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Impact of Sulphur Fertilization on Growth, Yield, Sulphur and Oil Content, Sulphur Uptake and Economics of Sesamum (*Sesamum indicum* L.) Cultivars during *Pre-kharif* in South Odisha

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ABSTRACT: Sesamum is the queen among all the oilseed crops having a wider range of adaptability to different agro-climate and is being cultivated in India due to its market value, good quality oil and nutritional content. Some important reasons for achieving low productivity of sesamum are less or no application of some fertilizer nutrients and improper selection of cultivar. Being an oilseed crop, application of primary nutrients along with sulphur can improve seed and oil yield as well as oil quality of sesamum. Sulphur plays key role in protein synthesis in oilseeds and helps in plant metabolic activity and ultimately improve yield. Along with sulphur application, selection of best suitable cultivated crop variety for a location can also enhance the productivity of sesamum. Indian farmers generally do not apply sulphur separately through a different sulphur-based fertilizer due to lack of awareness. Considering these facts, a field investigation was taken to assess the enhancement in the growth, yield, sulphur and oil content, sulphur uptake and economics of sesamum cultivars due to sulphur fertilization under this agro-climatic region. Field investigation was done during *pre-kharif* season of 2022 at Post Graduate Research Farm, M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Odisha. The present study was planned in factorial randomized block design with three different cultivars (YLM 11, Gowri and YLM 66) and four levels of sulphur (0, 20, 40 and 60 kg ha^{-1}) replicated thrice. Sulphur was applied through bentonite sulphur fertilizer which contains 90% sulphur. As per the experimental findings, cultivation of the sesamum cultivar "Gowri" combined with sulphur application at the rate of 60 kg ha^{-1} was beneficial for obtaining more growth, yield, oil and sulphur content, higher sulphur uptake and economic benefit than all the other combinations of sesamum cultivar and sulphur application rate.

Keywords: Cultivar, Growth, Oil, Sulphur, Sesamum, Yield.

INTRODUCTION

Sesamum, the "queen of oilseeds" belongs to the family Pedaliaceae. This crop is being cultivated in all the three seasons due to its wide range of climatic adaptability. India ranks first in acreage (45%), production (36%) and exportation (45%) of the sesame in the world. Sesamum is quite nutritious and around 50% oil and 25% protein present in seed. Seed oil contains a large content of linoleic and oleic acid. Sesame seeds have a combination of poly unsaturated fatty acids, several vitamins, such as niacin (Vitamin B) and minerals like calcium (Ca) and phosphorus (P) and amino acids like methionine, tryptophan etc. Moreover, sesame oil has potent therapeutic properties that strengthen the immune system (Biswas *et al.*, 2019). The productivity of sesame in our country is not eye-catching because of its cultivation in sub-marginal fields and absence of high yield performing cultivars (Kumari *et al.*, 2023; Manjeet *et al.*, 2020). To improve the productivity of sesame, adoption of better management practices such as sufficient and balanced fertilization (Lallawmzuali *et al.*, 2022) as well as choosing the suitable cultivar for the growing condition are required (Narayanan and Reddy, 1982). Increment in seed yield is a significant factor influencing the adoption of adverse climatic condition resilient sesamum cultivars (Lukurugu *et al.,* 2023).

Further applying N, P and K alone will not be enough to achieve the maximum yield potential of the crop, suggested amounts of secondary and micronutrients are needed to be applied together (Sujatha *et al.,* 2021). In terms of secondary nutrients, sulphur (S) is the fourth most important nutrient for plants followed by N, P, and K (Bindraban *et al*., 2020). S is necessary for the synthesis of essential oils and crucial for the formation of chlorophyll which is necessary for the growth of cells and it boosts resistance to cold and drought (Murmu *et al.,* 2015). Since this nutrient enhances the production of organic compounds, oil glands and vitamin B_1, all oilseed crops have the S-loving character (Shelke *et al.,* 2014). Lack of S impairs plant N metabolism, enzyme synthesis and the production of S-containing amino acids which has significant negative influence on both seed and oil production (Scherer *et al.,* 2001; Rathore *et al.,* 2015). Therefore, this experiment was conducted with the hypothesis that adequate S application can enhance the plant growth, seed yield and seed oil content of sesamum in the presence of high yielding cultivars.

