

Original Research Article

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Nutrient Management in Mungbean [*Vigna radiata* (L.) Wilczek] for Higher Production and Productivity under Semi-arid Tract of Central India

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ABSTRACT

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A field experiment was carried out during *kharif* 2013-14 at Agriculture Research Farm, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh to study the effect of nutrition management on growth, yield attributes and yields of mungbean. Results reveals that application of *Rhizobium* + PSB + 20 kg N/ha gave significantly higher number of nodules (25.10/plant) and dry weight of nodules (24.10 mg/plant) which was statistically at par with *Rhizobium* + PSB + 60 kg P₂O₅/ha. Similarly maximum yield attributes viz., number of pods (70.48), pod length (5.78), number of seeds (8.68) and test weight (40.05 g) were recorded with the application of *Rhizobium* + PSB + 60 kg P₂O₅/ha. Further results showed that highest grain yield (1235 kg/ha), straw yield (2507 kg/ha), harvest index (33.0%) and production efficiency (17.39 kg/ha/day) were also recorded under *Rhizobium* + PSB + 60 kg P₂O₅/ha. Therefore, it is suggested that for achieving sustainable higher production and productivity of mungbean should be fertilized with *Rhizobium* + PSB + 60 kg P₂O₅/ha.

Introduction

Mungbean (*Vigna radiata* L.) is widely cultivated throughout southern Asia including India, Pakistan, Bangladesh, Sri Lanka, Thailand, Laos Taiwan south china and Malaysia in India, mungbean is cultivated in all the three seasons, that is *kharif*, *rabi* and *zaid*. It is one of the important pulse crops cultivated in India ranking third having about 70% of the world area and 45% of production. Mungbean is mostly grown in the state of Rajasthan (30.81%), Maharashtra (19.51%), Karnataka (15.35%), Andhra Pradesh (12.79%), Orissa (7.41%), Tamil Nadu (4.97%), and Uttar Pradesh (2.09%). In India

area occupied by mungbean is about 3.0 m ha with total production of 1.1 million tones but average productivity is 3.20 (q/ha). It is one of the worth of crops rich in protein. Mungbean seeds are rich in protein that is used completed, split peas or flour. Compare with the varieties mungbean very easily digestible, palatable and tastier. Its seed for produce soup, seasoned rice is used. 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 (Kumawat *et al.*, 2009b). The

yield and nutrition quality of pulses is greatly influenced by application of nutrient elements, organic manures and biofertilizers (Kumawat *et al.*, 2010). The association of *Rhizobium* and pulse plants helps in improving fertility of soil and is a cost effective method of nitrogen fertilization in legumes (Meena *et al.*, 2014). The amount of nitrogen fixed varies with the strain of *Rhizobium*, the plant species and environmental conditions. Because of nitrogen fixation legumes are self-dependent for their N requirement and play a significant role in maintaining the nitrogen balance in the soil. They also improve both physical properties such as soil aggregate stability, bulk density and biological properties of soil (Bahadur and Tiwari, 2014).

Application of nitrogen in combination with phosphorus to mungbean also increases its yield and yield components while nitrogen uptake and protein content of mungbean increase with increasing rate of applied phosphorus. Phosphorus is an essential constituent of nucleic acids and stimulates root growth as well as increase nodule activity in plant. Thus increase the mungbean yield and improves its quality (Malik *et al.*, 2003). Combined inoculation of *Rhizobium* and PSB not only significantly enhanced the growth characteristics and yield attributes but also resulted significantly higher yield as compared to *Rhizobium* and PSB inoculation alone because of dual benefit of N fixation and P solubilization in greengram (Singh, 1998). Therefore, present study was taken to investigate the effect of nitrogen and biofertilizer on yield attributes and yields of mungbean.

