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Effect of N, P and Biofertilizers on Growth Attributes and Yields of Mungbean [*Vigna radiata* (L.) Wilczek] under Semi-arid Tract of Central India

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ABSTRACT
The objective of the planned study was to find out the best treatment for enhancing production and productivity of mungbean under semi-arid tract of central India. The experiment was conducted during kharif of 2013-14 at Agriculture Research Farm of Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh. The experiment was laid out in Randomized Block Design (RBD) with three replications and net plot size was 3.0 m^2. The experiment comprised of the eight treatment combinations i.e. control, Rhizobium, PSB, Rhizobium+ PSB, Rhizobium + 20 N/ha, PSB + 60 P_2O_5/ha, Rhizobium+PSB+20 N/ha and Rhizobium+PSB+60 P_2O_5/ha. Results revealed that mostly all the growth attributes (viz., plants height, maximum horizontal plant spread, number of leaves/plant, number of branches/plant, fresh weight and dry weight/plant) were recorded with the application of Rhizobium+PSB+60 P_2O_5/ha at different growth stages of crop. Similarly the highest grain yield (12.35 q/ha) and biological yield (37.42 q/ha) was also obtained under Rhizobium+PSB+60 P_2O_5/ha enhancing by 68.03 and 30.38 per cent higher over control. Therefore, it recommended that to achieving highest production of mungbean crop should be seed inoculated with biofertilizers (Rhizobium+ PSB) along with 60 kg P_2O_5/ha.
Key words: *Rhizobium, PSB, Growth attributes, Phosphorus, Grain yield, Biological yield*

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INTRODUCTION

Mungbean [*Vigna radiata* (L.) Wilczek] is the third most important legume crop after gram and pigeonpea, generally grown in the arid and semiarid regions of country [1]. It is occupies 14 percent of total pulses area and 7 percent of total pulse production in India, with an average national productivity of 363 kg/ha [2]. This crop is grown in all seasons, however, maximum area is under the *kharif* crop but now due to awareness area increasing under summer mungbean. During summer, it is also used as a green manure crop in the some part of the country. It has premier place for its excellent protein quality and high digestibility. It also contains high quality of lysine (4600 mg/ g N) and tryptophan (60 mg/ g N) and consumed as whole grain or as well as in the form of Dal for table purposes. The sprouted seeds of mungbean are rich in ascorbic acid (vitamin C), riboflavin and thiamine [3].

Fertilizer is the single most important input in modern agriculture for raising crop productivity and production. Though nitrogen requirement of legume is low as compared to phosphorus, but both are equally important exploiting the genetic potential of crop. Nitrogen and phosphorus alone or in combination play a remarkable role in increasing yield and improving the quality of mungbean [4]. Nitrogen is an essential constituent of protein and chlorophyll and is present in many other compounds helps in plant metabolism. Phosphorus is an essential constituent of nucleic acids and stimulates root growth as well as increase nodule activity in plant. The seed of pulses is inoculated with *Rhizobium* with an objective of increasing their number in the rhizosphere, so that there is substantial increase in the

microbiologically fixed nitrogen for the plant growth. The inoculation of seeds with suitable *Rhizobium* and PSB culture increased the green pod yield over un-inoculated control [5]. It has been estimated that inoculation with effective *Rhizobium* strain improved mungbean yield to the extent of 13-33 per cent [6]. Similarly, seed inoculation with PSB plays an important role in supplementing phosphorus requirement of crops. PSB bring more amount of fixed unavailable native P_2O_5 into soluble and available from by producing organic acids. To reduce the production cost and to fulfill the demand, more pulse production could be achieved through seed inoculation with *Bradyrhizobium* strains which is known to increase biological nitrogen fixation. *Bradyrhizobium* inoculation increased mungbean seed yield from 4.3% to 16.2% [7]. In Bangladesh, inoculation with *Bradyrhizobium* increased 25% dry matter production, 28% grain yield and 21% hay yield over non-inoculated [8]. Keeping all these facts in view, the present study was planned to find out the effect of biofertilizers (*Rhizobium* and PSB), nitrogen and phosphorus levels on growth attributes and yields of mungbean.

