Annals of Plant and Soil Research 15(2): 164-166 (2013)
Short communication

EFFECT OF *RHIZOBIUM*, PSB AND PHOSPHORUS ON YIELD AND ECONOMICS OF MUNGBEAN

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Received: September, 2012, Revised accepted; June, 2013

Mungbean [*Vigna radiata* (L.) Wilczek] is an important pulse crop after chickpea and pigeonpea. Pulses are wonderful gifts of nature, because of their ability of biological nitrogen fixation (15 - 35 kg/ ha), deep root system, mobilization of insoluble soil nutrients and bringing qualitative changes in soil physical properties, they are known as soil restorers. Mungbean is an excellent source of protein (24.5%) with high quality lysine (460 mg/g N) and tryptophan (60 mg/g N). It contains fairly good amount of ascorbic acid (4.8 mg /100 g), riboflavin (0.21 mg/100g) and minerals (3.84 g/100g) when sprouted (Gopalan *et al.*, 1995). Therefore, pulses have emerged as a viable option to improve soil health, conserve natural resources and sustain the agricultural productivity. In view of increased cost of fertilizers and present energy crisis, the current emphasis is on integrated use of different sources of plant nutrients such as organic manure and biofertilizers in combination with chemical fertilizers. Biofertilizers play an important role in nutrient supply to crops in a more eco-friendly and sustainable manner. Inoculation of seeds with *Rhizobium* culture is a very low cost method of nitrogen fertilization in legume and increasing availability of nitrogen by biological fixation of atmospheric nitrogen. Phosphate solubilizing microorganisms convert the insoluble hosphates into soluble forms by acidification, chelation, exchange reactions and production of gluconic acid (Gupta, 2006). The chemical fertilizers, no doubt, are important source, which can meet the nutrient requirement, but their imbalance and continuous use has led to environmental pollution and deterioration of soil health. Further, availability of fertilizer at economic prices is another problem for semi arid and arid region farmers. Under these circumstances, a system comprising balanced use of fertilizer alongwith low cost biofertilizer needs to be evolved. Hence, the present investigation was carried out to study the response of *Rhizobium*, PSB and phosphorus fertilization on yield and economics of mungbean.

The field experiment was conducted during *Kharif* season of 2009 at farm of Agricultural Research Station, Swami Keshwanand Rajasthan Agricultural University Bikaner situated under Hyper Arid Partially Irrigated North-Western Plain Zone of Rajasthan (Ic). The soil of experimental field was sandy loam in texture, alkaline in reaction (pH 8.3), having low organic carbon (0.8 g kg^{-1}) with low available nitrogen (125 kg ha^{-1}), low available phosphorus (18 kg ha^{-1}) and medium in potassium (215 kg ha^{-1}). The experiment consisted of 12 treatments i.e. Control, 20 kg P_2O_5 ha^{-1}, 40 kg $P_2O_5 ha^{-1}$, *Rhizobium*, Phosphorus solubilizing bactria, *Rhizobium* + PSB, 20 kg P_2O_5 ha^{-1} + *Rhizobium*, 20 kg P_2O_5 ha^{-1} + PSB, 20 kg P_2O_5 ha^{-1} + *Rhizobium* + PSB, 40kg P_2O_5 ha^{-1} + *Rhizobium*, 40 kg P_2O_5 ha^{-1} + PSB and 40 kg P_2O_5 ha^{-1} + *Rhizobium* + PSB, were laid out in randomized block design with 3 replications. Mungbean "RMG-268" was sown with the onset of monsoon at 15 July, at a row-to-row and plant to plant spacing 30 cm x 10 cm with a seed rate of 20 kg ha^{-1}. The recommended dose of fertilizes applied were 20 kg N and phosphorus as per treatments was drilled manually through urea and single superphosphate, and seed treatment with *Rhizobium* and in marked plots. The crop was raised with recommended package of practices.Yield attributes and yield of grain and straw was recorded at harvest. The economics was calculated considering the prevailing market prices.

Application of 40 kg P_2O_5 ha^{-1} with dual inoculation of biofertilizers registered highest seed yield (Table 1). Application of 40 kg P_2O_5 ha^{-1} + *Rhizobium* + PSB registered 66.3, 9.5 and 8.6% and 61.4, 5.0, 10.4 and 6.1 % higher seed and straw yield over control, 20 kg P_2O_5 ha^{-1} + *Rhizobium*, 20 kg P_2O_5 ha^{-1} + PSB, respectively. Difference among 40 kg P_2O_5 ha^{-1} + *Rhizobium* + PSB, 20 kg P_2O_5 ha^{-1} + *Rhizobium* + PSB and 40 kg P_2O_5 ha^{-1} + PSB was non-significant. This might be due to increased availability of nitrogen and phosphorus leading to better nutritional environment in the root zone for growth and development. Similarly, increased supply of available phosphorus plays an important role in the conservation and transfer of energy in the metabolic reactions of living cells including biological energy

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transformation. Phosphorus not only plays an important role in root development and proliferation but it improves nodule formation and N_2 fixation by supplying assimilates to the roots. The significant increase in yields under the combined application of inorganic fertilizer and bio-organics was largely a function of improved growth and subsequent increase in number of pods/ plant and other yield attributes. The finding of this investigation confirms the result of Rathore *et al.* (2007) Yadav *et al.* (2007) and Vishwakarma *et al.* (2012).