Materials and Methods

A field experiment was conducted during *kharif* 2013-14 at Agriculture Research Farm of Institute of Agricultural Sciences,

Bundelkhand University, Jhansi, Uttar Pradesh, which is geographically located at 25°27' N latitude and 78°35' E longitude at an altitude of 271 meters above the mean sea level in semi-arid tract of central India. The soil 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 P₂O₅/ha) and medium in potassium (185.0 kg K₂O/ha) content. The experiment was laid out in randomized complete block design with three replications. The experiment comprised of the eight treatment combinations i.e. control, *Rhizobium*, PSB, *Rhizobium* + PSB, *Rhizobium* + 20 N/ha, PSB + 60 P₂O₅/ha, *Rhizobium* + PSB + 20 N/ha and *Rhizobium* + PSB + 60 P₂O₅/ha.

The mungbean cv. 'Pant Mung-5' was sown on 30th July, 2013 using seed rate of 25 kg/ha with a row spacing of 30 cm. The crop was harvested on 08th October, 2013. 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. Just after sowing, furrows in each plot were covered with soil by manual labour while at complete sowing; planking was done on whole experimental area.

The nodules/plant was taken at flowering stage. Uproot plants and put in a bucket filled with water and roots were washed. After proper washing of roots, nodules were counted separately for each plant root. Figures of all the five plant were added together and sum was divided by five to get the average number of root nodules/plant.

Fully mature and develop pods from randomly selected five plants from each plot were plucked and number of seeds were counted. The average number of pods and seeds/plants was worked out. After threshing and winnowing the weight of seeds for each

net plot area was recorded in kg/plot and then converted to kg/ha. Production efficiency was calculated as following formula suggested by Kumawat *et al.*, (2015). The data collected were analyzed statistically using analysis of variance techniques (ANOVA) for randomized block design as prescribed by Cochran and Cox (1957).

Standard error of mean in each case and the critical difference only for significant cases were computed at 5% levels of probability as under.

Results and Discussion

Results of the study were revealed that number of nodules/plant, nodules dry weight/plant, yield attributes (number of pods/plant, pod length, number of seeds/pod, seed yield/plant and test weight) and seed and straw yield of mungbean (Table 1). Results showed marked variation due to application of fertilizers and biofertilizers as compared to control.

Higher number of nodules (25.10) and dry weight of nodules/plant (24.10 mg) was recorded in *Rhizobium* + PSB + 20 kg N/ha which was statistically at par with *Rhizobium* + PSB + 60 kg P₂O₅/ha and *Rhizobium* + PSB and significantly superior to rest of treatments.

This could be attributed to combined application of nitrogen, phosphorus and biofertilizers has play vital functions such as utilization of sugar and starch cell division, photosynthesis and root growth.

Also, spreading root system gives more size for infection by *Rhizobium* and increases their proliferation in rhizosphere, thus help in formation of higher number of as well as better size of nodules, thereby increasing dry weight of root nodules which is in accordance with that of Kumawat *et al.*, (2009c), Singh *et*

al., (2013). Further data showed that yield attributes viz., number of pods/plant, pod length, number of seeds/pod, seed yield/plant and test weight as influenced by chemical fertilizers and biofertilizers. Maximum pods/plant (70.48) was recorded in the fertilized plot *Rhizobium* + PSB + 60 kg P₂O₅/ha which as at par to each other and significantly superior to control and alone seed inoculation of *Rhizobium* + PSB. Similarly higher pod length (5.78 cm) was noted under *Rhizobium* + PSB + 60 kg P₂O₅/ha and significantly superior over rest of the treatments. Maximum seeds/pod (8.63) was also recorded with the application of *Rhizobium* + PSB + 60 kg P₂O₅/ha it was statistically similar with *Rhizobium* + PSB + 20 kg N/ha, PSB+60 kg P₂O₅/ha and dual seed inoculation with biofertilizers (*Rhizobium* + PSB). Further table 1 indicated that highest seed yield (4.58 g/plant) was obtained under application of *Rhizobium* + PSB + 60 kg P₂O₅/ha followed by *Rhizobium* + PSB + 20 kg N/ha and PSB+60 kg P₂O₅/ha which was statistically at par to each other's.

