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GROWTH, YIELD AND NUTRIENT CONTENT OF BLACKGRAM (*Vigna mungo*) AS INFLUENCED BY LEVELS OF PHOSPHORUS, SULPHUR AND PHOSPHORUS SOLUBILIZING BACTERIA

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ABSTRACT

A field experiment was conducted at Allahabad Agricultural Institute-Deemed University, Allahabad to study the effect of levels of phosphorus, sulphur and Phosphorus Solubilizing Bacteria (PSB) on growth, yield and nutrient content of blackgram for consecutive two years 2004 and 2005. The crop growth parameters viz., plant height, number of nodules and number of leaves per plant, yield and nutrient content increased significantly with the application of high levels of phosphorus, sulphur with or without bio-fertilizer inoculation. Application of 60 kg P_2O_5 ha^{-1} recorded maximum plant height (49.9 cm), number of leaves $plant^{-1}$ (50.8), number of nodules $plant^{-1}$(27.8), haulm yield (28.9 q ha^{-1}), grain yield (8 q ha^{-1}) and phosphorus, sulphur and protein content of grain (0.356 %, 0.253% and 22.64%, respectively) as compared to lower levels. Application of Sulphur @ 40 kg ha^{-1} recorded maximum plant height (47.31 cm), number of leaves $plant^{-1}$ (49.80), number of nodules $plant^{-1}$ (25.58), haulm yield (28.80 q ha^{-1}), grain yield (7.92 q ha^{-1}) and phosphorus, sulphur and protein content (0.295 , 0.281 and 21.79%, respectively). Inoculation of blackgram seeds with phosphorus solubilizing bacteria recorded slightly higher grain yield (7.49 q ha^{-1}) as compared to no inoculation (7.39 q ha^{-1}).

Key words: Blackgram, phosphorus, sulphur, PSB, nutrient content

INTRODUCTION

Blackgram (***Vigna mungo***) is one of the important pulse crops grown throughout India. Proper fertilization is essential to improve the productivity of blackgram. It can meet its nitrogen requirements by symbiotic fixation of atmospheric nitrogen. The nutrients which need attention are phosphorus and sulphur

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(Thakur and Negi, 1985; Nandal, et al., 1987). Blackgram is very much responsive to sulphur application (Aulakh, et at., 1997). Both phosphorus and sulphur can improve the quality and quantity of the crop. Hence, the present investigation was undertaken to find out the response of blackgram to different levels of phosphorus, sulphur and PSB application.

MATERIALS AND METHODS

Field experiments were conducted at soil science research farm of Allahabad Agricultural Institute-Deemed University, Allahabad for two consecutive years (2004 and 2005) with blackgram. The soil of the experimental plot was sandy loam having pH 7.8, organic carbon 0.31%, and the available N, P S and K 213, 23.40, 13.55 and 230.10 kg ha^{-1} respectively. The experiment was carried out in a randomized block design with three replications. The treatments consisted of three levels of phosphorus (0, 30 and 60 kg ha^{-1}), three levels of sulphur (0, 20 and 40 kg ha^{-1}) with or without PSB inoculation. The PSB culture "microphos" containing inoculums of *Pseudomonas straita* was used for inoculation blackgram @ 10 g kg^{-1} of seed. Growth parameters viz., plant height, number of leaves per plant and number of nodules per plant were recorded at 20 days interval, where as yield parameters (grain and haulm yield qha^{-1}) were recorded at harvesting stage and averages were calculated and statistically analysed by ANOVA technique (Fisher, 1950). Phosphorus and sulphur content in grains was estimated by wet digestion method, and protein content by multiplying factor 6.24 to nitrogen content.

RESULTS AND DISCUSSION

Effect on growth and yield

Growth, yield and nutrient status parameters (plant height, number of nodule, number of leaves per plant, grain yield, haulm yield, phosphorus content, sulphur content and protein content) of blackgram increased significantly with higher levels of phosphorus, sulphur and PSB inoculation during both the years (Table 1). Among different phosphorus levels, phosphorus @ 60 kg ha^{-1} recorded comparatively higher growth and yield. An increase of about 59.61, 19.71, 19.49 and 12.78% in plant height, number of leaves, grain yield and haulm yield, respectively was observed as compared to control. Among the sulphur levels, sulphur @ 40 kg ha^{-1} significantly increased the plant height (39.59%), number of leaves $plant^{-1}$(15.86), grain yield q ha^{-1} (13.46%) and haulm yield (10.93%) of blackgram as compared to no sulphur application. Inoculation of seeds with PSB also showed positive response as compared to no inoculation by producing taller plants, more number of leaves and nodules $plant^{-1}$. An increase of about 4.0, 1.77, 1.35and 1.10% in plant height, number of leaves, grain yield and haulm yield respectively was observed with PSB seed treatment as compared to without seed treatment .With increasing levels of phosphorus, the response of sulphur also increased significantly. Similar results were

observed by Aulakh and Pasrich (1978) and Arunachalam, et al., (1995). The significant role of sulphur in increasing the growth and yield might be attributed to its role in chlorophyll synthesis.

