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RESEARCH NOTE

Response of sesame (*Sesamum indicum* L.) to sulphur nutrition during summer

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A field experiment was carried out to assess the Effect of sources and levels of sulphur on sesame during 2016 summer in UKP command area at Agriculture Research Station, Almel Sindagi taluk Vijayapura. The results indicated that, application of suplhur at 25 kg ha^{-1} either of the sources (sulphur bentonic and gypsum) recorded significantly higher plant height (133.20 cm), number of capsules per plant (65.60), drymatter accumulation (10.90 g plant^{-1}), seed yield (899 kg ha^{-1}), oil content (48%) and oil yield (435kg ha^{-1}) over other levels of sulphur (10,15, and 20 kg sulphur ha^{-1}). Application of sulphur up to 25 kg ha^{-1} to the sesame crop increased the seed yield significantly as compared to control (487 kg ha^{-1}, 31% and 435 kg ha^{-1} seed yield, oil content and oilt yield respectively). Among the levels of sulphur applied, significanlty higher net returns (₹ 41,002 ha^{-1}) and benefit cost ratio (3.00) was recorded with application of 25 kg sulphur ha^{-1} irrespectively of sulphur sources as compared to control (₹ 14,497, ha^{-1} and 2.00), respectively. Both the sources of sulphur *viz*; sulphur bentonite and gypsum were on par with respect to oil content, seed and oil yield and also incresed the net returns and benefit cost ratio per unit area.

Key words: Bentonite, Gypsum, Sulphur

Sesame (*Sesamum indicum* L.) is the most ancient oil seed crop of the world. Among the oil seed crops sesame has the highest oil content of 46-64 % with 25 % protein. It has earned a poetic label **"Queen of Oilseeds"** because the seeds have poly unsaturated stable fatty acids which offer resistance to rancidity. It consists of methionine, tryptophan, vitamin (niacin) and minerals (Ca and P). Sesame seed has pronounced antioxidant activity and thereby offer higher shelf life. In India, sesame is grown over an area of 17.46 lakh ha with an annual production of 8.28 lakh tonnes. In Karnataka, it is grown over an area of 0.44 lakh ha with an annual production of 0.22 lakh tonnes with a productivity of 500 kg per ha (Anon., 2015).

The main reason for low productivity (474 kg ha^{-1}) of sesame is its poor management and cultivation in marginal and sub-marginal lands with input starved rainfed conditions. Among the management practices, nutrient management is the most important factor in determining yield of sesame. Sulphur application improves the seed yield and quality of crops (Tiwari and Gupta, 2006)

The experiment was conducted at Agricultural Research Station, Almel, Sindagi taluk of Vijayapura district during *kharif* 2016 which is situated at 16°49' N latitude, 75°43' E longitude and at an altitude of 593.8 m above mean sea level. The soils of the experimental site are clayey textured soils belongs to vertisols, slightly alkaline in pH, low in organic carbon (0.40 %), very low in available nitrogen (111.00 kg ha^{-1}), low in available phosphorus (14.50 kg ha^{-1}) and medium in potassium (255.00 kg ha^{-1}). The experiment was laid out in factorial randomized block design with three replications and consists of nine treatments (Table.1). The crop was raised by adopting a spacing of 45 cm x 10 cm. Sulphur fertilizers were applied as per the sources (Sulphur bentonite & Gypsum) with different levels (10,15,20,25 kg ha^{-1}). To keep the crop free from sucking pests Imidachloprid 17.8 % SL was sprayed at the rate of 0.5 ml l^{-1} during fourth week after sowing.

