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Influence of Sulfur and Foliar Spray of Boron on Growth and Yield of Sesame

Teladala Harshanand, Shikha Singh, Anu Nawhal, Sivangula Gowthami, Ramayanam Surya Vardhan Raju

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ABSTRACT

A field experiment was conducted at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj, UP, during the *zaid* season of 2022 on sandy loam soil. The experiment was laid out in Randomized Block Design, consisting of three levels of sulfur (10 kg/ha, 20 kg/ha, 30 kg/ha) and three levels of boron as foliar spray (1000, 1250, 1500 ppm). The variety Gujarat Til-3 was sown in April 2022. The results of the experiment revealed that the application of 30 kg/ha of sulfur along with 1000 ppm of boron significantly increased the growth parameters viz., plant height (113.83 cm), and dry weight (15.63 g/plant). Whereas, application of 30 kg/ha of sulfur and boron at 1500 ppm had significantly increased yield parameters viz., no. of capsules per plant (49.07), no. of seeds per capsule (71.47), no. of branches per plant (4.87), seed yield (0.916 t/ha), stover yield (1.77 t/ha) and oil content (48.07 %). This treatment also showed a positive effect on economics viz., gross returns (73,472 INR/ha), net returns (46,738 INR/ha), B:C (1.74).

Keywords Boron, Economics, Growth parameters, Sesame, Sulfur, Yield parameters.

INTRODUCTION

Oil seeds are the main source of fats and protein particularly for vegetarians. In the Indian economy, oilseeds occupy an important place and contribute about 15% of the gross cropped area and account for nearly 5% of the gross national product. Sesame or gingelly originated from Southwest Africa and is botanically termed as (*Sesamum indicum* L.) of family Pedaliaceae. It is an important oil seed crop next to groundnut, rapeseed and mustard. The oil content and protein content in sesame generally vary from 46 to 52% and 18 to 20%, respectively (Jerusha *et al.* 2021). Sesame is one of the drought-tolerant oil seed crops which is cultivated in the *zaid* and *kharif*

Teladala Harshanand[1]*, Dr Shikha Singh[2], Anu Nawhal[3], Sivangula Gowthami[4], Ramayanam Surya Vardhan Raju[5]
[2]Assistant Professor, [3]PhD Scholar
Department of Agronomy, Sam Higginbottom Institute of Agricultural Technology and Sciences, Naini, Prayagraj 211007, UP, India
Email: harshaspark0515@gmail.com
* Corresponding author

seasons in most areas. In India, it was cultivated in an area of 16.2 lakh hectares with a production of 7.33 lakh tones and productivity of 450 kg/ha. In Uttar Pradesh, it was cultivated in an area of 3.29 lakh hectares with a total production of 79.78 lakh tones and productivity of 240 kg/ha in 2021 (Directorate of Economics and Statistics 2022). It is a short-day plant but thrives well in long-day areas too and thrives best on moderately fertile and well-drained soils with a pH of 5.5 to 8.0. It was reported that the sesame hulls possess a considerable amount of antioxidant activity due to the presence of high levels of phenolic compounds (Dhaliwal *et al.* 2021). Sulfur is required for the synthesis of chlorophyll, sulfur-containing amino acids like methionine (21%), and cysteine (26%) which are essential protein production in sesame. Approximately 90% of plant sulfur is present in these amino acids. Constituent of sulfur-bearing vitamins like biotin, thiamine and coenzyme-A are also needed for the synthesis of amino acid, oxidation of intermediates of the citric acid cycle and synthesis and oxidation of fatty acids. It is required for oil formation and improves oil quality. It is an important part of ferredoxin (Fe-S protein) needed for NO_2- and SO_4^{2-} reduction in chloroplast and nitrogen assimilation by nitrogen-fixing bacteria. Sulfur forms disulphide bonds between polypeptide chains in a protein that is responsible for protein folding. Sulfur is also required for root growth and increases seed formation (The Handbook of Agriculture 2019, Agronomy facts for competitions by Meena and Sihag 2021). Boron is one of the essential micro-nutrients required for the normal growth of crops. Its deficiency causes great losses in crop production both qualitatively and quantitatively. The primary function of boron is to maintain cell wall integrity, also needed for cell expansion, and hydrogen ions transport regulation. In oil seeds, it is important for pollen tube growth, flowering, fruit-setting and seed development. It plays a vital role in the transportation of nutrients and water to newly growing plant parts, and in the translocation of photosynthates from source to sink. It is required for the synthesis of phenols, IAA, RNA, and carbohydrates, they are needed for new cell development in meristematic tissues It regulates the opening of stomata and imparts drought resistance to crops. (The Handbook of agriculture 2019, Agronomy facts for competitions by Meena and Sihag (2021).

