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Response of Organic Manures, PSB and Phosphorus Fertilization on Growth and Yield of Mungbean

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Abstract

A field experiment was conducted during rainy seasons (*kharif*) of 2005 and 2006 to study the effect of organic manures, PSB and phosphorus fertilization on growth and yield of *kharif* mungbean. The results revealed that application of organic manures, PSB and phosphorus fertilization markedly influenced the growth and yield of mungbean. Results showed that application of vermicompost, seed inoculation with PSB and 40 kg P_2O_5 /ha significantly increased the growth attributes i.e. plant height, number of branches/plant, dry matter accumulation/meter row length, chlorophyll content, effective nodules, dry weight of nodules/plant, total nodules and finally seed yield (8.09 q/ha) of mungbean.
Key words : Organic manures, PSB, Phosphorus fertilization, Dry matter accumulation, Seed yield.

Mungbean is widely adopted and acclimatized pulse crop cultivated over a wide range of agro-climatic zones of the country. Rajasthan is one of the major mungbean growing states covering an area of 3.0 million hectares with an annual production 1.3 million tones (1). This crop is grown in all seasons, however, maximum area is under the *kharif* crop. Its growth is adversely affected due to unfavorable climatic and edaphic factors. 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. Since information on these aspects is scanty under the agro-climatic condition of Rajasthan, an attempt was made to study the effect the organic manures, PSB and phosphorus fertilization on growth and yield of *kharif* mungbean.

Methods

The field experiment was conducted on mungbean during two consecutive *kharif* seasons of 2005 and 2006 at research farm of S.K.N. College of Agriculture, Jobner, 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 experiment were laid out in randomized block design with three replications, treatments considering three levels of organic manures (control, vermicompost at 2t/ha and FYM at 4t/ha), two levels of PSB (no inoculation and with inoculation) and three levels of phosphorus (0,20 and 40 kg/ha). The healthy seeds were inoculated with liquid culture of PSB (*Bacillus polymyxa*), 2 hours before sowing using 10% gur solution. All the doses of phosphatic fertilizers through SSP were applied as basal. Other cultural operations were done following recommendation and crop requirements.

Results and Discussion

Effect of Organic Manures

Application of organic manures significantly increased the growth attributes i.e. plant height, number of branches/plant, dry matter accumulation/meter

Table 1. Growth and yield of mungbean as affected by organic manures, PSB and phosphorus fertilization (mean data of two years).

Treatments	Plant height (cm) 25 DAS	Plant height (cm) 50 DAS	Plant height (cm) At harvest	Number of branches/plant 50 DAS	Number of branches/plant At harvest	Dry matter accumulation/ meter row length (g) 25 DAS	Dry matter accumulation/ meter row length (g) 50 DAS	Dry matter accumulation/ meter row length (g) At harvest
Organic Manures								
Control	11.47	32.84	38.07	3.67	4.22	3.21	32.18	70.01
FYM 4 t/ha	11.60	36.35	40.38	4.08	4.60	3.26	35.42	74.56
Vermicompost 2 t/ha	11.62	38.03	42.87	4.44	4.92	3.32	38.30	78.59
SE ±	0.25	0.57	0.69	0.11	0.10	0.07	0.86	1.30
CD (*P* =0.05)	NS	1.65	1.98	0.31	0.28	NS	2.48	3.75
PSB								
No inoculation	11.48	34.34	39.38	3.89	4.42	3.24	33.90	72.72
Inoculation	11.64	37.13	41.50	4.24	4.73	3.29	36.71	76.36
SE ±	0.21	0.47	0.56	0.09	0.08	0.06	0.70	1.06
CD (*P* = 0.05)	NS	1.35	1.62	0.26	0.23	NS	2.02	3.06
Phosphorus (P_2O_5 kg/ha)								
0	11.45	32.67	37.37	3.63	4.12	3.19	31.83	69.57
20	11.57	35.93	40.56	4.12	4.67	3.26	35.77	74.90
40	11.67	38.61	43.38	4.47	4.95	3.33	38.31	78.70
SE ±	0.25	0.57	0.69	0.11	0.10	0.07	0.86	1.30
CD (*P* = 0.05)	NS	1.65	1.98	0.31	0.28	NS	2.48	3.75

Table 1. Continued.

Treatments	Chlorophyll content (mg/100g) at 40 DAS	Effective nodules/ plant	Dry weight of nodules/plant (mg/plant)	Total nodules/ plant	Grain yield (q/ha)
Organic Manures					
Control	3.23	26.62	17.78	29.20	5.97
FYM 4 t/ha	3.37	28.64	21.05	31.54	7.41
Vermicompost 2 t/ha	3.56	30.12	21.80	33.15	8.09
SE ±	0.05	0.47	0.25	0.46	0.19
CD (*P* = 0.05)	0.13	1.35	0.72	1.31	0.56
PSB					
No inoculation	3.33	26.13	17.37	17.37	6.92
Inoculation	3.44	30.79	23.04	23.04	7.39
SE ±	0.04	0.38	0.20	0.20	0.16
CD (*P* = 0.05)	0.11	1.10	0.58	0.58	0.45
Phosphorus (P_2O_5 kg/ha)					
0	3.22	26.64	18.45	18.45	6.24
20	3.40	28.61	20.52	20.52	7.19
40	3.54	30.13	21.65	21.65	8.03
SE ±	0.05	0.47	0.25	0.25	0.19
CD (*P* = 0.05)	0.13	1.35	0.72	0.72	0.56

