Journal of crop and weed 2(1) : 67-70 (2006)

Influence of manure, sludge and PSM on effectiveness of *Bradyrhizobium* strains towards growth, yield and nutrient acquisition of mungbean

B.R. MAURYA AND S.K. SINGH

Department of Soil Science and Agricultural Chemistry
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, U.P.

ABSTRACT

A field experiment was conducted at Agricultural Research Farm, Institute of Agricultural Sciences, B.H.U. in Kharif 1999 with the objective to delineate effectiveness of *Bradyrhizobium* strains (MO_5 and BM_1) alone and along with *Pseudomonas* striata/cattle dung manure/digested sludge on growth, nodulation, yields and nutrients acquisition of mungbean. Required quantity of cattle dung manure and digested sludge for 10 kg N ha^{-1} was applied as per the treatments before sowing the seeds. It was found that ODW of nodules, plant and roots, yields and uptake of N, P & K by mungbean was improved more by strain MO_5 than BM_1. With *Bradyrhizobium* MO_5, *Pseudomonas striata* gave 6% more grain yield than with *Bradyrhizobium* BM_1. Organic manures, supplimented with *Bradyrhizobium* strains increased growth, nodulation, yield and acquisition of nutrients over their respective strains. Effectiveness of *Bradyrhizobium* strains was enhanced more by cattle dung manure than digested sludge. Nodule N was highly correlated with N acquisition by grain. Digested sludge caused greater test weight but lesser grain yield than cattle dung manure applied with *Bradyrhizobium* strains. Seed inoculation of *Bradyrhizobium* MO_5 along with cattle dung manure was the best treatment combination to achieve good yield of mungbean.

Key words : Digested sludge, Cattle dung manure, PSM, *Bradyrhizobium*, Mungbean.

Mungbean is an important multipurpose leguminous crop in India. Intensive cultivation and excess use of chemical fertilizers resulted in ill health of soil and reduced the yield of crops. A greater concern regarding use of bio-fertilizers and organic sources as supplement of chemical nitrogen fertilizers has been derived to reduce the input cost in agricultural production. Being a leguminous crop productivity of mungbean can be increased with inoculation of *Bradyrhizobium* strains which enhance the nitrogen nutrition of the crop through the symbiotic fixation of atmospheric nitrogen.

Phosphate solubilising microorganisms increase phosphate availability by means of phosphate solubilization (Gaur, 1990). Sewage sludge is an important source of organic matter and plant nutrition (Stranchman et al., 1983). Use of cow dung as fuel in rural areas is an wastage of organic manure cause environmental pollution. A very few studies on inoculation and use of organic manures in cultivation of mungbean in eastern U.P. Hence, in this investigation an attempt was made to study the effectiveness of two strains of *Bradyrhizobium* sp.(*vigna*) singly as well as in combination with phosphate solubilizing micro-organism or cattle dung manure or digested sludge on growth, nodulation, yield and nutrient acquisition by grain and straw of mungbean.

MATERIALS AND METHODS

A field experiment was conducted in Kharif 1999 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The soil was silty loam having pH 7.7-7.8, EC 0.23-0.25 dS m^{-1}, organic C 0.53-0.55% and available N, P and K 240-242, 11-12 and 274-280 kg ha^{-1}, respectively. The nine treatments, viz. control, *Bradyrhizobium* MO_5, *Bradyrhizobium* BM_1, *Bradyrhizobium* MO_5 + PSM, *Bradyrhizobium* BM_1 + PSM, *Bradyrhizobium* MO_5 + CDM, *Bradyrhizobium* BM_1 + CDM *Bradyrhizobium* MO_5 + DS and *Bradyrhizobium* BM_1 + DS were replicated thrice in randomized block design. Nitrogen and phosphorous @ 10 and 21 kg ha^{-1} through urea and single superphosphate, respectively were applied as basal dressing in furrows. Molybdenum @ 20 g ha^{-1} as sodium molybedate was applied with sticker solution during seed inoculation. Required quantity of cattle dung manure (CDM) containing 0.62% N

& P and 0.72% K or digested sludge (DS) having 1.68, 0.68 and 0.78% N, P & K, respectively was applied as per treatments before sowing of seeds for 10 kg N ha^{-1}.

Mungbean cv. HUM-1 was sown @ 20 kg ha^{-1}. Seeds were inoculated with *Bradyrhizobium sp. (vigna)* MO_5 and BM_1,(BRh·MO_5 and BRh·BM_1) used alone and in combination with *Psedomonas striata* (PSM)/DS/CDM. Plant growth and nodulation were studied plot wise 60 days after sowing on five random and carefully up rooted plants. Plants, roots and detached nodules were dried in hot air oven at 70° ± 1°C for 36-40 hours for determining their oven day weights. Crop was harvested at maturity and grain and stover yields were recorded. Grain and stover samples were ground and analysed for nitrogen, phosphorous and potassium following the standard procedure as outlined by Wallinga *et al.* (1989). Nitrogen in nodules was also determined following the same procedure.

