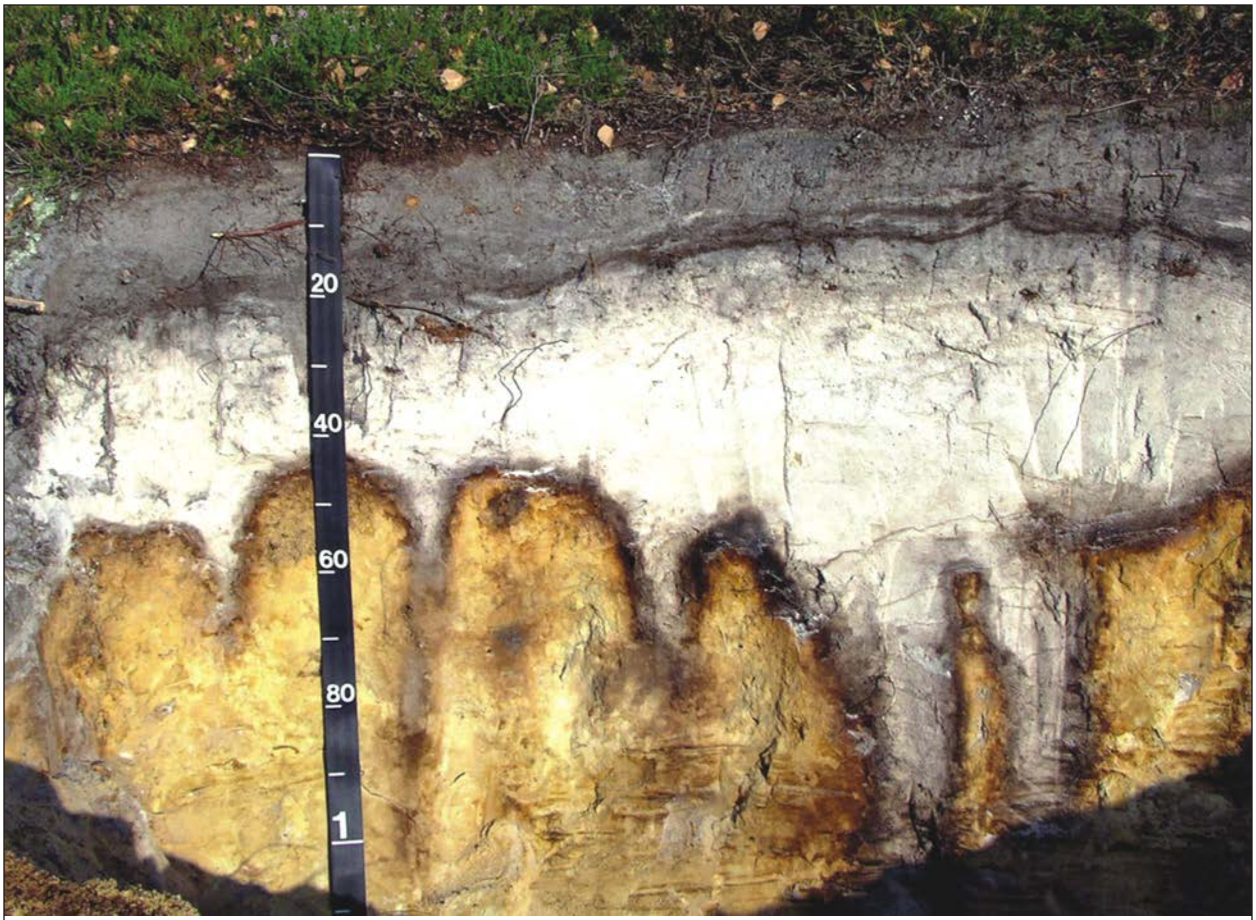

International Journal of

Soil Science

ISSN 1816-4978

Academic Journals Inc.

www.academicjournals.com

International Journal of Soil Science 2 (4): 278-285, 2007
ISSN 1816-4978

Sulphur Levels on Nutrient Uptake and Yield of Sesame Varieties and Nutrient Availability

