



ISSN Print: 2618-060X
 ISSN Online: 2618-0618
 NAAS Rating (2026): 5.20
 IJRA 2026; 9(9): 1098-1101
www.agronomyjournals.com
 Received: 22-06-2026
 Accepted: 15-08-2026
 Published: 26-09-2026

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Yield, oil content and economics of sesame (*Sesamum indicum* L.) as influenced by levels and sources of soil-applied sulphur in a Vertisol

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i9o.6653>

ABSTRACT

A field experiment entitled “Performance of sesame (*Sesamum indicum* L.) as influenced by soil application of sulphur in a Vertisol” was conducted during Rabi 2025-26 at the Agricultural Research Station, Dhadesugur, University of Agricultural Sciences, Raichur. The experiment was laid out in a split-plot design with three replications, with three sulphur levels (10, 15 and 20 kg S ha⁻¹) in the main plots and three sulphur sources (bentonite sulphur, gypsum and elemental sulphur) in the sub plots. Sulphur level and source significantly influenced capsules plant⁻¹, test weight, seed and stalk yield, oil content and oil yield, whereas harvest index and all interactions were non-significant. Application of 20 kg S ha⁻¹ recorded the higher seed yield (1113.33 kg ha⁻¹), stalk yield (2580 kg ha⁻¹), oil content (49.07 per cent) and oil yield (523.76 kg ha⁻¹), a seed yield gain of 19.4 per cent over 10 kg S ha⁻¹. Among the sources, bentonite sulphur recorded the higher seed yield (1083.66 kg ha⁻¹), oil content (49.20 per cent) and oil yield (512.68 kg ha⁻¹) and gypsum the lowest. Net returns (₹58,900 ha⁻¹) and B:C ratio (2.42) were higher at 20 kg S ha⁻¹ and bentonite sulphur recorded the higher net returns (₹56,030 ha⁻¹) and B:C ratio (2.35). Numerically, 20 kg S ha⁻¹ through bentonite sulphur gave a seed yield of 1185.00 kg ha⁻¹, oil content of 50.30 per cent, net returns of ₹64,950 ha⁻¹ and a B:C ratio of 2.55. Hence, application of 20 kg S ha⁻¹ through bentonite sulphur is suggested for sesame on Vertisols of the Northern Dry Zone of Karnataka.

Keywords: Sesame, Sulphur levels, Sulphur sources, Bentonite sulphur, Oil content, Economics, Vertisol

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Introduction

Sesame (*Sesamum indicum* L.), known as the queen of oilseeds, is one of the oldest cultivated oilseed crops, with 44-58 per cent oil and 18-25 per cent protein in the seed (Weiss, 2000; Elleuch *et al.*, 2007). India has the largest area under sesame in the world, 15.31 lakh hectares in 2023-24, producing 8.47 lakh tonnes at a productivity of 553 kg ha⁻¹ (DES, 2024) [1]. In Karnataka the crop occupies about 44,000 ha with a productivity of around 500 kg ha⁻¹ (Anonymous, 2015) [2]. The low yield is largely due to rainfed cultivation, poor soil fertility and inadequate nutrient management.

Sulphur is needed for the synthesis of cysteine, methionine, proteins, enzymes, chlorophyll and oil (Havlin *et al.*, 2014). Oilseeds have a higher sulphur requirement than cereals and a deficiency reduces capsule formation and seed and oil yield (Scherer, 2001). In sesame, sulphur application can improve growth, seed yield and oil content (Deshmukh *et al.*, 2010; Sowmya *et al.*, 2019). The size of the response depends on the source, rate, soil properties, genotype and climate (Bhat *et al.*, 2025) [3]. Gypsum, bentonite sulphur and elemental sulphur differ in sulphur concentration, solubility and speed of release and elemental sulphur has to be oxidised by soil microorganisms before it becomes available (Germida and Janzen, 1993). Recommendations on the rate and source of sulphur for sesame on Vertisols are still inadequate. The present investigation entitled “Performance of sesame (*Sesamum indicum* L.) as influenced by soil application of sulphur in a Vertisol” was therefore undertaken and this paper reports its effect on yield, oil content and economics.

