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Response of spring mungbean (*Vigna radiata* L.) to nutrient management in Western U.P.

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Abstract
A field experiment was conducted at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, during spring season of 2015. The ten treatments viz. control, N (18 kg/ha), NP (18:46 kg/ha), NPK (18:45:30 kg/ha), NPKS (18:45:30:20 kg/ha), NPK S Zn (18:45:30:20:20 kg/ha), NPK S Zn Fe (18:45:30:20:20:5 kg/ha), NPK S Zn Fe *Rhizobium* (18:45:30:20:20:5 kg/ha), NPKS Zn Fe PSB (18:45:30:20:20:5 kg/ha) and NPK S Zn Fe *Rhizobium* PSB (18:45:30:20:20:5 kg/ha) were tested in randomized block design with three replications. The experimental soil was sandy loam in texture, low in organic carbon and medium in available P and K. The SML-668 variety of moongbean was planted. Among all the treatment application of 18, 46, 30, 20, 20 and 5 kg ha^{-1} N P K S Zn Fe with *Rhizobium* and PSB received maximum plant height, number of green trifoliate leaves, dry matter accumulation, number of active nodules, number of pod $plant^{-1}$, number of grain pod^{-1}, straw and biological yield, which was significantly more than the other treatments. An increase of 381 and 64 percent over control and N P K respectively in grain yield were recorded due to nutrient management and also to be found significantly higher gross return, net return and increment in nutrient availability compare to control treatments.

Keywords: Moongbean, Nutrient management, *Rhizobium*, PSB

Introduction
India is recognized as a major pulse producing country which account for roughly one-third of total pulse area and one-fourth of total pulse production of world and one-fifth of the total area under food grain crops and contribute about one-twelfth of the total food grain production in the country. Despite being the largest producer in the world, the country is in short supply of pulses. Among the pulses grown in India, mungbean [*Vigna radiata* (L.) Wilczek] is one of the important crop it is grown in India on an area of 3.38 m ha^{-1} with production about 1.39 m ton with the productivity of 474 kg ha^{-1}(AICRP on MULLaRP, 2013-14) and in U.P. on an area 78,000 ha with production 39,000 ton and productivity 500 kg ha^{-1}(AICRP on MULLaRP, 2015-14).

Pulses are mainly grown in low fertility land therefore productivity is poor. Generally in pulse crop farmer mainly apply Urea / DAP resulting soil fertility is decline continuously. Apart from primary macronutrient deficiency the deficiency of secondary macronutrient, micronutrient particularly of sulphur, Zinc & Iron is also emerging and it is being limiting factor. The management of nutrient is one of the important factors that greatly affect the growth, development and yield of pulses. In western U.P. sugarcane harvesting in month of Feb-march and field are fellow till the month of June-July, in this period we can grow spring mungbeen as catch crop and utilized the land. Rice-wheat cropping system is dominant in western U.P. in this cropping system after wheat harvesting field are fallow or farmer grow sorghum for fodder, sorghum is exhausting crop and thus decline soil fertility. If farmer grow mungbeen in rice-wheat cropping system its better utilization of land and also improve soil fertility. Keeping all above points in view the present investigation entitled "Response of spring mungbean (*Vigna radiata* L.) to nutrient management in western U.P." was carried out to see the effect of nutrient management practices on growth, yield attributes and yield of mungbean.

Methodology
The experiment was conducted at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, during spring season of 2015. The ten treatments viz. T_1-control, T_2-N (18 kg/ha), T_3-NP (18:46 kg/ha), T_4-NPK (18:45:30 kg/ha), T_5-NPKS (18:45:30:20 kg/ha), T_6-NPK S Zn (18:45:30:20:20 kg/ha),T_7-NPK S Zn Fe

(18:45:30:20:20:5 kg/ha), T_8-NPK S Zn Fe *Rhizobium* (18:45:30:20:20:5 kg/ha), T_9-NPK S Zn Fe PSB (18:45:30:20:20:5 kg/ha) and T_{10}-NPK S Zn Fe *Rhizobium* PSB (18:45:30:20:20:5 kg/ha) were tested in randomized block design with three replications. The experimental soil was sandy loam in texture, low in organic carbon and medium in available P and K. The SML-668 variety of moongbean was planted.