The different sulphur sources did not influence plant height, number of capsules and drymatter accumulation per plant of sesame. While levels of sulphur had significant influence on plant height, number of capsules and drymatter accumulation per plant. The application of 25 kg sulphur per ha recorded significantly higher plant height (133.20 cm), number of capsules per plant (65.60) and drymatter accumulation (10.90 g plant^{-1}) at harvest as compared to control (108.50 cm, 57.00 and 7.40 g plant^{-1}, respectively). This might be due to higher growth parameters ascribed to addition of sulphur bentonite and gypsum sources favoured availability of sulphur compared to no sulphur application & easy availability of sulphate (SO_4^{-2}) sulphur present in sulphur bentonite and gypsum, which essentially requires oxidation for change in to SO_4^{-2} prior to its absorption by the plants. Naga Madhuri *et al.* (2011) revealed that application of sulphur at 100 kg ha^{-1} had significantly influenced the cane yield but it was comparable with the application of sulphur at 80 kg ha^{-1} in sugarcane irrespective of source of sulphur.

Chaudhary *et al.* (2013) noticed application of 40 kg S ha^{-1} affirmed potential role in enhancing productivity of quality protein maize and also proved economically profitable compared to control.

When four levels of sulphur and zinc were tried on rice and lentil showed that maximum yield was recorded with combined application of 30 kg sulphur and 6 kg zinc (Singh *et al.,* 2013) .

Vaiyapuri *et al.* (2004) also revealed that application of 45 kg sulphur per ha in the form of gypsum recorded the highest growth parameters of sesame and significant improvement in dry matter production might have resulted from better sulphur nutrition of the crop. These results were in conformity with the findings of Shinde *et al.* (2011) in sesame who reported that higher doses of sulphur leads to better growth parameters.

The different sulphur sources did not influence on oil content, oil yield and seed yield of sesame. While levels of sulphur had significant influence on oil content, oil yield and seed yield. The application of 25 kg sulphur per ha recorded significantly higher oil content (48%), oil yield (435 kg ha^{-1}) & seed yield (899 kg ha^{-1}) as compared to control (oil content

Table 1. Effect of different sources and levels of sulphur on growth, yield and yield components of sesame

Treatments	Plant height (cm)	No of. Capsules plant^{-1}	Dry matter accumulation plant^{-1}	Seed yield kg ha^{-1}	Oil Yield kg ha^{-1}	Oil content (%)	Gross returns ₹ ha^{-1}	Net returns ₹ ha^{-1}	B:C
L1S1	115.60	56.40	7.9	561	202	36	37587	18797	2
L1S2	108.70	50.20	8.30	585	208	36	39173	20659	2
Mean	112.10	53.30	7.90	573	205	36	38380	19728	2
L2S1	117.20	57.70	7.90	703	268	38	47123	28073	2
L2S2	112.8	56.00	8.60	605	232	38	40557	21935	2
Mean	115.00	56.90	8.30	654	250	38	43840	25004	2
L3S1	120.60	57.80	10.20	731	298	41	48977	29687	3
L3S2	117.90	60.30	8.90	694	275	40	46498	27762	2
Mean	119.20	59.10	9.50	713	286	40	47738	28725	3
L4S1	128.00	62.70	10.80	832	388	47	55766	36216	3
L4S2	138.40	68.50	11.00	965	482	50	64633	45787	3
Mean	133.20	65.60	10.90	899	435	48	60200	41002	3
Mean of S1	120.30	58.70	9.10	707	289	40	47363	28193	2
Mean of S2	119.40	58.80	9.20	712	299	41	47715	29036	3
Control(No sulphur)	108.50	57.00	7.40	487	154	31	32662	14497	2

