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EFFECT OF BIO AND CHEMICAL FERTILIZERS ON GROWTH AND YIELD OF MUNGBEAN [*Vigna radiata* (L.) Wilczek]

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ABSTRACT

Effect of bio and chemical fertilizers on growth and yield of mungbean [*Vigna radiata* (L.) Wilczek] the experiment was conducted with three levels of bio fertilizers and three N-levels with control in main plots and four P_2O_5-levels with control in sub plots. Thus, 36 treatment combinations were tested in split plot design and replicated thrice. Mungbean variety PS-16 was sown in lines at the rate of 20 kg/ ha. The lines were drawn with the help of rope manually maintaining row to row distance of 30 cm. The seeds were put in the rows at intra row spacing of 10 cm. Nitrogen application was done through Urea, applied in two equal splits (1/2) basal and other half 30 days after sowing of the crop while as entire Phosphorus (Single Super Phosphate) was applied in single dose as basal. Vasicular Arboscular Mycorrhizae (VAM) culture was applied as 20 kg/ha. The mung, PS-16 seed was inoculated with Rhizobium an hour before sowing. This experiment was conducted at the research farm of Amar Singh College, Lakhaoti, Bulandshahr. U.P. during the kharif season 2008 and kharif 2009. The results of the experiment it may be concluded that the Rhizobium inoculation had a significant effect on the seed yield of mungbean and yield recorded was 633 kg/ha was significantly different from that of VAM 620 kg/ha and control 603 kg/ha. Rhizobium inoculation record 2.09 and 4.97% higher yield than VAM and control, respectively, while as VAM registered 2.81% higher yield over control 30 kg N/ha recorded maximum P content (%) and results were significantly different from 15 and 0 kg N/ha at all the growth stages. Similar, results were obtained with P-uptake. Phosphorus application had a significant effect on 1000-seed weight. 60 kg P_2O_5/ha recoded maximum seed weight (31.26g). Which was significantly different from 40, 20, and 0 kg P_2O_5/ha.

Key words : *Mungbean, VAM, Rhizobium, Nitrogen, Phosphorus.*

India is a major pulse production country. Third rank of mungbean among all pulses grown in India after chickpea and pigeonpea. Pulses are an important component of Indian diet being a good source of protein (24%) (1). Mung is an important source of proteins for many people for whom animal protein is unavailable. It is widely regarded to be non- flatulent and easily digested.

In India mungbean occupies 3.3 million ha area with production of 1.1 mt. and average productivity about 425 kg ha-1. In general, pulses yield is much less than the cereals (2). Pulses have the ability to fix atmospheric nitrogen in symbiosis with appropriate rhizobium and can be supplement chemical fertilizers by saving 20-30 kg N/ha (3). Organic manures although not use as sole sources of nutrients, are however, good complementary sources with inorganic fertilizers (4). Only half of the nitrogen and one fifth of phosphorus may be recovered from organic manures in first season of application (5). For sustainable agriculture production system, it is imperative utilize renewable source of energy which is apparently environmental and farmers friendly. The non-availability, soaring prices of fertilizers and low purchasing power of farmers, warrant their exploitation and utilization. Thus integration of bio and chemical fertilizers for optimization of pulses production on sustainable basis assumes much importance as the present yield of pulses being too low. The mungbean plant responds to bio and chemical fertilization it may be more efficiently utilized in different fertilization systems and maximum advantage can be taken by exploiting the yield potential per unit area in a given system. Keeping these things in view a field experiment was carried out to study the effects of bio and chemical fertilizers on growth and yield of mungbean.

MATERIALS AND METHODS

The field experiment was conducted during kharif 2008

Table-1 : Growth attributes of mungbean as influenced by the bio & chemical fertilizers at harvest stage. (mean (2008 and 2009) kharif data)

Treatments	Plant height (cm)	Leaf area index (LAI)	Dry matter accumulation (q/ha)	No. of nodules /plant	Fresh weight of nodules (mg)	Branches /plant
Bio fertilizers						
B_0 control	89.73	3.03	14.95	24.06	119.86	16.13
B_1 VAM	93.83	3.09	15.46	25.43	146.36	17.16
B_2 Rhizo.	97.04	3.59	15.87	26.84	179.61	18.50
SEM ±	1.03	0.14	0.07	0.45	0.85	0.37
CD at 5%	3.11	0.43	0.23	1.36	2.57	1.11
N-levels (kg/ha)						
N_0 control	91.00	3.04	15.03	22.19	119.50	15.91
N_1 15 kg N	93.42	3.24	15.39	26.25	154.83	17.55
N_2 30 kg N	93.42	3.69	15.87	28.22	171.50	18.33
SEM ±	1.03	0.14	0.07	0.45	0.85	0.37
CD at 5%	3.11	0.43	0.23	1.36	2.57	1.11
Phosphorus levels (kg/ha)						
P_0 control	90.19	2.85	13.19	19.81	111.37	15.85
P_1 20 kg P_2O_5	92.45	3.13	15.37	24.55	144.55	15.69
P_2 40 kg P_2O_5	95.16	3.61	16.32	27.77	164.51	17.92
P_3 60 kg P_2O_5	96.54	3.90	16.84	30.04	174.00	19.33
SEM ±	0.22	0.06	0.10	0.36	1.46	0.42
CD at 5%	0.63	0.17	0.30	1.02	4.42	1.20