Material and methods

A field experiment was conducted during Rabi 2025-26 at the Agricultural Research Station (ARS), Dhadesugur, University of Agricultural Sciences, Raichur, Karnataka. The site is located in agro-climatic zone III (Northern Dry Zone) at 16°09' N latitude, 77°29' E longitude and 358 m altitude. The soil was a clayey Vertisol, alkaline in reaction (pH 8.22) and low in organic carbon (3.50 g kg⁻¹), available nitrogen

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(265.32 kg ha⁻¹) and available sulphur (9.80 mg kg⁻¹), with medium available phosphorus (35.23 kg P₂O₅ ha⁻¹) and potassium (369.25 kg K₂O ha⁻¹). Rainfall during the crop period was 62.2 mm against a normal of 146.2 mm and the crop was irrigated five times.

The experiment was laid out in a split-plot design with three replications. The main plots carried three sulphur levels (S₁: 10, S₂: 15 and S₃: 20 kg S ha⁻¹) and the sub plots carried three sources (F₁: bentonite sulphur, F₂: gypsum and F₃: elemental sulphur), giving nine treatment combinations. Sulphur was applied basally and incorporated before sowing. Sesame variety Swetha was sown at 30 × 15 cm spacing in gross plots of 5.4 × 3.6 m. Farmyard manure at 5 t ha⁻¹ and the recommended fertilizers at 50:20:20 kg N:P₂O₅:K₂O ha⁻¹ were applied uniformly and other agronomic and plant protection practices were followed as recommended.

Capsules plant⁻¹ and test weight were recorded from five tagged plants per net plot (4.2 × 3.0 m). Seed and stalk yield from the net plot were converted to kg ha⁻¹ and harvest index was worked out as the ratio of seed yield to biological yield. Oil content was determined on oven-dried seed by nuclear magnetic resonance (NMR) at the Regional Agricultural Research Station, Raichur and oil yield was calculated from seed yield and oil content. Cost of cultivation was worked out treatment-wise on a hectare basis, gross returns were calculated at the market price of ₹9,000 q⁻¹ of seed, net returns as gross returns minus cost of cultivation and the benefit-cost ratio (B:C) as gross returns divided by cost of cultivation. Data were analysed as described by Panse *et al.* (1967) [4] and treatment means were compared at 5 per cent critical difference (CD).

Results and discussion

Number of capsules plant⁻¹ and test weight increased significantly with each increase in sulphur level and differed significantly among the sources (Table 1). 20 kg S ha⁻¹ recorded 48.83 capsules plant⁻¹ and a test weight of 3.24 g, against 37.30 and 3.02 g at 10 kg S ha⁻¹. Among the sources, bentonite sulphur recorded the most capsules (46.20 plant⁻¹) and the heavier seed (3.18 g), followed by elemental sulphur (42.80 and 3.14 g) and gypsum (39.20 and 3.09 g). Sulphur forms part of sulphur-containing amino acids, proteins and enzymes, which supports flower initiation, flower retention and capsule set and an adequate supply during seed filling improves the movement of assimilates into the seed. Dutta (2025) [5] reported a significant increase in capsules plant⁻¹ with sulphur and Karanam Navya Jyothi *et al.* (2025) [6] found bentonite sulphur to perform better than gypsum in sesame.

Seed yield rose significantly with each increment of sulphur, from 932.26 kg ha⁻¹ at 10 kg S ha⁻¹ to 1027.06 kg ha⁻¹ at 15 kg S ha⁻¹ and 1113.33 kg ha⁻¹ at 20 kg S ha⁻¹, a gain of 19.4 per cent over the lowest level. Stalk yield followed the same trend (2340, 2450 and 2580 kg ha⁻¹). The yield increase is in line with the higher capsule number and test weight and with better growth under adequate sulphur. Dutta (2025) [5] reported a significant seed yield response up to 40 kg S ha⁻¹ and Sharma *et al.* (2025) [7] also reported higher yield with sulphur, so the response in the present study may well continue beyond 20 kg S ha⁻¹, the highest level tested.

Bentonite sulphur gave a seed yield of 1083.66 kg ha⁻¹, significantly more than elemental sulphur (1020.33 kg ha⁻¹) and gypsum (971.93 kg ha⁻¹), an advantage of 11.5 per cent over gypsum. Elemental sulphur and gypsum were on par for seed and stalk yield and both gave significantly lower stalk yield (2443.33 and 2370.00 kg ha⁻¹) than bentonite sulphur (2556.66 kg ha⁻¹). The better performance of bentonite sulphur may be attributed to a more gradual release of sulphur, which kept the supply going through vegetative growth, flowering and seed filling. Prusty *et al.* (2024) [8] also reported that the source of sulphur influenced yield attributes and seed yield of sesame, although in their acid Alfisol single super phosphate performed best. Harvest index was not significantly affected by level (28.41–30.14 per cent) or source (29.08–29.76 per cent), which shows that sulphur raised seed and stalk yield in proportion without altering the partitioning of dry matter.

