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Effect of Basal Application of Sulphur and Foliar Application of Micro-nutrients on Growth and Yield of Summer Sesame

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during zaid season 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and sciences. Prayagraj (UP), India. The aim was to study the effect of basal application of sulphur and foliar application of micronutrients on growth and yield of summer sesame. Treatment consisted of application of 10, 20, 30 kg/ha of sulphur and micronutrients as foliar spray (0.5% zinc, 0.5% iron, 0.2% boron). There were 10 treatments, each repeated 3 times. The soil in the experimental plot was sandy-loamy in texture, nearly neutral in soil response (pH 7.8), poor in organic carbon (0.35%), available N (163.42 kg/ha), available P (21.96 kg/ha), kg/ha). And available K (256.48 kg/ha). As a result, sulphur 30 kg/ha + zinc 0.5% (treatment -7), plant height (95.1 cm), plant dry weight (20.48 g/plant), number of capsules/plant (52.9), high number of seeds/ Capsules (63.2), test weight (3.26 g), seed yield (1.41 t/ha), stover yield (6.44 t/ha), Harvest index (17.92%).

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1. INTRODUCTION

Sesame (*Sesamum indicum* L.) is a long-grown oilseed. Peanuts and canola rank alongside mustard as the major edible oilseeds. Sesame is called the "queen of oilseeds" in ancient texts and sesame oil is one of the oldest known oils. For human consumption [1]. One of the oilseeds native to Southwest Africa is sesame (*Sesamum indicum* L.), which belongs to the Pedaliaceae family. Oil accounts for 46-64% of its composition and protein accounts for 15-16%. Over 73% of domestic sesame production is used for oil extraction, 14.5% for domestic use such as candy and confectionery for cooking and confectionery, 8.3% for hydrogenation, and 4.2% for industrial use such as oils, medicines, pesticides [2].

Oilseed crops require more sulphur (S) than cereal crops, and S deficiency interferes with plant metabolism and synthesis of S-containing amino acids, thereby adversely affecting both seed and oil yields. S is essential for plant growth and development and plays an important role in plant metabolism, essential oil synthesis and chlorophyll formation [3]. It also improves cell growth, cold resistance, and drought resistance [4], and components of many organic compounds [5], oil storage organs, especially oil glands [6] and vitamin B1 [7].

Zinc (Zn), one of the essential micronutrients, plays an important role in various enzymatic and physiological activities in plants. It is also an essential component of synthetic and natural organic complexes of plants. It is estimated that over 30% of agricultural soils worldwide are deficient in available zinc, leading to deficiencies in crops grown on these soils [8]. Therefore, Zn malnutrition has become a major health problem among resource-poor populations, [9]. In India, Zn is one of the multi nutrient deficiencies that cause reduced crop Yields.

Boron is one of the essential micronutrients required for normal plant growth. Its deficiency results in large losses in crop production, both qualitatively and quantitatively. Boron's main function is to maintain cell wall integrity. It is also required for cell expansion and regulation of hydrogen ion transport. In oilseeds, it is important for pollen tube growth, flowering, seed setting, and seed development. play an important role in transporting nutrients and water to the newly growing parts of the plant, and in translocation of photosynthesis from source to sink. It regulates stomata opening and makes plants drought tolerant (The Handbook of agriculture 2019; Agronomy Facts for Competition by Meena and Sihag 2021 [10].

Iron is involved in the formation of chlorophyll in plants. Iron-based plant haemoglobins are another promising target for altering iron levels in plant foods. Plant haemoglobin is similar to human haemoglobin, Fe-binding capacity, and is most commonly found in nodule-like legumes (nitrogen-fixing plants) [11].

2. MATERIALS AND METHODS

A field experiment was conducted during zaid season 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agricultue,Technology and sciences. Prayagraj (UP), India. The soil in the test plot was sandy-loamy in texture, nearly neutral in soil response (pH 7.8) and poor in organic carbon (0.35%). The treatments are 10 kg/ha sulphur + 0.5% zinc, 10 kg/ha sulphur + 0.5% iron, 10 kg/ha sulphur + 0.2% boron, 20 kg/ha sulphur + 0.5% zinc, sulphur 20 kg /ha + 0.5% iron, 20 kg/ha sulphur + 0.2% boron, 30 kg/ha sulphur + 0.5% zinc, 30 kg/ha sulphur + 0.5% iron, 30 kg/ha sulphur + 0.2% boron, and control. The experiment was set up in a randomized block design with 3 replicates of 10 treatments. Several plant growth parameters were recorded during the period from germination to harvest. These parameters are recorded growth parameters, plant height and plant dry weight. Yield parameters such as number of capsules/plants, number of seeds/capsules, test weight (g), seed yield (t/ha), stover yield (t/ha), Harvest index (%). Data were subjected to statistical analysis by the analysis of variance method [12].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Plant height: At 90 DAS, a significantly higher plant height (95.1 cm) was observed for treatment -7 (30 kg/ha sulphur + 0.5% zinc foliar). However, treatment 8 (30 kg/ha sulphur + 0.5% iron foliar) was statistically at par with treatment 7 (30 kg/ha sulphur + 0.5% zinc foliar) shown in (Table 1). The significantly high plant height is probably due to the application of 30 kg/ha of sulphur. The presence of sulphur appeared to play an important role in increasing the metabolic utilization of sulphur in plants, promoting mitotic activity, resulting in higher apical growth and increased photosynthetic surface area. The results were consistent with [13]. Significant improvements in plant height have also been shown with zinc application. The increase in plant height may be due to the involvement of zinc in various physiological processes, such as enzyme activation, electron transport, chlorophyll formation, and stomatal regulation. Zinc gradually increases plant height. I was allowed to resulting in enhanced vegetative growth. Similar results were reported by [14].

