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Effect of sources and levels of sulphur on growth and yield of sesame (*Sesamum indicum* L.) under southern agro-climatic zone of Andhra Pradesh

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Abstract
A field experiment was carried out during summer (January to April)2019, 2020 and 2021 at the Regional Agricultural Research Station, Tirupati, Andhra Pradesh, India to study the effect of sources and levels of sulphur on growth, and yield of sesame. The soil of the experimental site was sandy clay loam in texture, neutral in soil reaction, low in organic carbon and available nitrogen, high in phosphorus, medium in potassium and deficient in sulphur. The experiment was laid out in randomized block design with factorial concept and replicated thrice with ten treatment combinations. Ten treatment combinations comprising of two sources of sulphur *viz*., S_1: Sulphur Bentonite S_2: Gypsum and five levels of sulphur *viz*., L_1: 0 kg S ha^{-1}, L_2: 10 kg S ha^{-1}, L_3: 15 kg S ha^{-1} L_4: 20 kg S ha^{-1}, L_5: 25 kg S ha^{-1}. The results of the experiment revealed that, among the sources of sulphur, application of Sulphur bentonite registered significantly higher stature of growth, yield attributes and yield as compared to the application of gypsum. With regard to the levels of sulphur, application of 25 kg S ha^{-1} registered significantly higher growth, yield attributes and yield as compared to the lower levels of sulphur tried. Interaction between the sources and levels of sulphur didn't exert any significant influence on any one of the parameters studied in sesame.

Keywords: Sesame, sulphur bentonite, gypsum, levels of sulphur

1. Introduction

Sesame (*Sesamum indicum* L.), also called as sesamum, gingelly, beniseed, sim-sim, and till, is possibly the earliest domesticated oil seed crops (Cui *et al*, 2021) [4]. Studies have found that sesame seeds contain 21.9% protein and 61.7% fat, and are rich in minerals such as Fe and Ca (Rout *et al*., 2018) [27]. Sesame seeds are rich in nutrients and have the reputation of being an "all-purpose nutrient bank" and the "crown of eight grains" [Haixia and Lu, 2015] [8].As the seeds contain poly unsaturated stable fatty acids that resist rancidity, it has acquired the lyrical moniker "Queen of Oilseeds" (Wang *et al*., 2014) [33]. Sesame seeds have a high level of antioxidant activity and thus have a longer shelf life. India is one of the one of the leading producers and importers of edible oils and holds a prominent place in the global oilseed industry (Kamal *et al*., 2024a) [12]. In India Sesame is cultivated over 15.23 Lakh hectares with a production of 8.02 Lakh tonnes and productivity of 527 kg ha^{-1}. In Andhra Pradesh it is grown in area of 0.33 Lakh hectares with a production of 0.08 Lakh tonnes and a productivity of 376 kg ha^{-1}respectively (Anonymous, 2024) [2]. However, there is a significant difference between the potential yield and the average sesame yield. As a result, finding effective techniques that will benefit all stakeholders will necessitate a concerted and integrated agronomic effort. The reason for low productivity of sesame is primarily due to its poor management and cultivation in marginal and sub-marginal fields and in rainfed areas where inputs are limited. Nutrient management is the most essential factor in determining sesame yield among the management practices. Oilseed crops typically exhibit a similar demand for Sulphur as they do for Phosphorus. (Kamal *et al*., 2023) [11]. As an essential component of S-containing amino acids such as cystine, cysteine, and methionine, sulphur plays a critical role in the nutritional needs of oilseed crops. Sulphur's role in the synthesis of vitamins and enzymes underscores its crucial involvement in many biochemical processes (Kamal *et al.*, 2024b) [13]. Factors contributing to S deficiency encompass the increased utilization of S-free fertilizers like urea in lieu of ammonium sulphate and diammonium phosphate instead of single superphosphate. The prevalence of S deficiency is increasingly acknowledged as a widespread issue. This deficiency of S greatly reduces both the yield and quality of agricultural produce, exerting a significant impact on the agro-based economy (Patil *et al.*, 2014) [24]. The persistent utilization of S-free fertilizers has expanded the ratio of N: P2O5: K2O: S to 14.7: 5.1: 1.6: 1 within the agricultural practices in India (TSI, 2014) [32]. Therefore, it is essential to address and manage S levels in the soil through the adoption of advanced techniques. Administration of sulphur to the soil can be facilitated by using several appropriate carriers, such as gypsum, elemental S, ammonium sulphate and potassium sulphate etc. Gypsum and Elemental Sulphur are most extensively used sulphur sources in soils deficit with sulphur. The response of oilseeds to sulphur fertilization for the production of higher yield was documented by Ray *et al.* (2014) [26], Kumar *et al*. (2021) [19], Mohiuddin *et al*. (2023) [21] in mustard, Devi *et al.* (2022) [5], Dileep *et al.* (2021) [6], Aier and Nongmaithem (2021) [1] in groundnut, Pattanayak *et al*. (2023) [25] in sunflower. On the basis of the above facts, the present study was taken up to identify the suitable source of sulphur as well as the optimum sulphur requirement to achieve sustainable yield in sesame under southern agro-climatic zone of Andhra Pradesh.

