Research Article

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Yield, Economics and Soil Health of Mungbean as Influenced by Organic Manures and Phosphorus Levels

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The field experiment was conducted during rainy season on sandy loam soil to study the effect of organic manures, Phosphorus Solubilizing Bacteria (PSB) and levels of phosphorus on yield, economics and soil fertility of mungbean under rainfed condition. Results revealed that application of vermicompost @ 2 t/ha produced highest biological yield (24.33 q/ha), gross returns (Rs. 22657/ha) which was significantly superior to Farm Yard Manure (FYM) @ 4 t/ha and control. Whereas the higher B:C ratio, organic carbon, available N and P were recorded in FYM @ 4 t/ha which was comparable with vermicompost @ 2 t/ha. Seed inoculation with PSB significantly increased the biological yield (22.95 q/ha), gross returns (Rs. 20807/ha), B:C ratio (1.59) available N (137.51 kg/ha) and P (18.70 kg/ha) as compared to control. Similarly, the highest biological yield (24.33 q/ha), gross returns (Rs. 22527/ha), B:C ratio (1.69), organic carbon (0.166%), available N (139.87 kg/ha) and P (19.59 kg/ha) were recorded with the application 40 kg P_2O_5/ha of which was significantly superior to 20 kg P_2O_5/ha and control (0.0 kg/ha).

Introduction

Mungbean [*Vigna radiata* (L.) Wilczek.] is one of the important pulse crops grown in the arid and semi-arid regions of our country (Kumawat et al. 2009a). It is a short duration kharif pulse crop which can be grown as catch crop between rabi and kharif seasons. During summer, it can also be used as a green manure crop. Being a leguminous crop, it has the capacity to fix atmospheric nitrogen. Its green plants are used as fodder after removing the mature pods. Mungbean is an excellent source of protein (25%) with high quantity of lysine (4600 mg/N) and tryptophan (60 mg/N) and consumed as whole grain as well as dal in variety of ways for table purposes.

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 physico-chemical properties of the soil. Furthermore, availability of fertilizer at economic prices is another problem for the farmers. Under these circumstances, a system comprising balanced use of fertilizer along with multi-nutrient organic manures and low cost

biofertilizer needs to be evolved. Hence, efficient use of phosphatic fertilizers along with organic manures and PSB helps in enhancing the production, productivity and restore the soil fertility. Therefore, it was considered important to find out judicious combinations of phosphatic fertilizers (SSP) along with organic manure and PSB to boost up the productivity of mungbean by modifying the growth pattern and nutrient uptake of mungbean (Kumawat et al., 2009b). Keeping the above facts in view, the present investigation was planned and carried out during kharif 2005 at Research Farm of Sri Karan Narendra (SKN) College of Agriculture, Jobner to assess the effect of organic manures, PSB and phosphorus on yield, economics and chemical properties of rainfed mungbean.

Materials and Methods

The field experiment was carried out at research farm of Sri Karan Narendra (SKN) College of Agriculture, Jobner, Rajasthan Agricultural University (RAU), Bikaner on sandy loam soil with pH 8.2 and containing low in organic carbon (0.16%), available nitrogen (130 kg/ha), phosphorus (17.9 kg/ha) and medium in available potassium (150 kg/ha). The treatments consisted of factorial combinations of three organic manures (control, FYM 4 t/ha and vermicompost 2 t/ha), two levels of PSB (no inoculation and with incoulation) and three levels of P (0, 20 and 40 kg/ha) arranged in factorial randomized block design with three replications. The healthy seeds were inoculated with liquid culture of PSB (*Bacillus polymyxa*), 2 hours before sowing using 10% jaggery solution. All the doses of phosphatic fertilizers through Single Super Phosphate (SSP) were applied as basal organic manures (FYM and vermicompost) were applied as applied as per treatments 15 days prior to sowing of crop. Other cultural operations were done following package and practices of crop. The biological yield was recorded after complete sun drying, picked pods and harvested bundles of each net plot were weighed for biological yield and converted in terms of q/ha. Gross return was calculated on the basis of produce received under each treatment was multiplied with the prevailing market price of seed and straw. The cost of cultivation for each treatment was subtracted from the gross returns and net returns were worked out accordingly. The statistical analysis of data pertaining to growth, yield and quality characters was done by standard statistical methods of analysis of variance as described by Gomez and Gomez (1984).