MATERIALS AND METHODS

The field experiment was carried out during *kharif* season of 2013-14 at Agriculture Research Farm of Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh. The research farm situated at $25^0.27$" N latitude and $78^0.35$ E longitude at an altitude of 271 meters above the mean sea level. The soil of the experimental plot was sandy loam in texture, neutral in reaction (pH 7.4), low in organic carbon (0.48%), low available nitrogen (212.0 kg/ha), medium available phosphorus (14.0 kg P_2O_5/ha) and medium in potassium (185.0 kg K_2O/ha). The experiment was laid out in Randomized Block Design (RBD) with three replications and net plot size was 3.0 m^2. The experiment comprised of the eight treatment combinations i.e. control, *Rhizobium*, PSB, *Rhizobium*+ PSB, *Rhizobium* + 20 N/ha, PSB + 60 P_2O_5/ha, *Rhizobium*+PSB+20 N/ha and *Rhizobium*+PSB+60 P_2O_5/ha. After preparation of field, sowing of the seed of mungbean @ 25 kg/ha was done keeping 30 cm distance from row to row and maintained 10 cm from plant to plant. Seed treated with thiram @ 2.5 g/kg seed and inoculated as per technical programme were sown in furrows behind small hand driven country plough. Thinning of plants ensured proper spacing. The mungbean cv. 'Pant Mung-5' was sown on 30th July, 2013 and harvested on 08th October, 2013. Other cultural operations were done following recommendation and crop requirements. Data on growth attributes i.e. plant height, horizontal plant spread, number of branches/plant, number of leaves/plant fresh weight/plant and dry weight/plant were recorded at different crop growth stages. After harvesting of crop, threshing and winnowing done and weight of seeds for each net plot area was recorded in kg/plot and then converted to q/ha. All the data obtained from trail was statistically analyzed using the F-test [9]. Critical difference (CD) values at P=0.05 were used for determine the significance of differences between mean values of treatments.

RESULT AND DISCUSSION

Results presented in table 1 showed that plant height, horizontal plant spread, number of branches/plant, number of leaves/plant fresh weight/plant and dry weight/plant varied significantly due to application of nutrient management treatments. Among the nutrient management treatments, application of *Rhizobium*+PSB+20 N/ha produced taller plants at 30 and 60 DAS, however at maturity the taller plants were recorded in *Rhizobium*+PSB+60 P_2O_5/ha. Difference between *Rhizobium*+PSB+20 N/ha and *Rhizobium*+PSB+60 P_2O_5/ha was at par at 30 DAS and 60 DAS. Similarly, maximum horizontal plant spread (32.08, 51.10 and 52.10 cm) was recorded with the application of *Rhizobium*+PSB+P_{60} and it was statistically similar to *Rhizobium*+PSB+20 N/ha and significantly superior to rest of treatments at all the growth stages of crop. Further data reveals that maximum number of leaves/plant (9.10, 27.06 and 28.10) was recorded under *Rhizobium*+PSB+60 P_2O_5/ha which was comparable to *Rhizobium*+PSB+20 N/ha at all the stages of crop growth, respectively. Whereas, higher number of branches/plant (8.38, 8.04 and 7.28) were recorded in *Rhizobium*+PSB+20 N/ha but it was at par with *Rhizobium*+PSB+60 P_2O_5/ha and *Rhizobium* + PSB these treatments significantly superior to rest of the treatments. Among the nutrient management treatments, application of *Rhizobium*+PSB+20 N/ha and *Rhizobium*+PSB+60 P_2O_5/ha also produced highest fresh weight (25.62 and 24.68 g/plant, respectively) both treatments were at par to each other at all the growth stage of crop and significantly better than remaining treatments. Similarly, highest dry weight (5.06, 11.55 and 15.22 g/plant at 30 DAS, 60 DAS and at maturity, respectively) was recorded with the application of *Rhizobium*+PSB+60 P_2O_5/ha. Seed and biological yield of mungbean as influenced y different nutrient management treatment. This can be justifies that nitrogen and phosphorus can increase factors such as root growth, increased leaf area, increasing the number of leaves and at last vegetative growth and uses of environmental factors would be better, because the plant is growing well and fast. Overall improvements in the crop growth under the influence of microbial fertilization i.e.

Rhizobium, PSB alone and *Rhizobium* +PSB along with nitrogen and phosphorus seems to be on account of their impact on nutritional environment and involvement in various physiological process in the plant system which are considered to be presence of better nutritional environment in rhizosphere. Significant improvement of various growth components due to nitrogen, phosphorus and biofertilizers have closed conformity with the findings of Kumawat *et al*. [10], Kumawat *et al*., [11], Singh *et al*. [3], Bhanwariya *et al*. [12] and Rinku *et al*. [13],

