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Productivity of Soybean as Influenced by Sources and Rates of Sulphur

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Abstract: *A field experiment was conducted during Kharif 2006 at agricultural college farm, department of Soil Science and Agricultural Chemistry, Marathwada Agricultural University, Parbhani. The soil of the experimental plot was medium black with clay texture. Before sowing, initial soil sample was taken from 0-15 cm depth. Soil of Parbhani is brown to black in colour, with adequate content of calcium carbonate. The deep black soils are classified as Vertisols. These soils are fine calcareous, montmorillonite, isohyperthermic member of the family of chromusterts. The experiment was conducted in Randomized Block Design with eleven treatments and three replications, consisting of four levels (0, 20, 40 and 60 kg S ha*$^{-1}$*) and four sources of sulphur. i.e. gypsum, SSP, sulphur bentonite and elemental sulphur. The results indicated that, Soybean showed positive response to sulphur fertilization by increasing grain, straw and biological yield. There was linear increase in grain and straw yield with increasing rates of S from all the four sources. All the treatments have recorded increase in grain and straw yield over lower levels and control.*

Keywards: *Soybean productivity, grain, fodder and straw yield, forms of sulfur*

INTRODUCTION

Soybean (*Glycine max.* L Merill) is a leguminous crop and belongs to the family leguminoceae with subfamily papilionaceae. Soybean is originated in China which is basically a pulse crop, but is gaining importance as an oilseed crop. Soybean is a nature's versatile plant. It gives 2-3 times more protein yield per hectare than the other leguminous oilseed crops. It contains about 40-44% protein, 23% carbohydrate and 20% cholesterol free oil.

Soybean protein is rich in valuable amino acids, lysine (5%) which is deficient in most of the cereals. It also contains 60% poly-unsaturated fatty acids, (52.8% linolenic acid + 7.2% linolenic acid), Vitamin A (710 I.U.), Vitamin B (300 I.U.) and Vitamin C,D,E,K. and it also contains 0.69% phosphorus, 0.0115% iron, 0.024% calcium and other essential amino acids. It has high calories value releasing 432 calories from 100 g edible protein as compared to 350 calories from cereals of the same quantity. Soybean is the crop of the warm temperature to tropical zone, thriving best on a wide range of pH and soil types. There must be good rooting condition for obtaining higher yield. Good yield can be achieved by balanced nutrition. Sulphur plays a multiple role in the formation of oil compounds, synthesis of sulphur containing amino acids, biosynthesis of proteins, nitrogen and carbohydrate metabolism, involvement in biological nitrogen fixation by promoting nodulation in legumes and heavier grain of oilseeds; hence it improves the quantity and quality of both pulses and oilseeds. Sulphur has rapidly become recognized as the fourth major limiting nutrient around the world next to nitrogen, phosphorus and potassium. In some areas of India, sulphur is the second or third limiting nutrient.

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MATERIALS AND METHODS

The present investigation was undertaken to ascertain the productivity of soybean as influenced by sources and rates of sulfur was conducted at agricultural college farm of Marathwada Agricultural University, Parbhani during *Kharif* season, 2006-2007. A field experiment was conducted during *Kharif* 2006 at agricultural college farm, department of Soil Science and Agricultural Chemistry, Marathwada Agricultural University, Parbhani. The soil of the experimental plot was medium black with clay texture. Before sowing, initial soil sample was taken from 0-15 cm depth. The experiment was conducted in Randomized Block Design with eleven treatments and three replications, consisting of four levels (0, 20, 40 and 60 kg S ha^{-1}) and four sources of sulphur. *i.e.* gypsum, SSP, sulphur bentonite and elemental sulphur.

The recommended doses of fertilizers are 30: 60: 30 kg N, P_20_5 and K_20 ha^{-1} for soybean crop. Nitrogen, phosphorus and potassium were applied through urea (46% N), DAP (46% P_20_5) and MOP (60% K_20) respectively. Entire dose of N, P, K and S was applied at the time of sowing. Sources like gypsum, SSP, sulphur bentonite and elemental sulphur were applied three weeks prior to sowing of soybean. Calculated quantities of NPK and S through various sources were applied. Entire dose of N, P, K and S was applied at the time of sowing. Sources like gypsum, SSP, sulphur benotonite and elemental sulphur were applied three weeks prior to sowing of soybean. After harvest of the crop the grain and dry matter yield from net plot was recorded.

The details of sulphur are as follows.

Rates of Sulphur Application

L_0 – Control	L_1 – 20 kg S ha^{-1}
L_2 – 40 kg S ha^{-1}	L_3 – 60 kg S ha^{-1}

RESULT AND DISCUSSSION

Sulphur has a crucial role in seed production. Legumes are known to respond favourably to the application of sulphur.

Grain Yield of Soybean

From the data presented in Table 1, it was observed that the soybean crop responded to sulphur application. All the sulphur treatments have recorded significantly higher yield over control. There was linear increase in grain yield with increasing levels of sulphur. The grain yield was also variable with respect to sources. Highest grain yield (24.97q ha^{-1}) was recorded with T_{11} *i.e.* 60 kg S ha^{-1} through elemental sulphur however this yield was at par with the treatments T_{10}, T_8, T_7,T_5 and T_2. (23.40, 24.73, 23.00, 24.09 and 23.65). Here all the three sources *i.e.* gypsum, elemental sulphur, sulphur benotonite @ 40 and 60 kg S ha^{-1} and S though SSP were at par with each other. Thus the application of S through sulphur benotonite, elemental sulphur and gypsum @ 40 kg S ha^{-1} and S through SSP. were found superior for getting optimum yield of soybean. The application of recommended dose of P through SSP (45 kg S ha^1) was at par with 40 kg S ha^{-1} through elemental S, benotonite S and gypsum with respect to soybean yield.