Result and discussion

Response of crop parameters to various treatments was also affected by the environmental and soil conditions existing during the crop period. The growth parameters were increased with the integration of bio-fertilizer with chemical fertilizer application. The highest plant height, number of branches plant^{-1}, number of leaves plant^{-1}and dry matter accumulation were recorded in T_{10} (N P K S Zn Fe *Rhizobium* PSB) treatment (Table-1) which was significantly higher than the other treatments. However the lowest values of growth characters were recorded in control plot (T_1) which was significantly lower than the other treatments. The increase in growth character under nutrient management may be mainly due to the improved soil condition and also by regulating the metabolic and enzymatic process including photosynthesis and respiration in plants due to the integration of biofertilizer with chemical fertilizer application. These results find conformity from the finding of that Srivastava *et al.* (2006) [11], Ram *et al.* (2008) [7] and Sekhon *et al.* (2008) [8].

Dry matter accumulation is a function of many factors like photosynthetic efficiency, leaf area, net assimilation rate (NAR) etc. The highest dry matter accumulation in T_{10} (N P K S Zn Fe *Rhizobium* PSB) treatment might be due to the favourable soil condition for sufficient nutrient availability and growth of crop their by resulting more plant height and dry matter accumulation. This could be attributed to the high cell turgidity and increased cell number, cell turgidity is responsible for the elongation of cell. In nutrient deficit treatments the turgidity of the cell is supposed to reduction in cell elongation and cell number. As have been reported by various scientists, nutrient supply causes a significant improvement in the vegetative growth. Similar kind of trend was also observed by Singh and Singh (2004) [10].

The grain yield of mungbean increased with the nutrient management (Table-2). The highest grain yield (1344 kg ha^{-1}) was found with T_{10} (N P K S Zn Fe *Rhizobium* PSB) which was significantly superior to other treatments while lowest grain yield (279 kg ha^{-1}) was recorded in control plot (T_1). The yield per hectare improved may be due to better plant growth and higher availability of nutrients. Improvement in grain yield with higher availability of plant nutrients was reflected through improvement in number of pods plant^{-1}, number of grain pod^{-1} and 1000- grain weight (Table-1). These results find conformity by the findings of Karwasra *et al.* (2006) [5], Srivastava *et al.* (2006) [11] and Ram *et al.* (2008) [7].

The total nutrient (N P K S Zn Fe) uptake by plants was higher in treatment T_{10} (N P K S Zn Fe *Rhizobium* PSB) (Table-3). This might be due to the application of *Rhizobium* and PSB increase the availability of nitrogen, phosphorus and potash in soil. The nutrient uptake depends on nutrient content and dry matter production by plants. Application of fertilizers along with *Rhizobium* and PSB increase the dry matter production and resulted in to higher nutrient uptake. Similar kind of trend was also observed by Rajesh *et al.* (2006) [6], Sharma *et al.* (2008) [9], Bhat *et al.* (2011) [3]. The total variable cost of cultivation increased slightly with different sources of fertilizer (Table-2). The highest cost of cultivation (Rs 14669), gross income (Rs 67399), net income (Rs 52530) and benefit cost ratio (3.5) was calculated in T_{10} (N P K S Zn Fe *Rhizobium* PSB) treatment while the lowest cost of cultivation (Rs 10934), gross return (Rs 1492), net income (Rs 3358) and benefit cost ratio (0.3) was calculated in T_1 control plot. The highest net income (Rs 52530) of mungbean was recorded in T_{10} (N P K S Zn Fe Rhizobium PSB) because of highest yield of grain and straw. Similar trend was also observed by Jain *et al.* (2006) [4]. From the foregoing discussion it may be concluded that application of 18, 45, 30, 20, 20, 5 kg ha^{-1} N P K S Zn and Fe with *Rhizobium* and PSB inoculation in greengram should be preferred to get higher yield of greengram.

