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Response of Liquid Biofertilizers (*Bradyrhizobium* and PSB) on Nutrient Content in Soybean (*Glycine max* L.)

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A field experiment was carried out on "Nutrient content in soybean plants as influenced by liquid biofertilizers (*Bradyrhizobium* and PSB)". It was conducted in *Kharif* season during the year 2013-14 at the research farm of Oil Seed Research Station, Latur, Maharashtra, in factorial randomized block design with three replications and variety MAUS-81 as a test crop along with 16 treatment combination containing four levels of liquid *Bradyrhizobium* (0ml, 5ml, 10ml, and 15ml) and four levels of liquid PSB (0ml, 5ml, 10ml, and 15ml). Nitrogen content in plant was significantly increased by seed inoculation with liquid 10ml of *Bradyrhizobium* (A_2) at maturity 7.93% and at harvest 3.62% over control. Phosphorus content was significantly improved (at maturity 28.57% and at harvest 31.25%) by seed inoculation with liquid 10ml of PSB (B_2) over control.

Introduction

Soybean (*Glycine max*) a leguminous crop originated in China. It is basically a pulse crop and gained the importance as an oil seed crop as it contains 20% cholesterol free oil. It posses a very high nutritional value, and contains 40 per cent high quality protein due to this reason, soybean is known as `poor man's meat'. India stands next only to China in the Asia pacific region, with respect to production (12.9 m.t). Maharashtra is the second largest producer in India, with 4.86 m.t of production (*Anonymous*, 2013). Soybean played a key role in the yellow revolution. It is newly introduced and commercially exploited crop in India. Soybean has been playing an important role in national economy by earning an average of Rs. 32,000 million per annum through export of soy meal and contributing about 18% to the edible oil production (*Anonymous*, 2012).

The prices of fertilizers are increasing day by day and therefore, it is necessary to reduce the cost of fertilizers by using *Bradyrhizobium* and PSB inoculation to increase yield of legume crops. Biofertilizers cannot replace chemical fertilizers, but certainly are capable of reducing their input. Seed inoculation with effective *Bradyrhizobium* inoculant is recommended to ensure adequate nodulation and N_2 fixation for maximum growth and yield of pulse crop. Biofertilizer do not supply nutrients directly to crop plants but have capacity to fix atmospheric nitrogen and convert insoluble phosphate into soluble form. Hence, soil microorganisms play significant role in mobilizing P for the use of plant and large fraction of soil microbial population can dissolve insoluble phosphate in soil.

Dhage and Kachhave (2008) conducted research work on effect of dual inoculation of *Rhizobium* and PSB on yield, nutrient content, availability of nutrients and quality of soybean [*Glycine max* (L.) Merrill] and they observed at flowering stage the highest N (3.13%), P (2.05%), and K (2.13%) and at harvest stage N, P and K contents of 6.23, 2.68 and 2.29 per cent were recorded in 100% RDF + *Rhizobium* + PSB treatment, respectively.

Materials and Methods

The field experiment was conducted in *Kharif* season during the year 2013-14 at the research farm of Oil Seed Research Station, Latur, Maharashtra, geographically situated between 18^0 05' to $18^{0.}$75' N latitude and between 76^0 25' to $77^0$36' E longitude on the Deccan plateau with height mean sea level (MSL) about 633.85 meters and average rainfall is 750-800mm. The experimental soil was deep black in color with good drainage, moderate calcareous in nature and moderate alkaline in reaction with pH (1:2.5) 8.30, EC (1:2.5) 0.36 dSm^{-1} $CaCO_3$ (5.03%) and organic C (5.4 g kg^{-1}) The available soil N, P, K and S were 131.20, 19.68, 597.9, 15.35 $kgha^{-1}$ respectively.

