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Response of black gram (*Vigna mungo* L.) to graded doses of Sulphur under rainfed conditions

Jitendra Singh Jaiswal, Yogita Kashyap and Vivek Bharve

Abstract
A field experiment was conducted during kharif season, 2016-17 at the Department of Agronomy, College of Agriculture, Indore (M.P.). The experimental materials for the present investigation were comprised of 16 treatments combination of nutrients i.e. Sulphur. Significantly increases the mean plant height (cm) at harvest stage (43.41), mean leaf area cm^2/plant (345.79), mean dry matter/plant (12.38), mean no. of pods/plant (25.52), mean no. of seeds/pod (5.98), mean seed yield (1405.83kg/ha), straw yield (1874.17kg/ha), net profit (51662.0 (Rs/ha). Were obtained 30kg/ha Sulphur over control.

Keywords: Rainfed, graded dose, black gram, Sulphur

Introduction
Blackgram (*Vigna mungo* L.) is one of the important kharif pulse crop. It belongs to leguminoseae and sub family papilionaceae, and is being grown as one of the principle crop since ages in Madhya Pradesh as well as in the country. India is the largest producer as well as consumer of black gram. It produce about 15 to 19 lakh tones black gram annually from about 35 lakh ha. of area, with an average productivity of 500kg/ha (Ministry of Agriculture, GOI 2014-15). There exists a vast gap between potential productivity and actual productivity of black gram being realized at present. Black gram being a leguminous crop requires adequate amount of Sulphur as well as apart from other nutrients these are directly involved in growth and development of plant. S is a part of amino acids cysteine and methionine, hence essential for protein production. Sulphur containing amino acid cystine is derived by oxidation of cysteine. Sulphur is involved in formation of chlorophyll, activation of enzymes, and is a part of co-enzyme. Sulphur is known to help in chlorophyll formation, stimulating growth, seed formation and N fixation by enhancing nodule formation. Unlike N, S-deficiency symptoms appear first on the younger leaves, and will persist even after N application. Plants deficient in S are small and spindly with short and slender stalks, growth is retarded, maturity in cereals is delayed, nodulation in legumes may be poor and N fixation reduced, crops with a relatively high requirement of S and sensitive to S deficiency are legumes, oilseed, crucifers, forages etc in that order. Thus, involvement of Sulphur in plants metabolism and yield responses makes Sulphur as the fourth major element after nitrogen, phosphorus and potassium.
In view of the above cited facts the present investigation entitled "Response of Black Gram (V*igna mungo* L.) to Graded Doses of Sulphur under Rainfed Conditions" was carried out with the following broad objectives.

1. To study the effect of Sulphur on growth and development of black gram.
2. To evaluate the effect of Sulphur on yield of black gram.
3. To work out the economic viability of different treatments.

Material and Methods
1.1 Experimental site and details
The present experiment was laid out in the field of the research scheme of AICRP on pulses, department of Agronomy, College of Agriculture Indore during kharif season, 2016. Indore is situated in Malwa plateau region in the Western part of the state of Madhya Pradesh at an altitude of 555.5 meters above mean sea level. It is located at latitude 22.43^0 N and longitudinal of 75.66^0 E. It has subtropical climate having a temperature range of 21^0 C to 45^0 C and 6^0 C to 31^0 C in summer and winter season, respectively. The climate of Chitrakoot is subtropical. The annual average rainfall is 964 mm, most of which received from first week of July to last week of September, with a few showers occur during winter also. Indore knows the effect of Sulphur on growth and yield of kharif black gram (*Vigna mungo* L.). The soil of the experiment field was clayey in texture, low in available nitrogen (211.1 kg ha^{-1}) medium in available phosphorus (10.4 kg ha^{-1}) and also medium in Sulphur 8.76 kg ha^{-1}, available with.5 pH. The blackgram25 Kg/ha seed rate variety JU-18 was

7 sown 30th June 2016 keeping 40 cm inter-row spacing and intra-row spacing of 8 cm was maintained by thinning operation. Recommended dose of 20:40:25 kg NPK ha-1 and other cultural practices were also adopted as per need of crop. The present experiment consisting of the 16 treatment combination was carried out in a Factorial Randomized Block Design.