Table 1: Growth and yield attributes of moongbean as influenced by nutrient management.

Treatments	Growth attributes				Yield attributes		
	Plant height (cm)	Number of branches/plant	Number of trifoliate leaves/plant	Dry matter accumulation (g/plant)	Number of pods plant^{-1}	Number of grains pod^{-1}	Test weight (g)
T_1	33.3	4.3	5.4	8.46	5.5	3.7	32.13
T_2	40.8	6.2	8.0	9.46	7.4	4.5	33.30
T_3	42.3	7.2	10.5	10.23	9.1	5.0	33.93
T_4	43.9	7.5	11.6	10.33	9.5	5.4	34.20
T_5	44.9	8.1	12.7	10.60	9.8	5.8	34.43
T_6	45.8	8.9	14.4	10.93	10.2	6.2	34.83
T_7	48.5	9.5	15.5	11.43	10.5	6.4	35.13
T_8	50.7	9.9	16.7	12.16	11.0	6.6	35.73
T_9	52.0	10.6	17.7	12.63	11.4	7.0	35.90
T_{10}	53.5	11.4	18.8	13.25	11.9	7.2	36.03
SEm±	0.2	0.1	0.4	0.34	0.3	0.1	0.08
CD (P=0.05)	0.6	0.5	1.4	1.02	0.9	0.5	0.25

Table 2: Yield and economics of moongbean cultivation as influenced by nutrient management.

Treatments	Yield (kg ha^{-1})			Harvest index (%)	Economics of cultivation			
	Grain yield	Straw yield	Biological yield		Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
T_1	279.1	726.7	1040.9	26.8	10934	1492	3358	0.3
T_2	466.6	1133.5	1600.2	29.2	11184	23730	12546	1.1
T_3	640.2	1489.1	2129.4	30.1	12069	32427	20358	1.6
T_4	734.1	1655.2	2389.9	30.7	12669	37106	24437	1.9
T_5	818.0	1818.6	2636.7	31.0	12969	41265	28296	2.1
T_6	929.1	2040.5	2969.6	31.3	13969	46819	32850	2.3
T_7	991.6	2152.5	3144.1	31.5	14069	49718	35649	2.5
T_8	1109.7	2345.9	3455.6	32.7	14219	55737	41468	2.9
T_9	1229.1	2572.1	3801.2	32.3	14369	61682	47213	3.2
T_{10}	1344.4	2778.5	4122.2	32.6	14669	67399	52530	3.5
SEm±	22.2	62.4	84.2	0.3	-	-	-	-
CD P=0.05)	66.7	186.9	255.3	0.9	-	-	-	-

Table 3: Nutrient uptake by moongbean as influenced by nutrient management.

Treatments	Nutrient uptake					
	Nitrogen (kg ha^{-1})	Phosphorus(kg ha^{-1})	Potassium(kg ha^{-1})	Sulphur(kg ha^{-1})	Zinc (g ha^{-1})	Iron (g ha^{-1})
T_1	12.89	1.55	9.7	1.11	127.4	93.7
T_2	18.76	2.69	14.9	1.83	198.4	147.3
T_3	19.26	4.22	19.9	2.54	266.0	198.5
T_4	19.61	4.86	24.3	2.99	300.5	228.7
T_5	19.93	5.83	26.9	4.06	333.5	252.9
T_6	20.09	6.54	30.4	4.57	396.3	287.9
T_7	20.35	7.16	32.3	4.91	421.1	328.9
T_8	21.01	8.13	35.5	5.60	467.6	366.3
T_9	21.07	9.63	39.2	6.37	518.9	407.8
T_{10}	21.51	10.9	42.9	7.22	574.9	450.2
SEm±	0.18	0.22	0.92	0.14	10.4	9.1
CD (P=0.05)	0.56	0.66	2.78	0.42	31.1	27.2

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