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Abstract: A field experiment was conducted in sandy clay loam soils to study the influence of sulphur on yield of sesame and nutrient uptake and available nutrient status at different growth stages of the crop during summer season of 2005 in Randomized Block Design (FRBD) with three replications. Three sesame varieties (TMV 4, TMV 6 and KS 95010) were tested with five levels of sulphur (S_0: 0, S_{15}: 15, S_{30}: 30, S_{45}: 45 and S_{60}: 60 kg S ha^{-1}). The available sulphur (S) was found to be higher at higher levels of S because of treatmental variation but the available nitrogen (N), phosphorus (P) and potassium (K) status in soil was decreasing with increased levels of S due to enhanced crop growth and development. The maximum S uptake was at 60 kg S ha^{-1} and N uptake was at 60 kg S ha^{-1} because increased S uptake accelerated increased N utilization. Maximum P uptake was with 45 kg S ha^{-1} due to the positive interaction i.e., S application might have been increased P availability in soil by reducing the soil pH. The K uptake was higher with 60 kg S ha^{-1} to KS 95010. Application 60 and 45 kg S ha^{-1} recorded higher seed yield and KS 95010 was significantly superior over varieties. The highest seed yield was obtained from KS 95010 with the application of 60 kg S ha^{-1}. The physical optimal rate was 47.27 kg S ha^{-1} and the economic optimal rate was 46.09 kg S ha^{-1}. The highest levels of S increased crop uptake and resulted in better seed yield. The results revealed that 60 kg S ha^{-1} increased the nutrient uptake and yield of sesame and maintain the soil available nutrient status and the optimum level of S can be fixed as 48 kg ha^{-1}.

Key words: Sesame, sulphur, yield, available, uptake

INTRODUCTION

Oilseeds are important constituent in human dietary system next to carbohydrate and protein, (Pal and Gangwar, 2004). Among the oilseeds crops, sesame has the highest oil content of 46-64% (Goel and Sanjayakumar, 1994). Sulphur (S) plays a vital role in chlorophyll formation (Singh *et al*., 2000) and constituent of a number of organic compounds (Shamina and Imamul, 2003); oil storage organs particularly oil glands (Jaggi *et al*., 2000) and vitamin B_1 (Thirumalaisamy *et al*., 2001). Sulphur increases cold resistance and drought hardiness (Patel and Shelke, 1995). Sulphur requirement of sesame is equal to that of phosphorus (Scherer, 2001). The response of sesame to S for producing higher yield ranges between 40 kg ha^{-1} (Nagwani *et al*., 2001; Kathiresan, 2002) and 50 kg ha^{-1} (Sarkar and Panik, 2002). As the intensity of cropping is gradually increasing, the response of oilseeds to sulphur is also increasing (Ghosh *et al*., 2002). Use of high analysis S free fertilizers, heavy S removal by the crops under intensive cultivation and neglect of S replenishment contributed to

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widespread S deficiencies in arable soils. Hence this study was attempted to study the importance of S in realizing the better nutrient uptake and yield in sesame crop and available nutrient status of the soil at different stages of crop growth.

MATERIALS AND METHODS

Experimental Site, Design and Treatment Details

The experiment was conducted in a sandy clay loam soil of Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Union Territory of Pondicherry, India during the year 2004-2005. The experimental site is situated 12 km from Bay of Bengal, lies between 10° 49' and 11° 01' North latitude and 78° 43' and 79° 52' East longitude with an altitude of 4 m above Mean Sea Level (MSL). The initial soil analyses show that the soil was sandy clay loam in texture falls in *Fluventic haplustept* taxonomic class. The soil was optimum in bulk density (1.25 M g^{-3}) and particle density (2.20 M gm^{-3}) with the porosity of 43.18%. The soil reaction was neutral (pH: 7.61) and the Electrical Conductivity was low (0.35 dS m^{-1}). The soil was low in available nitrogen ($KMnO_4$-N: 146 kg ha^{-1}) and available potassium (NH_4OAc-K: 145 kg ha^{-1}), medium in available phosphorous (Olsen-P: 12.6 kg ha^{-1}) and high in organic carbon content (0.88%). The sulphur content was 16.9 kg ha^{-1}.