Soybean was grown in factorial randomized block design with three replications and variety MAUS-81 as a test crop along with 16 treatment combination containing four levels of liquid *Bradyrhizobium* (0ml, 5ml, 10ml, and 15ml) and four levels of liquid PSB (0ml, 5ml, 10ml, and 15ml).

Soybean seed after inoculation with required quantity of liquid biofertilizers *viz.* *Bradyrhizobium* and PSB was sown at spacing 45 × 5cm @ 75 kg ha^{-1} in 4th July, 2013. A uniform dose of fertilizers (30:60:30:30 kg ha^{-1} of N, P_2O_5, K_2O, S) were supplied through urea, SSP, MOP and bensulph before sowing. Hand weeding was carried out at 26 DAS first spray of Chloropyriphos 25 ml/10lit water, bavistin 20 gm/10lit water at time of incidence of insect pests (30DAS) and second of proclaim (benzoet) 15gm/10lit of water at in 30 days interval of first spray. The crop was harvested on 15 Oct. 2013.

Results and Discussion

Concentration of nutrients in plant

In order to study the impact of different levels of liquid *Bradyrhizobium* and PSB on nutrient content in soybean, plant samples were analyzed for N, P, K and S and result presented here.

Concentration of nitrogen

The N content in soybean plant was not influenced significantly by liquid *Bradyrhizobium* at branching, flowering and pod formation stages but it was significantly influenced at maturity and at harvest stages (Table 1). The higher N content in soybean was recorded due to the treatment A_2 (10ml of *Bradyrhizobium japonicum* kg^{-1} seed) at branching, flowering and pod formation stages. The treatment A_2 (10ml of *Bradyrhizobium japonicum* kg^{-1} seed) recorded significantly higher N content over A_0 and A_1 treatments at maturity and at harvest stages of soybean. However the treatments A_0 (control) and A_1 (5ml *Bradyrhizobium japonicum* kg^{-1} seed) as well as A_2 (10ml *Bradyrhizobium japonicum* kg^{-1} seed) and A_3 (15ml *Bradyrhizobium japonicum* kg^{-1} seed) were on par with each other. Among the different stages of soybean crop at branching stage N content in soybean plant was higher followed by flowering, pod formation and maturity stages and it was lower at harvest stage of soybean. This might be due to the fact that *Rhizobium* inoculation increased the root nodulation through better root development and more nutrient availability, resulting in better absorption and utilization of all plant nutrients, thus resulted in to more N and P content and uptake in seed and straw. Similar finding also reported by Singh *et al.,* (2007).

Nitrogen content of soybean was not influenced significantly due to different PSB levels presented in table 1. However higher N content in soybean was recorded with the treatment B_2 (10ml of PSB kg^{-1} seed) at all the growth stages of soybean crop.

The interaction effect between liquid *Bradyrhizobium* and PSB (A×B) on N concentration in soybean plant was not significant. The treatment A_2B_2 was not significant but it gave maximum N content at all the growth stages of soybean crop. However dual as well as multi inoculation of biofertilizers with or without FYM statistically increased the uptake of N and P. This might be attributed to enhanced activity of nitrogenase and nitrate-reductase enzyme in the soil (Oad *et al.*, 2002).

Concentration of phosphorus

The data on P content in soybean as influenced by different levels of liquid *Bradyrhizobium* and PSB are presented in table 2. Phosphorus content of soybean was not influenced significantly due to different liquid *Bradyrhizobium* levels but the higher P content in soybean was recorded under the treatment A_2 (10ml of *Bradyrhizobium* kg^{-1} seed) at all the growth stages of soybean crop.

The P content in soybean was not influenced significantly by liquid PSB at branching, flowering and pod formation stages but it was significantly influenced at maturity and harvest stages (Table 2). The higher P concentration in soybean was recorded under the treatment B_2 (10ml of PSB kg^{-1} seed) at branching, flowering and pod formation stages. The treatment B_2 (10ml of PSB kg^{-1} seed) recorded significantly higher P content over B_0 and B_1 treatments at maturity and harvest stages of soybean.

