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Effect of fertilizer doses, organic manure and biofertilizer for yield maximization on mungbean and their residual effect on succeeding mustard crop

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Abstract
A field experiment was carried out at CCS Haryana Agricultural University, Hisar (Haryana) during *kharif* 2020 to study the effect of inorganic fertilizer, organic manure and biofertilizer for yield maximization of mungbean [*Vigna radiata* (L.) Wilczek] and their residual effect on succeeding mustard crop. The experiment was conducted with three sources of nutrients having eighteen combination *viz*., three fertilizers doses i.e 75%, 100% and 125% of recommended dose of fertilizers (RDF) with two FYM levels (no fym and 5 ton/ha. fym) and three biofertilizers i.e. *Rhizobium*, *LNm 16* and *Rhizobium* + *LNm 16* in Factorial Randomized Block Design replicated thrice. It was found that in 100% RDF recorded significantly higher seed yield (737.39 kg/ha), 1000 seed weight (38.92) and pods per plant (25.75) of mungbean over 75% RDF (583.11 kg/ha, 37.72 and 23.37), respectively. Seed yield in 100% RDF was higher to the tune of 26.46 percent over 75% RDF. The application of 5 ton/ha FYM recorded significantly higher seed yield (713.48 kg/ha), pods per plant (25.19) and branches per plant (3.26) over control. Seed inoculation with *Rhizobium* + PSB strain *LNm 16* recorded maximum and significantly higher seed yield (706.45 kg/ha), branches per plant (3.2) and pods per plant (25.08) over seed inoculation with PSB strain *LNm* 16. Residual effect of different fertilizers level on mustard crop yield was non significant whereas seed yield of mustard crop was significantly effected by residual effect of FYM application and it was highest (3540) at 5 ton/ha FYM over control.

Keywords: Mungbean, RDF, recommended dose of fertilizers, FYM and Biofertilizers

Introduction
Pulses occupy a unique position in the Indian diet because of the constituting cheapest source of vegetable protein for the vegetarian population of India (Anonymous 2015). Green gram is second most important pulse crop in India after pigeon pea in the acreage. It is one of the important pulse crops cultivated in India ranking third having about 70% of the world area and 45% of production. 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 requirement of fertilizer for the mungbean crop is not too high as it is a leguminous crop. In mungbean, roots have symbiotic rhizobia bacteria which help in fixing atmospheric nitrogen into the soil (Anjum *et al*., 2006) [1]. Organic manures provide a good substrate for the growth of microorganisms and maintain a favourable nutritional balance and soil physical properties (Chaudhary *et al*, 2004) [2]. Application of FYM increased the activity of acid and alkaline phosphatase, phosphodiesterase, inorganic pycophosphatase and dehydrogenase leading to faster hydrolysis of easter-bond P to plant available P (Dinesh *et al*, 2003) [3]. 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) [7]. 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) [8].

Material and Method
Field experiment was conducted during kharif 2020 at the Pulses Research Farm, Department of Genetics and Plant Breeding of Chaudhary Charan Singh Haryana Agricultural University, Hisar which is situated at latitude of 29°10’ North, longitude of 75°46’ East and elevation of

215.2 m above mean sea level in the semi-arid, subtropical climate zone of India. The experiment was laid out in factorial Randomized Block design on sandy loam (64.2% sand, 16.8% silt and 19.6% clay) soil which is slightly alkaline in reaction, low in organic carbon and nitrogen, medium in available phosphorus and potassium. The treatments having combination of three fertilizers doses i.e 75%, 100% and 125% of recommended dose of fertilizers (RDF) with two FYM levels (no FYM and 5 ton/ha. FYM) and three biofertilizers i.e. *Rhizobium*, *LNm 16* and *Rhizobium* + *LNm 16* replicated thrice. Fertilizers were applied through urea and diammonium phosphate. FYM was applied before 15 days of sowing as per treatments and seeds were treated with biofertilizer (Rhizobium, PSB strain *LNm 16 and Rhizobium* + PSB strain *LNm* 16) except control. Mungbean variety "MH 421" was used as the test crop. Seeds were sown on 15th Augest 2020 at about 5.0 cm depth by drilling in rows using 15 kg seed $ha^{-1}$and spacing of 30 cm between rows and 10 cm between plants and harvested at physiological maturity. All the cultural practices were followed as per package of practice. The data on various growth and yield attributes, seed and straws were recorded under various treatments.