Plant dry weight: At 90 DAS, a significantly higher plant dry weight (20.48 g/plant) was observed for treatment-7 (30 kg/ha sulphur + 0.5% zinc foliar). However, treatment 8 (30 kg/ha sulphur + 0.5% iron foliar) was statistically at par with treatment 7 (30 kg/ha sulphur + 0.5% zinc foliar). Plant dry weight gain can be affected by an application of 30 kg sulphur per hectare. This may be due to increased amino acid synthesis, increased chlorophyll levels in the growing area, and improved photosynthetic activity, which ultimately leads to increased cell division and increased plant growth rate. Sufficient supply of sulphur increases photosynthetic production and facilitates its movement to the sink. These results are consistent with [15]. This could be because branching of sesame was improved and shoot development was promoted mainly by auxin along with this zinc application, but zinc application ultimately increased the availability of other nutrients and photo assimilation. It facilitated the migration of sesame and ultimately contributed to the increase in plant dry weight of sesame. Similar results were reported by [16].

3.2 Yield Attribute

Capsules per plant: A significantly higher number of capsules/plant (52.9) was recorded for treatment 7 (30 kg/ha sulphur + 0.5% zinc foliage), which is superior to all treatments. However, Treatment - 9 with 30 kg/ha sulphur + 0.2% boron foliar was found to be statistically at par with Treatment - 7 (30 kg/ha sulphur + 0.5% zinc foliage). The increased number of capsules per plant was due to a significant improvement in sulphur application, which, as mentioned above, could be attributed to an overall improvement in vigour and plant growth as a result of a balanced nutrient environment. Adequate supply of sulphur also aids in flower primordial development. The reproductive part of a plant that gives rise to capsule and seed development. Similar results were previously reported by [17].

Number of seeds/capsules: A significantly higher number of seeds/capsules (63.2) was recorded for treatment 7 (30 kg/ha sulphur + 0.5% zinc foliar), which is superior to all treatments. However, Treatment - 9 with 30 kg/ha sulphur + 0.2% boron foliar was found to be statistically at par with Treatment - 7 (30 kg/ha sulphur + 0.5% zinc foliar). An increase in the number of seeds/capsules with an increase in sulphur application rate could be better for root growth, cell proliferation, plant elongation, and cell expansion with an increase in sulphur application rate, ultimately increasing seed yield. is increased with similar results. Conformity with [18].

3.3 Test Weight

Significantly Higher Treatment 7 (30 kg/ha sulphur + 0.5% zinc foliar) recorded a higher number of test weights (3.26 g), superior to all treatments. However, Treatment - 9 with 30 kg/ha sulphur + 0.2% boron foliar was found to be statistically at par with Treatment - 7 (30 kg/ha sulphur + 0.5% zinc foliar). Zinc application to sesame generally improves capsule growth through synthesis of tryptophan and auxin. The enhancing effects on seeds/capsules and capsules/plants are attributed to the beneficial effects of zinc application to plants on nutrient metabolism, biological activity and growth parameters, thus applied zinc leads to increasingly higher enzymatic activity. that in turn more seeds/capsules, capsules/plants and test weights of seeds. Similar results were previously reported by [19].

3.4 Seed Yield

A significantly higher seed yield (1.41 t/ha) was recorded for treatment 7 (30 kg/ha sulphur + 0.5% zinc foliar), superior to all treatments. However, Treatment - 9 with 30 kg/ha sulphur + 0.2% boron foliar was found to be statistically at par with Treatment - 7 (30 kg/ha sulphur + 0.5% zinc foliar). This may be due to the stimulatory effects of sulphur on cell division, cell elongation and regulation of cell structure. Higher doses also result in greater leaf area and chlorophyll content, enhancing the photosynthetic, anabolic and metabolic activity required throughout reproduction. phase and ultimately responsible for improving seed yield. The results resonated with [20]. Zinc plays an important role in increasing seed yield as it occurs in many physiological processes in plants such as: Chlorophyll formation, stomata regulation and starch utilization to increase seed yield. Zinc also converts ammonia to nitrates within the plant, contributing to yield. These results support the work of [21].