row length, chlorophyll content, effective nodules and dry weight of nodules/plant over no organic manure and higher values of these parameters were recorded with the application of vermicompost which was also significantly superior to FYM (Table 1). This might be due to better soil physical conditions, prolonged availability of major (NPK) and micro-nutrients to crop during the entire growing season. The organic manures play an important role in root development and proliferation, nodules formation and nitrogen fixation by supplying assimilates to the roots. They also increase the CEC, water holding capacity and phosphate availability in soil and thus provide better environment in rhizosphere for growth and development. The superiority of vermicompost over FYM was possibly due to rapid mineralization on account of narrow C : N ratio (11 : 1) compared to 25 : 1 of FYM which enhanced the release of nutrients early in the crop period. Moreover, vermicompost is richer in nutrients as compared to FYM. Such beneficial effects of vermicompost along with better edaphic environment available to the crop might have improved all the growth attributes. Similar results were also obtained by Rajkhowa et al. (2) in mungbean. It is well established that seed yield of a crop is function of yield attributes such as number of pods/plant and seeds/pod. Increase in these yield attributes due to fertilization might have increased grain yield of mungbean.

Effect of PSB

The significant increase in growth parameters i. e. plant height, number of branches/plant, dry matter accumulation/ meter row length, chlorophyll content, effective nodules and dry weight of nodules per plant was observed due to seed inoculation with PSB (Table 1). It might be due to increased amount of available phosphorus in the root zone for the growth and reproduction of plants. Solubilization of phosphorus by phosphate solubilizing bacteria is attributed to excretion of organic acids like glutamic, succinic,lactic, glyoxalic, maleic, fumeric, tartaric, alfa-ketobutyric, from chelates with cations such as Ca^{++} and Fe^{++}, which results in effective solubilization of phosphates (3). In addition to phosphate solubilization, these microbes can mineralize organic phosphorus into a soluble form. These reactions take place in the rhizosphere and because the micro-organisms render more P into soil solubilization than is required for their own growth and metabolism and surplus is available for plants to absord. PSB also produce fungistatic and growth promoting substances, which influence plant growth. In the present investigation, since the available P_2O_5 status of experimental field was low (17.9 kg/ha) and P was applied in the readily available form, the PSB might have helped in reducing the fixation by its chelating effect and also solubilized the unavailable form leading to better growth attributes. The results obtained in present investigation are in line with the findings of Singh and Pareek (4) in mungbean. In the present study, PSB might have helped in reducing P fixation by its effect and also solubilized the unavailable form of P leading to more uptakes of nutrients and reflected in better grain yield. The findings of this investigation are in line with those of Gaind and Gaur (5) and Kumar and Kumar (6) in lentil who reported higher values of yield attributes and yield due to PSB inoculation in different leguminous crops.

Effect of Phosphorus Fertilization

Application of 40 kg P_2O_5/ha significantly increased the growth parameters i. e. plant height, number of branches/plant at 50 DAS and at harvest, dry matter accumulation/meter row length at 50 DAS and at harvest chlorophyll content, effective nodules and dry weight of nodules/plant over control and 20 kg P_2O_5/ha (Table 1). It is obvious that phosphorus has long been considered as an essential constituent of all living organisms, which plays an important role in conservation and transfer of energy in metabolic reactions of living cells including biological energy transformations. Phosphorus not only plays an important role in root development and proliferation but also improves nodulation and N fixation by supplying assimilates to the roots. It is the main constituent of co-enzymes, ATP and ADP which act as "energy currency" within plants. Almost every metabolic reaction of any significance proceeds via phosphate derivatives. Thus, phosphorus influenced photosynthesis, biosynthesis of protein and phospholipids, nucleic acid synthesis, membrane transport and cytoplasmic streaming. Increased availability of phosphorus owing to its application in the soil which was otherwise low in phosphorus content, improved the availability of nutrients, resulting into more uptake of N, P and K by the crop. The greater uptake of nutrients might have increased the photosynthetic and carbohydrate synthesis and then translocation to different parts for promoting meristematic development in potential apical buds and intercalary meristem which ultimately increased root and shoot development in terms of all the growth parameters. These results are in agreement with those of Luikham et al. (7). in greengram. The regulatory functions of phosphorus in photosynthesis and carbohydrate metabolism in leaves can be considered to be one of the major factors limiting plant growth particularly during the reproductive phase. The level of phosphorus during this period regulates starch/sucrose ratio in the source leaves and the reproductive organs (8). Probably , this effect of phosphorus on partitioning is 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 (9).

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