MATERIALS AND METHODS

"The field trial was conducted during the zaid season from April to August 2022 in Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP which is located at 25^0 24' 42" N latitude, 81^0 50' 56" E longitude and 98 m altitude above the mean sea level. This area is located on the right side of river Ganga which is 11 km away from Prayagraj city". The soil of the experimental field is neutral in nature with a pH of 7.2. It had a sandy loam texture, high in Nitrogen (N), Potassium (K) and a medium in Phosphorus (P). The experiment was laid out in Randomized Block Design consisting of ten treatment combinations viz.,

1 Sulfur 10 kg/ha + boron 1000 ppm,
2 Sulfur 10 kg/ha + boron 1250 ppm,
3 Sulfur 10 kg/ha + boron 1500 ppm,
4 Sulfur 20 kg/ha + boron 1000 ppm,
5 Sulfur 20 kg/ha + boron 1250 ppm,
6 Sulfur 20 kg/ha + boron 1500 ppm,
7 Sulfur 30 kg/ha + boron 1000 ppm,
8 Sulfur 30 kg/ha+ boron 1250 ppm,
9 Sufur 30 kg/ha + boron 1500 ppm and
10 RDF 50-40-30 kg/ha of NPK (Control)

were replicated thrice. The experimental field was ploughed thoroughly and brought to a fine tilth by removing stubbles. 30 plots of each 3.0 m x 3.0 m were made. Major nutrients were applied in 50-40-30 kg/ha amount through urea, DAP, and MOP, to all treatments after opening the furrows and covered with soil while sulfur was applied in the form of elemental sulfur and boron was applied in the form of solubor boron as a foliar spray at 25 DAS. Til 3 variety was sown by line sowing method in furrows with the spacing of 30 cm between rows and 10 cm between plants. The growth parameters viz., plant height (cm), dry weight (g/plant), were recorded at 15 days-time intervals till physiological maturity and yield parameters viz., capsules per plant (No.), seeds per capsule (No.), branches per plant (No.), seed yield (t/ha), stover yield (t/ha) were recorded at the time of harvesting on per hectare basis and data was statistically analyzed by using ANOVA technique.

Oil content was extracted by using Soxhlet's

Table 1. Influence of sulphur and boron on growth attributes of sesame.

Sl. No.	Treatments	At 75 DAS Plant height (cm)	Dry weight (g/plant)
1	Sulfur at 10 kg/ha and boron at 1000 ppm	99.67	13.53
2	Sulfur at 10 kg/ha and boron at 1250 ppm	100.93	13.73
3	Sulfur at 10 kg/ha and boron at 1500 ppm	102.83	13.93
4	Sulfur at 20 kg/ha and boron at 1000 ppm	103.47	14.01
5	Sulfur at 20 kg/ha and boron at 1250 ppm	106.11	13.60
6	Sulfur at 20 kg/ha and boron at 1500 ppm	106.93	14.30
7	Sulfur at 30 kg/ha and boron at 1000 ppm	113.83	15.63
8	Sulfur at 30 kg/ha and boron at 1250 ppm	107.84	14.43
9	Sulfur at 30 kg/ha and boron at 1500 ppm	109.80	15.37
10	Control (50:40:30 kg/ha NPK)	103.40	13.17
	SEm (±)	1.90	0.39
	CD (5%)	5.66	1.16

extraction method by taking 4 g of seeds as a sample from each treatment, after extraction the oil content % was calculated by using the formulae:

$$\text{oil content \%} = \frac{\text{Final weight of the flask (with oil)-initial weight of the flask (without oil)}}{\text{Weight of the sample (g)}} \times 100$$