The treatments B_0 (control) and B_1 (5ml PSB kg^{-1} seed) as well as B_2 (10ml PSB kg^{-1} seed) and B_3 (15ml PSB kg^{-1} seed) were at par with each other. It was also noticed that the higher concentration of phosphorus in plant in presence of biofertilizers was found at branching stage of crop and there after gradually decreased P content in plant decreased with advancement of crop growth. It might be due to dilution effect of nutrient at later growth stages of soybean. Secondly more nutrients are translocated for reproductive process of crop growth.

The higher concentration of phosphorus at branching might be due to the ability of PSB to transform insoluble phosphate in soil in to soluble forms by screating organic acids resulting in effective solubilization and utilization of phosphate. Inoculation of PSB alone increased the concentration of phosphorus in plant. Dubey (1997) found that phosphate solubilizing microorganisms play a major role in the solubilization and uptake of native and applied soil phosphorus.

The interaction effect between liquid *Bradyrhizobium* and PSB (A×B) on P concentration in soybean plant was non-significant. The combined treatment A_2B_2 (10ml of *Bradyrhizobium* + 10ml PSB kg^{-1} seed) gave maximum P content at all the growth stages of soybean crop. However dual as well as multi inoculation of biofertilizers with or without FYM statistically increased the concentration of N and P. This might be attributed to enhanced activity of nitrogenase and nitrate-reductase enzyme in the soil (Purbey and Sen 2007), leading to greater biological nitrogen fixation by *Rhizobium* and increased availability of P in the soil due to greater solubilization of phosphate compound by phosphate solubilizing bacteria.

Concentration of potassium

The data regarding K content in soybean as influenced by different levels of liquid *Bradyrhizobium* and PSB are presented in table 3. Potassium content in soybean was not influenced significantly due to different liquid *Bradyrhizobium* levels but the higher K content in soybean was recorded with the treatment A_2 (10ml of *Bradyrhizobium* kg^{-1} seed) at all the growth stages of soybean crop.

The data indicated that the difference in K content due to different liquid PSB levels were not reach to the level of significance except branching stage. Maximum and minimum K content (Table 3) was recorded with B_2 (10ml PSB kg^{-1} seed) and B_0 (control) at all the growth stages of soybean. The interaction effect between liquid *Bradyrhizobium* and PSB (A×B) on K concentration in soybean plant was failed to reach the levels of significance. The combined treatment A_2B_2 (10ml of *Bradyrhizobium* + 10ml PSB kg^{-1} seed) was not significant but it gave maximum K content at all the growth stages of soybean crop.

Table.1 Effect of liquid bio-fertilizers on N content at various critical growth stages of soybean

Treatments	N content (%) in plant				
	branching	flowering	pod formation	maturity	harvest
***Rhizobium* levels (A)**					
A_0 (0ml)	2.70	2.40	2.32	2.27	2.21
A_1 (5ml)	2.77	2.47	2.39	2.29	2.23
A_2 (10ml)	2.91	2.61	2.53	2.45	2.29
A_3 (15ml)	2.85	2.55	2.48	2.39	2.27
S.Em±	0.06	0.07	0.06	0.01	0.02
CD at 5%	NS	NS	NS	0.04	0.42
PSB levels (B)					
B_0 (0ml)	2.74	2.44	2.36	2.26	2.23
B_1 (5ml)	2.79	2.49	2.41	2.38	2.24
B_2 (10ml)	2.86	2.56	2.48	2.44	2.28
B_3 (15ml)	2.85	2.55	2.47	2.40	2.28
S.Em±	0.06	0.07	0.06	0.01	0.02
CD at 5%	NS	NS	NS	NS	NS
Interaction (A×B)					
S.Em±	0.13	0.14	0.12	0.02	0.04
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**

Table.2 Effect of liquid bio-fertilizers on P content at various critical growth stages of soybean