2. Materials and Methods

This experimental trial was carried out during summer, 2019 to 2021 from January to Aprilat the Regional Agricultural Research Station, Tirupati, Andhra Pradesh, India.

2.1. Experimental site description

The research was conducted in the geographical location of an altitude of 182.9 m above mean sea level, 13°N latitude and 79°E longitude. The soil of the experimental site was sandy clay loam in texture, neutral in soil reaction, low in organic carbon and available nitrogen, high in phosphorus, medium in potassium and deficient in sulphur.

2.2. Experimental design and crop management

The experiment was laid out in randomized block design with factorial concept and replicated thrice with ten treatment combinations. The nutrient sources used in the research plot were urea, DAP and MOP to fulfil the requirements of nitrogen, phosphorous and potassium. The sources of sulphur were gypsum (18.6% S) and bentonite sulphur (90%). The recommended dose of 40 kg N,20 kg P_2O_5, 20 kg K_2O ha^{-1} and sulphur was applied according the treatment details. A basal dose of 20 kg N and fulldose of phosphorus and potassium were applied at the time of sowing. All the sources of sulphur were applied basal. The remaining N (20 kg ha^{-1}) was top-dressed 30 days after sowing after the first irrigation. The variety YLM-66 (Sarada) was sown @5 $kgha^{-1}$. 10 days after sowing, gap filling was done

2.3. Treatment details

Ten treatment combinations comprising of two sources of sulphur *viz.*, S_1: Sulphur bentoniteS_2: Gypsum and five levels of sulphur *viz.*, L_1: 0 kg S ha^{-1}, $L_{2:}$ 10 kg S ha^{-1}, L_3: 15 kg S ha^{-1} L_4: 20 kg S ha^{-1}, L_5: 25 kg S ha^{-1}.

2.4. Observations and procedure of data recorded

The biometric observations for different growth parameters, yield attributes and yield of summer sesame were recorded. The crop was harvested after the completion of pre-harvest observations. Average plant height was measured and recorded by taking five plants in net plot. Five randomly selected plants were harvested from each plot and plants were dried in an oven at 60 ºC to a constant weight for recording aerial dry matter accumulation which was then expressed as kg ha^1. Whereas, the yield parameters like Number of branches $plant^{-1}$, capsules $plant^{-1}$, seed yield (kg ha^1) were recorded to estimate the yield of sesame.

2.5. Methods of statistical analysis

The data was statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design with Factorial concept (Gomez and Gomez, 1984) [7]. Significant difference of sources of variation was tested at the probability level of 0.05. The standard error of the mean (S.Em±) and the CD value were indicated in the tables to compare the difference between the mean values.

3. Results and Discussion

3.1. Plant height

There was no discernible effect of sulphur sources on plant height of sesame at harvest. Still, numerically, sulphur bentonite (102 cm) recorded higher plant height than gypsum (100 cm).

With respect to the levels of sulphur, the highest plant height was recorded with the application of 25 kg S ha^{-1} (99 cm) which was however on par with that of the other levels of sulphur except the control which recorded the lowest plant height.

This increase in plant height with increment in the sulphur levels might be due to interaction of sulphur with nitrogen which enhanced the cell division, cell elongation, expansion. Sulphur also plays a vital role in the chlorophyll synthesis, meristematic tissue activity and shoot development, which in turn led to the increment of plant height. The increased plant height could also be attributed due to improved root development as sulphur helps in increased uptake of other nutrients and more vegetative growth which in turn resulted in taller plants. These findings are in accordance with those reported by Khan *et al*. (2021) [16].

