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Nutrient Uptake and Yield of Mungbean *Vigna radiata* (L.)Wilczek as Influenced by Organic Manures, PSB and Phosphorus Fertilization

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Abstract

A field experiment was conducted to the study effect of organic manures, PSB and phosphorus fertilization on nutrient uptake in grain, straw, their total uptake, yield and finally protein content in mungbean on a sandy loam soil during rainy (*kharif*) seasons of 2005 and 2006.The soil was low in organic carbon (0.16%), available nitrogen (130 kg/ha), phosphorus (17.9 kg/ha) and medium in available potassium (150 kg/ha). Application of organic manures, PSB and phosphorus fertilization markedly influenced the nutrient concentration, their uptake, yield and protein content in mungbean. Results showed that application of vermicompost at 2t/ha, seed inoculation with PSB and 40 kg P_2O_5/ha significantly increased the N, P and K concentration in seed, straw, their total uptake and protein content mungbean.
Key words : Organic manures, PSB, Phosphorus, Nutrient uptake, Grain yield.

Mungbean is one of the major rainy (*kharif*) season pulse crop of India. The yield and nutritional quality of mungbean is greatly influenced by application of nutrient element along with organic manures and inoculation of seed with PSB. The crop responds favorably to application of fertilizer phosphorus (1). The rate of PSB in increasing crop yield, nutrient availability and uptake has been demonstrated under some soil of India but such information on these aspects in mungbean layout been investigated under Rajasthan. Like other legume crops mungbean Vigna radiata (L.) has potential to fix atmospheric nitrogen through its root nodules, which requires phosphorus for their proper growth and development. Besides phosphorus, pulses are require nitrogen as a starter dose along with organic manures and seed inoculation with effective strain of PSB for cultivation. Therefore, the present study was made to workout the optimum dose of phosphorus and organic manures with PSB inoculation in mungbean.

Methods

An field experiment was conducted in mungbean during *kharif* season of 2005 and 2006 at research farm of S.K.N. College of Agriculture, Jobner, RAU, Bikaner on sandy loam soil. The soil was low in organic carbon (0.16%), available nitrogen (130 kg/ha), phosphorus (17.9 kg/ha) and medium in available potassium (150 kg/ha) with pH 8.2. The experiment was laid out in randomized block design factorial with three replications, treatments considering three levels of organic manures Control, Vermicompost at 2 t / 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 phosphorus were applied as basal dose through single super phosphate. PSB cultures were used to inoculate the seed as per the need of the treatment. Other cultural operations were done following recommendation and crop requirements.

Results and Discussion

Organic Manures

Nitrogen, phosphorus and potassium content in grain, straw and protein content mungbean (Table 1) were significantly enchanced due to application of

Table 1. N, P and K concentration and their total uptake and protein content in grain of mungbean as affected by organic manures, PSB and phosphorus fertilization (pooled data of two years).

Treat-ments	Yield (q/ha)		N concentration (%)		Total N uptake	P concentration (%)		Total P uptake	K concentration (%)		Total K uptake	Protein control
	Grain	Straw	Grain	Straw	(kg/ha)	Grain	Straw	(kg/ha)	Grain	Straw	(kg/ha)	(%)
Organic Manures												
Control	5.97	13.64	3.490	1.034	35.28	0.378	0.174	4.68	1.723	1.215	22.57	22.03
FYM 4t/ha	7.41	15.02	3.763	1.067	44.07	0.393	0.187	5.76	1.980	1.283	26.71	23.35
Vermicom-post 2t/ha	8.09	16.24	3.893	1.148	50.33	0.412	0.200	6.61	2.153	1.333	29.75	24.11
SE ±	0.19	0.40	0.037	0.008	1.21	0.005	0.004	0.15	0.013	0.014	0.73	0.13
CD (P=0.05)	0.56	1.15	0.106	0.023	3.49	0.014	0.011	0.42	0.036	0.040	2.10	0.38
PSB												
No inocu-lation	6.92	14.37	3.672	1.031	40.59	0.387	0.181	5.35	1.946	1.271	25.25	22.76
Inoculation	7.39	15.56	3.758	1.136	45.87	0.402	0.192	6.03	1.959	1.283	27.44	23.56
SE ±	0.16	0.33	0.030	0.006	0.99	0.004	0.003	0.12	0.010	0.011	0.60	0.11
CD (*P*=0.05)	0.45	0.94	0.086	0.019	2.85	0.011	0.009	0.35	NS	NS	1.72	0.31
Phosphorus (P_2O_5 kg/ha)												
0	6.24	13.50	3.552	0.976	35.65	0.346	0.169	4.47	1.932	1.255	23.23	22.31
20	7.19	15.11	3.744	1.084	43.56	0.395	0.187	5.70	1.952	1.278	26.57	23.40
40	8.03	16.29	3.850	1.190	50.47	0.442	0.204	6.90	1.973	1.298	29.23	23.78
SE ±	0.19	0.40	0.037	0.008	1.21	0.005	0.004	0.15	0.013	0.014	0.73	0.13
CD (*P*=0.05)	0.56	1.15	0.106	0.023	3.49	0.014	0.011	0.42	NS	NS	2.10	0.38