Treatments	P content (%) in plant				
	branching	flowering	pod formation	maturity	harvest
***Rhizobium* levels (A)**					
A_0 (0ml)	0.49	0.47	0.42	0.35	0.31
A_1 (5ml)	0.50	0.48	0.43	0.38	0.34
A_2 (10ml)	0.53	0.51	0.46	0.42	0.39
A_3 (15ml)	0.52	0.50	0.45	0.41	0.38
S.Em±	0.06	0.03	0.02	0.02	0.04
CD at 5%	NS	NS	NS	NS	NS
PSB levels (B)					
B_0 (0ml)	0.50	0.47	0.43	0.35	0.32
B_1 (5ml)	0.51	0.48	0.44	0.36	0.33
B_2 (10ml)	0.53	0.50	0.46	0.45	0.42
B_3 (15ml)	0.53	0.50	0.46	0.40	0.37
S.Em±	0.06	0.03	0.02	0.02	0.04
CD at 5%	NS	NS	NS	0.05	0.06
Interaction (A×B)					
S.Em±	0.02	0.06	0.04	0.04	0.08
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**

Table.3 Effect of liquid bio-fertilizers on K content at various critical growth stages of soybean

Treatments	K content (%) in plant				
	branching	flowering	pod formation	maturity	harvest
***Rhizobium* levels (A)**					
A_0 (0ml)	2.36	2.02	1.61	1.50	1.35
A_1 (5ml)	2.43	2.09	1.68	1.57	1.42
A_2 (10ml)	2.57	2.23	1.82	1.71	1.56
A_3 (15ml)	2.52	2.18	1.77	1.66	1.51
S.Em±	0.06	0.07	0.06	0.08	0.06
CD at 5%	NS	NS	NS	NS	NS
PSB levels (B)					
B_0 (0ml)	2.40	2.06	1.65	1.54	1.39
B_1 (5ml)	2.45	2.11	1.70	1.59	1.44
B_2 (10ml)	2.52	2.18	1.77	1.66	1.51
B_3 (15ml)	2.51	2.17	1.76	1.65	1.50
S.Em±	0.06	0.07	0.06	0.08	0.06
CD at 5%	NS	NS	NS	NS	NS
Interaction (A×B)					
S.Em±	0.12	0.14	0.12	0.16	0.12
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**

Table.4 Effect of liquid bio-fertilizers on S content at various critical growth stages of soybean

Treatments	S content (%) in plant				
	branching	flowering	pod formation	maturity	harvest
***Rhizobium* levels (A)**					
A_0 (0ml)	0.45	0.43	0.37	0.35	0.33
A_1 (5ml)	0.46	0.44	0.38	0.36	0.34
A_2 (10ml)	0.49	0.47	0.41	0.39	0.37
A_3 (15ml)	0.48	0.46	0.40	0.38	0.36
S.Em±	0.01	0.02	0.01	0.03	0.02
CD at 5%	NS	NS	NS	NS	NS
PSB levels (B)					
B_0 (0ml)	0.46	0.43	0.38	0.35	0.33
B_1 (5ml)	0.47	0.44	0.39	0.36	0.34
B_2 (10ml)	0.49	0.46	0.41	0.38	0.36
B_3 (15ml)	0.49	0.46	0.41	0.38	0.36
S.Em±	0.01	0.02	0.01	0.03	0.02
CD at 5%	NS	NS	NS	NS	NS
Interaction (A×B)					
S.Em±	0.02	0.04	0.02	0.06	0.04
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**

Disintegration of K minerals due to release of organic acids by bioinoculants used for seed inoculation purpose. It was also noticed that dual inoculation of *Rhizobium* + PSB showed its superiority over single inoculation of PSB and *Rhizobium*. These results are in line with the finding of Sharma and Namdeo (1999) found seed inoculation with *Rhizobium* and PSB in presence of FYM gave higher N, P and K contents in plant and seed.