The interaction between sulphur level and source was non-significant for all yield characters. As the two factors acted independently, the best level and the best source combined and S₃F₁ recorded the numerically higher capsules plant⁻¹ (53.20), test weight (3.30 g), seed yield (1185.00 kg ha⁻¹) and stalk yield (2680.00 kg ha⁻¹), whereas S₁F₂ recorded the lower (34.80, 3.00 g, 890.60 and 2250.00 kg ha⁻¹, respectively). Ruchitha *et al.* (2023) [9] reported 1235.01 kg ha⁻¹ of seed yield with soil-applied sulphur and foliar zinc.

Oil content and oil yield increased significantly with each increase in sulphur level, from 46.87 per cent and 432.52 kg ha⁻¹ at 10 kg S ha⁻¹ to 49.07 per cent and 523.76 kg ha⁻¹ at 20 kg S ha⁻¹. Bentonite sulphur recorded the higher oil content (49.20 per cent) and oil yield (512.68 kg ha⁻¹), followed by elemental sulphur (48.10 per cent and 484.71 kg ha⁻¹) and gypsum (46.80 per cent and 449.11 kg ha⁻¹) and all three sources differed significantly. Sulphur takes part in the synthesis of sulphur-containing compounds and in fatty acid metabolism and a steady supply during seed filling supports oil accumulation, while the higher seed yield added to oil yield. Watsh *et al.* (2024) [10] reported significantly higher oil content with 40 kg S ha⁻¹ and Yadav *et al.* (2022) [11] observed an increase in oil content with increasing sulphur levels. The interaction was non-significant and S₃F₁ recorded the numerically highest oil content (50.30 per cent) and oil yield (556.22 kg ha⁻¹).

The cost of cultivation varied only slightly, from ₹40,550 to ₹41,700 ha⁻¹ among the treatment combinations, because the treatments differed only in the quantity and cost of sulphur (Table 2). Returns varied much more. Gross returns rose significantly from ₹83,904 ha⁻¹ at 10 kg S ha⁻¹ to ₹92,437 and ₹100,200 ha⁻¹ at 15 and 20 kg S ha⁻¹. Raising sulphur from 10 to 20 kg S ha⁻¹ added only ₹550 ha⁻¹ to the cost, yet net returns went up from ₹43,154 to ₹58,900 ha⁻¹ and B:C from 2.05 to 2.42, with all levels differing significantly. Among the sources, bentonite sulphur was the costliest (₹41,500 ha⁻¹) but recorded the higher gross returns (₹97,530 ha⁻¹), net returns (₹56,030 ha⁻¹) and B:C ratio (2.35). Its net returns were significantly higher than those of elemental sulphur (₹50,730 ha⁻¹) and gypsum (₹46,381 ha⁻¹) and its B:C ratio was significantly higher than that of gypsum (2.14), although on par with elemental sulphur (2.23). The extra cost of bentonite sulphur (about ₹700 ha⁻¹ over gypsum) was small against the ₹10,349 ha⁻¹ gain in gross returns.

The interaction was non-significant for gross returns, net returns and B:C ratio. Numerically, S₃F₁ recorded the higher gross returns (₹106,650 ha⁻¹), net returns (₹64,950 ha⁻¹) and B:C ratio (2.55), while S₁F₂ recorded the lowest (₹80,154 ha⁻¹, ₹39,604 ha⁻¹ and 1.98). Kalyani *et al.* (2025) [12] reported a progressive rise in net returns and B:C ratio with increasing sulphur in sesame and Jat *et al.* (2021) [13] identified 49.19 kg S ha⁻¹ as the economically optimum dose, which again suggests that the optimum on this soil may lie above 20 kg S ha⁻¹. Sujatha *et al.* (2021) [14] recorded the highest net returns and B:C ratio with gypsum at 45 kg S ha⁻¹, so the economics of a source depends on the yield response it produces and not on the price of the fertilizer alone.

Conclusion

Soil application of sulphur increased capsule number, test weight, seed and stalk yield, oil content and oil yield of sesame on a sulphur-deficient Vertisol and all of these responses were significant up to 20 kg S ha⁻¹, the highest level tested. Bentonite sulphur was superior to elemental sulphur and gypsum for most characters, while harvest index was unaffected. Both the level and the source paid for themselves: 20 kg S ha⁻¹ recorded the higher net returns (₹58,900 ha⁻¹) and B:C ratio (2.42) and bentonite sulphur recorded ₹56,030 ha⁻¹ and 2.35. Because the interaction was non-significant, the effects were additive and 20 kg S ha⁻¹ through bentonite sulphur (S₃F₁) recorded the numerically higher seed yield (1185.00 kg ha⁻¹), oil content (50.30 per cent), net returns (₹64,950 ha⁻¹) and B:C ratio (2.55). This treatment can be suggested for sesame on Vertisols of similar fertility status in the Northern Dry Zone of Karnataka. Trials with higher sulphur rates over more seasons would help to fix the economic optimum.