Results and Discussion

A perusal of data (Table 1) revealed that application of organic manures (FYM and vermicompost), PSB and phosphorus significantly increased the biological yield of mungbean over control. Application of vermicompost enhanced the biological yield by 4.72 and 1.91 q/ha over control and FYM, respectively. The corresponding increase in terms of percentage was 24.07 and 8.52. This may be attributed primarily to the beneficial effect of organic manures on overall physical properties of the soil. Better growth and development in the above treatments might be due to increased availability of primary and secondary nutrients to the plant for a longer period. Similar findings were also reported by Kumawat et al. (2009a, 2009c) and Meena et al. (2014). The maximum gross return (Rs 22657/ha) was recorded with the application of vermicompost @ 2 t/ha followed by FYM @ 4 t/ha. Higher B:C ratio (1.64) was recorded under FYM @ 4 t/ha followed in control and lowest was in vermicompost. Chemical properties of soil i.e. organic carbon, available N and P were significantly influenced by organic manures. Higher organic carbon (0.172%), available N (136.73 kg/ha) and available P (18.91 kg/ha) were recorded with the application of FYM @ 4 t/ha which was par at par with vermicompost @ 2 t/ha. This may be ascribed to the beneficial role of organic manures (vermicompost and FYM) in mineralization of native as well as applied nutrients in addition to their own nutrient content

which increased the available nutrient pool of the soil. As a matter of fact, all the available nutrients were not taken up by the plants and rest remained in the soil which improved available nutrient status of soil after harvest. Higher value of available N in FYM treated plots might be due to its slow mineralization as compared to vermicompost. Similar observations were also made by Rajkhowa et al. (2003).

Table 1: Effect of organic manures, PSB and phosphorus fertilization on biological yield, economics and chemical properties of soil in mungbean crop

Treatments	Biological Yield (q/ha)	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	B:C ratio	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)
Organic manures							
Control	19.61	6648	16963	1.54	0.150	131.93	16.28
FYM 4 t/ha	22.42	7856	20765	1.64	0.172	138.92	18.91
Vermicompost 2 t/ha	24.33	9778	22657	1.31	0.164	136.73	18.21
SEm ±	0.59	-	543	0.04	0.003	1.37	0.33
CD (P=0.05)	1.71	-	1562	0.12	0.09	3.94	0.95
PSB							
No inoculation	21.29	8090	19450	1.41	0.161	133.96	16.90
Inoculation	22.95	8097	20807	1.59	0.163	137.51	18.70
SEm ±	0.49	-	444	0.03	0.003	1.12	0.27
CD (P=0.05)	1.40	-	1275	0.09	NS	3.22	0.78
Phosphorus (P_2O_5 kg/ha)							
0	19.73	7728	17612	1.28	0.157	131.37	15.90
20	22.31	8108	20246	1.52	0.163	135.75	17.91
40	24.33	8446	22527	1.69	0.166	139.87	19.59
SEm ±	0.59	-	543	0.04	0.003	1.37	0.33
CD (P=0.05)	1.71	-	1562	0.12	0.157	3.94	0.95

Further data presented in table 1 revealed that there was significant influence of seed inoculation on biological yield over without inoculation treatment with the quantum increase of 1.66 q/ha. The respective enhancement in terms of per cent was 7.80. PSB might have improved available phosphorus in rhizosphere as phosphorus solubilizers. Thus, the increased availability of phosphors due to PSB might have opened the door for increased utilization of others nutrient and resulted in more increase in growth and yields of mungbean. Similar findings were also reported by Verma et al. (2017).

Further data showed that seed inoculation with PSB gave higher gross return (Rs. 20807/ha) and lower in no seed inoculation. Chemical properties of soil (organic carbon, available N and P) were influenced by seed inoculation with PSB. Significantly higher available N (137.51 kg/ha) and P (18.70 kg/ha) were recorded in the seed inoculation treatments. Similarly application of 40 kg P_2O_5/ha increased the biological yield over control and 20 kg P_2O_5/ha was 23.31 and 9.05 per cent, respectively which amounted to 4.60 and 2.02 q/ha. Probably, this effect of phosphorus on partitioning was also responsible in part for the insufficient photosynthate supply to the nodulated roots of legumes grown on phosphorus deficient soils. Phosphorus deficiency limits N fixation mainly by reducing the growth of host plant. Thus, application of phosphorus might have resulted in increased carbohydrate accumulation and their remobilization

to reproductive parts of the plant, being the closest sink and hence, resulted in increased flowering, fruiting and seed formation (Nadeem et al., 2004) and Verma et al., (2017b).

Application of 40 kg P_2O_5/ha gave maximum gross returns (Rs. 22527/ha) followed by 20 kg P_2O_5/ha and lowest in control plot. Soil health parameters (organic carbon, available N and P) were significantly affected due to application of phosphorus. The highest available N (139.87 kg/ha) and P (19.59 kg/ha) were recorded by application of 40 kg P_2O_5/ha followed by 20 kg P_2O_5/ha and lowest in control plot. It might be due to the beneficial effect of phosphorus on root growth and development and nodulation of mungbean which led to more N_2-fixation and thus after harvest of crop, N depletion under phosphorus treatment was low as compared to control. These findings are in close conformity with those of Balai (2002) in cowpea and Kumawat et al. (2010) in mungbean.

Conclusion

Application of vermicompost @ 2 t/ha, seed inoculation with PSB and 40 kg P_2O_5/ha can be used for enhanced yield, improved soil fertility and higher economic returns from mungbean crop under rainfed conditions of Rajasthan.

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