For comparisons of treatments	S.Em±	C.D. at 5%	S.Em±	C.D. at 5%	S.Em±	C.D. at 5%	S.Em±	C.D. at 5%	S.Em±	C.D. at 5%	S.Em±	C.D. at 5%	S.Em±	C.D. at 5%	S.Em±	C.D. at 5%	S.Em±	C.D. at 5%
Sulphur source(S)	1.58	NS	0.93	NS	0.19	NS	16	NS	7	NS	0.2	NS	1082	NS	1269	NS	0.01	NS
Sulphur level(L)	2.23	6.76	1.32	4.0	0.27	0.82	23	69	10	31	0.3	1.0	1530	4641	1795	5445	0.01	0.01
SxL	3.15	NS	1.86	5.66	0.38	1.16	32	98	15	44	0.50	1.4	2164	6564	2539	7700	0.01	0.01
Control v/s Treatments	3.29	9.85	1.83	5.50	0.37	1.10	38	113	16	48	0.6	1.80	2535	7601	2851	8546	0.01	0.01

Note: Recommended dose of fertilizer (20:40.20 kg N:P_2O_5:K_2O ha^{-1}) was applied to all treatments.
L1 = 10 kg ha^{-1}, L2 = 15 kg ha^{-1}, L3 = 20 kg ha^{-1}, L4 = 25 kg ha^{-1}
S1 = Sulphur bentonite S2 = Gypsmm

(31%), oil yield(154.00 kg ha^{-1}) and seed yield (487.00 kg ha^{-1}), this might be due to sulphur application which increases the oil content and oil yield of sesame up to 45 kg ha^{-1}. Sulphur is essential for oil synthesis, (Krishnmamoorthy, 1989) as the increasing levels of sulphur increases the sesame seed oil content progressively as it is involved in protein and enzyme synthesis as well as a constituent of the amino acids methionine, cystine and cysteine. The increase in oil content with increase in sulphur level might be due to the involvement of sulphur in electron transport chain (Kumar *et al.,* 2007). Sesame yield improved due to sulphur application resulting in increased seed yield. The lower sesame seed yield recorded under control treatment might be due to the limited availability of sulphur nutrient in soil coupled with low sulphur status of the experimental field (9.80 ppm).Similar results were reported by Pandey *et al.* (2003) in Tamil Nadu and they reported that suphur requirement is higher in oilseed crops followed by pulses and least in cereals. Further maximum maize grain yield (4060 kg ha^{-1}), biological yield (12490 kg ha^{-1}) and ear weight (185.5 g/ear) was recorded in 60 kg ha^{-1} sulphur application in soil. Sulphur application had significant effect on nitrogen and phosphorus uptake. In foliar application maximum grain and biological yield (3237 and 9340 kg ha^{-1}) was found in treatment where sulphur was applied at 20 kg ha^{-1} by foliar application.(Sarfaraz *et al.* (2014)

The study conducted on quality protein maize with four levels of nitrozen and three levels of sulphur. In which Interaction effect of 150 kg N ha^{-1}with 45 kg S ha^{-1} obtained significantly higher tryptophan content (0.83%) and lysine content (3.99) than 100 kg N ha^{-1} with 15 kg S ha^{-1}. (Sabhajeet *et al.,* 2012)

Significantly higher net returns (₹ 41,002 ha^{-1}) and B:C (3.00) was recorded in the treatment which received 25 kg sulphur per ha^{-1} as compared to control (₹ 14,497 ha^{-1} and 2.00 respectively) ,this might be due to higher seed yield of sesame. Deshmukh *et al.* (2010) also revealed that maximum net return and BC ratio by application of 30 kg sulphur ha^{-1}, although it was on par with 40 kg sulphur ha^{-1}. Further, Jayaram *et al*. (2010) noticed that, sulphur application @ 200 kg ha^{-1} (104 kg S through N and P sources and 96 kg S through elemental sulphur) recorded the highest cane and sugar yield of 182.45 t ha^{-1} and 23.08 t ha^{-1}, respectively and recorded the highest net return and benefit cost ratio of sugarcane.

Based on these results it was concluded that application of 25 kg sulphur ha^{-1} through gypsum was found to be most economical and which also improves productivity and profitability of sesame. it can be applied through gypsum in addition to recommended dose of $NP_20_5K_2o$ for getting higher yield, oil content, oil yield and net returns.

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