MATERIALS AND METHODS

Field experimentation was done in the Post Graduate Research Farm (23°39′N latitude and 87°42′E longitude and 182.9 m above the mean sea level) of M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Gajapati, Odisha during *pre-kharif*, 2022 to study the impact of sulphur application on sesamum (*Sesamum indicum* L.) cultivars in southern Odisha. The experimental field was sandy loam in texture with the soil pH of 6.2, available N, P_2O_5, K_2O and S were 228, 12.7, 120.2 and 20.1 kg ha^{-1}, respectively. The weekly mean of maximum and minimum temperature ranged from 29.43°C to 40.71°C and 15.86°C to 26.71°C, respectively during the growing season. The experiment was conducted in factorial randomized block design (FRBD) replicated three times. Three cultivars were taken as three levels of the 1st factor (YLM 11, Gowri, YLM 66) and four different rates of S were taken as four levels of the 2nd factor (control, 20, 40 and 60 kg S ha^{-1}). Each net plot size was 5 m × 4.8 m. All the three cultivars were sown on 1st February, 2022 with the row to row spacing of 30cm and the plant to plant spacing of 10cm. The fertilizer recommendation, 60-30-30 kg ha^{-1} of N-P_2O_5-K_2O was followed. Half N, 100% P_2O_5 and K_2O of the recommended rate was applied as basal at the time of sowing and remaining 50% of recommended N was top-dressed at 35 DAS. Full rate of S was applied as basal in the form of bentonite sulphur (90% S). First irrigation was given at 3 days after sowing (DAS) and three more irrigations were given during the pre-reproductive stage, early bloom stage and late bloom stage, respectively.

RESULTS AND DISCUSSION

A. Growth attributes of sesamum

All the growth attributing characters were significantly varied among different cultivars except crop growth rate (CGR) at 30-60 DAS (Table 1). Chongdar *et al.* (2015); Ali *et al.* (2020); Jahan and Mamun (2021) also reported significant variation among the cultivars in plant height at harvest and dry matter production at harvest. Significant difference among the sesamum cultivars was noticed earlier by Shilpa *et al.* (2022) in case of CGR at 60 DAS-harvest. Tallest plants at harvest were found in the cultivar, Gowri (109.10 cm) which were significantly taller than all other cultivars. The shortest plants were noticed in the cultivar, YLM 11 (103.27 cm) at harvest which was statistically at par with the cultivar, YLM 66 (104.43 cm). The significant difference in plant height among different cultivars could be attributed to their varietal characteristics (Kalyani *et al.,* 2020) and genetic potential (Rakesh *et al.*, 2012; Rana *et al.*, 2020). Number of branches plant^{-1} at harvest was recorded significantly highest in the same cultivar, Gowri (6.21). The cultivar, YLM 11 showed lowest number of branches plant^{-1} (5.62) at harvest but it was statistically similar to the cultivar, YLM 66 (5.82). Previous findings of Lattief (2015) with respect to plant height at harvest and number of branches plant^{-1} corroborated the results of this experiment. Although, the cultivar, YLM 66 showed maximum dry matter accumulation (280.40 g m^{-2}) at harvest and CGR at 60 DAS-harvest (8.74 g m^{-2} d^{-1}), it was statistically at par with the cultivar, Gowri (DMA was 268.57 g m^{-2} at harvest and CGR was 7.99 g m^{-2} d^{-1} at 60 DAS-harvest) in both the cases. The data on leaf area index (LAI) noted down at 60 DAS was significantly higher in the cultivar, Gowri (2.11) than all others. The lowest LAI was recorded at 60 DAS in the cultivar, YLM 11 (1.90) which was statistically similar with the cultivar, YLM 66 (1.98). Days to maturity were significantly varied among the sesamum cultivars only. Abrha (2018) also reported significant variation among the sesamum cultivars in days to maturity. Maximum no. of days was taken by the cultivar, YLM 11 (88.25 DAS) to mature which was statistically at par with the cultivar, Gowri (85.08 DAS) and significantly higher from the cultivar, YLM 66 (81.58 DAS). This was might be due to higher uptake of N, P and K by the cultivar, Gowri and YLM 11 than the cultivar, YLM 66 which promoted the prolonged vegetative growth and delayed in maturity (Kalyani *et al.,* 2020).