Acknowledgement

This research was a part of M.Sc. thesis and the author greatly appreciates the research facilities and support provided by the College of Agriculture, Raichur, for conducting this study. The author is grateful to the members of the advisory committee, Major advisor Dr. Ravi S, Senior Soil Scientist, ICAR-KVK, Hagari and members Dr. M V Ravi, Professor, soil science and Extension leader, AEEC, Koppal, Dr. Manjunatha Bhanuvally, Associate Professor, Soil science, AEEC,

Huvina Hadagali and Dr. Krishnamurthy D, Senior Scientist (Agronomy), AICRP, ICAR-KVK, Hagari, UAS, Raichur. For their engrossing guidance, incessant encouragement, constructive suggestions propitious assistance, keen and sustained interest, kind and gracious patronage during the entire course of investigation and preparation of this manuscript.

- NS: non-significant. Harvest index is the ratio of seed yield to biological yield, expressed as per cent.

Table 1. Yield attributes, yield and oil content of sesame as influenced by levels and sources of sulphur

Treatment	Capsules plant ⁻¹	Test weight (g)	Seed yield (kg ha ⁻¹)	Stalk yield (kg ha ⁻¹)	Harvest index (%)	Oil content (%)	Oil yield (kg ha ⁻¹)
Main plot: Sulphur levels (S)							
S ₁ : 10 kg S ha ⁻¹	37.30	3.02	932.26	2340.00	28.41	46.87	432.52
S ₂ : 15 kg S ha ⁻¹	42.07	3.15	1027.06	2450.00	29.53	48.17	490.22
S ₃ : 20 kg S ha ⁻¹	48.83	3.24	1113.33	2580.00	30.14	49.07	523.76
S.Em ±	0.28	0.01	11.64	26.77	0.31	0.15	5.73
C.D. at 5%	1.09	0.03	35.83	85.11	NS	0.49	22.49
Sub plot: Sulphur sources (F)							
F ₁ : Bentonite sulphur	46.20	3.18	1083.66	2556.66	29.76	49.20	512.68
F ₂ : Gypsum	39.20	3.09	971.93	2370.00	29.08	46.80	449.11
F ₃ : Elemental sulphur	42.80	3.14	1020.33	2443.33	29.37	48.10	484.71
S.Em ±	0.27	0.01	17.76	34.85	0.52	0.25	8.34
C.D. at 5%	0.85	0.03	54.74	102.02	NS	0.77	25.69
Interaction (S × F)							
S ₃ F ₁ (numerically highest)	53.20	3.30	1185.00	2680.00	30.65	50.30	556.22
S ₁ F ₂ (numerically lowest)	34.80	3.00	890.60	2250.00	28.35	45.90	408.84
S.Em ±	0.48	0.02	30.77	54.21	0.89	0.38	14.44
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS

Note:

Table 2. Economics of sesame as influenced by levels and sources of sulphur

Treatment	Cost of cultivation (₹ ha ⁻¹)	Gross returns (₹ ha ⁻¹)	Net returns (₹ ha ⁻¹)	B:C
Main plot: Sulphur levels (S)				
S ₁ : 10 kg S ha ⁻¹	40,750	83,904	43,154	2.05
S ₂ : 15 kg S ha ⁻¹	41,000	92,437	51,437	2.25
S ₃ : 20 kg S ha ⁻¹	41,300	100,200	58,900	2.42
S.Em ±	—	1050.42	634.08	0.03
C.D. at 5%	—	4124.48	2489.71	0.10
Sub plot: Sulphur sources (F)				
F ₁ : Bentonite sulphur	41,500	97,530	56,030	2.35
F ₂ : Gypsum	40,800	87,181	46,381	2.14
F ₃ : Elemental sulphur	41,100	91,830	50,730	2.23
S.Em ±	—	1598.78	880.12	0.04
C.D. at 5%	—	4926.32	2711.93	0.12
Interaction (S × F)				
S ₃ F ₁ (numerically highest)	41,700	106,650	64,950	2.55
S ₁ F ₂ (numerically lowest)	40,550	80,154	39,604	1.98
S.Em ±	—	2769.16	1524.42	0.07
C.D. at 5%	—	NS	NS	NS

Note:

- S₁: 10 kg S ha⁻¹; S₂: 15 kg S ha⁻¹; S₃: 20 kg S ha⁻¹. F₁: bentonite sulphur; F₂: gypsum; F₃: elemental sulphur. Sulphur was applied basally and incorporated before sowing.

