Research Article

Effect of Phosphorus and Bio-inoculants on Yield and Yield Attributes in *Summer* Mungbean(*Vigna radiata* L.) (Wilszeck)

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Abstract

The experiment was conducted in field no. D-5 at Institutional Farm Rajasthan College of Agriculture, Udaipur during *Summer* season of 2015-16. Significantly higher number of seeds per pod and test weight in *Summer* mungbean found significantly higher with application of 40 kg P_2O_5 and PSB + *Aspergillus awamori.* Among interaction of phosphorus and bio-inoculants, application of (40 kg P_2O_5 + PSB + *A. awamori)* recorded significantly higher number of pods per plant, seed yield and straw yield (48.68, 1583kg/ha and 3655kg/ha, respectively) as compared to other treatment combinations and treatment combination 40 kg P_2O_5 + *A. awamori* and 40 kg P_2O_5 + PSB found at par with each other.

Keywords: Mungbean, Bio-inoculants, *A. awamori*, PSB, Yield and Yield Attributes

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Introduction

Pulses play an important role in human life. They are important source of dietary protein and have unique ability of maintaining balance diet. The 68th UN General Assembly declared 2016 as International Year of Pulses (IYP) nutritious food for a sustainable future [1]. On an average 100 grams of pulses contain energy 345 k cal, protein 24.5 g, calcium 140 mg, phosphorus 300 mg, iron 8 mg, thiamin 0.5 mg, riboflavin 0.3 mg and niacin 2 mg [2]. Phosphorus is an important nutrient next to nitrogen. At present 5% of the Indian soils have adequate available P, 49.3% are under low category, 48.8% under medium and 1.9% under high category [3]. Bio-inoculants, a component of integrated nutrient management and are considered to be cost effective, eco-friendly and renewable source of non-bulky, low cost plant nutrient supplementing fertilizers in sustainable agriculture system in India. Therefore, the role of bio-inoculants assumes a special significance in present context of very high costs of chemical fertilizers. The seed of pulses are inoculated with Phosphorus solublizers with an objective of increasing their number in the rhizosphere and substantial increase in the P availability for the plant growth. Keeping these points in view a field experiment entitled "Effect of phosphorus and bio-inoculants on soil fertility and yield of *Summer* mungbean [*Vigna radiata* (L.) Wilczek]" was carried out at MPUAT (Rajasthan) during *Summer* season of 2016.

Material and Methods

The field experiment was conducted under irrigated condition during *Summer* season of 2016. The soil of experimental site was clay loam in texture in field no. D-5 at Instructional Farm Farm Rajasthan College of Agriculture, Udaipur, which is situated at South-Eastern part of Rajasthan at an altitude of 582.17 metre above mean sea level and at 24º 35′ N latitude and 73º 42′ E longitude. The region falls under Agro-climatic Zone IV a (Sub-humid Southern Plain and Aravalli Hills) of Rajasthan. The soil was medium in available nitrogen and phosphorus while high in potassium, and sufficient in DTPA extractable micronutrients.

The experiment consisted 16 treatments combination of four levels of phosphorus *viz.*, control, 20, 40 and 60 kg P_2O_5 ha^{-1} and four treatments of bio-inoculants *viz.*, control, PSB, *Aspergillus awamori* and PSB + *A. awamori* and replicated thrice in randomized block design. Mungbean var. SML-668 was taken as test crop.

The whole quantity of phosphorus was applied through SSP as per treatment details prior to sowing and incorporated manually in top 15 cm of soil. As per treatments, the seeds were inoculated with PSB, *A. awamori* and PSB + *A. awamori* before sowing using standard method and dried in shade [4]. Thereafter, sowing was done in each

marked plots. Five plants in each treatment were randomly selected and tagged with a label for recording various growth and yield parameters.

In order to test the significance of variation in experimental data obtained for various treatment effects, the data were statistically analysed as described by Fisher [5]. The critical differences were calculated to assess the significance of treatment mean wherever the 'F' test was found significant at 5 per cent level of probability. To elucidate the nature and magnitude of treatment effects, summary tables along with SEm ± and CD (P=0.05) were prepared and are given in the text of the chapter "Results" and their analysis of variance are given in appendices at the end.