and kharif 2009, at the research farm of Amar Singh College, Lakhaoti, Bulandshahr (U.P.). The farm is situated at 28.4° N latitude, 77.10°E longitude and at an altitude of 207.3 meters above mean sea level. The area lies in the heart of western Uttar Pradesh and a sub-tropical climate. The mean annual rain fall is about 700 mm of which 80-90% is received in June to September. The minimum and maximum temperature showed fluctuation during the cropping season and varied from 15.00c to 32.1°C and 26.3°C to 38.3°C respectively. The soil of the experimental site was sandy loam in texture, low in organic carbon (0.46%), available nitrogen (207 kg/ha), available phosphorus (9.3 kg/ha), and medium in available potassium (143.0 kg/ha) and was neutral in reaction (pH 7.0). The treatment consisted of three bio fertilizers viz. (B0-without bio fertilizer, B1-VAM, B2-Rhizobium inoculation) and three levels of nitrogen viz. (N_0-0 kg N/ha, N_1- 15 kg N/ha, N_2-30 kg N/ha) in main plots and four levels of phosphorus viz. (P0-0 kg P_2O_5/ha, P_1-20 kg P_2O_5/ha, P_2-40 kg P_2O_5/ha, P_3-60 kg P_2O_5/ha) in sub plots. The experiment was laid out in split plot design and three time replicated. Prior to sowing, fertilizer were weighed and thoroughly mixed with the soil.

K_2O was supplied through MOP equally to all plots @ 20 kg/ha. N application was done through Urea, applied two equal splits (1/2) basal and other half 30 days after sowing. Which coincided with branching stage of the crop. While as entire phosphorus (single super phosphate) and potassium (Muriate of potash) was applied in single dose as basal. 20 kg VAM culture per ha was applied. For the treatments receiving B3 (Rhizobium culture @ 500 g/ha) the mung, PS-16 seeds was inoculated with rhizobium an hour before sowing. 10 kg of seeds and one packet of rhizobium were weighed. The sowing of seed was done in lines at the rate of 20 kg/ha. The lines were drawn with the help of rope manually maintaining row to row distance of 30 cm. The seeds were put in the rows at intra row spacing of 10 cm and the sowing depth of seeds is 5 cm during last week of June, first thinning was done after full germination and second thinning was done at 60 days after sowing to remove the unwanted weeds

Table -2 : Yield attributes of mungbean as influenced by the bio & chemical fertilizers at harvest stage. (mean (2008 and 2009) kharif data)

Treatments	No. of pods/plant	Pod length (cm)	No. of seeds/pod	Seed yield (kg/ ha)	1000-seed weight (g)
Bio fertilizers					
B_0 control	19.36	8.11	10.86	603	29.13
B_1 VAM	20.25	8.36	11.54	620	30.23
B_2 Rhizo.	22.00	8.36	11.93	633	31.17
SEM ±	0.44	—	0.11	0.04	0.22
CD at 5%	1.32	N.S.	0.35	0.12	0.68
N-levels (kg/ha)					
N_0 control	18.86	8.11	10.41	603	28.89
N_1 15 kg N	20.50	8.30	11.42	617	30.42
N_2 30 kg N	22.25	8.43	11.80	637	31.23
SEM ±	0.44	—	0.11	0.04	0.22
CD at 5%	1.32	N.S.	0.35	0.12	0.68
Phosphorus levels (kg/ha)					
P_0 control	17.48	7.88	10.77	588	28.66
P_1 20 kg P_2O_5	19.70	8.11	11.37	611	30.00
P_2 40 kg P_2O_5	21.85	8.44	11.96	632	30.80
P_3 60 kg P_2O_5	23.11	8.69	12.33	645	31.26
SEM ±	0.18	0.05	0.11	0.02	0.12
CD at 5%	0.52	0.14	0.23	0.06	0.35

with the help of khurpi. The crop was given two light irrigation to tide over the dry spells during the crop growing period. The plant protection was done by two sprays of copper fungicide, Blitox @ 2% was given against patches of yellow mosaic virus. Observations on growth and yield attributes were recorded from three plants selected randomly per plot in both the years. While the grain and straw yield were recorded from the net plot at harvest and recorded as kg per plot. It was converted into kg/ha by multiplying the conversion factor. All the data recorded were analyzed statistically by the method out lined by (6). The plant samples were collected at branching, flowering and at harvest stage and were grinded and estimated for N-content by “modified Kjeldahls method” (7).