Table 1: Growth, yield parameters and yield of sesame as influenced by sources and levels of sulphur

Treatments	Plant Height (cm)	Dry matter Production (kg/ha)	No. of branches plant^{-1}	No. of capsules Plant^{-1}	Yield (kg ha^{-1})			
					2019	2020	2021	Pooled
Factor-I: Sources (2)								
S_1-Gypsum	100	4381	5.2	64	839	973	986	932
S_2-Sulphur bentonite	102	4487	5.2	67	864	1048	1042	985
S.Em±	0.9	17.5	0.09	0.4	4.7	23.4	18.2	12.7
CD (*p*=0.05)	NS	52	NS	1	14	69	54	38
Factor-II: Levels of sulphur (5)								
L_1: Control (no sulphur)	97	4251	5.4	61	798	916	838	851
L_2:10 kg ha^{-1}	98	4373	5.1	63	822	953	957	913
L_3: 15 kg ha^{-1}	95	4442	5.2	65	842	1002	1006	945
L_4: 20 kg ha^{-1}	97	4520	5.0	69	872	1068	1091	1010
L_5: 25 kg ha^{-1}	99	4587	5.3	71	924	1114	1176	1072
S.Em±	1.3	27.8	0.15	0.6	7.5	37.0	28.7	20
CD (*p*=0.05)	4	83	NS	2	22	110	86	60
Interaction								
S.Em±	1.85	39.3	0.21	0.9	10.5	52.4	52.4	28.5
CD (*p*=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

3.2. Drymatter production
The dry matter accumulation was found significant with different sources of sulphur only at harvest sulphur bentonite registered significantly higher dry matter (4487 kgha^{-1}) as compared to gypsum

As regards the levels of sulphur tried, application of 25 kg S ha^{-1} registered higher drymatter production which was however on with that of the application of 20 kg S ha^{-1} which inturn-maintained parity with the application of 15 kg S ha^{-1}. This might be attributed to the increased plant height, higher number of leaves, its role in formation of aminoacids, synthesis of proteins, vitamins and chlorophyll, which in turn resulted in optimum crop growth, which ultimately resulted in higher dry matter production. These results were in conformity with the findings of Saren *et al*. (2004) [28] and Bhavana *et al*. (2022) [3]. The lowest dry matter production of sesame was associated with control plots where no sulphur was applied. This might be due to poor and imbalanced nutrition of the plants that manifested in lowest dry matter accumulation.

3.3. Number of branches plant^{-1}
Neither the sources nor the levels of sulphur exerted significant influence on the number of branches plant^{-1} in sesame

3.4. Number of capsules plant^{-1}
Maximum number of capsules plant^{-1} in sesame was registered with the sulphur bentonite when compared with that of the gypsum.

With respect to the different levels of sulphur tried, higher capsules plant^{-1}were noticed with the application of 25 kg S ha^{-1} and 20 kg S ha^{-1} without any significant difference between them. An adequate supply of sulphur aids in the development of the floral primordial i.e., the reproductive organs, which increases the number of capsules plant^{-1}. Similar results have also been reported by Patel and Shelke (1995) [23], Patel *et al*. (2009) [22], Shilpi *et al*. (2012) [30] and Kumar *et al*. (2019) [17]. Minimum number of capsules plant^{-1} were recorded with control (S1) without sulphur application.

3.5. Seed yield
The pooled data of seed yield during three years of investigation revealed that the seed yield of sesame was significantly influenced by various sources and levels of sulphur. The highest seed yield was obtained with the application of sulphur bentonite (985 kg ha^{-1}) and was significantly superior to the gypsum (932 kg ha^{-1}).

Incremental increase in the seed yield was observed from 0 to 25 kg S ha^{-1}. Application of 25 kg S ha^{-1} resulted in a maximum seed yield of 1072 kg ha^{-1}, followed by the application of 20 kg S ha^{-1} (1010 kg ha^{-1}) and both were demonstrated statistical superiority, over 15 and 10 kg S ha^{-1} which inturn maintained statistical parity with each other. The lowest seed yield (851 kg ha^{-1}) was recorded from control (0 kg S ha^{-1}), which showed factual inadequacy over rest of the sulphur levels tried. This might be attributed to a balanced nutritional environment and the stimulatory action of sulphur on protein synthesis and their translocation to the productive organs, enhancing all the growth and production-attributing traits and finally resulting in maximum seed yield. Higher S levels led to greater leaf area and chlorophyll content in leaves, which further boosted photosynthesis, assimilation, and metabolic activities. These factors improved the vigour and yield attributes of the sesame and also contributed to the accumulation of dry matter, its partitioning, and seed yield. The above results were in conformity with the findings of Sarkar and Saha (2005) [29], Kumar and Yadav (2007) [18], Kader and Mona (2013) [9] and Kalegore *et al*. (2018) [10]. Kumar *et al*. (2019) [17], Bhavana *et al*. (2022) [3] and and Lallawmzuali *et al*. (2022) [20].