Table 1. Effect of sulphur and micro nutrients on growth attributes of sesame

S. No.	Treatment combinations	Plant height (cm) 90DAS	Dry weight (g/plant) 90DAS
1.	Sulphur 10 Kg/ha + 0.5 % Zinc foliar	93.0	18.68
2.	Sulphur 10 Kg/ha + 0.5 % Iron foliar	91.4	17.88
3.	Sulphur 10 Kg/ha + 0.2 % Boron foliar	92.1	18.34
4.	Sulphur 20 Kg/ha + 0.5 % Zinc foliar	93.9	19.74
5.	Sulphur 20 Kg/ha + 0.5 % Iron foliar	93.0	19.09
6.	Sulphur 20 Kg/ha + 0.2 % Boron foliar	93.6	19.40
7.	Sulphur 30 Kg/ha + 0.5 % Zinc foliar	95.1	20.48
8.	Sulphur 30 Kg/ha + 0.5 % Iron foliar	94.4	20.01
9.	Sulphur 30 Kg/ha + 0.2 % Boron foliar	94.6	20.33
10.	N-P-K 50-40-30 kg/ha (control)	89.8	17.23
	F test	**S**	**S**
	S Em. (±)	0.22	0.13
	CD (P=0.05)	0.66	0.41

Table 2. Effect of sulphur and micro nutrients on yield attributes of sesame

S. No.	Treatment combinations	Capsules/plant (no.)	Seeds/capsule (no.)	Test weight(g)	Grain yield(t/ha)	Stover yield (t/ha)	Harvest index (%)
1.	Sulphur 10 Kg/ha + 0.5 % Zinc foliar	49.4	60.9	2.84	1.07	5.97	15.20
2.	Sulphur 10 Kg/ha + 0.5 % Iron foliar	48.5	59.1	2.79	0.93	5.62	14.19
3.	Sulphur 10 Kg/ha + 0.2 % Boron foliar	49.0	59.9	2.82	0.98	5.75	14.64
4.	Sulphur 20 Kg/ha + 0.5 % Zinc foliar	51.3	62.2	3.00	1.32	6.26	17.41
5.	Sulphur 20 Kg/ha + 0.5 % Iron foliar	50.2	61.5	2.87	1.16	6.07	15.99
6.	Sulphur 20 Kg/ha + 0.2 % Boron foliar	50.8	61.8	2.93	1.25	6.18	16.81
7.	Sulphur 30 Kg/ha + 0.5 % Zinc foliar	52.9	63.2	3.26	1.41	6.44	17.92
8.	Sulphur 30 Kg/ha + 0.5 % Iron foliar	51.9	62.4	3.07	1.35	6.30	17.65
9.	Sulphur 30 Kg/ha + 0.2 % Boron foliar	52.7	62.8	3.14	1.39	6.35	17.91
10.	Control	47.7	57.8	2.63	0.83	5.27	13.64
	F test	**S**	**S**	**S**	**S**	**S**	**S**
	S Em. (±)	0.28	0.22	0.05	0.02	0.04	0.24
	CD (P=0.05)	0.85	0.66	0.13	0.06	0.14	0.72

3.5 Stover Yield

A significantly higher stover yield (6.30 t/ha) was recorded for treatment 7 (30 kg/ha sulphur + 0.5% zinc foliage), superior to all treatments. However, treatment - 9 (30 kg/ha sulphur + 0.2% boron foliar) was found to be statistically at par with treatment - 7 (30 kg/ha sulphur + 0.5% zinc foliar). When applying sulphur, the bioactivity of sulphur played an important role in improving yield attributes such as capsule per plant, capsule length, thereby ultimately increasing seed and stem yields. There is a possibility. Similar results were obtained by [22].

3.6 Harvest Index (%)

Significant Maximum yield index (17.92%) was recorded for treatment -7 (30 kg/ha sulphur + 0.5% zinc foliage), superior to all treatments. However, treatment 4 -20 kg/ha sulphur + 0.5% zinc foliar (17.41%), treatment 8 - 30 kg/ha sulphur + 0.5% iron foliage (17.65%), and treatment 9 - 30 kg/ha sulphur + 0.2% boron foliar (17.91%), which was statistically found to be at par with a foliar treatment 7 -30 kg/ha sulphur + 0.5% zinc.