Phosphorus @ 60 kg ha^{-1} produced significantly maximum grain and haulm yield of 8.02, 8.06 and 8.04 q ha^{-1} 28.90, 28.96 and 28.93 q ha^{-1}during 2004, 2005 and pooled data respectively. Sulphur application significantly influenced the grain and haulm yield of blackgram. Maximum grain yield during 2004, 2005 and pooled data respectively (7.90, 7.94 and 7.92 q ha^{-1}) and haulm yield (28.77, 28.83 and 28.80 q ha^{-1}) was observed with the application of sulphur @ 40 kg ha^{-1} as compared to lower levels. The increase in yield might be due to vigorous growth which helped the plants in more absorption of nutrients from the soil (Singh, et al., 1994). The results were in line with those of Dubey, (1996) and Karwasara and Roy, (1984).

Nutrient content

Phosphorus and sulphur content in grains of blackgram increased with increasing levels of phosphorus, sulphur and PSB application during both the years and pooled data as shown in table 2. Application of Phosphorus @ 60 kg ha^{-1}, Sulphur @ 40 kg ha^{-1} and inoculation with PSB culture recorded maximum nutrient concentration of 0.356, 0.295 and 0.301% of phosphorus content, whereas 0.253, 0.281 and 0.247% sulphur content in grains compared to lower levels and without inoculation. Phosphorus solubilizers increased the availability thereby improved phosphorus and sulphur nutrition of plant and uptake of nutrient manifested in increased concentration (Trivedi, 1996). These results are in conformity with the findings of Raut et al. *(*2000).

Higher sulphur content in grains with fertilizer application might be due to higher absorption of nutrients as the pool of available nutrients increased in the soil. Dubey et al., 1999; Stewat and Whitfield, 1985 also reported that addition of sulphur produced plants with high content of both nitrogen and sulphur.

Protein content improved with the increasing levels of sulphur and phosphorus. An increase of 10.27, 1.77 and 3.53% in protein content was recorded during 2004, 2005 and pooled data respectively as shown in table 2. The maximum content of protein was recorded at the highest levels of applied nutrients. It might be due to enhanced absorption of nitrogen, which ultimately increased the protein content in seeds. Favourable influence of sulphur on protein content was due to synthesis of sulphur containing amino acids and nitrogen uptake. Similar views were also reported by Singh et al. (1992) and Kushwaha and Srivastava (1978).

Table 1: Effect of different levels of Phosphorus, Sulphur and PSB on plant height, number of leaves, number of nodules, grain and haulm yield of blackgram

Treatment	Plant height (cm)			No. of leaves plant^{-1}			No. of nodules plant^{-1}			Grain yield (q ha^{-1})			Haulm yield (q ha^{-1})		
	2004	2005	Pooled	2004	2005	Pooled	2004	2005	Pooled	2004	2005	Pooled	2004	2005	Pooled
P_2O_5 (kgha^{-1})															
0	31.20	31.34	31.27	42.13	42.37	42.25	11.57	11.83	11.70	6.71	6.74	6.72	25.63	25.67	25.65
30	42.07	42.31	42.19	46.56	46.90	46.73	21.17	21.70	21.43	7.56	7.58	7.57	27.41	27.47	27.44
60	49.82	50.12	49.97	50.67	51.03	50.85	27.37	28.27	27.82	8.02	8.06	8.04	28.90	28.96	28.93
CD (P=0.05)	0.235	0.166	0.152	0.192	0.225	0.203	0.180	0.235	0.166	0.043	0.031	0.022	0.144	0.152	0.135
S (kg ha^{-1})															
0	33.80	33.98	33.89	42.82	43.13	42.98	13.63	13.90	13.77	6.88	6.90	6.98	25.93	25.98	25.96
20	42.12	42.33	42.23	46.90	47.20	47.05	21.30	21.90	21.60	7.50	7.54	7.52	27.24	27.29	27.26
40	47.17	47.45	47.31	49.63	49.97	49.80	25.17	26.00	25.58	7.90	7.94	7.92	28.77	28.83	28.80
CD (P=0.05)	0.235	0.166	0.152	0.192	0.225	0.203	0.180	0.235	0.166	0.043	0.031	0.022	0.144	0.152	0.135
PSB															
Without PSB	40.20	40.42	40.31	46.04	46.36	46.20	19.33	19.84	19.59	7.38	7.41	7.39	27.17	27.22	27.19
With PSB	41.20	42.08	41.97	46.87	47.18	47.02	20.74	21.36	21.05	7.47	7.51	7.49	27.46	27.52	27.49
CD (P=0.05)	0.192	0.136	0.124	0.157	0.184	0.166	0.150	0.192	0.136	0.035	0.025	0.018	0.188	0.124	0.111

Table 2: Effect of Phosphorus, Sulphur and PSB on nutrient content in grains and available phosphorus in post harvest soil