vermicompost which might be the result of increased availability of nitrogen, phosphorus and potassium to plant. This might also be due to improved nutritional environment in the rhizosphere as well as its utilization in the plant system leading to enhanced translocation to reproductive structures viz., pods, seeds and other plant parts. The nitrogen, phosphorus and potassium might have been utilized in greater quantities due to their abundant availability. Another reason for higher nitrogen content might be due to increased activity of nitrate reductase in synthesis of protein in seeds because it is a primary component of amino acids which are the building blocks of protein molecules. These findings are in close conformity with those of Yadav (2) in cowpea. Application of vermicompost also recorded significantly higher nitrogen, phosphorus and potassium uptake over control and FYM. Since uptake of nutrients is a function of their content and yield, increase in grain and straw yield along with higher content of N, P and K might have resulted in higher uptake of these nutrients in the crop. Mathur (3) also observed significantly higher, N, P and K uptake and protein yield of mungbean due to application of 20 kg N through vermicompost. It is well established fact that seed yield of a crop is function of yield attributes such as number of pods per plant and seeds per pod. Increase in these yield attributes due to fertilization might have increased grain yield of mungbean. The significant increase in straw yield due to application of vermicompost could be attributed to the increased vegetative growth possibly as a result of effective utilization of nutrients absorbed through extensive root system and prolific shoot development on account of improved nourishment through organic fertilization. As already mentioned that vermicompost improves the physical and biological properties of soil including supply of almost all the essential plant nutrients for growth and development of plant, thus, balanced nutrition under favorable environment might have helped in production of new tissues and development of new shoots. Findings of Mathur (3)

in greengram and Kumar et al. (4) in mungbean also lend support to the findings of the present investigation.

PSB Inoculation

Significant increase in N and P, as well as total N, P and K uptake by the crop was observed with PSB seed inoculation (Table 1). The phosphate solubilizing bacteria enhanced the availability of phosphorus to the plants which might have utilized in greater root development and nodulation which in turn resulted in higher nitrogen fixation in the soil by nodules. Thus, increased availability of nitrogen, phosphorus and potassium resulted in greater uptake by the plants and ultimately increased their concentration in plant. Significant increase in N. P and K uptake might be due to increased concentration of these nutrients either in seed or straw or both and significant increase in seed and straw yields. These findings are in accordance with those of Singh and Kapoor (5) Singh and Pareek (6) in mungbean. Since protein content of seed is essentially a manifestation of N content, increased N content due to seed inoculation with PSB resulted in higher protein content because of their beneficial role in enhancing N content in seed.Findings of Singh and Pareek (6) in mungbean also provided support to the present investigation. Since the available P was low, PSB might have helped in reducing P fixation by its effect and also solubilized the unavailable form of P leading to more uptake of nutrients and reflected in better yield attributes Viz., pods per plant, seeds per pod and test weight. Increase in seed and straw yields was the cumulative effect of increased growth and yield attributes. The findings of this investigation are in line with those of Tomer et al. (7) in urdbean who reported higher values of yield attributes and yield due to PSB inoculation in different leguminous crops.

Phosphorus Fertilization

A significant increase in N, P and K concentration was observed due to application of phosphorus upto 40 kg P_2O_5/ha (Table 1). The application of phosphorus might have improved the nutritional environment in rhizosphere as well as in plant system leading to increased uptake and translocation of nutrients especially of N, P and K in reproductive structures which led to higher content and uptake. Further, the significant and positive correlation of seed yield with nutrient uptake also evidenced the above findings. Since, uptake of N, P and K is the function of seed and straw yields and their concentration, the significant increase in concentration of these nutrients coupled with increased seed and straw yield enhanced the total uptake of N, P and K. Protein content is essentially the manifestation of N concentration in seed. Hence, increased N concentration might have increased the protein content. These results are in close conformity with the findings of Yakadri et al. (8) and Naagar and Meena (9). Application of graded levels of phosphorus upto 40 kg P_2O_5/ha significantly increased the yield of mungbean. 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 (10). 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 (11). These findings collaborate the results of Choudahry et al. (12) in greengram and Singh (13) in urdbean.

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