4. CONCLUSION

It was concluded that applying 30 kg/ha of sulphur together with 0.5% zinc recorded a significantly higher seed yield (1.41 t/ha) compared to the other treatments. Results are based on studies conducted in one season, so further testing may be required to confirm results.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Prasad R. Textbook of Field Crop Production Commercial Crops. Indian Council of Agricultural Research New Delhi. 2017;II(2):200.
2. Shiny, Joy Dawson Betha Pudi Suvarna. Effect of levels of sulphur and boron on growth and yield of sesame (*Sesamum indicum* L.). The Pharma Innovation Journal. 2021;10(10):924-926.
3. Ajai singh SP, Singh K, Singh PP. Response of nitrogen and sulphur on economic yield of sunflower under soidic soil condition. Indian J. Agric. Sci. 2000;70:536-537.
4. Patel JR, Shelke VB. Effect of farmyard manure, phosphorus and sulphur on growth, yield and quality if Indian mustard. Indian J. Agron. 1995;43:713-717.
5. Shamina, Imamul. Mineralization pattern of added sulphur in some Bangladesh soils under submerged condition. Indian J. Agric. Chem. 2003;36:13-21.
6. Jaggi R, Rakesh C, Sharma K, Paliyal SS. Sulphur as second major nutrient in cruciferous oilseed. Indian Fam. 2000;12:14-18.
7. Thirumalaisamy K, Srinivasan PS, Pangarusamy U, Thangaraj M, Mallika V, Kannaiyan S. Nutrient Deficiency and Remedial Management in Crops. 1st Edn., Sigar Graphics Pub., Coimbatore, India. 2001;10-11.
8. Alloway BJ. Zinc in soils and crop nutrition. Second edition. IZA and IFA Brussels Belgium and Paris, France. 2008;135.
9. Singh MV. Scenario of zinc deficiency in Indian soils and its influence on zinc enrichment in crops for improving human and animal health. (In): 3rd International Zinc Symposium: Improving Crop Production and Human Health, Hyderabad, India. 2011;10-14.
10. Meena RS, Sandeep KS. Agronomy facts for competitions, Jain brothers publishing House, New Delhi; 2021.
11. Kundu S,Trent JT, Hargrove MS. Plants, humans and haemoglobins. Trends in Plant Sci. 2003;8:387-393.
12. Gomez KA, Gomez AA. Three or more factor experiment. (In*:)* Statistical Procedure for Agricultural Research 2nd ed. 1976;139 -141.
13. Paul SK, Khatun MM, Sarkar AR. Effect of sulphur on the seed yield and oil content of sesame. Journal of Bangladesh Agriculture University. 2019;17(1):33-38.
14. Shehu HE. Effects of Manganese and Zinc Fertilizers on Shoot content and Uptake of N, P and K in Sesame (*Sesamum indicum* L.)

on Lithosols. International Research Journal of Agricultural Science and Soil Science. 2014;4(8):159-166.
15. Dev CM, Sarawagi SK. Balance sheet of nitrogen, phosphorus and potassium as influenced by spacing and nutrient management in Sunflower (*Helianthus annus* L.). Journal of Oilseeds Research. 2004;21(1):187-188.
16. Kumar A, Kumar S, Kumar P, Ashok Kumar, Shiv Kumar, Savita Arya and Sushil Kumar. Effect of zinc and iron application on yield and acquisition of nutrient on mustard crop (*Brassica juncea* L.). *International Journal of Agricultural Sciences.* 2014;10(2):797-800.
17. Tripathi ML, Rajput RL. Response of sesame (*Sesamum indicum* L.) genotypes to levels of fertilizers. Advances in Plant Sciences. 2007;20(2):521-522.
18. Murmu S, Murmu K, Satapathy M. Effect of sulphur fertilization on growth, yield and quality of sesamum (*Sesamum indicum* L.) in Mid Central Zone of Odisha. International Journal Biological Research. Env. Agril. Sci. 2015;1(1):5-12.
19. Ram M, Meena, RC, Sundria MM. Enhancing sesame productivity and profitability through zinc and iron application in western Rajasthan. The Pharma Innovation Journal, 2021;SP-10(10):924-928.
20. Khan SA, Umesha C, Karimunnisa SK. Effect of Sulphur Levels on Growth and Yield of different varieties of Sesame (*Sesamum indicum* L.). Biological Forum – An International Journal, 2021;13(3): 155-158.
21. Jahan N, Alam ABMS, Mitu AS, Habib MA, Ali MKJ. Effect of Zinc on growth and yield of Sesame. International Journal of Natural and Social Sciences. 2019;6(3): 11-16.
22. Raja A, Hattab KO, Gurusamy L, Vembu G, Suganya S.. Sulphur application on growth, yield and quality of sesame varieties. International Journal of Agricultural Research, 2007;2(7):599-606.

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