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Short Communication

RESPONSE OF SUMMER MUNGBEAN TO PHOSPHORUS AND BIOFERTILIZERS IN EASTERN UTTAR PRADESH

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Mungbean (*Vigna radiata* L.) is one of the most important legume crops. It enhances the soil fertility through nitrogen fixation with the help of symbiotic microbial association. The productivity of mungbean in Uttar Pradesh was 577 kg ha^{-1} in 2010-11 (Anonymous, 2011). The productivity of mungbean of the country as well as state is very low as compared to other countries. Mungbean is capable of fixing atmospheric nitrogen through *Rhizobium* species living in root nodules, *Rhizobium* spp. invades the root hairs of mungbean and results in the formation of nodules, where free air nitrogen is fixed. These bacteria, although present in most of the soils help to improve nodulation, N_2-fixation solicit crop growth and yield of leguminous crops**.** *Rhizobium* inoculation has been provided as a cheapest source of nitrogen fertilizer input for better crop yield particularly in legumes. Phosphorus plays a vital functional role in energy transfer and metabolic regulation and it is an important structural component of many molecules. Application of P along with *Rhizobium* inoculants has been reported to influence nodulation, N_2 fixation, and specific nodule activity (Zahran, 2000, Rana *et al* 2011). On the other hand, P fertilization usually result in enhanced nodule number and mass, as well as greater N_2 fixation activity per plant (Seraj and Gyamfi, 2004) as nodules is strong sink for P, reaching concentrations.Both phosphorus status and P-fixing capacity of soil strongly influences the phosphorus availability. Phosphorus solubilizing bacteria (PSB) has been proved as the cheapest source of phosphorus particularly in legumes that enhance the availability of phosphorus and productivity of crops (Tagore *et al.* 2013). The ability of phosphorus solublizing bacteria (PSB) to convert insoluble forms of phosphorus to an accessible form is an important trait in sustainable farming for increasing plant yields. However, meager information is available on the sole and combined effect of *Rhizobium* and phosphorus in summer mungbean under agro-ecological conditions of Uttar Pradesh for maintaining higher productivity and soil fertility. Thus keeping the importance of *Rhizobium*, PSB and phosphorus, the present study was designed to evaluate the effect of *Rhizobium* inoculation alone and in combination with PSB and phosphorus on mungbean production.

The field experiment was conducted during *summer* season, 2012 at Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). The twelve treatment combinations comprised with three levels of phosphorus (0, 20 and 40 kg ha^{-1}) and biofertilizers (*Rhizobium* and PSB with and without) in randomized block design replicated as thrice. The variety Narendra Munng-1 was taken as a test crop. The soil had pH (1:2.5) 8.2, EC 0.36 dSm^{-1}, organic carbon 2.9 g kg^{-1}, available N 145, P_2O_5 17 and K_2O 214 kg ha^{-1}. The uniform recommended doses (20 kgN and 40 kg K_2O ha^{-1}) were applied through urea and Muriate of potash respectively. The phosphorus was applied as basal through single super phosphate. The strain of *Rhizobium* specific to mung bean was applied as seed treatment using 200 g for 10 kg seed.

The data (Table 1) revealed that the yield attributes increased with the inoculation of *Rhizobium* and PSB along with increasing levels of P up to 40 kg P_2O_5 ha^{-1}. The maximum plant height (64.85 cm), numbers of branches (8.12), pods $plant^{-1}$ (46.93), grain $plant^{-1}$ (11.85) were recorded with inoculation of *Rhizobium* and PSB + 40 kg P_2O_5 ha^{-1} followed by *Rhizobium* + 40 kg P_2O_5 ha^{-1} and minimum values in control. The significant higher yield of grain (13.50 q ha^{-1}) and straw (42.90 q ha^{-1}) were obtained with *Rhizobium* and PSB inoculation along with 40 kg P_2O_5 ha^{-1} over with and without inoculation of *Rhizobium* and PSB along with rest lower levels of phosphorus. This might be due to synergistic effect of the two types of microorganisms for biological nitrogen fixation and better availability of phosphorus that resulted in increased growth, yield attributes and yields as against their individual application. The results are in line with the findings of Bhat *et al.* (2005), Vikram *et al.* (2008), Rana *et al* 2011 and Tagore *et al.* (2013). The maximum value of harvest index (23.9 %) was recorded with the inoculation of *Rhizobium* and PSB