Concentration of sulphur

Data indicating concentration of sulphur recorded at branching, flowering, pod formation, maturity and at harvest was presented in table 4. It was evident from the results that the concentration of sulphur was not affected due to individual seed treatment with *Bradyrhizobium* and PSB levels. Sulphur content in soybean was not influenced significantly due to levels of liquid *Bradyrhizobium* and PSB. The higher S content was recorded under the treatments A_2 (10ml of *Bradyrhizobium* kg^{-1} seed) and B_2 (10ml of PSB kg^{-1} seed) at all the growth stages of soybean. Normally lower S content was observed with A_0 and B_0 (control) treatment at all the growth stages of soybean.

The higher content of S in seed and straw together with increased seed and straw yield might be the result of greater uptake of sulphur. These results are in agreement with those of Tomar (2011).

The interaction effect between liquid *Bradyrhizobium* and PSB (A×B) on S concentration in soybean was failed to reach the levels of significance. The treatment A_2B_2 (10ml of *Bradyrhizobium* + 10ml PSB kg^{-1} seed) was not significant but it gave maximum S content at all the growth stages of soybean crop.

References

Anonymous (2012).Soybean basic introduction. *w.w.w.pnbkrishi.com/soybean.htm.*

Anonymous (2013). Soybean Processors Association of India.*w.w.w.sopa.org.*

Chandra, R. (2006) *Rhizobium* inoculation in urdbean and its residual effect on wheat. *Indian J. Pulses Res.*, 19 (2): 213-215.

Dhage, S.J., and Kachhave, K. G. (2008). Effect of dual inoculation of *Rhizobium* and PSB on yield, nutrient content, availability of nutrients and quality of soybean [*Glycine max* (L.) Merrill]. *An Asian J. Soil Sci.*, 3 (2): 272-276.

Dubey, S.K. (1997). Co-inoculation of phosphorus solubilizing bacteria with *Bradyrhizobium japonicum* to increase phosphate availability to rainfed soybean on *Vertisol*. *J. Indian Soc. Soil Sci.*, 45 (3):506-509.

Oad, F.C., Kumar, L. and Biswas, J.K. (2002). Effect of *Rhizobium japonicum* inoculum doses (liquid culture) on the growth and seed yield of soybean crop. *Asian J. Plant Sci*., 1 (4): 340-342.

Pratibha Sahai and Ramesh Chandra (2011). Performance of liquid and carrier-based inoculats of *Mesorhizobium ciceri* and PGPR (*Pseudomonas diminuta*) in Chickpea (*Cicer arietinum* L.) on nodulation yield and soil properties. *J. Indian Soc. Soil Sci*. 59 (3): 263-267.

Purbey, S.K. and Sen, N.L. (2007). Effect of bioinoculants and bioregulators on yield and nutrient uptake by fenugreek. *Indian J. Agric. Res.*, 41 (2): 154-156.

Sharma, K.N. and Namdeo (1999). Effect of biofertilizers and phosphorus on growth and yield of soybean, *J. Crop Res*. 17 (2): 160-163.

Singh, S.R., Najar, G.R. and Ummed Singh (2007). Productivity and nutrient uptake of soybean (*Glycine max (L.*)) as influenced by bio-inoculants and farmyard manure under rainfed conditions. *Indian J. Agron.*, 52 (4): 325-329.

Thenua, O.V.S., Shivakumar, B.G. and Jitendra kumar, M. (2006). Effect of biofertilizers and phosphorous fertilization on nodulation pattern productivity and phosphorous uptake by summer mung (*Vigna radiata*). *Biofertilizer Newsletter*, 14 (2): 0.

Tomar, R.K.S. (2011). Effect of integration of bio-fertilizers and farm yard manure with inorganic fertilizers on productivity of soybean (*Glycine max*) in farmers' fields. *J. Oilseed Res*., 28 (20): 112-114.

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