Results and Discussion

Beneficial effect of fertility levels on growth and development of mungbean has been clearly brought out in this investigation. Perusal of the data (Table 1) revealed that fertility levels significantly affect all growth as well as yield attributes where plant height (53.07cm), number of nodules per plant (25.4) and dry weight of nodules (63.3 mg) were recorded maximum with application of 125% of recommended dose of fertilizers and branches per plant was at par with 100% RDF. The application of 100% RDF recorded significantly higher seed yield (737.39 kg/ha), 1000 seed weight (38.92) and pods per plant (25.75) of mungbean over 75% RDF (583.11 kg/ha, 37.72 and 23.37), respectively. Seed yield in 100% RDF was higher to the tune of 26.46 percent over 75% RDF. Residual effect of different fertilizers level on mustard crop yield was non significant. However the yield (3525 kg/ha) was maximum with 125% RDF

For the organic manure, the application of 5 ton/ha FYM affected all growth as well as yield attributes and recorded significantly higher seed yield (713.48 kg/ha), pods per plant (25.19) and branches per plant (3.26) over control. Percent increase in seed yield of mungbean was to the tune of 12.96% over control. Seed yield of mustard crop was also significantly effected by residual effect of application of fym and it was highest (3540) at 5 ton/ha fym over control.

Seed inoculation with Rhizobium + PSB strain LMn 16 recorded maximum and significantly higher seed yield (706.45 kg/ha), branches per plant (3.2) and pods per plant (25.08) over seed inoculation with PSB strain LMn 16. Percent increase in seed yield was to the tune of 11.1 over seed inoculation with PSB strain LMn 16. Seed yield with seed inoculation with rhizobium (675.28 kg/ha) remained at par with seed inoculation with Rhizobium + PSB strain LMn 16. The increase in yield 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) [9], Kumar *et al.*, (2010) [6] and Kumar and Kumawat (2014) [14]. Non-significant difference was observed for all growth as well as yield attributes on application of different biofertilizers. Residual effect of different biofertilizers on yield of mustard crop was non-significant

Table 1: Effect of fertilizer doses, organic manure and biofertilizer on growth, yield and yield attributes of mungbean.

	Treatment	Plant height (cm)	Branches/plant	No. of nodules/plant	Nodules dry wt.(mg)	Pods/plant	Seeds/pod	1000 seed wt. (g)	Seed yield (kg/ha) Mungbean	Seed yield (kg/ha) Mustard
A. Main plot: Fertilizer doses										
1.	75% RDF	45.36	2.94	18.3	53.2	23.4	7.5	37.72	583.11	3,368
2.	100% RDF	48.58	3.33	23.2	60.1	25.7	11.17	38.92	737.39	3,450
3.	125% RDF	53.07	3.30	25.4	63.3	25.7	10.28	38.68	697.17	3,525
S.Em±		0.57	0.05	1.1	1.1	0.21	0.27	0.33	26.65	40.4
CD (P=0.05)		1.65	0.14	3.2	3.3	0.6	0.76	0.96	83	NS
B. Sub plot: Organic manure										
1.	Control	47.96	3.12	17.5	52.1	24.7	9.2	38.17	631.63	3,355
2.	5 ton/ha	50.04	3.26	24.2	64.2	25.2	10.1	38.71	713.48	3,540
S.Em±		0.47	0.04	1.6	2.1	0.17	0.22	0.27	21.65	32.98
CD (P=0.05)		1.35	0.12	4.8	6.3	0.49	0.62	NS	68	103.9
C. Sub Sub plot: Biofertilizers										
1.	*Rhizobium*	49.04	3.18	20.2	53.6	24.96	9.64	38.57	675.28	3433
2.	LNm 16	48.54	3.18	18.3	51.2	24.8	9.42	38.32	635.95	3389
3.	*Rhizobium* + LNm 16	49.41	3.20	24.5	61.7	25.1	9.89	38.44	706.45	3520
S.Em±		0.57	0.05	1.2	1.7	0.21	0.27	0.33	10.67	57.12
CD (P=0.05)		NS	NS	3.5	5.3	NS	NS	NS	31	NS

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