RESULTS AND DISCUSSION

Observations of growth attributes viz., plant height, dry weight were presented in (Table 1). Significantly highest plant height (113.83 cm), was recorded with the application of 30 kg/ha of sulfur and boron at 1000 ppm. Similarly, the highest dry weight (15.63 g/plant) at 75 DAS was recorded with the application of 30 kg/ha of sulfur and boron at 1000 ppm. However, the application of 30 kg/ha and boron at 1500 ppm in plant height (109.80 cm) and dry weight (15.3 g/plant) was found to be statistically at par with the highest. The growth parameters viz., plant height, dry weight was significantly influenced by sulfur and boron treatments. Increase in plant height with increasing sulfur level might be resulted from synthesis of sulfur containing amino acids, proteins and activity of proteolytic enzymes. Addition of boron increased the plant height due to escalated chlorophyll content of leaves which increased the photosynthetic activity and new tissue growth (Sarkar *et al.* 2019).

The yield attributes i.e., no. of branches per plant (4.87) was significantly highest with application of 30 kg/ha of sulfur along with 1500 ppm of boron, whereas application of 30 kg/ha of sulphur along with 1250 ppm of boron (4.53) and application of 30 kg/ha of sulfur along with 1000 ppm of boron (4.60) were found to be statistically at par with highest. No. of capsules per plant (49.07), no. of seeds per capsule (71.47), grain yield (0.91 t/ha), stover yield (1.77 t/ha) were significantly highest with application of 30 kg/ha of sulfur along with 1500 ppm of boron. While application of 30 kg/ha sulfur along with 1000 ppm of boron was found to be statistically at par with highest. Significantly highest oil content (48.07%) was recorded with application of 30 kg/ha of sulfur along with

Table 2. Influence of sulfur and foliar spray of boron on yield parameters, yield and oil content of sesame.

Sl. No.	Treatments	No. of branches plant^{-1} (No.)	Capsules plant^{-1} (No.)	Seeds capsule^{-1} (No.)	Grain yield (t/ha)	Stover yield (t/ha)	Oil content (%)
1	10 kg/ha S and 1000 ppm of B	3.93	36.33	62.40	0.830	1.56	45.27
2	10 kg/ha S and 1250 ppm of B	4.10	43.87	61.80	0.836	1.59	45.93
3	10 kg/ha S and 1500 ppm of B	3.73	43.53	60.40	0.843	1.62	46.37
4	20 kg/ha S and 1000 ppm of B	3.67	42.27	59.27	0.850	1.64	46.53
5	20 kg/ha S and 1250 ppm of B	4.17	44.53	64.73	0.856	1.70	46.60
6	20 kg/ha S and 1500 ppm of B	4.13	44.53	63.07	0.846	1.71	46.73
7	30 kg/ha S and 1000 ppm of B	4.60	46.07	60.13	0.880	1.73	46.85
8	30 kg/ha S and 1250 ppm of B	4.53	44.80	64.47	0.853	1.71	47.33
9	30 kg/ha S and 1500 ppm of B	4.87	49.07	71.47	0.916	1.77	48.07
10	Control (RDF)	3.87	43.13	60.13	0.823	1.63	45.60
	SEm (±)	0.20	1.17	1.89	0.08	0.02	0.43
	CD (5%)	0.58	3.49	5.60	0.04	0.06	1.27

Table 3. Influence of sulfur and foliar spray of boron on economics of sesame.