RESULTS AND DISCUSSION

Growth attributes

The growth attributes were significantly affected by different treatments tried in the experiment (Table-1). Rhizobium inoculation (B_2) increased the plant height (97.04 cm), leaf area index LAI (3.59), dry matter accumulation (15.87q/ha), no. of nodules/plant (26.84), fresh weight of nodules/plant (179.61 mg) and no. of branches/plant (18.50) significant differences between VAM (B_1) and control (B_0) were also at the harvest stage. (8), reported the results of field experiment exhibited that synergistic effect exists when co-inoculation of mungbean was done with rhizobium and PSB. Maximum values for number and dry weight of nodules, leghaemoglobin content were recorded with treatment R + PSB + Fluchloralin 0.675 kg/ha, followed by R + Fluchloralin 0.675 kg/ha. Use of biofertilizers (Rhizobium and PSB) proved superior over the control for grain yield, but maximum increase of 16% was recorded with R + PSB + Fluchloralin and R+Fluchloralin treatment over R + PSB and Rhizobium treatments.

Application of nitrogen @ 30 kg/ha (N_2) recorded maximum plant height (93.42 cm), leaf area index LAI (3.69), dry matter accumulation (15.87 q/ha), no. of nodules/plant (28.22), fresh weight of nodules/plant (171.50 mg), no. of branches/plant (18.33). 30 kg N/ha

Table-3 : Nitrogen content (%), nitrogen uptake (kg/ha), phosphorus content (%) and phosphorus uptake (kg/ha) by mungbean as influenced by the bio & chemical fertilizers at harvest stage (seed + straw). (mean (2008 and 2009) kharif data)

Treatments	Nitrogen content (%)	Nitrogen uptake (kg/ha)	Phosphorus content (%)	Phosphorus uptake (kg/ha)
Bio fertilizers				
B_0 control	3.82	57.74	0.401	6.16
B_1 VAM	4.11	64.05	0.451	7.13
B_2 Rhizo.	4.70	75.85	0.542	7.16
SEM ±	0.03	0.59	0.012	0.19
CD at 5%	0.09	1.77	0.037	0.59
N-levels (kg/ha)				
N_0 control	3.51	53.44	0.372	5.77
N_1 15 kg N	4.16	64.57	0.431	6.74
N_2 30 kg N	4.97	79.64	0.490	7.95
SEM ±	0.03	0.59	0.012	0.19
CD at 5%	0.09	1.77	0.037	0.59
Phosphorus levels (kg/ha)				
P_0 control	3.60	47.76	0.321	4.27
P_1 20 kg P_2O_5	3.99	61.81	0.381	5.94
P_2 40 kg P_2O_5	4.46	73.12	0.464	7.62
P_3 60 kg P_2O_5	4.80	80.84	0.560	9.45
SEM ±	0.02	0.71	0.012	0.21
CD at 5%	0.08	2.03	0.035	0.60

though remained at par with 15 kg N/ha (N_1) but significantly differed from that of control (N_0) at the harvest stage. The differences between 15 and 0 kg N/ha (N_1 and N_0) differed significantly. Vedram et al. 2008 have also reported application of nitrogen @ 15 kg/ha together with Rhizobium and Azotobactor inoculation, 40 kg/ha and 15 kg ZnO/ha resulted in grain yield of 936.74, 939.78 and 909.38 kg ha-1respectively. All the three factors individually showed significant effect on yield attributes and nutrient content. It was observed that application of S @ 40 kg/ha resulted in higher content of N,P,K,S and lower Zn content in mungbean whereas ZnO @ 15 kg/ha increased N, K and Zn content and decreased the P and S content at different growth stages in mungbean. These treatments had significant influence on dry matter, height and branches/plant, number of pods/plant, pod length, number of seeds/pod and 1000–grain weight.

On the contrary application of P_2O_5 @ 60 kg/ha (P_3) recorded maximum plant height (96.54 cm), leaf area index LAI (3.90), dry matter accumulation (16.84 q/ha), no. of nodules/plant (30.04), fresh weight of nodules/plant (174.00 mg), no. of branches/plant (19.33) at harvest stage and differed significantly from that of 40 kg P_2O_5/ha (P_2), 20 kg P_2O_5/ha (P_1) and 0 kg P_2O_5/ha (P_0).