Highest test weight (40.05 g) was obtained from the plot fertilized with *Rhizobium* + PSB + 60 kg P₂O₅/ha which was similar to *Rhizobium* + PSB, *Rhizobium* + 20 kg N/ha, PSB + 60 kg P₂O₅/ha and *Rhizobium* + PSB + 20 kg N/ha.

The increase in yield attributes due to inoculation with dual (*Rhizobium* + PSB) might be due to production of growth promoting substances such as auxins, gibberellins and cytokines which might improve plant growth and stimulate the microbial development. The cumulative effect might be due to supply of nitrogen and phosphorus to the crop and also increased solubilization of mineral phosphates and other nutrients similar observation was recorded by Tanwar, (1997), Kumar *et al.*, (2010) and Kumar and Kumawat (2014).

Table.1 Effect of nutrition management on nodulation, yield attributes and yields of mungbean

Treatments	No. of nodules/ plant	Dry weight of nodules (mg/plant)	No. of pod/ plant	Pod length (cm)	No. of Seeds/ pod	Seed yield /plant	Test weight (gm)	Seed yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)	Production efficiency (kg/ha/day)
Control	14.02	12.06	47.08	4.75	5.95	3.32	34.08	735	2135	25.61	10.35
<i>Rhizobium</i>	22.04	22.10	60.88	5.48	7.65	3.75	34.10	945	2258	29.50	13.31
PSB	19.07	20.08	55.42	5.45	7.09	3.89	35.11	938	2303	28.94	13.21
<i>Rhizobium</i> + PSB	23.06	24.04	68.55	5.65	8.08	3.92	37.09	1088	2510	30.24	15.32
<i>Rhizobium</i> + N ₂₀	21.10	22.04	64.80	5.55	7.09	4.12	36.48	968	2368	29.02	13.63
PSB + P ₆₀	22.04	21.08	66.55	5.07	8.05	4.18	36.58	1006	2428	29.30	14.17
<i>Rhizobium</i> +PSB+N ₂₀	25.10	24.10	69.35	5.68	8.03	4.30	38.09	1095	2606	29.59	15.42
<i>Rhizobium</i> +PSB+P ₆₀	25.08	24.04	70.48	5.78	8.68	4.58	40.05	1235	2507	33.00	17.39
SEm_±	0.75	0.89	1.56	0.16	0.23	0.17	1.27	28	186	0.90	0.44
CD at 5%	2.62	2.71	4.70	0.47	0.68	0.49	3.75	86	563	2.72	1.34

Varying treatments of nutrient management has significant effect on the seed yield, straw yield and harvest index of mungbean (Table 1). The highest seed yield (1235 kg/ha) was obtained in *Rhizobium* + PSB + 60 kg P₂O₅/ha which was significantly superior over rest of the treatments. Similarly the maximum straw yield (2507 kg/ha) was also noted under *Rhizobium* + PSB + 60 kg P₂O₅/ha and this treatment statistically at par to all the treatments except control and *Rhizobium* alone. The data regarding harvest index and production efficiency as affected by various treatments. Dual seed inoculation along with 60 kg P₂O₅/ha gave maximum harvest index (33.0%) and production efficiency (17.39 kg/ha/day) which was significantly superior to rest of the treatments. The enhanced nodulation and improved nitrogen fixation by plant might have also increased the seed yield due to the better nutritional environment during crop period. Due to the phosphorus supplying might have stimulated at the rate of various physiological process favouring increased growth and yield attributes and finally the yield. Thus, it appears that the increase in seed yield owing to application of phosphorus was resulted of cumulative effect of improved growth and yield attributes. This results obtained are in close conformity with those of Moolani *et al.*, (2006), Kumawat *et al.*, (2009a), Panwar *et al.*, (2012) and Bhanwariya *et al.*, (2013).

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