In the investigated data of all the growth parameters, the application of S at the rate of 60 kg ha^{-1} though being statistically similar with the application rate of 40 kg S ha^{-1} ensured significant increment in all the growth parameters except dry matter production at harvest and significantly higher than no S application and S application at the rate of 20 kg ha^{-1} during the period of experimentation. At harvest, significantly taller plants were noticed with the application of 60 kg S ha^{-1} (112.39 cm) at harvest as compared to the application of 0 and 20 kg S ha^{-1}.

Previously, Arvind *et al.* (2018) reported on the impact of S application on plant height at harvest which corroborated this result. Significant enhancement in the plant height with S application at higher rates might be attributed to indirect involvement of S in photosynthesis of plants (Patil *et al.,* 2014). S application might have improved metabolic activity and photosynthetic rate because of its involvement in chlorophyll development, activation of enzymes *vis-à-vis* primary and secondary metabolism (Rana *et al.*, 2020). Maximum number of branches plant^{-1} was obtained with the application of 60 kg ha^{-1} of S (6.54) at harvest, it was statistically at par with application of 40 kg ha^{-1} of S (6.41). Similar observations regarding number of branches plant^{-1} were reported earlier by Akter *et al.* (2013) under the application of 30 kgSha^{-1}. S helps in stimulation of cell division and photosynthetic process as well as chlorophyll development. S application might also be the reason of improvement in soil physico-chemical properties and hence higher nutrient availability to the crop was observed during vegetative growth period (Khan *et al.*, 2021) which ultimately led to a greater number of branches plant^{-1}. Among the S rates, 60 kg S ha^{-1} showed maximum DMA at harvest (299.30 g m^{-2}) which were significantly greater than all other S rates. These results were in accordance with the earlier report of Usharani *et al.* (2002); Saren *et al.* (2004). Increase in DMA might be because of the higher availability and utilization of primary nutrients (N, P, and K) with the application of S in sesamum (Raja *et al.*, 2007b) which resulted in increased plant height, higher LAI, vigorous crop growth and ultimately led to higher dry matter production (Kalyani *et al.,* 2020). At 60 DAS, highest LAI was obtained with the application of 60 kg S ha^{-1} (2.29) which was statistically at par with the application of 40 kg S ha^{-1} (2.19). Previous report of Ramakrishna *et al.* (2017) was in agreement with the highest LAI of sesamum obtained in this experiment. Sesamum plants attained higher LAI with higher S application rate which might be due to higher activities of meristematic plant tissues, enhancing the number and size of cells and ultimately increased total photosynthetic surface area of plants (Kalyani *et al.*, 2020) along with larger time period of green leaf area and late senescence of leaves (Ahmed *et al.*, 2005; Begum *et al.,* 2012). Best results of CGR at 30 DAS-60 DAS (2.98 g m^{-2} d^{-1}) and CGR at 60 DAS-harvest (9.93 g m^{-2} d^{-1}) were found with the application of S at the rate of 60 kg ha^{-1} and results obtained with the application of S at the rate of 40 kg ha^{-1} (2.91 and 8.22 g m^{-2} d^{-1} in CGR at 30 DAS-60 DAS and 60 DAS-harvest, respectively) were statistically similar in both cases. Significant impact of interaction between sesamum cultivars and S application rates was found in LAI at 60 DAS (Table 2). Highest LAI at 60 DAS was noted down from the interaction between the sesamum cultivar, Gowri and S application rate of 60 kg ha^{-1} (2.68) which was statistically at par with the interaction effect of the sesamum cultivar, Gowri and S application rate of 40 kg ha^{-1} (2.61) at 60 DAS. According to Murmu *et al.* (2015), S is essential for the formation of plant cells. LAI of sesamum at 60 DAS was non significantly enhanced with enhancing S application rate from 40 to 60 kg ha^{-1} because the S application beyond the rate of 40 kg ha^{-1} alone might not be enough for further enhancement in leaf cell formation.