The highest seed yield of 12.35 (q/ha) was obtained under *Rhizobium*+PSB+60 P_2O_5/ha and significantly superior over remaining treatments. The quantum difference in seed yield was 5.0 q/ha which in terms of percentage was 68.03. Similarly, application of *Rhizobium*+PSB+60 P_2O_5/ha gave highest biological yield but statistically at par to each other treatment except control and *Rhizobium* alone. The quantum of increase in biological yield due to this treatment (*Rhizobium*+PSB+60 P_2O_5/ha) over control 8.72 q/ha, respectively and corresponding increase in terms of percentage was 30.38. It could be due to inter relationship between seed yield and various growth and yield attributing characters, which validated strong dependence of crop productivity on vegetative and reproductive growth of crops. It is on account of its direct influence on dry matter production, while indirect influence seems to be due to increased plant height and number of branches/ plant and. The result of present experiment is in close agreement with findings of Kumawat *et al*. [14], Kumawat *et al*. [1], Kumar *et al*. [15], Azadi *et al*. [16], Bahadur and Tiwari [17] and Kumar and Kumawat [18].

Table 1. Effect of N, P and biofertilizers on growth attributes of mungbean

Treatments	Plant height (cm)			Horizontal plant spread (cm)			Number of leaves/plant			Number of branches/plant		
	30 DAS	60 DAS	At maturity	30 DAS	60 DAS	At maturity	30 DAS	60 DAS	At maturity	30 DAS	60 DAS	At maturity
Control	23.05	43.6	44.2	23.02	33.68	34.15	6.08	16.28	16.08	1.00	3.35	3.88
Rhizobium	26.07	48.9	49.6	26.10	45.95	46.45	7.06	18.08	18.09	2.08	6.60	6.85
PSB	26.08	47.4	48.5	27.07	46.45	46.88	7.04	20.15	21.28	2.10	5.80	6.18
Rhizobium+ PSB	27.03	52.6	51.5	27.10	47.09	48.18	7.03	`19.95	20.05	2.75	6.75	7.28
Rhizobium + 20 kg N/ha	28.10	52.8	53.0	26.09	46.08	47.04	7.08	19.08	20.05	2.68	6.15	6.07
PSB + 60 kg P_2O_5/ha	27.09	52.5	53.9	27.06	47.28	48.48	7.06	19.08	19.55	2.95	5.28	5.10
Rhizobium+PSB+ 20 kg N/ha	32.06	62.9	59.4	30.04	49.98	50.75	9.06	25.68	26.48	3.48	8.01	8.38
Rhizobium+PSB+ 60 kg P_2O_5/ha	31.10	58.9	64.7	32.08	51.10	52.10	9.10	27.06	28.10	3.62	7.95	8.04
SEm±	1.56	1.61	1.73	1.60	0.80	0.67	0.25	1.015	1.06	0.28	0.44	0.41
CD (P= 0.05)	3.29	3.43	3.99	3.42	2.40	2.00	0.08	1.35	1.22	0.08	1.35	1.22

Table 2. Effect of N, P and biofertilizers on growth attributes and yields of mungbean

Treatments	Fresh weight (gm)/ plant			Dry weight (gm)/ plant			Seed yield (q/ha)	Biological yield (q/ha)
	30 DAS	60 DAS	At maturity	30 DAS	60 DAS	At maturity		
Control	17.48	35.04	41.68	4.06	9.28	13.02	7.35	28.70
Rhizobium	19.55	39.15	46.35	4.08	10.07	13.82	9.45	32.03
PSB	19.75	39.35	43.35	4.55	10.03	12.88	9.38	32.41
Rhizobium+ PSB	20.04	41.04	47.68	4.82	10.11	14.22	10.88	35.98
Rhizobium + 20 kg N/ha	21.35	39.88	44.35	5.02	10.11	13.62	9.68	33.36
PSB + 60 kg P_2O_5/ha	20.55	40.00	44.00	4.10	11.02	13.02	10.06	34.34
Rhizobium+PSB+ 20 kg N/ha	25.62	41.68	48.00	4.52	11.34	14.08	10.95	37.01
Rhizobium+PSB+ 60 kg P_2O_5/ha	24.68	43.68	51.68	5.06	11.55	15.22	12.35	37.42
SEm±	1.57	0.57	0.85	0.11	0.22	0.34	0.28	2.14
CD (P= 0.05)	4.78	1.75	2.78	0.29	0.63	1.04	0.86	6.49

CONCLUSION

On the basis of one year field experimentation, it seems quite logical concluded that for achieving higher production and productivity of mungbean should be fertilized with 60 kg P_2O_5 along with dual seed inoculation of biofertilizers (*Rhizobium*+PSB).

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