RESULTS AND DISCUSSION

Plant growth

Oven dry weight of plants and roots $plant^{-1}$ of greengram were increased significantly by inoculation of *Bradyrhizobium* strains in comparison to uninoculated control (Table 1). Judicious use of *Bradyrhizobium* strains with CDM or DS gave significantly taller plants than control. Over control, 17.8 and 74.2% greater plant height and root dry weight, respectively were recorded with combined inoculation of BRh. MO_5 and digested sludge. Highly significant correlation between root weight and plant height indicates translocation of sufficient quantity of nutrients absorbed by roots to the shoots which favoured the growth of plants. Height of plant was positively and significantly correlated with dry weight of plants. In general, inoculation of BRh·MO_5 alone or in combination with PSM or CDM or sludge gave greater plant dry weight than seed inoculation of BRh·BM_1 alone or with similar combination. Effectiveness of *Bradyrhizobium* strains influenced more by cattle dung manure than digested sludge towards plant weight but reverse was recorded for height of plant.

Nodulation and nitrogen in nodules

Maximum oven dry weight of nodules $plant^{-1}$ was recorded with BRh MO_5 + CDM which showed its significant superiority over all other treatments except *Bradyrhizobial* strains in combination with sludge or BRh BM_1 + CDM (Table 1). *Bradyrhizobium* MO_5 caused insignificantly greater ODW of nodule than BRh·BM_1 and they also varied insignificantly when used with PSM and organic manures. Oven dry weight of root had direct bearing on nodule dry weight as correlation between them was highly significant. Though BRh·MO_5 with sludge caused maximum root weight but highest nodule weight was recorded with BRh·MO_5 + CDM. This may be ascribed due to the higher content of phosphorus (0.68%) in sludge which might helped in elongation and proliferation of roots. However, its higher quantity of nitrogen (1.68%) perhaps adversely affected the formation of nodules which resulted insignificant decrease in ODW of nodules (Peoples and Craswell, 1992). Both Bradyrhizobial strains were recorded as efficient strains in fixing greater nitrogen in nodules when hey were used with CDM and DS but not with PSM. Content of N in nodules was significantly correlated with ODW of nodules which elicits the effectiveness and efficiency of Bradyrhizobial strains. However, BRh·MO_5 was more efficient than BRh·BM_1. Maximum and significantly higher N in nodules was recorded with BRh·MO_5 + CDM in comparison to *Bradyrhizobial* strains alone or in combination with PSM.

Table 1 Effect of seed inoculation and manures on growth, nodulation and nodule nitrogen of mungbean

Treatment	Plant height (cm)	Oven dry weight			Nodule N (%)
		Plant (g $plant^{-1}$)	Root (g $plant^{-1}$)	Nodule (mg $plant^{-1}$)	
No inoculation	51.8	2.52	0.31	31.6	4.18
Bradyrhizobium MO5	54.0	3.34	0.38	41.9	4.25
Bradyrhizobium BM1	52.9	3.23	0.37	41.1	4.23
BRh·MO5 + PSM	51.5	3.42	0.52	45.2	4.25
BRh·BM1 + PSM	55.8	3.36	0.48	44.2	4.22
BRh·MO5 + CDM	60.5	4.33	0.53	49.8	4.35
BRh·BM1 + CDM	58.0	4.11	0.52	48.3	4.33
BRh·MO5 + DS	61.0	3.88	0.54	49.3	4.32
BRh·BM1 + DS	59.8	3.85	0.53	48.0	4.29
SEM ±	1.31	0.05	0.017	0.94	0.025
CD (P = 0.05)	3.94	0.17	0.051	2.83	0.077

BRh = Bradyrhizobium sp. (vigna)
CDM = Cattle dung manure
PSM = Pseudomonas striata
ODW = Oven dry weight
DS = Digested sludge

Yield and test weight

The inoculation of mungbean with two *Bradyrhizobial* strains (MO_5 or BM1) alone and in combination with PSM or CDM or DS significantly increased grain and stover yields over uninoculated control (Table 2). *Bradyrhizobium* ·MO_5 + CDM as well as BRh·MO_5 + sludge showed significant superiority over the remaining treatments except BRh·MO_5 + PSM. Maximum grain and stover yields were recorded with BRh·MO_5 + CDM followed by BRh·MO_5 + sludge. This was in conformity to the finding of Sanoria and Rani (1998) who have reported significant increase in grain and stover yields due to application of *Bradyrhizobial* strains alone and in combination with PSM or CDM or sludge. Combined inoculation of BRh·MO_5 + CDM gave 15.4% and 14.6% greater grain and stover yields, respectively, than uninoculated control. All inoculated treatments except BRh. BM_1 showed significant increase in test weight of mungbean over the control. Maximum test weight was obtained with treatment BRh·MO_5 + DS. Test weight was positively and highly significantly correlated with grain yield.