Sl. No.	Treatments	Gross returns (INR/ha)	Net returns (INR/ha)	B:C
1	10 kg/ha S and 1000 ppm of B	64,989	38,995	1.50
2	10 kg/ha S and 1250 ppm of B	64,458	38,444	1.47
3	10 kg/ha S and 1500 ppm of B	66,006	39,972	1.53
4	20 kg/ha S and 1000 ppm of B	68,355	42,011	1.59
5	20 kg/ha S and 1250 ppm of B	68,550	42,206	1.60
6	20 kg/ha S and 1500 ppm of B	66,241	39,857	1.51
7	30 kg/ha S and 1000 ppm of B	68,884	42,190	1.58
8	30 kg/ha S and 1250 ppm of B	72,220	45,506	1.70
9	30 kg/ha S and 1500 ppm of B	73,472	46,738	1.74
10	Control (RDF)	66,440	39,576	1.59

1500 ppm of boron, whereas, the application of 30 kg/ha of sulfur along with 1250 ppm of boron (47.33) and the application of 30 kg/ha of sulfur along with 1000 ppm (46.85) of boron was found to be statistically at par with highest, which were presented in Table 2. The increase in the number of capsules per plant and seeds per capsule might be because sulfur might help in floral primordial initiation that resulted in a greater number of capsules per plant and seeds per capsule. Sulfur application exhibited a positive correlation with number of capsules per plant, seeds per capsules and seed yield. These components helped in seed yield improvement. Application of sulfur-maintained balance source-sink relationship and ultimately resulted in increased seed yield. Application of boron helped in availability of enhanced leaf chlorophyll content, leaf stomatal conductance net photosynthetic rate and non-structural carbohydrate export from leaf to yield attributing sink (Sarkar *et al*. 2019). The increase in oil content might be due to the fact that sulfur is a constituent of glutathione which helps in the synthesis of oil. Boron also had a positive role on the enhancement of oil content probably due to its indirect effect on the synthesis of fat as proposed by Mathew *et al.* (2013).

The economics of sesame were presented in Table 3. Gross returns (73,472 INR/ha), net returns (46,738 INR/ha) and B:C (1.74) were highest with the application of sulfur at 30 kg/ha and 1500 ppm of boron.

CONCLUSION

In eastern zones of Uttar Pradesh under inceptisol soil order, cultivation of sesame during *zaid* season with the application of sulfur at 30 kg/ha and boron at 1500 ppm was found to be more desirable in terms of growth, yield attributing characters and yield when compared to other treatments. It also fetched good net returns and B:C.

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REFERENCES

Dhaliwal SS, Sharma V, Shukla AK, Verma V, Behera SK, Sandhu PS, Kaur K, Gaber A, Althobaiti YS, Abdelhadi AA (2021) Assessment of agroeconomic indicators of *Sesamum indicum* L. as influenced by application of boron at different levels and plant growth stages. *Molecules* 26: 6699. https://doi.org/10.3390/ molecules 26216699.

Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare (2022) Normal Estimates of Area, Production and Yield of Selected Principal Crops. Department of Agriculture and Farmers Welfare. https://eands.dacnet.nic.in.

Directorate of Knowledge Management in Agriculture, Indian Council of Agriculture Research (2019). Hand Book of Agriculture. 12th reprint of 6th edn. New Delhi, India.

Jerusha K, Singh V, Tiwari D (2021) The effect of plant growth hormones and bio-fertilizers on growth yield and economics of sesame. *Biol Forum-An Int J* 13(2): 552-556.

Mathew J, George S, Indira M (2013) Effect of sulfur and boron on the performance of sesame in Onattukara sandy soil of Kerala, India. *Ind J Agric Res* 47(3): 214-219.

Meena RS, Sihag SK (2021) Agronomy Facts for Competitions, Jain Brothers.Publishing House, New Delhi.

Sarkar NC, Kumar B, Maity S, Maiti R (2019) Effect of different levels of sulfur and boron on the growth and yield of sesame under red-laterite soils. *Res Crops* 20(3): 515-524.