B. Yield attributes, yields and oil content of sesamum

Among the yield attributing features, no. of capsules plant^{-1}, number of seeds capsule^{-1} and 1000-seed weight were significantly influenced under different cultivars and levels of S application (Table 3). The cultivar, Gowri was recorded highest in the number of capsules plant^{-1} (37.94) and 1000-seed weight (2.00 g) which were significantly higher than all other cultivars. Variation in no. of capsules plant^{-1} and 1000-seed weight of sesamum cultivars was noticed earlier by Pérez-Bolaños and Salcedo-Mendoza (2018). In case of number of seeds capsule^{-1}, highest data was recorded in the cultivar, Gowri (28.03) which was statistically at par with the cultivar, YLM 11 (26.60). Archana and Singh (2011); Yadav *et al.* (2018) also noted down similar variation in cultivars in case of number of seeds capsules^{-1}. These results could be attributed to their genetic differences as also exemplified in agronomic traits (Rana *et al.*, 2020). Superiority of the cultivar, Gowri with significant variation had been noted down in seed yield (658.18 kg ha^{-1}) and stalk yield (1993.76 kg ha^{-1}) among all the cultivars. Earlier report of Pérez-Bolaños and Salcedo-Mendoza (2018) strengthened these findings related to seed yield of sesamum. The increment in seed yield of the cultivar, Gowri could be due to its genetic potential for utilizing and translocating the photosynthates from vegetative parts to reproductive parts more efficiently under such climatic situation (Kalyani *et al.*, 2020). The cultivar, Gowri also performed significantly superior (265.29 kg ha^{-1}) than all other cultivars in case of oil yield. This finding was in line with the earlier report of Lattief (2015). In the investigated data of oil content, maximum oil percentage was found in the cultivar, Gowri (39.95%) which was statistically similar to the cultivar, YLM 66 (38.90%) but significantly higher than the cultivar, YLM 11 (37.78%). This result was in agreement with the previous report of Tiwari *et al*. (2000). The significant variation in oil content and oil yield with different cultivars could be due to their different genetic make-up and growing environments (Uzun *et al.*, 2002; Lattief, 2015).

In case of all the yield attributes, the S application rate of 60 kg ha^{-1} provided significantly superior results (38.77, 28.63 and 1.99 g were the number of capsules plant^{-1}, number of seeds capsule^{-1} and 1000-seed weight, respectively) over no S application and the application of 20 kg S ha^{-1}. Previous report of Khan *et al.* (2021) related to significant variation in the number of capsules plant^{-1}, number of seeds capsule^{-1} and 1000-seed weight with the variation in application of 20 kg S ha^{-1} corroborated these findings. Increment in yield related attributes could be due to the increase in availability and utilization of primary nutrients with enhanced rate of S application (Raja *et al.,* 2007b) which resulted in higher chlorophyll synthesis, photosynthesis, cell division and translocation of assimilates to the reproductive parts from the vegetative parts (Garg, *et al.*, 2006). Application of S at the rate of 60 kg ha^{-1} showed statistically similar results with 40 kg S ha^{-1} in case of all the above-mentioned yield attributes. S rate of 60 kg ha^{-1} provided the significantly higher results regarding seed yield (737.93 kg ha^{-1}) and stalk yield (2318.96 kg ha^{-1}) of sesamum than all other treatments. Higher dose of S application increased seed yield due to the considerable increase in number of capsules plant^{-1}, number of seeds capsule^{-1} and 1000-seed weight (Raza *et al.*, 2018). Higher dry matter production at harvest with higher S doses might be ascribed to S functioning in advantageous nutritional environment of the root zone as well as plant system which ultimately led to higher stalk yield of sesamum (Rana *et al.*, 2020). Oil content was recorded highest with the application of 60 kg S ha^{-1} (41.75%) which was statistically superior to all other S application rates. The enhancement in oil content could be because of higher S storage in the plant which is enhanced with enhancing the dose of S as it plays integral part of the biological molecule such as cysteine, methionine and cysteine (Rehm and Albert 2006). The effect of S fertilization rate on oil yield of sesamum was found to be maximum with the application of 60 kg S ha^{-1} (308.28 kg ha^{-1}) which was statistically superior to all other rates of S application. Full utilization of carbohydrate for oil synthesis with the application of S could be the reason behind enhancement of oil yield (Yadav and Harishankar 1980).