The experiment was conducted during summer season 2005 in Randomized Block Design (RBD) with three replications. Three sesame varieties (TMV 4, TMV 6 and KS 95010) were tested to five levels of sulphur (S_0: 0, S_{15}: 15, S_{30}: 30, S_{45}: 45 and S_{60}: 60 kg S ha^{-1}) (Table 1). The sulphur (S) was supplied through gypsum as per the treatments to the corresponding plots. The nitrogen (N) was supplied through di-ammonium phosphate (at the rate of 35 kg N ha^{-1}) in three splits half at basal and remaining half in two equal splits at vegetative stage (VS) and at flower initiation stage (FI); phosphorous (P) (at the rate of 23 kg P_2O_5 ha^{-1}) was supplied through Di-Ammonium Phosphate as basal; potassium (K) (at the rate of 23 kg K_2O ha^{-1}) through muriate of potash as basal. Thinning was done twice at 15 and 30 days after sowing. The Dry Matter Production (DMP) was recorded at VS, FI and Harvest Stage (HS). The N, P, K and S content in plant was analyzed and recorded at VS and FI and by seeds and stover. Multiplying the DMP with nutrient content, the nutrient uptakes were calculated. The soil available N, P, K and S were analyzed at VS, FI and post harvest stage (PH). The crop was harvested separately from the plots, harvested and winnowed and grain yield was recorded. The observations collected from the experiment and the data on the results of analysis of plant samples were subjected to statistical scrutiny as per the procedure of Gomez and Gomez (1984).

Table 1: Sulphur application on seed and stover yield sesame varieties

	Seed yield (kg ha^{-1})				Stover yield (kg ha^{-1})			
	Varieties				Varieties			
S levels	TMV 4	TMV 6	KS95010	Mean	TMV 4	TMV 6	KS95010	Mean
S_0	424	431	433	430	2952	3020	3069	3014
S_{15}	509	532	501	514	2994	3066	3086	3049
S_{30}	588	562	593	581	3055	3118	3152	3108
S_{45}	598	610	597	601	3106	3165	3200	3157
S_{60}	554	591	617	587	3109	3178	3207	3165
Mean	535	545	548		3043	3110	3143	
	S	V	S×V		S	V	S×V	
S Ed	7	5	11		19	15	33	
CD	14	10	23		39	30	NS	

ns: non significant

RESULTS AND DISCUSSION

Effect of Sulphur on Available S, N, P and K at Different Stages of Growth

Available Sulphur at Different Stages

The soil available S status was significantly influenced by S levels at VS, FI and PH. Soil available S was higher at 60 kg S ha^{-1}. This could be quite possible that higher the supply of S keeps higher availability in soil. The lowest value for soil available S was observed under S control plot, where the S was not supplemented (Table 2). Increased supply of any nutrient increases availability and it was reported for N by Prabhu (2004).

Available N, P and K

Though the application of S might increased the N, P and K availability as synergistic, the available N, P and K recorded in soil at higher levels of S decreased due to uptake by the crop. As such, application of S increased the growth and yield and nutrient uptake of crop. This probably resulted in low available N, P and K at all stages of crop growth with higher doses of S (Table 2 and 3). The available N, P and K decreased with advancement of growth stages of sesame. Any crop with advancement of growth results in more biomass and more accumulation of nutrients in plants and decreased the available status in soil. Therefore, increased S application up to 60 kg S ha^{-1} decreased the available N, P and K at VS, FI and PH. Of course, the higher available N, P and K were recorded with S control. Among the varieties compared, in PH stage, the lowest available N, P and K was registered with KS 95010 due to its higher absorption for the higher biomass. A marked reduction of

Table 2: Sulphur application on Available S and N at different stages of growth

	Available S at VS				Available S at FI				Available S at HS			
	Varieties				Varieties				Varieties			
S levels	TMV 4	TMV 6	KS95010	Mean	TMV 4	TMV 6	KS95010	Mean	TMV 4	TMV 6	KS95010	Mean
S_0	17.2	17.2	16.3	16.9	15.2	15.7	14.8	16.7	11.4	10.6	9.7	10.6
S_{15}	21.2	22.1	20.4	21.2	18.6	18.6	17.4	20.0	12.7	12.7	11.9	12.4
S_{30}	24.9	24.9	24.5	24.8	22.9	22.0	22.4	26.1	15.7	14.2	14.4	14.7
S_{45}	29.4	28.9	28.9	29.1	25.8	27.1	25.4	28.9	17.4	17.5	16.9	17.4
S_{60}	31.9	31.4	31.1	31.5	28.4	29.6	28.8	31.0	19.9	19.4	18.6	19.3
Mean	24.9	24.9	24.3		22.1	22.6	28.9		15.4	14.9	14.3	
	S	V	S x V		S	V	S x V		S	V	S x V	
S Ed	0.6	0.5	1.0		0.4	1.2	0.7		0.3	0.2	0.5	
CD	1.2	0.9	NS		0.9	0.5	NS		0.6	0.5	NS	