4. Conclusion
From the results it could be concluded that, the growth and yield parameters of sesame were greatly influenced due to appropriate external supply of sulphur, which was deficient in the soil. A dose of 25 kg S ha^{-1} was found optimum to obtain higher seed yield (1072 kg ha^{-1}) of sesame. Therefore 25 kg S ha^{-1} in the form of sulphur bentonite could be recommended for remunerative seed yield of sesame.

5. References

1. Aier I, Nongmaithem D. Response of Groundnut (*Arachis hypogaea* L.) to lime and different levels of sulphur. Int J Bio-Resource Stress Manag. 2021;11(6):585-589.
2. Anonymous. India Stat Crop Statistics 2024. Selected State/Season-wise Area, Production and Productivity of Sesamum in India (2023-2024). Available from: http://www.indiastat.com/en/#data/QC. Accessed on 9th January, 2025.
3. Bhavana T, Shankar T, Maitra S, Sairam M, Kumar PP. Impact of phosphorus and sulphur levels on growth and productivity of summer sesame. Crop Res. 2022;57(3):178-

184.
4. Cui C, Liu Y, Liu Y, Cui X, Sun Z, Du Z. Genome-wide association study of seed coat color in sesame (*Sesamum indicum* L.). PLoS ONE. 2021;16(5):e0251526. https://doi.org/10.1371/journal.pone.0251526.
5. Devi LM, Singh R, Singh E. Effect of nitrogen and sulphur on growth and yield of summer groundnut (*Arachis hypogaea* L.). Biol Forum. 2022;14(1):1184-1187.
6. Dileep D, Singh V, Tiwari D, George SG, Swathi P. Effect of variety and sulphur on growth and yield of groundnut (*Arachis hypogaea* L.). Biol Forum. 2021;13(1):475-478.
7. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. 2nd ed. New York: John Wiley & Sons; 1984. 680 p.
8. Haixia L, Lu C. Dietary Chinese Herbs. Vienna: Springer; 2015. p. 525-533.
9. Kader EL-A, Mona G. Effect of sulphur application and foliar spraying with zinc and boron on yield, yield components and seed quality of peanut (*Arachis hypogaea* L.). Res J Agric Biol Sci. 2013;9(4):127-135. Available from: http://www.aensiweb.net/AENSIWEB/rjabs/rjabs/2013/127-135.pdf.
10. Kalegore NK, Kirde GD, Bhusari SA, Kasle SV, Shelke RI. Effect of different levels of phosphorus and sulphur on growth and yield attributes of sesame. Int J Econ Plants. 2018;5(11):163-166.
11. Kamal DK, Prakash R, Sharma A, Dhaka BK. Effect of phosphorus and sulphur levels on nutrient content and uptake of groundnut (*Arachis hypogaea* L.). Biol Forum. 2023;15(2):1023-1026.
12. Kamal DK, Rana A. Effect of Sulphur Application in Oilseed Crops: A Review. Agric Rev. 2024;doi: 10.18805/ag.R-26.
13. Kamal DK, Singh B, Kamboj E, Preeti, Sharma A. Effect of phosphorus and sulphur levels on biomass partitioning in groundnut (*Arachis hypogaea* L.). Res Crops. 2024;25(1):57-64.
14. Kathiresan G. Response of sesame (*Sesamum indicum*) genotypes to levels of nutrients and spacing under different seasons. Indian J Agron. 2002;47:537-540.
15. Khan N, Khalil SK, Amanullah A, Ali A, Ullah Z, Ali M. Effect of nitrogen and sulfur on yield and yield components of sesame (*Sesamum indicum* L.) in calcareous soil. Pure Appl Biol. 2016;5(3):471-475.
16. Khan SA, Umesha C, Karimunnisa SK. Effect of sulphur levels on growth and yield of different varieties of sesame (*Sesamum indicum* L.). Biol Forum. 2021;13(3):155-158.
17. Kumar B, Sarkari NC, Maity S, Maiti R. Effect of different levels of sulphur and boron on the growth and yield of sesame under red-laterite soils. Res Crops. 2019;20(3):515-524.
