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Effect of Different Sources and Rates of Sulphur Application on Quality Parameters of the Soybean

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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, Sulphur application was found beneficial in influencing quality of seeds by increasing the test weight, oil content, oil yield and protein content. Sulphur application showed significant variation in oil content and oil yield. Highest oil content was obtained at 40 kg S ha^{-1} through sulphur bentonite (21.63 per cent). While highest oil yield was obtained as 535.18 kg ha^{-1} with 60 kg S ha^{-1} through elemental sulphur which was at par with 60 kg S ha^{-1} through sulphur bentonite. Thus, increased oil yield was due to cumulative effect of increased oil content and seed yield response to S application. Significant differences were observed in case of protein content and test weight of seed and highest protein content (39.29%) were noted with 60 kg S ha^{-1} through sulphur bentonite. And highest test weight of seed (12.37%) was recorded with 60 kg S ha^{-1} trough elemental sulphur and it was at par with the 40 kg S ha^{-1} through same source.*

INTRODUCTION

Soybean (*Glycine max. Lm 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 has high calories value releasing 432 calories from 100 g edible protein as compared to 350 calories from cereals of the same quantity. Being a leguminous crop, it helps in fixing atmospheric nitrogen in soil and improves the soil fertility and productivity, due to which higher cost benefit ratio, less requirement of nitrogenous fertilizers and beneficial effects on crops and soil conservation. And hence it is called as the "Gold of Soil." In present condition soybean occupied major part of market with new processed products of soybean, like soy nuggets, soy granules, soy flour, soybean oil, and soy cheese or tofu and soy milk. Due to its higher nutritive value, soybean is rightly called pearl of orient, Cinderella crop, yellow jewel, great treasure etc. Soybean has globally emerged as a 'functional food of century' attributed to diverse nutracential benefits derived from it, *viz.* cholesterol free and PUFA (Poly Unsaturated Fatty Acid) rich oil good for heart patients, lactose free milk suitable for lactose intolerant children, vitamin E as antioxidant, and high levels of isoflavones, which can reduce the risk

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of hazardous diseases like heart attack, kidney stones, asteoporasis and breast cancer (Kalpana and velayntham, 2005).

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. The 100 seeds from each plot were collected and weighed. Oil percentage in soybean seed was determined with Soxhlet apparatus using petroleum ether as an extractant (Plummer, 1998). The formula for calculation of oil percentage is-

$$\text{Oil percentage} = \frac{\text{Weight of oil}}{\text{Weight of seed sample}} \times 100$$

The crude protein content was obtained by multiplying the percentage of nitrogen in grain sample by a constant factor 6.25 (AOAC, 1975).

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 is essential for protein production and activation of enzyme. It is a constituent of the amino acids like cysteine, cystine and methionine. And it involves in the formation of glucosides or glusinolates which on hydrolysis increase the oil content and improve its quality too. Thus sulphur application was found beneficial in influencing quality of seeds by increasing its test weight, protein content, oil content and oil yield. Data presented in Table 1 showed significant variation in test weight, protein content, oil content and oil yield. Test weight of soybean ranged from 10.38 to 12.37. While the highest test weight was recorded at 60 kg S ha^{-1} (12.37g) through elemental sulphur and it was at par with 40 kg S ha^{-1} (12.30g) through the same source and also at par with 60 kg S ha^{-1} (12.15g) through gypsum.

Protein content varied from 36.99 per cent to 89.25 per cent and highest protein content was

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. $\pm$	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

obtained at 60 kg S ha^{-1} (39.29%) through sulphur bentonite source and it was at par with 40 kg S ha^{-1} through the same source. While sources *i.e.* gypsum, sulphur bentonite and elemental sulphur were at par with each other. While oil content showed significant variation and highest oil content was obtained at 40 kg S ha^{-1} through sulphur bentonite (21.63%) which was significantly superior over control. Oil content ranged from 18.74 per cent to 21.63 per cent. While all the three sources *i.e.* gypsum, elemental sulphur and sulphur bentonite was at par with each other.

Oil yield also showed significant variation, in which highest oil yield was obtained at 60 kg S ha^{-1} (535.18 kg ha^{-1}) through elemental sulphur and at 60 kg S ha^{-1} (535.05 kg ha^{-1}) through sulphur bentonite and it was at par with 40 kg S ha^{-1} through elemental sulphur and sulphur bentonite respectively. Increase in test weight of seeds reflected in the health of seed which eventually influenced by protein and oil content of seeds (Dongarkar and Pawar 2005). Sulphur significantly influenced 100 seed weight (g). It gave significantly highest test weight with 40 kg S ha^{-1} over control and 20 kg S ha^{-1}, which may be due to more synthesis of amino growing region and increasing cell division. Increased oil yield was due to cumulative effect of increased oil content and seed yield response to application of sulphur recorded about 4 per cent increase in oil content over control in sunflower (Gangadhara, *et al.,* 1990). The higher percentage of crude protein, oil yield and test weight were recorded at 60 kg elemental sulphur ha^{-1} (Singh *et al.,* 2000) in niger crop. The application of 60 kg S ha^{-1} significantly increased the oil content by 21.27 per cent over control. However 40 kg S ha^{-1} significantly increased the protein content of seed by 12.51 per cent over control in taramira (Singh and Pareek 2003) Similar results were reported by Kalaiyarasan and Vaiyapuri (2003) in groundnut, Misra (2003) in mustard, Poonia (2003) in sunflower, Tripathi and Hazra (2003) and Jadhav and Ingole (2004) in groundnut.

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