	Available N at VS				Available N at FI				Available N at HS			
	Varieties				Varieties				Varieties			
S levels	TMV 4	TMV 6	KS95010	Mean	TMV 4	TMV 6	KS95010	Mean	TMV 4	TMV 6	KS95010	Mean
S_0	157.7	159.6	151.2	156.8	135.3	131.6	134.4	133.8	122.1	122.4	121.9	122.1
S_{15}	152.1	153.1	143.7	149.6	129.7	135.3	130.7	131.9	115.3	112.9	110.8	113.0
S_{30}	143.7	147.5	139.1	143.4	126.9	132.5	126.9	128.8	107.6	106.8	104.5	106.3
S_{45}	140.0	142.8	131.6	138.1	122.3	126.9	121.3	123.5	99.9	99.1	101.7	100.2
S_{60}	136.3	135.3	131.7	134.4	119.5	123.2	117.6	120.1	94.9	95.4	93.7	94.7
Mean	145.9	147.6	139.5		126.7	129.9	126.2		108.0	107.3	106.5	
	S	V	S x V		S	V	S x V		S	V	S x V	
S Ed	1.4	1.1	2.4		1.5	1.2	2.6		0.8	2.5	1.4	
CD	2.8	2.2	NS		3.1	2.4	NS		1.7	NS	NS	

ns: non significant

Table 3: Sulphur application on Available P and K at different stages of growth

	Available P at VS				Available P at FI				Available P at HS			
	Varieties				Varieties				Varieties			
S levels	TMV 4	TMV 6	KS95010	Mean	TMV 4	TMV 6	KS95010	Mean	TMV 4	TMV 6	KS95010	Mean
S_0	25.5	24.9	24.4	24.9	23.9	23.3	23.9	23.7	21.1	22.2	21.0	21.5
S_{15}	22.1	23.2	22.1	22.5	22.2	21.6	21.6	21.8	18.8	19.4	18.8	18.9
S_{30}	20.5	21.0	19.8	20.3	20.5	20.5	19.4	20.1	17.1	15.9	17.0	16.7
S_{45}	19.4	19.9	19.4	19.9	18.8	19.4	18.8	18.9	15.1	14.8	15.4	15.1
S_{60}	19.9	20.5	18.8	19.6	19.9	19.9	18.2	19.4	16.5	17.7	14.2	16.1
Mean	21.5	21.9	20.9		21.1	20.9	20.2		17.7	17.9	17.3	
	S	V	S×V		S	V	S×V		S	V	S×V	
S Ed	0.4	0.3	0.7		0.3	0.3	0.6		0.5	0.4	0.8	
CD	0.8	0.7	NS		0.7	0.5	1.1		1.0	NS	1.7	
	Available K at VS				Available K at FI				Available K at HS			
	Varieties				Varieties				Varieties			
S levels	TMV 4	TMV 6	KS95010	Mean	TMV 4	TMV 6	KS95010	Mean	TMV 4	TMV 6	KS95010	Mean
S_0	146.2	146.2	146.1	146.2	131.5	133.3	131.5	132.1	118.3	119.9	118.3	118.9
S_{15}	144.2	144.8	144.7	144.8	124.4	127.9	129.7	127.3	115.1	117.9	113.9	115.5
S_{30}	143.7	143.7	143.5	143.6	119.1	126.2	124.4	123.2	111.9	110.3	111.9	111.4
S_{45}	142.4	142.4	142.3	142.4	119.0	122.6	119.1	120.2	107.1	107.1	107.1	107.2
S_{60}	143.3	143.3	145.8	143.1	117.3	124.4	120.8	120.8	108.7	111.9	105.5	108.7
Mean	144.1	144.1	143.9		122.2	126.9	125.1		112.3	113.5	111.3	
	S	V	S×V		S	V	S×V		S	V	S×V	
S Ed	0.1	0.1	0.1		1.4	1.1	2.4		1.2	0.6	2.0	
CD	0.1	0.1	NS		2.8	2.2	NS		2.4	NS	NS	

ns: non significant

available K associated with higher S levels of 45 kg S ha^{-1} at all the stages. This type of result and positive interaction is quite normal and is in accordance with the theoretical background explained by Ravichandran *et al.* (2003) in sesame; Pasricha (1987) in toria; Rathee and Chahal (1977) in groundnut.