C. S content and S uptake of sesamum seed and stalk

The S content in seed was influenced significantly by the cultivars (Table 4). Highest S content in seed was found in the cultivar, Gowri (0.25%) which was statistically at par with the cultivar, YLM 11 (0.24%). Lowest S content in seed was observed in the cultivar, YLM 66 (0.21%). This might be because of more dry matter accumulation and partitioning in reproductive parts of plants in the cultivar, Gowri (Raza *et al.*, 2018). Maximum S uptake in sesamum seed (1.67 kg S ha^{-1}) and stalk (5.40 kg S ha^{-1}) was also observed in the cultivar, Gowri which was statistically superior to the other cultivars used in the experiment.

Significant impact of S doses was noted down on S content in sesamum seed and stalk. Highest S content in seed (0.30%) and stalk (0.32%) were observed with the application of 60 kg S ha^{-1} which was statistically superior to all other S rates. Lowest S content in seed (0.17%) and stalk (0.19%) were obtained with no S application. Highest S uptake by seed was obtained with the application of 60 kg S ha^{-1} (2.19 kg S ha^{-1}) which was significantly higher than all other S rates. This was mainly because of optimum availability of S with the application of 60 kg S ha^{-1} during the early growth stages of sesame which in turn enhanced the dry matter production (Raza *et al.*, 2018). Highest S uptake by stalk was also noticed with the application of 60 kg S ha^{-1} (7.44 kg S ha^{-1}) which was significantly higher than all other S rates. This was mainly because of successive increase in S application (Saini *et al.*, 2015) upto 60 kg S ha^{-1} resulted in optimum availability of S during the early growth stages of sesame which in turn improved DMA (Raza *et al.*, 2018).

D. Economics of sesamum

In study of economics (Table 5), the cost of cultivation was similar in all the cultivars (Rs. 31650 ha^{-1}) which was mainly due to same market price of the seeds of all the cultivars. Among the S rates, 60 kg S ha^{-1} had highest cost of cultivation (Rs. 36650 ha^{-1}). Gross return, net return and benefit-cost ratio (BCR) were also found highest in the cultivar, Gowri (Rs. 62606 ha^{-1}, Rs. 30955 ha^{-1} and 0.97, respectively) which were followed by the cultivar, YLM 66 (Rs. 57750 ha^{-1}, Rs. 26099 ha^{-1} and 0.82 were gross return, net return and benefit-cost ratio, respectively). This was because of obtaining higher seed yield in the cultivar, Gowri than all other cultivars.

Table 1: Growth attributing parameters of sesamum as influenced by different cultivars combined with S application rates.

Treatments	Plant height at harvest (cm)	Number of branches plant^{-1} at harvest	Dry matter production at harvest (g m^{-2})	Leaf area index at 60 DAS	Days to maturity (DAS)	CGR (g m^{-2} d^{-1})	
						30 - 60 DAS	60 DAS - harvest
Cultivars							
YLM 11	103.27	5.62	257.38	1.90	88.25	2.72	6.03
Gowri	109.10	6.21	268.57	2.11	85.08	2.90	7.99
YLM 66	104.43	5.82	280.40	1.98	81.58	2.78	8.74
S. Em. (±)	1.56	0.11	5.46	0.03	1.25	0.07	0.61
C.D. (P=0.05)	4.57	0.31	16.01	0.10	3.67	NS	1.79
S application rates (kg ha^{-1})							
0	99.60	5.08	233.14	1.83	85.00	2.56	5.53
20	102.29	5.49	262.35	1.88	85.44	2.76	6.66
40	108.11	6.41	279.84	2.19	84.11	2.91	8.22
60	112.39	6.54	299.80	2.29	85.33	2.98	9.93
S. Em. (±)	1.80	0.12	6.30	0.04	1.44	0.08	0.71
C.D. (P=0.05)	5.28	0.36	18.49	0.11	NS	0.22	2.07
Interaction effect							
S. Em. (±)	3.12	0.21	10.92	0.07	2.50	0.13	1.22
C.D. (P=0.05)	NS	NS	NS	0.20	NS	NS	NS

Table 2: Interaction effect between different cultivars and S application rates on leaf area index at 60 DAS.

Treatments	Leaf area index at 60 DAS			
	0 kg ha^{-1} S	20 kg ha^{-1} S	40 kg ha^{-1} S	60 kg ha^{-1} S
YLM 11	1.80	1.84	2.04	1.92
Gowri	1.82	1.91	2.61	2.68
YLM 66	1.85	1.88	2.23	1.97
S.Em. (±)	0.07			
C.D. (P=0.05)	0.20			

Table 3: Yield attributing characters, yields and oil content of sesamum as influenced by different cultivars combined with S application rates.