Table 1: Effect of *Rhizobium*, PSB and phosphorus on yield and economics of mungbean

Treatment	Test weight (g)	Yield (kg ha^{-1})		Net returns (Rs ha^{-1})	B/C ratio
		Seed	Straw		
Control	34.4	592	1482	24396	2.82
20 kg P_2O_5 ha^{-1}	35.6	810	1953	37047	3.68
40 kg P_2O_5 ha^{-1}	34.8	879	2111	40981	3.88
Rhizobium	34.4	738	1780	32915	3.45
PSB	35.2	783	1897	35759	3.66
Rhizobium + PSB	35.6	812	1962	37522	3.78
20 kg P_2O_5+ *Rhizobium*	36.1	900	2177	42690	4.08
20 kg P_2O_5+ PSB	35.7	907	2263	43293	4.12
20 kg P_2O_5+ *Rhizobium* + PSB	36.8	978	2319	47473	4.42
40 kg P_2O_5+ *Rhizobium*	37.0	940	2287	44831	4.14
40 kg P_2O_5+ PSB	37.2	964	2335	46282	4.24
40 kg P_2O_5+ *Rhizobium* + PSB	37.7	985	2403	47649	4.33
CD (P = 0.05)	1.4	36.4	139.1	2305	

Application of 40 kg P_2O_5 ha^{-1}with dual inoculation of biofertilizer registered highest test weight. Application of 40 kg P_2O_5 ha^{-1} +*Rhizobium* + PSB remained significantly at par with 20 kg P_2O_5 ha^{-1} + *Rhizobium* + PSB, 40 kg P_2O_5 ha^{-1} +*Rhizobium* and 40 kg P_2O_5 ha^{-1}+PSB. Application of 40 kg P_2O_5 ha^{-1} with dual inoculation of *Rhizobium* + PSB registered 9.5, 4.4 and 5.6% higher test weight over control and 20 kg P_2O_5 ha^{-1} + *Rhizobium* and 20 kg P_2O_5 ha^{-1}+PSB, respectively. During certain phases of development, more assimilate is produced than used in growth and development and the excess is diverted to storage compounds. At later stages in reproductive phase when the current photosynthesis is not able to furnish the increased assimilate demand of plant sinks, the storage compounds probably remobilize and move to active sinks (pods and seeds) which ultimately increased pods and seeds/pod. During leaf senescence also, carbohydrates, nitrogenous compounds, phosphorus, sulphur and other mobile nutrients are remobilized and translocated to current plant sinks *i.e.* seeds which are very close to the source resulting into higher test weight due to bold grain formation. These results are also in cognizance with those of Kumar and Kushwaha (2006) and Kumawat *et al.* (2009).

Application of 40 kg P_2O_5 with dual inoculation of biofertilizers registered highest net return. Difference among 20 kg P_2O_5 + Rhizobium + PSB and 40 kg P_2O_5 ha^{-1} + Rhizobium + PSB was non significant. Application of 40 kg P_2O_5 ha^{-1} +Rhizobium + PSB registered Rs 23253, Rs 2818, Rs 1367, Rs 4958, and Rs 4355 ha^{-1} higher net return over control ,40 kg P_2O_5 ha^{-1} + *Rhizobium*, 40 kg P_2O_5 ha^{-1}+PSB , 20 kg P_2O_5 ha^{-1}+*Rhizobium* and 20 kg P_2O_5 ha^{-1} + PSB, respectively (Table 1). The cost of phosphorus through single superphosphate and bio fertilizers is very low (Rs 18.75 per kg P_2O_5 and Rs 10.0 per packet for *Rhizobium* or PSB) in comparison to the added output, application of 20 kg P_2O_5 ha^{-1} +*Rhizobium* + PSB was found profitable over control and 40 kg P_2O_5 ha^{-1} + *Rhizobium* + PSB, therefore 20kg P_2O_5 ha^{-1} + *Rhizobium* + PSB led to the maximum net returns with B: C ratio of 4.42 **(**Table 1). Thus, there was a net saving of 20 kg P_2O_5 ha^{-1} as a consequence of *Rhizobium* + PSB inoculation without sacrificing the crop yield. Application of 20 kg P_2O_5 ha^{-1} + *Rhizobium* + PSB enhanced the nutrient availability in soil for plant use resulted in increased number of growth and yield attributes ultimately led to higher seed yield which increased the net returns of Rs 23077 ha^{-1} over control with a B:C ratio of 4.42. Similar result was also obtained by Sharma *et al.* (2006) Khatkar *et al.* (2007).

The above results indicate that the maximum yield of mungbean could be achived with the application of 40 kg P_2O_5 ha^{-1} with rhizobium and PSB. This treatment also improved the quality and uptake of nutrients by the crop.

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