Effect of Sulphur on S, N, P and K Uptake at Different Stages of Growth:

Sulphur Uptake

Sulphur uptake was significantly influenced by the increased S application. Among the S levels, 60 kg ha^{-1} recorded maximum S uptake. The same was reported by Tandon (1990). Application of 60 kg S ha^{-1} to KS 95010 recorded higher S uptake at VS, FI and by stover in HS, whereas application of 60 kg S ha^{-1} to TMV4 recorded higher S uptake in seeds. This showed the behaviour of varieties at different environment and their genetic characters. The amount of S absorbed was large due to the highest tissue S concentration (Table 4).

Nitrogen Uptake

The higher N uptake was recorded with the application of 60 kg S ha^{-1} at all the stages and by seeds and stover (Table 4). The interaction between the N and S was synergistic and hence application of S increases the concentration and uptake of nitrogen and vice versa (Kumar *et al*., 2002). Sulphur increases the chlorophyll content of leaf, which has nitrogen as a constituent and thus increased nitrogen concentration in plants (Aulakh and Pasricha, 1988). Sulphur ensures better root and shoot growth and thus increase absorption of N, P and S from soil (Shivran, 2001). Among the varieties, KS 95010 recorded higher N uptake at all the stages due to higher DMP especially at 60 kg S ha^{-1}.

Table 4: Sulphur application on S and N uptake at different stages of growth

	S uptake at VS				S uptake at FI				S uptake by seeds				S uptake by stover			
	Varieties				Varieties				Varieties				Varieties			
S level	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean
S_0	0.12	0.13	0.16	0.14	1.56	1.79	1.87	1.74	1.16	1.59	2.07	1.61	3.34	3.42	3.58	3.45
S_{15}	0.22	0.27	0.25	0.23	2.05	2.14	2.00	2.06	1.18	1.93	2.21	1.73	4.19	4.39	4.53	4.37
S_{30}	0.27	0.25	0.30	0.27	2.16	2.25	2.33	2.25	1.58	2.00	2.23	1.94	4.99	5.09	5.25	5.11
S_{45}	0.34	0.30	0.38	0.34	2.55	2.71	2.63	2.63	1.69	2.06	2.24	1.99	5.59	5.69	5.97	5.75
S_{60}	0.40	0.37	0.45	0.41	2.93	3.00	3.03	2.99	1.76	2.09	2.32	2.06	6.32	6.57	6.74	6.54
Mean	0.27	0.25	0.31		2.25	2.38	2.37		1.47	1.93	2.22		4.89	5.04	5.21	
	S	V	S×V		S	V	S×V		S	V	S×V		S	V	S×V	
S Ed	0.003	0.01	0.010		0.04	0.03	0.06		0.02	0.06	0.13		0.08	0.65	0.15	
CD	0.010	0.02	0.012		0.07	0.06	0.13		0.05	0.12	0.27		0.17	0.13	NS	

	N uptake at VS				N uptake at FI				N uptake by seeds				N uptake by stover			
	Varieties				Varieties				Varieties				Varieties			
S level	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean
S_0	2.03	1.99	2.21	2.08	18.8	18.2	20.4	19.1	12.97	13.01	13.24	13.07	19.78	21.45	22.10	21.04
S_{15}	2.89	2.77	2.92	2.86	20.6	21.6	22.6	21.6	15.96	16.77	15.67	16.13	25.15	26.78	27.01	26.49
S_{30}	3.13	3.01	3.27	3.12	24.2	22.7	24.5	23.8	18.53	17.95	18.95	18.48	29.02	30.67	31.63	30.44
S_{45}	3.49	3.41	3.83	3.58	26.7	27.4	28.3	27.5	19.72	20.33	20.25	20.10	32.40	31.97	34.24	32.87
S_{60}	4.28	3.91	4.71	4.29	29.3	28.5	29.4	29.1	19.79	20.53	21.29	20.54	35.45	36.12	37.63	36.39
Mean	3.16	3.02	3.39		23.9	23.7	25.0		17.39	17.72	17.88		28.36	29.36	30.63	
	S	V	S×V		S	V	S×V		S	V	S×V		S	V	S×V	
S Ed	0.01	0.01	0.02		0.08	0.06	0.13		0.10	0.08	0.18		0.29	0.22	0.50	
CD	0.02	0.03	0.05		0.16	0.12	0.27		0.21	0.16	NS		0.59	0.46	NS	