Treatments	Number of capsules plant^{-1}	Number of seeds capsule^{-1}	1000-seed weight (g)	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Oil content (%)	Oil yield (kg ha^{-1})
Cultivars							
YLM 11	34.54	26.60	1.72	593.50	1787.76	37.78	226.02
Gowri	37.94	28.03	2.00	658.18	1993.76	39.95	265.29
YLM 66	34.75	24.90	1.73	607.89	1857.98	38.90	237.04
S. Em. (±)	0.97	0.69	0.05	14.10	45.56	0.43	5.84
C.D. (P=0.05)	2.83	2.03	0.13	41.35	133.59	1.26	17.13
S application rates (kg ha^{-1})							
0	32.80	24.33	1.67	496.27	1507.82	36.50	180.12
20	34.68	25.73	1.71	576.44	1700.40	37.28	214.97
40	36.73	27.33	1.89	668.78	1992.14	39.98	267.75
60	38.77	28.63	1.99	737.93	2318.96	41.75	308.28
S. Em. (±)	1.11	0.80	0.05	16.28	52.60	0.50	6.75
C.D. (P=0.05)	3.27	2.35	0.15	47.75	154.25	1.46	19.79
Interaction effect							
S. Em. (±)	1.93	1.39	0.09	28.20	91.11	0.86	11.69
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS

Table 4: S content and S uptake of sesamum seed and stalk as influenced by different cultivars combined with S application rates.

Treatments	S content (%)		S uptake (kg ha^{-1})	
	Seed	Stalk	Seed	Stalk
Cultivars				
YLM 11	0.24	0.26	1.43	4.72
Gowri	0.25	0.26	1.67	5.40
YLM 66	0.21	0.25	1.31	4.69
S. Em. (±)	0.009	0.005	0.04	0.14
C.D. (P=0.05)	0.03	NS	0.13	0.42
S application rates (kg ha^{-1})				
0	0.17	0.19	0.81	2.82
20	0.21	0.23	1.18	3.91
40	0.25	0.28	1.69	5.56
60	0.30	0.32	2.19	7.44
S. Em. (±)	0.010	0.005	0.05	0.17
C.D. (P=0.05)	0.03	0.02	0.15	0.49
Interaction effect				
S. Em. (±)	0.018	0.009	0.09	0.29
C.D. (P=0.05)	NS	NS	NS	NS

Table 5: Economics of sesamum cultivation as influenced by different cultivars combined with S application rates.

Treatments	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	BCR
Cultivars				
YLM 11	31650	56383	24732	0.77
Gowri	31650	62606	30955	0.97
YLM 66	31650	57750	26099	0.82
S application rates (kg ha^{-1})				
0	26650	47145	20495	0.77
20	29984	54762	24778	0.83
40	33317	63639	30322	0.91
60	36650	70104	33453	0.91

Application of S at the rate of 60 kg ha^{-1} had maximum gross return (Rs. 70104 ha^{-1}), net return (Rs. 33453 ha^{-1}) and BCR (0.91). Similar BCR was also noted down in the treatment, S application rate of 40 kg ha^{-1} (0.91). S fertilization significantly improved the DMA and distribution of that dry matter towards the reproductive parts and ultimately gave maximum profit to the farmer through improving seed yield (Raza *et al.,* 2018). Previous reports of Raza *et al.* (2018); Lallawmzuali *et al.* (2022) were in agreement with the result of highest BCR observed with the application of 40 kg S ha^{-1}.

CONCLUSIONS

From the above findings, it can be inferred that S application along with the primary nutrients might have positive impact on the growth and yield attributes and yield *vis-à-vis* oil percentage of improved sesamum cultivars. Application of S at the rate of 60 kg ha^{-1} in combination with the cultivar, Gowri could be the best option to achieve maximum growth, yield and profit during *pre-kharif* season in southern Odisha region.

FUTURE SCOPE

Balanced nutrition of sesamum through introducing some region-specific deficient micronutrients in the presence of some high yielding suitable cultivars in southern Odisha will be an effective area for further research in the direction of achieving higher seed yield and oil content.

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Conflict of Interest. None.

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