Acquisition of nutrients

Bradyrhizobium inoculation of mungbean either alone or with PSM/organic manures caused greater uptake of nutrients by grain and straw compared to uninoculated control (Table 2). Higher uptake of nutrients was obtained by judicious use of *Bradyrhizobial* strains with organic manures. With cattle dung manure, BRh·MO_5 gave maximum uptake of nitrogen and phosphorus by grain and straw. Though, digested sludge contains greater quantity of N, P and K than the content of N (0.62%), P (0.060%) and K (0.72%) of cattle dung manure. However, grater acquisition of N, P & K by grain and straw was recorded with *Bradyrhizobial* strains when these were combindly used with CDM. This was in accordance to the findings of Jansson (1972) and Bhriguvanshi (1988).

Based on the results of present investigation, it can be concluded that there is a tremendous scope of enhancing the yield and supply of nutrients to legumes through manures and efficient *Rhizobium* strains. Seed inoculation of *Bradyrhizobium* MO_5 along with cattle dung manure was found to be the best treatment combination to achieve maximum yield of mungbean.

Table 2 Effect of seed inoculation and manures on yield and uptake of nutrient by mungbean

Treatments	Yield (kg ha^{-1})		Test weight	Nutrient uptake of Mungbean (kg ha^{-1})					
	Grain	Straw	(g)	By Grain			By Straw		
				N	P	K	N	P	K
No inoculation	751.0	2887.6	34.10	25.90	2.62	6.72	66.19	3.99	52.58
BRh.MO_5	828.7	3153.2	35.05	30.40	2.93	7.61	77.25	5.04	66.99
BRh.BM_1	789.1	2968.3	34.75	28.54	2.82	7.16	71.53	4.58	65.89
BRh·MO_5 + PSM	857.6	3136.5	36.80	32.31	3.13	7.58	77.16	4.69	69.00
BRh·BM_1 + PSM	811.2	3086.6	36.08	29.86	3.07	7.35	75.83	4.99	67.60
BRh·MO_5 + CDM	888.2	3379.6	36.95	36.24	3.76	8.57	83.82	5.04	75.36
BRh·BM_1 + CDM	844.2	3212.2	36.80	34.61	3.51	8.10	79.04	4.32	73.14
BRh·MO_5 + DS	882.6	3356.1	37.76	35.98	3.58	8.36	82.56	4.91	74.85
BRh·BM_1 + DS	840.5	3196.4	37.05	34.03	3.25	7.91	78.31	4.17	71.65
SEM ±	12.66	19.21	0.28	0.82	0.14	0.03	2.01	0.53	1.24
CD at 5%	38.03	57.61	0.85	2.47	0.44	0.17	5.62	NS	1.34

BRh = Bradyrhizobium sp. (vigna); CDM = Cattle dung manure; PSM = Pseudomonas striata; DS = Digested sludge

Table 3 Correlation coefficients between some characteristics of mungbean

Characteristics	Value of 'r'
Root weight and Plant height	+ 0.96 * *
Plant height and Plant weight	+ 0.87 * *
Root weight and Nodule weight	+ 0.99 * *
Nodule weight and Nodule nitrogen	+ 0.97 * *
Test weight and Grain yield	+ 0.99 * *

** - significant at P=0.01

REFERENCES

Bhriguvanshi, S.R. (1988). Long term effect of high doss of farm yard manure on soil properties and crop yield. J. Indian Soc. Soil. Sci., **36** : 784-786.

Gaur, A.C. (1990). Phosphate solubilizing microorganisms. Omega Scientific Publisher, New Delhi.

Jansson, R.L. (1972). Sewage sludge in Swedish Agriculture. Soil and Fertilizer. **35** : 528-529.

Peoples, M.B. and Craswell, E.T. (1992). Biological nitrogen fixation : Investment, expectations and contribution to agriculture. Plant and Soil, **141** : 13-39.

Sanoria, C.L. and Rani, R. (1998). Role of PSM, manure, sludge and pyrites on effectiveness of *Bradyrhizobium* strains towards yield and NPK contents of soysbean. *Indian J. of Agricultural Chemistry*, **31**(1) : 41-45.

Stranchman, S.D., Nelson, D.H. and Somar, S.L. (1983). Sewage sludge components extractable with monoequous solvents. *J. Environ. Qual.*, **12** : 69-74.

Wallinga, I.,Vanmark, W. Houba, V.J.G. and Vender Lee, J.J. (1989). Soil and plant analysis. Plant Analysis procedures, Part. 7, Published by Department of Soil Sci. & Pl. Nutri; Wageningen Agri. Univ. The Netherlands.