ns: non Sifnificant

Table 5: Sulphur application on P and K uptake at different stages of growth

	P uptake at VS				P uptake at FI				P uptake by seeds				P uptake by stover			
	Varieties				Varieties				Varieties				Varieties			
S level	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean
S_0	1.69	1.78	1.79	1.76	3.54	3.12	3.99	3.75	0.16	0.15	0.17	0.16	1.59	1.70	1.89	1.73
S_{15}	2.28	2.35	2.24	2.29	4.49	4.39	4.63	4.51	0.21	0.22	0.23	0.22	2.07	2.17	2.06	2.10
S_{30}	2.82	2.77	2.93	2.84	5.19	5.30	5.59	5.35	0.26	0.25	0.27	0.26	2.28	2.35	2.33	2.32
S_{45}	2.92	3.09	2.95	2.99	5.90	6.01	6.08	5.99	0.31	0.30	0.33	0.31	2.46	2.56	2.60	2.54
S_{60}	2.85	3.07	3.10	3.03	6.01	6.04	6.02	6.08	0.33	0.31	0.37	0.34	2.60	2.67	2.76	2.68
Mean	2.51	2.62	2.61		5.03	5.09	5.29		0.26	0.25	0.28		2.20	2.29	2.33	
	S	V	S×V		S	V	S×V		S	V	S×V		S	V	S×V	
S Ed	0.03	0.03	0.06		0.06	0.05	0.11		0.04	0.01	0.01		0.03	0.02	0.05	
CD	0.69	0.05	0.12		0.13	0.10	NS		0.09	0.03	0.02		0.06	0.04	0.10	

	K uptake at VS				K uptake at FI				K uptake by seeds				K uptake by stover			
	Varieties				Varieties				Varieties				Varieties			
S level	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean	TMV4	TMV6	KS95010	Mean
S_0	0.90	0.80	0.93	0.83	18.52	18.48	18.67	18.56	1.74	1.88	1.89	1.84	26.27	26.88	27.32	26.83
S_{15}	1.24	1.15	1.26	1.22	20.47	20.51	21.55	20.84	2.83	2.98	2.79	2.87	29.94	30.46	32.71	31.03
S_{30}	1.35	1.33	1.51	1.39	22.48	23.44	23.63	23.18	3.86	3.50	3.9	3.75	35.34	36.07	37.50	36.30
S_{45}	1.56	1.57	1.74	1.62	23.65	24.65	24.79	24.36	3.88	4.21	3.94	4.01	35.92	37.66	38.08	37.22
S_{60}	1.74	1.71	1.92	1.79	25.67	24.85	25.10	25.20	3.27	4.07	4.24	3.86	33.89	35.69	37.09	35.56
Mean	1.34	1.31	1.47		22.16	22.39	22.75		3.12	3.33	3.35		32.27	33.35	34.54	
	S	V	S×V		S	V	S×V		S	V	S×V		S	V	S×V	
S Ed	0.08	0.06	0.14		0.08	0.02	0.14		0.12	0.09	0.21		0.67	0.52	1.17	
CD	0.16	0.13	0.28		0.16	0.04	0.28		0.24	0.19	0.43		1.38	1.07	NS	

ns: non Significant

Phosphorus Uptake

With 45 kg S ha^{-1} the P uptake at VS, FI and HS was higher (Table 5). The main reason would be, the high level of S increased the availability of P in soil by reducing pH due to the formation of sulphuric acid (Marok and Dev, 1980). The same was reported by Gangawar and Parameshwaran (1976) in sunflower; Rauth and Ali (1985) in rapeseed mustard; Shinde (1988) in sorghum; Singh and Ram (1989) in chickpea and Ravichandran *et al*. (2003) in sesame.