Factor details: Sulphur levels (4): S_0 = 0 kg/ha, S_1 = 10kg/ha, S_2 = 20kg/ha, S_3 = 30kg/ha.

Note- A Uniform dose of 20kg/ha. N and 20kg/ha K was be given to all Treatment as per practice

Statistical analysis

The data on various parameters were exposed to statistically analyze as drew by Panse and Sukhatme (1967). The treatment variances were tested by using "t" test and critical differences (at 5 and 1 per cent probability).

Result and Discussion

The present chapter deals with experimental finding obtained during the course of investigation. The results obtained from the presented study have been interpreted and presented under the following headings:

1. Pre harvest studies

1.1 Effect of different levels of Sulphur on mean plant population/m^2

Table 1.1: Effect of different levels of phosphorus on plant population/m^2 of black gram at 30 DAS and at harvest stages at 30 DAS and at harvest of the crop.

Factors	Treatments	Mean plant population at different stage	
		15 DAS	At harvest
Sulphur	S_0 –(0 kg S/ha)	36.00	33.16
	S_1 -(10 kg S/ha)	35.91	34.41
	S_2 –(20 kg S/ha)	35.83	34.08
	S_3 –(30 kg S/ha)	35.75	33.58

Data presented in Table 1.1 indicated the mean plant population/m^2 of black gram at 30 DAS and at harvest of the crop. Initially at the time of sowing little higher seed rate was maintained and plant population was made uniform in all the plots by thinning of the plants to maintain higher levels of accuracy in assessing the impact of different treatments under consideration. It is obvious from the data that the differences in plant population due to factors as well as due to their interaction were statistically non-significant so these was no treatment effect because plant population was maintained by thinning.

1.2 Effect of different levels of Sulphur on mean plant height (cm)

Table 1.2: Effect of different levels of phosphorus on plant Height (in cm) of black gram at 30 DAS, 45 DAS, 60 DAS and at harvest stages.

Factors	Treatments	Mean plant height (in cm) at different times			
		30DAS	45 DAS	60 DAS	At harvest
Sulphur	S_o -(0 kg P/ha)	21.01	31.26	37.45	43.10
	S_1 –(10 kg P/ha)	21.05	31.34	37.50	43.29
	S_2 –(20 kg P/ha)	21.35	31.58	37.87	43.37
	S_3 –(30 kg P/ha)	21.60	31.72	37.96	43.41

Data presented in Table 1.2 indicated the mean plant height (in cm) of black gram at 30,45, 60 and at harvest stages increased significantly with increasing doses of Sulphur.

1.3 Effect of different levels of Sulphur on mean no. of root Nodules/plant

Table 1.3: Effect of different levels of phosphorus on mean no. of root nodules of black gram at 30 DAS, 45 DAS, 60 DAS.

Factors	Treatments	mean no. of root Nodules/plant at different Stage		
		30DAS	45 DAS	60 DAS
Sulphur	S_o -(0 kg P/ha)	38.94	51.84	40.01
	S_1 –(10 kg P/ha)	40.01	52.44	43.02
	S_2 –(20 kg P/ha)	40.84	53.11	46.13
	S_3 –(30 kg P/ha)	41.22	53.98	48.31

Data presented in Table 1.3 indicated the mean no. of root nodules of black gram per plant gradually increased with the advancement of growth period up to 45 DAS. There was steep decline in the mean no. of root nodules per plant during the period from 60 DAS to harvesting. Mean no. of root nodules increased significantly with increasing doses of sulphur up to 45 DAS.

1.4 Effect of different levels of Sulphuron mean leaf area (cm^2/plant)

Factors	Treatments	mean leaf area (cm^2/plant)		
		30DAS	45 DAS	60 DAS
Sulphur	S_o -(0 kg P/ha)	154.64	266.89	310.48
	S_1 –(10 kg P/ha)	207.70	286.59	329.22
	S_2 –(20 kg P/ha)	216.45	310.84	333.26
	S_3 –(30 kg P/ha)	219.84	312.32	345.79

Data presented in Table 1.4 indicated that mean leaf area (cm^2/plant) of black gram at 30 DAS, 45 DAS, and 60 DAS of the crop. Increased significantly with doses of sulphur.