Treatment	P-content in grains (%)			S-content in grains (%)			Protein content (%)			Available phosphorus in soil (kg ha^{-1})		
	2004	2005	Pooled	2004	2005	Pooled	2004	2005	Pooled	2004	2005	Pooled
P_2O_5 (kg ha^{-1})												
0	0.23	0.23	0.23	0.23	0.23	0.23	20.46	20.61	20.53	24.69	23.55	24.12
30	0.26	0.26	0.26	0.24	0.24	0.24	21.49	21.77	21.63	27.97	27.59	27.78
60	0.35	0.35	0.35	0.25	0.25	0.25	22.52	22.77	22.64	31.20	30.56	30.88
CD (P=0.05)	0.009	0.011	0.011	0.004	0.004	0.004	0.244	0.263	0.166	0.224	0.117	0.071
S (kg ha^{-1})												
0	0.26	0.26	0.26	0.20	0.20	0.20	21.27	21.55	21.41	27.55	26.83	27.19
20	0.28	0.28	0.28	0.24	0.24	0.24	21.51	21.70	21.60	27.97	27.24	27.60
40	0.29	0.29	0.29	0.28	0.28	0.28	21.68	21.90	21.79	28.34	27.63	27.98
CD (P=0.05)	0.009	0.011	0.011	0.004	0.004	0.004	0.244	0.263	0.166	0.224	0.117	0.071
PSB												
Without PSB	0.26	0.26	0.26	0.24	0.24	0.24	21.21	21.39	21.30	27.47	26.59	27.03
With PSB	0.30	0.30	0.30	0.24	0.24	0.24	21.77	22.04	21.90	28.44	27.88	28.16
CD (P=0.05)	0.008	0.008	0.008	0.003	0.003	0.003	0.203	0.214	0.136	0.183	0.095	0.055

REFERENCES

Arunachalam, L., Purushothaman, S., Palniappan, S.P. and Mark Devesagayam, M. 1995. Response of pigeon pea to phosphorus and sulphur nutrition. *Madras Agricultural Journal*. 82: 266-267.

Aulakh, M. S and Pasricha, N. S.1978. Interaction effect of sulphur and phosphorus on growth and nutrient content of moong. *Plant and Soil*, 47: 341-350.

Dubey, S. K .1996. Response of rock phosphate applied with *Pseudomonas straita* in a typical chromustert. *Journal of Indian Society of Soil Science*, 44 (2): 252-255.

Dubey, Y. P; Kalstha, B. P and Jaggi, R. C.1999. Influence of irrigation and phosphorus on growth, green pod yield and nutrient uptake of pea (*Pisum sativum*) in Lahaul valley of H.P. *Indian journal of Agronomy*, 44: 137-140.

Fisher, R. A.1950. Handbook of Agricultural Statistics. Achal Prakashan Mandir, pp. 332-334.

Kushwaha, P. D and Srivastava, G. P .1978. Effect of nitrogen, phosphorus and inoculation on bio-chemical composition of moong grain. *Indian journal of Agricultural Chemistry*, 11: 43-49.

Karwasara, S. P. S and Roy, M .1984. Yield and sulphur uptake of green gram as affected by sources and levels of sulphur. *International Journal of Tropical Agri*culture,11(4): 331-335.

Nandal, D. P; Malik, D. S and Singh, K. P .1987. Effect of phosphorus levels on Dry matter accumulation of kharif pulses. Legume Research, 19 (1): 31-33.

Raut, R. F; Abdul Hamid; Hadole, S. S and Jeughale, G. S .2000. Effect of irrigation and sulphur on concentration, uptake and availability of sulphur, nitrogen andphosphorus in mustard. *Journal of Soils and Crops*, 10: 145-148.

Singh Pushpundra; Verma, B. S and Sahu, M. P .1994. Effect of levels and sources of phosphorus and bio-regulators on ground nut (*Arachis hypogaea* L.). *Indian journal of Agronomy*, 39 (1): 66-70.

Stewat, B. A and Whitfield, C. J .1985. Effect of crop residues, soil temperature and sulphur on growth of winter wheat. Soil Science Society of American Proceedings, 29: 752-755.

Surendra, Singh; Singh, A. P and Singh, B .1992. Direct and residual effect of pyrites on yield, protein content and sulphur uptake by blackgram and lentil. *Journal of Indian Society of Soil Science*, 40 (3): 584-585.

Thakur, R. C and Negi, S .1985. Effect of fertilizers and rhizobium inoculation in blackgram. *Indian journal of Agronomy*, 30 (4): 501-504.

Trivedi, S. K .1996. Response of blackgram (*Phaseolus mungo*) to nitrogen, phosphorus and sulphur. Legume Research, 19: 7-9

Trivedi, S. K and Sharma .1997. Response of soybean to nitrogen and sulphur fertilization and fate of mustard grown on residual nutrients. Crop Research, 13 (1): 81-85