Potassium Uptake

Sulphur increased the K uptake. The beneficial influence might be due to better root establishment, crop growth and thereby total DMP. The K uptake was higher in stover than seeds (Table 5). Application of 60 kg S ha^{-1} to KS 95010 recorded higher K uptake at VS, FI and stover in HS, whereas the K uptake by seeds was recorded differently higher with 45 kg ha^{-1} in TMV 6 and TMV 4 for KS 95010 with 60 kg S ha^{-1}. This kind of positive interaction between S and K in mustard (Chandal and Virmani, 1983) and groundnut (Sarkar and Panick, 2002) were observed.

Seed and Stover Yield

The effect due to S levels, varieties and their interactions was seen very conspicuously in realizing the seed yield (Table 1). Among the different S levels compared 45 and 60 kg S ha^{-1} recorded the highest seed yield of 601 and 587 kg ha^{-1}, respectively. With respect to the varieties, the highest seed yield (548 kg ha^{-}1) was recorded in KS 95010 with, followed by TMV 6 and TMV 4 Application of 60 kg S ha^{-1} to KS 95010 produced highest seed yield of 617 kg ha^{-1} but it was comparable with the yield of TMV 6 (610 kg ha^{-1}) with 45 kg S ha^{-1}. Supply of S in addition to N, P and K might act as a lifting factor behind the increased seed yield. Application of sulphur resulted in improved growth and yield parameters and therefore, finally increased the seed yield. These findings are in accordance with the earlier reports of Devakumar and Giri (1998) and Tiwari *et al*. (2000). The lowest yield recorded under control treatment might be due to the limited availability of nutrient in soil and uptake of nutrient by the crop, which ultimately reflected on these results. This finds support from the study of Singh *et al*. (1997) and Ansari *et al*. (1998). The interaction of S with varieties revealed that, application 60 kg S ha^{-1} performed better in KS 95010 (617 kg ha^{-1}) which was followed by TMV 6 and TMV 4 respectively at 45 kg S ha^{-1} and the lower yields in the variety of TMV 4 at different levels of S are ascribed due to their intrinsic characters and growth potential (Govindarasu *et al*., 1998). The stover yield was highest with the application of 60 kg S ha^{-1} and among the varieties KS95010 recorded highest stover yield.

The Response Function and Optimization of Sulphur

Response function between levels of S and seed yield of varieties were characterized by quadratic relationship. The results indicated that the physical optimal rate was 41.25 kg S ha^{-1} for TMV 4, 48.74 kg S ha^{-1} for TMV 6 and 56.25 kg S ha^{-1} for KS95010 and as a whole 47.27 kg S ha^{-1} for sesame. The economic optimal rate was 40.32 kg S ha^{-1} for TMV 4, 47.39 kg S ha^{-1} for TMV 6, 54.66 kg S ha^{-1} for KS95010 and as a whole 46.09 kg S ha^{-1} for sesame. From this investigation, the optimum level of S can be fixed as 48 kg ha^{-1} for irrigated sesame.

CONCLUSIONS

The available S was found to be higher at higher levels of S but available N, P and K status in soil was decreasing with increased levels of S due to enhanced crop growth and development of the crop with increased S levels. The S maximum N, K and S uptake was recorded at 60 kg S ha^{-1}. The higher N uptake because of increased S uptake accelerated the nitrate and nitrogen metabolism in plants. Maximum uptake of P at VS, FI and HS was recorded with 45 kg S ha^{-1} due to the positive interaction between P and S up to this level. The main reason would be high level of S application might increase P availability by reducing soil pH. Application of 60 and 45 kg S ha^{-1} recorded higher seed yield and KS 95010 was significantly superior to other varieties. The highest seed yield was obtained from KS 95010 with the application of 60 kg S ha^{-1}. The physical optimal rate was 47.27 kg S ha^{-1} and the economic optimal rate was 46.09 kg S ha^{-1}. The highest levels of S increased crop performance and yielded better seed yield. From this investigation, the optimum level of S can be fixed as 48 kg ha^{-1} for sesame and KS 951010 will be the more suitable varieties.

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