11.36	13.88	625.20
T6	9.70	49	9.00	13.67	598.57
T7	9.78	40	7.64	13.30	575.43
T8	8.92	38	8.35	14.06	581.46
T9	12.00	62	13.40	14.51	645.85
T10	11.25	54	10.29	14.27	643.84
T11	9.63	35	7.69	12.41	592.53
T12	9.62	42	8.30	12.05	586.49
SE(m)	0.777	1.312	0.998	0.042	1.99
CD(< P=0.05)	2.270	3.230	2.918	0.124	5.01

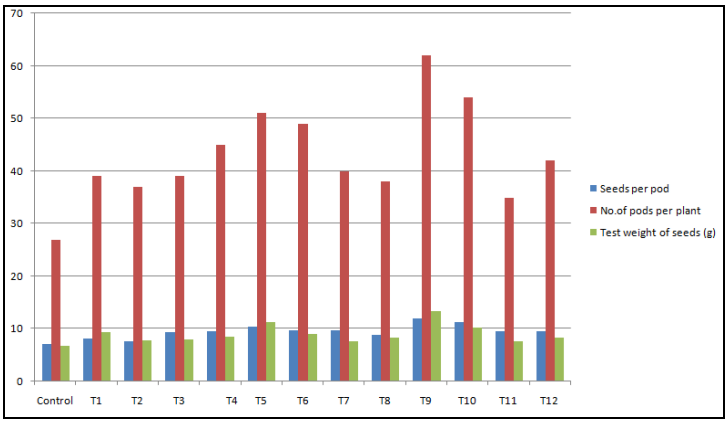

Fig 1; Influence of application of carrier and liquid based biofertilizers on seeds per pod, No of pods per plant, Test weight of seeds

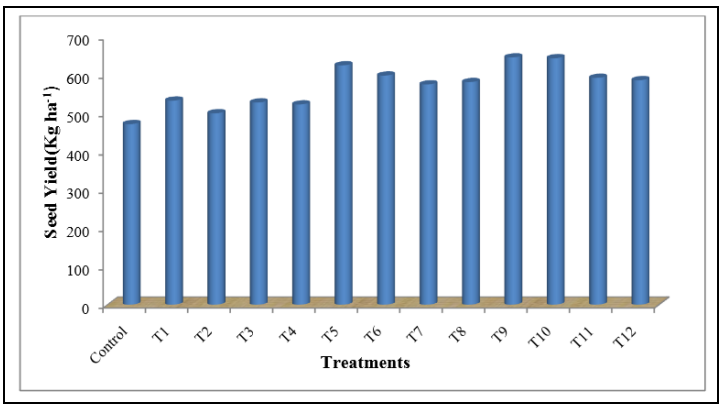

Fig 2: Influence of application of carrier and liquid based biofertilizers on seed yield.

Table 2: Influence of application of carrier and liquid based biofertilizers on organic carbon and available soil nutrients at harvesting stage.

Treatments	Organic carbon	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Control	0.28	215.28	29.46	219.63
T1	0.30	230.04	34.37	249.64
T2	0.29	246.85	38.57	250.47
T3	0.31	248.15	40.50	259.67
T4	0.32	253.38	42.70	262.73
T5	0.35	265.95	43.97	269.54
T6	0.36	275.67	45.53	284.26
T7	0.37	280.43	47.50	254.56
T8	0.38	287.08	49.67	244.42
T9	0.42	298.15	55.87	292.45
T10	0.40	293.78	52.70	265.67
T11	0.32	281.54	48.60	272.96
T12	0.35	288.18	50.88	279.45
SEm	0.028	0.892	1.22	1.54
CD(P=0.05)	0.082	2.608	3.54	4.93

Reference

1. Bhattacharyya P, Kumar R. Liquid biofertiliser - Current knowledge and future prospect. Proceedings of the National Seminar on Development and use of biofertilizers, biopesticides and organic manures, B.C.K.V., Kalyani, Nadia, West Bengal, 2002, 10-21.
2. Brahmaprakash GP, Girisha HC, Navi Vithal, Hedge SV. Biological nitrogen fixation in pulse crops. Pulses in New Perspective (Masood Ali, B.B Singh, Shiv Kumar and Vishwa Dhar, eds.), Indian Society of Pulses Research and Development, IIPR, Kanpur, India, 2004, 271-86.
3. Gupta SC. Evaluation of liquid and carrier based Rhizobium inoculants in chickpea. Indian journal of pulse research. 2005; 18(1):40-42.
4. Salahuddin Md, Ruhulamin AKM, Jafarullah Md, Asaduzzman Md. Interaction effect of variety and different fertilizers on the growth and yield of summer mungbean. American-Eurasian Journal of Agronomy. 2009; 2:180-184.
5. Satyendra T, suresh K, katiyar TPS, pawan KV. Influence of biofertilizers and phosphorous levels on yield attributes and Uptake of green gram. Environment and Ecology. 2015; 33(4):1848-1852.
6. Solamein ARM. Nitrogenase activity. Yield and yield contributing characters of chickpea as influenced by *Rhizobium* inoculant in presence and absence of nitrogen. Bangladesh Journal of Science and Technology. 1999; 1:141-144.
7. Subbaiah BV, Asija CL. A rapid procedure for the estimation of available nitrogen in soils. *Current Science.* 1956; 25:32.
8. Tagore GS, Namdeo SL, Sharma SK, Narendra K. Effect of Rhizobium and Phosphate Solubilizing Bacterial Inoculants on Symbiotic Traits, Nodule Leghemoglobin, and Yield of Chickpea Genotypes. Internationa Journal of Agronomy Article ID581627, http://dx.doi.org/10.1155/2013/581627, 2013.
9. Tairo EV, Ndakidemi PA. Yields and economic benefits of soybean (*Glycine max* L.) as affected by *Bradyrhizobium japonicum* inoculation and phosphorus supplementation. American Journal of Research Communication, 2013, 1(11).
10. Uma Maheswari N, Elakkiya T. Effect of Liquid Biofertilizers on Growth and Yield of Vigna mungo L. Int. J. Pharm. Sci. 2014; 29(2):42-45.
11. Walkley AJ, Black CA. An examination of different methods for determining soil organic matter and a proposed modifications of the chromic acid titration method. Soil Science. 1934; 37:29-38.
12. Watanabe FS, Olsen SR. Test of an ascorbic acid method for determining phosphorus in water and $NaHCO_3$ extracts from soil. Soil Science Society of America Proceedings. 1965; 29:677-678.