Yield attributes

Yield attributes were significantly affected by different treatments tried in the experiment (Table-2). Rhizobium inoculation (B_2) had a significant effect on number of pods/plant (22.00), pod length (8.36 cm), no. of seeds/pod (11.93), seed yield (633 kg/ha) and 1000-seed weight (31.17 g) and differed significantly from VAM (B1) and control (B_0). The nitrogen application @ 30 kg/ha (N2) increased in the no. of pods/plant (22.25), pod length (8.43 cm), no. of seed/pod (11.80), seed yield (637 kg/ha) and 1000-seed weight (31.23 g) and differences were significant from 15 kg N/ha (N_1) and 0 kg N/ha (N_0). Bansal 2009, reported significantly higher number of nodules/plant (21.0), dry weight of nodules/plant (87.66 mg) and grain yield (12.94 q/ha) when inoculation was

done with Rhizobium + PGPR+PSB over other treatments and uninoculated control (8.96 q/ha). The combined inoculation with Rhizobium + PGPR was at par grain yield of 12.14 q/ha.

Application of phosphorus @ 60 kg/ha (P_3) recorded the highest no. of pods/plant (23.11), pod length (8.69 cm), no. of seeds/pod (12.33), seed yield (645 kg/ha) and 1000-seed weight (31.26 g) and differences were significant from 40 kg P_2O_5/ha (P_2), 20 kg P_2O_5/ha (P_1) and 0 kg/P_2O_5/ha (P0) respectively.

Quality Contents

Nitrogen content (%) : Nitrogen content (%) recorded at harvest (seed + straw) is presented in experiment (Table-3). Rhizobium inoculation (B_2) markedly affected nitrogen content (4.70%) and results were significantly different from VAM (B_1) and control (B_0). Increasing levels of nitrogen increased the nitrogen content (%) at all the growth stages. 30 kg N/ha (N_2) recorded maximum nitrogen content (4.97%), at the harvest stage and results were significantly different from 15 kg N/ha (N_1) and 0 kg N/ha (N_0) respectively. Application of 60 kg P_2O_5/ha (P_3) recorded significantly higher N content (4.80%) at harvest stage and differed significantly from rest of the treatments. Although the differences between 40 kg P_2O_5/ha (P_2), 20 kg P_2O_5/ha (P_1), and 0 kg P_2O_5/ha (P_0) were significant.

Nitrogen uptake (kg/ha) : The nitrogen uptake recorded at harvest stage presented in experiment (Table-3). Rhizobium inoculation (B_2) had a pronounced effect on nitrogen uptake at the harvest (75.85 kg/ha) was significantly Different from VAM (B_1) and control (B_0). 30 kg N/ha (N_2) recorded maximum uptake (79.64 kg/ha) of N by the crop at harvest. The differences between 15 kg N/ha (N_1) and 0 kg N/ha (N_0) were also significant. Application of 60 kg P_2O_5/ha (P_3) proved to be an efficient dose and recorded maximum N uptake (80.84 kg/ha) at harvest stage followed by P_2, P_1 and P_0 in sequence.

Phosphorus content (%) : The phosphorus content (%) is presented in experiment (Table-3) Rhizobium inoculation (B_2) influenced P content (0.542%) and results were significantly different from that of VAM at harvest stage. The difference between VAM (B_1) and control (B_0) were also significant. Increasing levels of nitrogen (0 to 30 kg/ha) had a marked effect on P content (%) at all the growth stages and increase was linear. 30 kg N/ha recorded maximum P content (0.490%) and results were significantly different from 15 kg N/ha (N_1) and 0 kg N/ha (N_0) at harvest stage. Application of 60 kg P_2O_5/ha recorded maximum P content (0.560%) at harvest stage.

Phosphorus uptake (kg/ha) : The phosphorus uptake data are presented in the experiment Table-3. Rhizobium inoculation (B_2) had a significant effect on phosphorus uptake (7.16 kg/ha) at harvest stage and differences were significant between rhizobium (B_2) and VAM (B_1) excepting at harvest. Similarly, increasing levels of nitrogen (30 kg N/ha) consistently increased P uptake (7.95 kg/ha) at harvest stage. There were significant differences between the treatments. Increasing levels of phosphorus had a significant effect on P uptake at all the growth stages. By the 60 kg P_2O_5/ha, uptake of P by the crop (9.45 kg/ha) at harvest stage. The differences were significant between the treatments.

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