18. Kumar H, Yadav DS. Effect of phosphorus and sulphur levels on growth, yield and quality of Indian mustard (*Brassica juncea*) cultivars. Indian J Agron. 2007;52(2):154-157.
19. Kumar R, Yadav SS, Singh U, Verma HP. Growth, yield, quality and energetics of mustard (*Brassica juncea* L.) as influenced by weed management and sulphur fertilization under semi-arid conditions of Rajasthan. Int J Bio-Resource Stress Manag. 2021;12(4):255-263.
20. Lallawmzuali PC, Tzudir L, Nongmaithem D. Effect of levels and sources of sulphur on growth and yield attributes of sesame (*Sesamum indicum* L.) under rainfed condition of Nagaland. Indian J Agric Res. 2022;56(4):439-441.
21. Mohiuddin M, Paul AK, Sutradhar GNC, Bhuiyan MSI, Zubair HM. Response of nitrogen and sulphur fertilizers on yield, yield components and protein content of oilseed mustard (*Brassica* spp). Int J Bio-Resource Stress Manag. 2023;2(1):93-99.
22. Patel GN, Patel P, Patel DM, Patel DK, Patel RM. Yield attributes, yield, quality and uptake of nutrients by summer groundnut (*Arachis hypogaea* L.) as influenced by sources and levels of sulphur under varying irrigation schedule. J Oilseeds Res. 2009;26(2):119-122.
23. Patel JR, Shelke VB. Effect of farmyard manure, phosphorus and sulphur on growth, yield and quality of Indian mustard. Indian J Agron. 1995;43:713-717.
24. Patil SS, Choudhary AA, Goley AV, Rasal SJ. Effect of phosphorus and sulphur on growth yield and economics of linseed. J Soils Crops. 2014;24(1):159-164.
25. Pattanayak S, Behera A, Jena SN, Das P, Behera S. Growth and yield of sunflower (*Helianthus annuus* L.) hybrids under different nutrient management practices. Int J Bio-Resource Stress Manag. 2023;7(4):845-850.
26. Ray K, Pal AK, Banerjee H, Phonglosa A. Correlation and path analysis studies for growth and yield contributing traits in Indian mustard (*Brassica juncea* L.). Int J Bio-Resource Stress Manag. 2014;5(2):200-206.
27. Rout K, Yadav BG, Yadava SK, Mukhopadhyay A, Gupta V, Pental D, *et al*. QTL landscape for oil content in *Brassica juncea*: analysis in multiple bi-parental populations in high and “0” erucic background. Front Plant Sci. 2018;9:1448.
28. Saren BK, Tudu S, Nandi P. Effect of irrigation and sulphur on growth and productivity of summer sesame (*Sesamum indicum* L.). Madras Agric J. 2004;91(1-3):56-60.
29. Sarkar RK, Saha A. Analysis of growth and productivity of sesame (*Sesamum indicum* L.) in relation to nitrogen, sulphur and boron. Indian J Plant Physiol. 2005;10(4):333-337.
30. Shilpi S, Islam MN, Sutradhar GNC, Husna A, Akter F. Effect of nitrogen and sulfur on the growth and yield of sesame. Int J Bio-Resource Stress Manag. 2012;3(2):177-182.
31. Singh H, Choudhary RL, Jat RS, Rathore SS, Meena MK, Rai PK. Re-visiting of nitrogen and sulphur requirements in Indian mustard (*Brassica juncea*) under irrigated conditions. Indian J Agric Sci. 2023;93(1):51-56.
32. TSI. Sulphur in Indian Agriculture. Correction sulphur deficiency in Indian Agriculture. The Sulphur Institute, 1020, 19th Street, N.W., Suite 520 Washington, D.C., 20036, U.S.A. 2014.
33. Wang L, Yu S, Tong C, Zhao Y, Liu Y, Song C. Genome sequencing of the high oil crop sesame provides insight into oil biosynthesis. Genome Biol. 2014;15(2):R39. https://doi.org/10.1186/gb-2014-15-2-r39. PMID: 24576357.