1.5 Effect of different levels of sulphur on mean Chlorophyll Content (SPAD)

Table 1.5: Effect of different levels of Sulphuron mean chlorophyll content (SPAD) in black gram leaves at 30 DAS, 45 DAS, 60 DAS and at harvest stages.

Factors	Treatments	mean Chlorophyll Content (SPAD)		
		30DAS	45 DAS	60 DAS
Sulphur	S_o -(0 kg P/ha)	47.58	44.09	37.45
	S_1 –(10 kg P/ha)	48.91	46.25	37.60
	S_2 –(20 kg P/ha)	50.61	47.19	37.68
	S_3 –(30 kg P/ha)	51.89	48.19	37.82

Data presented in Table 1.5 indicated that the mean chlorophyll content in black gram increased significantly with increasing doses of sulphur, up to 45 DAS. While, at 60 DAS is no any significant difference. While, the chlorophyll content (SPAD) decreased with increase of the crop stages.

1.6 Effect of different levels of Sulphur on mean Light intensity by (lux meter)

Data presented in Table 1.6.1, 1.6.2, 1.6.3 indicated that the mean light intensity of black gram crop have no any significant effect of different levels of Sulphur.

Table 1.6.1: Effect of different levels of Sulphur on mean Light intensity at upper leaves of black gram crop at 30 DAS, 45 DAS and 60 DAS on 10 am and 2 pm.

Factors	Treatments	Mean light intensity of upper leaves on 10 am and 2 pm					
		30 DAS		45 DAS		60 DAS	
		10 am	2 pm	10 am	2 pm	10 am	2pm
Sulphur	S_o	644.4	807.8	759.25	773.16	869.91	929.25
	S_1	614.4	781	772.25	791.52	862.16	952.66
	S_2	616.5	815.5	758.58	769.66	865.16	933.41
	S_3	630.5	766	766.83	780.5	892.91	933.33

Table 1.6.2: Effect of different levels of Sulphur on mean Light intensity at middle leaves of black gram crop at 30 DAS, 45 DAS, 60 DAS on 10 am and 2 pm.

Factors	Treatments	Mean light intensity of middle leaves on 10 am and 2pm					
		30 DAS		45 DAS		60 DAS	
		10 am	2 pm	10 am	2 pm	10 am	2pm
Sulphur	S_o	385.0	535.41	584.25	460.7	485.58	656.6
	S_1	393.2	530.18	597.57	449.7	493.00	661.3
	S_2	387.9	526.16	585.83	464.7	484.25	646.3
	S_3	402.3	509.58	589.00	471.7	478.75	650.5

Table 1.6.3: Effect of different levels of sulphur on mean Light intensity at lower leaves of black gram crop at 30 DAS, 45 DAS, 60 DAS on 10 am and 2 pm.

Factors	Treatments	Mean light intensity of lower leaves on 10 am and 2 pm					
		30 DAS		45 DAS		60 DAS	
		10 am	2 pm	10 am	2 pm	10 am	2pm
Sulphur	S_o	180.7	244.83	203.14	251.9	258.7	267.4
	S_1	178.5	259.25	210.83	246.4	260.7	280.4
	S_2	190.0	264.16	205.58	241.8	261.3	276.0
	S_3	188.8	253.33	186.50	244.5	246.9	268.5

2. Post-harvest studies

Factors	Treatments	After harvest					
		Pods/plant	Seed/ pod	Seed index	Seed yield (kg/ha)	Straw yield(kg/ha)	B:C Ratio
Sulphur	S_o	24.44	5.33	3.18	970.08	1436.82	3.79
	S_1	24.87	5.49	3.23	1186.33	1663.25	4.58
	S_2	25.41	5.90	3.28	1337.00	1831.83	5.46
	S_3	25.52	5.98	3.33	1405.83	1874.17	5.16
	S. Em (+)	1.46	0.62	0.17	152.89	145.43	-
	C.D.	4.23	1.81	0.50	NS	NS	-

A field experiment was conducted at Allahabad Agricultural Institute- Deemed University, Allahabad to study the effect of levels of phosphorus, and Phosphorus Solubilizing Bacteria (PSB) on growth, yield and nutrient content of black gram 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 with or without bio-fertilizer inoculation. Mir *et al.* (2013) [8]. The similar results were reported by Abraham and Lal (2004) [1], Chaudhry *et al.* (2016) [3], Karache *et al.* (2012) [6], Kokani *et al.* (2014) [7].