Results

Yield attributes

Application of @ 40 kg P_2O_5 ha^{-1} significantly increased the number of pods per plant, number of seed per pod and test weight (40.93, 11.84 and 36.71 respectively) as compared to control (24.18, 7.45 and 31.89, respectively) and 20 kg P_2O_5 ha^{-1} (36.23, 9.63 and 34.80, respectively). It was further observed that the application of 60 kg P_2O_5 ha^{-1} was found at par with 40 kg P_2O_5 ha^{-1} **(Table 1)**.

Individual as well as combined inoculation of PSB, *Aspergillus awamori* and PSB + *A. awamori* produced significant effect on number of pods per plant, number of seed per pod and test weight at harvest over no inoculation. Seed inoculation with PSB + *A. awamori* recorded maximum number of pods per plant, number of seed per pod and test weight at harvest and proved its superiority over control, PSB and *A. awamori* inoculation but treatment B_1 and B_2 were at par **(Table 1)**.

Table 1 Effect of phosphorus and bio-inoculants on number of pods per plant, number of seeds per pod, test weight

Treatments	Number of pods/plant	Numbers of seeds/pod	Test Weight (g)
Phosphorus levels			
P_0 (Control)	24.18	7.45	31.89
P_1 (20 kg P_2O_5 ha^{-1})	36.23	9.63	34.80
P_2 (40 kg P_2O_5 ha^{-1})	40.93	11.84	36.71
P_3 (60 kg P_2O_5 ha^{-1})	42.25	12.05	37.29
SEm±	0.86	0.23	0.91
CD (P = 0.05)	2.47	0.65	2.62
Bio-inoculants			
B_0 (Control)	29.25	8.18	32.01
B_1 (PSB)	36.00	10.51	35.60
B_2 (*Aspergillus awamori*)	36.65	10.68	35.68
B_3 (PSB + *A. awamori*)	41.69	11.60	37.39
SEm±	0.86	0.23	0.91
CD (P = 0.05)	2.47	0.65	2.62

Yield

Interaction between phosphorus and bio-inoculants was found to be significant with respect to seed and straw yield (**Table 2**). The treatment combination (40 kg P_2O_5 + PSB + *A. awamori* (P_2B_3) recorded significantly higher seed and straw yield (1583.42 and 3655.13 kg ha^{-1}) of *Summer* mungbean and it was found statistically at par with treatment combination P_1B_3 and P_3B_3.

Table 2 Interactive effect of phosphorus and bio-inoculants on seed and straw yield of *Summer* mungbean

Treatments	Seed yield (kg ha^{-1})				Straw yield (kg ha^{-1})			
	P_0	P_{20}	P_{40}	P_{60}	P_0	P_{20}	P_{40}	P_{60}
B_0	519.36	752.20	912.54	962.74	1199.00	1725.37	1945.82	2054.75
B_1 (PSB)	761.59	1103.03	1338.16	1411.76	1888.60	2768.90	3122.69	3297.50
B_2 (*Aspergillus awamori*)	797.86	1155.56	1401.88	1478.99	1983.96	2908.71	3280.36	3464.00
B_3 (PSB + *A. awamori*)	801.18	1165.00	1583.42	1670.52	1999.00	2988.00	3655.13	3859.75
SEm±	56.81				125.64			
CD (P=0.05)	164.05				362.84			

Discussion

Application of graded levels of phosphorus upto 40 kg P_2O_5 ha^{-1} significantly increased the number of pods per plant, number of seeds per pod, test weight, seed yield and straw yield. It is well known fact that P played a vital role in improving nutritional status of plant through increased photosynthetic activity and N_2 fixation [6]. Significantly highest seed yield of green gram were recorded with treatment 40 kg ha^{-1} over rest of treatments. This might be due to the role of phosphorus on promotion of root growth and there by enhancement in renewable of nitrogen by the crop. The improvement in yield is attributed to increase in root nodulation due to phosphorus application [7]. These results are in agreement with the findings of [8], [9] and [10].

The increase of seed yield may be due to increase in P availability through solubilization of phosphate rich compound. The PSB secrete a number of organic acids which may form chelates resulting in effective solubilization of phosphate, favoured higher nitrogen fixation, dry matter accumulation, rapid growth, higher absorption and utilization of P and other plant nutrients and ultimately positive resultant effect on growth and finely yield attributes [9].

Conclusion

Based on the experimental results, it is concluded that application of 40 kg P_2O_5 ha^{-1} along with double inoculation with PSB and *Aspergillus awamori* gave significantly higher seed yield (1583.4 kg) of *Summer* mungbean than other treatments.

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