Table 1
Effect of sulphur sources and their rates on grain and Straw yield and biological yield of soybean

Treatment	*Grain yield (qha⁻¹)*	*Straw yield (qha⁻¹)*	*Total biological yield (q ha⁻¹)*
T_1 (NPK) Control	18.98	20.06	39.04
T_2 (NPK) P through SSP	23.65	22.90	46.55
T_3 (NPK) 20 kg S Gypsum	20.85	21.24	42.09
T_4 (NPK) 40 kg S Gypsum	22.49	22.86	45.35
T_5 (NPK) 60 kg S Gypsum	24.09	23.18	47.27
T_6 (NPK) 20 kg S Bentonite	21.39	22.86	44.25
T_7 (NPK) 40 kg S Bentonite	23.00	24.88	47.88
T_8 (NPK) 60 kg S Bentonite	24.73	25.88	50.61
T_9 (NPK) 20 kg S Elemental	21.89	24.70	46.59
T_{10} (NPK) 40 kg S Elemental	23.40	26.20	49.60
T_{11} (NPK) 60 kg S Elemental	24.97	26.70	51.67
S.E. ±	0.74	0.68	1.07
C.D. at 5% level	2.22	2.04	3.17

Table 2
Treatments

1.	NPK	(S control)
2.	NPK	(P through SSP)
3.	NPK	+ S 20 kg ha^{-1} through gypsum
4.	NPK	+ S 40 kg ha^{-1} through gypsum
5.	NPK	+ S 60 kg ha^{-1} through gypsum
6.	NPK	+ S 20 kg ha^{-1} through S Bentonite
7.	NPK	+ S 40 kg ha^{-1} through S Bentonite
8.	NPK	+ S 60 kg ha^{-1} through S Bentonite
9.	NPK	+ S 20 kg ha^{-1} through Elemental sulphur
10.	NPK	+ S 40 kg ha^{-1} through Elemental Sulphur
11.	NPK	+ S 60 kg ha^{-1} through Elemental Sulphur

Table 3
Other details of the experiment

1.	Plot size.	=	Gross = 5.4 m × 4.0 m Net = 4.5 m × 2.5 m
2.	Total number of Plots	=	33
3.	Row to row spacing	=	45 cm
4.	Plant to plant spacing	=	5 cm
5.	Method of sowing	=	Dibbling
6.	Date of sowing	=	12th July, 2006
7.	Variety of soybean	=	JS-335
8.	Design of the experiment	=	RBD
9.	Seed rate	=	75 kg ha^{-1}
10.	Date of harvest	=	29th Nov, 2006
11.	Gross plot size	=	5.4 m × 4.0 m
12.	Net plot size	=	4.5 m × 2.5 m
13.	No. of treatments	=	11
14.	No. of replications	=	3
15.	Total No. of plots	=	33

Straw Yield of Soybean

The data presented in Table 1. Showed significant variation in straw yield of soybean, with different sources of sulphur and their rates of application, graded levels of sulphur application found beneficial resulting significant increase in straw yield over control and lower levels too. Highest straw yield (26.70 q ha^{-1}) was recorded with T_{11} i. e. 60 Kg S ha^{-1} through elemental sulphur, however this yield was at par with 40 kg S ha^{-1} through same source (26.20 q ha^{-1}), 60 kg S ha^{-1} and 40 kg S ha^{-1} through sulphur benotonite (25.88 q ha^{-1} and 24.88 q ha^{-1}). Thus the application of 40 kg S ha^{-1} through S benotonite or elemental sulphur were found superior for getting optimum straw yield of soybean.

Total Biological Yield

The total biological yield of soybean varied from 39.04 q ha^{-1} to 51.67 q ha^{-1} with control and 60 kg S ha^{-1} through elemental sulphur respectively. Total biological yield with the treatment T_{11}, T_{10}, T_8 was at par with each other. The total biological yield with T_7 *i.e.* 40 kg S through bentonite S T_{10} *i.e.* 40 kg S through elemental sulphur indicating the optimum dose for getting good total biological yield of soybean. The application of sulphur significantly increased the seed yield and straw yield over control. It might be due to sulphur application which plays a role in the synthesis of chlorophyll, a part of active centre of some enzymes and affects various metabolic processes, which ultimately help in growth and development of plant. Significant increase in seed and straw yield of soybean with application of sulphur @ 50 kg S ha^{-1} over control. Lower dose of sulphur was slightly less effective than the higher dose (Sharma,2003) Agrawal and Verma (2000).

The application of S and P at four levels increased the seed and straw yield up to highest level of P and S application but were significant up to 60 kg P_2O_5 ha^{-1} and 40 kg S ha^{-1} (Agrawal and Verma 2000 and Singh, 2003) Significant increase in dry matter with the increasing S levels up to 60 kg S ha^{-1} in alfisols, whereas in case of vertisol increase in yield was obtained up to 40 kg S ha^{-1} level of application (Shreemannarayana, *et al.*, 1993). Significant difference in dry matter yield with 60 kg S ha^{-1} over 40 kg S ha^{-1} were not observed. It might be due to toxic level of SO_4 accumulation in plant tissue. Application of S and K in mustard, responded significantly to increase seed and straw yield (Mishra 2003) Highest seed yield (2035 kg ha^{-1}) and straw yield (5577 kg ha^{-1}) of mustard was recorded with the application of S @ 40 kg ha^{-1},which were 27.59 and 37.64 per cent higher over control (Paliwal 1999).

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