Gupta and Sharma (2006) [5] reported the results of a study which revealed inoculation with PSB and Phosphorus fertilization (60kg $P_2O_5ha^{-1}$) in influencing the seed yield.

Economics of treatments

The cost of production varied according to the cost of inputs incurred for employing a particular treatment as prescribed the mean cost of production incurred on the main treatments factors *i.e.* S levels of S0- (0kg ha-1), S1- (10kg ha-1), S2- (20kg ha-1), S3 – (30kg ha-1).The corresponding values of gross returns for these treatments were Rs. 42912, Rs 46951.16, Rs 51794.16, Rs. 63850.50, Rs 42912, Ra 53534.34, Rs 65803.00, Rs 64062.84 respectively. The mean net returns due to S treatments of S_0- (0kg ha^{-1}), S_1- (10kg ha^{-1}), S_2- (20kg ha^{-1}) and S_3 – (30kg ha^{-1}) was, Rs 31592, Rs 41854.34, Rs 53763, Rs 51662, respectively along with B : C ratio 3.79, 4.58, 5.46, 5.16 for the same S treatments. The increases in mean net returns due to S treatments S_1- (10kg ha^{-1}), S_2- (20kg ha^{-1}) and S_3 – (30kg ha^{-1}) over S_0- (0kgha^{-1}). These findings are in agreement with the findings of Chettri and Mondal (2004) [4].

4. Conclusion

Increasing doses of Sulphur up to 30 kg increased the growth and yield of black gram. The result lead to conclude that for achieving higher production, as well as net return, gross return from the crop may be fertilized with 30 kg S ha^{-1}

5. Suggestions for further work

On farm studies may be conducted to confirm the results seeking farmer's participation. In such studies other nutrients particularly NPK and Zinc and boron may also be combined and tried. The similar study can be tried in other pulses like pigeon-pea, lentil, pea and cowpea and also intercropping with black gram e.g. sorghum + black gram, cotton + black gram, etc.

6. Reference

1. Abraham T, Lal RB. Performance of black gram (*Vigna mungo* L.) under integrated nutrient management in a legume based cropping system for the inceptions of NEPZ. Indian J. Dry land Agric. Res. & Dev. 2004; 19(1):81-87.
2. Anonymous. Ministry of Agriculture, GOI, 2014-15.
3. Chaudhary MS, Singh S, Prasad M. Effect of nutrient management on yield and yield attributes of blackgram (*Phaseolus mungo* L.) in an Inceptisol of varanasi. International Journal of Applied and Pure Science and Agriculture (IJAPSA). 2016; 2(6).
4. Chettri M, Mondal SS. Response of black gram to different levels of potassium and sulphur under irrigated and non-irrigated condition. Legume Res. 2004; 27(4):265-269.
5. Gupta A, Sharma VK, Sharma GD, Chopra P. Effect of Biofertilizer and phosphorus levels on yield attributes yield and quality of urdbean (*Vigna mungo*). Indian Journal of Agronomy. 2006; 51(2):142-144.
6. Karache RP, Dalwadi MR, Patel JC, Gaikwad VP, Panchal DB. Influence of phosphorus and sulphur on yield and nutrient uptake by summer cluster bean grown on typicustochrept of anand. An Asian Journal of Soil Science. 2012; 7(2):239-241.
7. Kokani JM, Shah KA, Tandel BM, Nayaka P. Growth, yield and yield of summer blackgram (*Vigna mungo* L.) as influenced by FYM, phosphorus and sulphur. Journal of Environmental Sciences. 2014; 6:429-433.
8. Mir AH, Lal SB, Salmani M, Abidand M, Khan l. Growth, Yield and nutrient content of black gram (*Vigna mungo*) as influenced by levels of phosphorus, sulphur and phosphorus solubilising bacteria. SAARC Journal Agri. 2013; 11(1):1-6.
9. Singh YP. Role of Sulphur and phosphorus in blackgram (*V. mungo*) production. Fertilizer News. 2004; 49(2):33-36
10. Singh YR, Agrawal RL. Effect of Sulphur levels on yield, nutrient uptake and quality of black gram (*V. Mungo*). Indian Journal of Agronomy. 1998; 43(3):448-452