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Table 1: Effect of biofertilizers and phosphorus on growth, yield attributes, yield and economics of summer mung bean

Treatments	Plant height (cm)	Branches plant^{-1}	Pods plant^{-1}	Grains pod^{-1}	Test weight (g)	Grain yield (qha^{-1})	Straw yield (qha^{-1})	Harvest index (%)	Gross return (₹. ha$^{-1)}$	Net return (₹. ha$^{-1)}$	B:C ratio
Control	49.0	5.6	35.1	7.13	28.4	8.10	26.58	23.3	31286.4	16008.4	1.04
R_0 B_1 P_0	52.8	4.3	37.2	8.85	29.1	9.38	30.25	23.7	36188.0	19830.0	1.21
R_0 B_0 P_{20}	54.1	6.3	38.2	9.17	30.4	9.70	31.23	23.9	37418.4	22060.4	1.43
R_0 B_1 P_{20}	58.1	6.8	44.0	9.49	32.9	10.98	35.69	23.5	42383.2	25677.2	1.53
R_0 B_0 P_{40}	59.4	7.0	44.4	9.68	33.3	11.26	36.59	23.5	42663.2	26225.2	1.59
R_0 B_1 P_{40}	56.0	6.5	42.2	9.30	31.9	10.35	33.43	23.6	39934.4	21800.4	1.20
R_1 B_0 P_0	55.8	6.4	40.9	9.23	31.2	10.08	32.66	23.6	38900.8	21114.8	1.18
R_1 B_1 P_0	57.0	6.8	43.0	9.30	32.3	10.80	34.56	23.8	41644.8	22430.8	1.16
R_1 B_0 P_{20}	60.3	7.2	44.95	9.96	33.4	11.28	37.49	23.1	43319.2	26533.2	1.58
R_1 B_1 P_{20}	62.1	7.7	45.52	10.69	35.2	12.60	40.50	23.7	48608.0	30394.0	1.66
R_1 B_0 P_{40}	63.4	7.4	45.12	10.23	34.1	12.00	38.79	23.6	46303.2	28437.2	1.59
R_1 B_1 P_{40}	64.8	8.1	46.93	11.85	36.7	13.50	42.90	23.9	52032.0	32738.0	1.69
SEm±	1.75	0.22	1.29	0.32	0.98	0.33	1.18	0.71			
C.D (P 0.05)	5.15	0.66	3.77	0.95	2.88	0.97	3.4	2.08			

along with 40 kg P_2O_5 ha^{-1} followed by inoculation with *Rhizobium* + 40 kg P_2O_5 ha^{-1}. This might be due to partitioning of dry matter towards sink. These results corroborated with the findings of Prasad *et al.* (2014). The data (Table 2) revealed that the maximum net return of ₹. 32738 ha^{-1} and cost benefit ratio (1.69) were obtained with inoculation of *Rhizobium* and PSB along with phosphorus 40 kg P_2O_5 ha^{-1} followed by *Rhizobium* + PSB + 20 kg P_2O_5 ha^{-1} and minimum net return of ₹. 16000.40 ha^{-1} and cost benefit ratio (1.04) were received with control. The similar findings were reported by Kumawat and Kumawat (2009).

On the basis of results, it may be concluded that the growth and yield of mungbean was obtained with inoculation of *Rhizobium* and PSB along with 40 kg P_2O_5 ha^{-1} which was statistically at par with *Rhizobium* and PSB along with 20 kg P_2O_5 ha^{-1}. Hence, inoculation of *Rhizobium* and PSB along with 20 kg P_2O_5 ha^{-1} may be recommended for better performance as well as economics.

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