- NS: non-significant. Gross returns were calculated at ₹9,000 q⁻¹ of sesame seed; B:C is gross returns divided by cost of cultivation.

References

- DES. Area, production and productivity of principal crops in India. New Delhi: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India; 2024.
- Anonymous. Indiastat. 2015.
- Bhat TA, Nazir A, Jamsheed B, Jan B, Shah ZA, Dar EA, Tanwar H, Dar KA, Ayman ES. Quadratic response assessment of gypsum and elemental sulphur on the yield and S use efficiency for soybean. *Sci Rep*. 2025;15(1):38515.
- Panse VG, Sukhatme PV. Statistical methods for agricultural workers. 2nd ed. New Delhi: Indian Council of Agricultural Research; 1967.
- Dutta S. Effect of boron and sulphur on yield and quality of sesame (*Sesamum indicum* L.). *Int J Res Agron*. 2025;8(6):631-637.
- Karanam Navya Jyothi, Bharathi D, Sabitha N, Maheswar Reddy P, Naga Madhuri KV. Effect of sources and levels of sulphur on growth and yield of sesame (*Sesamum indicum* L.) under southern agro-climatic zone of Andhra Pradesh. *Int J Res Agron*. 2025;8(2S):38-41.
- Sharma N, Sharma OP, Chaturvedi V, Dhaker DL, Ahir SL, Kumawat R, Kanwar M. Influence of fertility and sulphur management on growth parameters, yield attributes and production potential of sesame (*Sesamum indicum* L.). *Int J Res Agron*. 2025;8(8):818-821.
- Prusty M, Alim MA, Swain D, Sahoo G, Ray M. Effect of different sources and levels of sulphur in sesame on yield, nutrient uptake and soil fertility in acid Alfisols of Odisha, India. *Int J Plant Soil Sci*. 2024;36(6):669-677.
- Ruchitha P, Umesha C, Ashok G. Response of sulphur and zinc on growth and yield of sesame (*Sesamum indicum* L.). *Environ Ecol*. 2023;41(3):1674-1679.
- Watsh SK, Shivran AC, Chandan AS, Kumawat M, Ashiq IM, Devi OR, Pradhan SK. Impact of varying sulphur concentrations and foliar application of liquid manure on quality attributes and profitability in sesame cultivation. *Plant Arch*. 2024;24(2):2753-2760.
- Yadav P, Yadav SS, Yadav LR, Choudhary S. Effect of sulphur and zinc fertilization on seed yield, protein and oil content of sesame (*Sesamum indicum* L.) in semi-arid eastern plains of Rajasthan. *Ann Agric Res*. 2022;43(3):322-326.
- Kalyani R, Nagavani AV, Mobeena S. Effect of varieties and graded levels of sulphur on yield, quality and economics of summer sesame. *Agric Sci Digest*. 2025;45(2):257-261.
- Jat L, Kumawat L, Jat ML, Dhayal S, Dhayal BC, Aechra S, Kumawat R, Balveer. Economics, quality and nutrient uptake of sesame [*Sesamum indicum* L.] as response of varieties to varying levels of sulphur fertilization. *Int J Agric Ext Soc Dev*. 2021;4(1):217-221.
- Sujatha V, Saritha R, Bhanu SH, Sirisha ABM, Rao SG. Effect of sulphur on growth, yield and economics of sesame (*Sesamum indicum* L.). *Int J Agric Sci*. 2021;17(1):233-236.
- Meel HR, Verma R, Meena D, Deekshith HN, Kumawat M, Pradhan SK, Saini AK. Effect of sulphur sources and organic manures on the productivity and quality of sesame (*Sesamum indicum* L.). *Int J Res Agron*. 2025;8(7):711-716.

How to cite this article: Aloni SS, S R, Ravi M, Bhanuvally M, D K. Yield, oil content and economics of sesame (*Sesamum indicum* L.) as influenced by levels and sources of soil-applied sulphur in a Vertisol. *International Journal of Research in Agronomy*. 2026;9(9):1098-1101. doi: <https://www.doi.org/10.33545/2618060X.2026.v9.i9o.6653>