Original Research Article

Effect of Sulphur and Boron on growth and yield of Sesame (*Sesamum indicum*)

Abstract

A field experiment was conducted during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out on Randomized Block Design with nine treatments each replicated thrice on the basis of one year experimentation. The treatments which are T_1: 10 kg/ha Sulphur + 1 kg/ha Boron, T_2: 10 kg/ha Sulphur + 1.5 kg/ha Boron, T_3: 10 kg/ha Sulphur + 2 kg/ha Boron, $T_4$20 kg/ha Sulphur + 1 kg/ha Boron, T_5: 20 kg/ha Sulphur + 1.5 kg/ha Boron, T_6: 20 kg/ha Sulphur + 2 kg/ha Boron, T_7: 30 kg/ha Sulphur + 1 kg/ha Boron, T_8: 30 kg/ha Sulphur + 1.5 kg/ha Boron, T_9: 30 kg/ha Sulphur + 2 kg/ha Boron are used. The results showed that application of 30 kg/ha Sulphur + 2 kg/ha Boron was recorded significantly higher plant height (96.22 cm), Plant dry weight (17.24 g/plant), whereas significantly highest Crop growth rate (8.74 g/m^2/day) was recorded with the treatment 20 kg/ha Sulphur + 2 kg/ha Boron. However,Significantly maximum No. of capsules/plant (52.88), No. of Seeds/capsule (62.16), Test weight (3.29 g), Seed yield (1.35 t/ha), Stover yield (6.24 t/ha), Harvest index (17.77 %) as compared to other treatments.

Key words: Sulphur, Boron, Sesame, Growth and yield.

Introduction

The oil seed crops play the second important role in the Indian agricultural economy next to food grains in terms of area and production. As Indian climate is suitable for the cultivation of oilseeds crop; large varieties of oilseeds are cultivated here. The government of India has been pursuing several development programs to meet the requirement of increasing demand of oilseeds in the country owing to increase in population, improvement in standard of living, increasing industrial requirements. The concerted efforts of these development programs/schemes register significant improvement in annual growth of yield and area under oilseed crops. Although country is having increasing production trend in domestic oil seeds but only 50 per cent of the total requirement is met from domestic production and nearly half of the requirement is still being made through imports **(Modhavadiya et al., 2017).**

Among the oilseed crops, sesame (Sesamum indicum L.) is one of the world most important and oldest known oil seed crops (Abou Gharbia et al., 1997). Sesame is a member of the padaliaceae plant family. Its cultivation has started since 1500 BC in the Middle East, Asia & Africa. India is the major producer of sesame (Sesamum indicum L.) and ranks first in both area (1.78 M ha) and production (0.81 Mt) with average productivity of 455 kg ha-1 . Odisha produces 0.09 million tonnes sesame seeds annually with average productivity of 403 kg ha-1 **(Murmu et al., 2015).** Higher nutritional, medicine and cooking quality has recognized it as 'the queen of oilseeds'. There is a decline in productivity in sesame due to its cultivation in marginal and sub-marginal lands and moreover poor crop management practice. Sulphur has long been recognized as one of the essential elements for plant growth particularly for oilseed crops. Sulphur is a constituent of three amino acids commonly found in plants *viz.*, cystine, cystenine and methionine, which are essential components of proteins. Sulphur increases the oil content and gives pungency to oil as it forms certain disulphide linkages. Oilseed crops require more sulphur than cereals as their oil storage organs are mostly proteins, rich in S. Deficiency of sulphur is known to hamper N metabolism in plants as well as synthesis of S-containing aminoacids and thus exerts adverse effects on both seed and oil yield. Sulphur (S) is essential for the growth and development, plays a key role in plant metabolism, indispensible for the synthesis of essential oils, plays a vital role in chlorophyll formation **(Singh *et al.*, 2000).**

Among the micronutrient deficiency, boron deficiency is the second most dominant problem globally. Among the micronutrients, boron deficiency is one of the most widespread micronutrient deficiency in India. Plants require boron for a number of growth processes like development of meristematic tissue, proper pollination and seed set, translocation of sugars, starches. It has been reported that boron is required for pollen germination and pollen tube growth **(Dugger, 1983)**.

Materials and Methods

The present examination was carried out during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the mean sea level. The experiment laid out in

Randomized Block Design which consisting of nine treatments with T_1: 10 kg/ha Sulphur + 1 kg/ha Boron, T_2: 10 kg/ha Sulphur + 1.5 kg/ha Boron, T_3: 10 kg/ha Sulphur + 2 kg/ha Boron, $T_4$20 kg/ha Sulphur + 1 kg/ha Boron, T_5: 20 kg/ha Sulphur + 1.5 kg/ha Boron, T_6: 20 kg/ha Sulphur + 2 kg/ha Boron, T_7: 30 kg/ha Sulphur + 1 kg/ha Boron, T_8: 30 kg/ha Sulphur + 1.5 kg/ha Boron, T_9: 30 kg/ha Sulphur + 2 kg/ha Boron are used. The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (P^H 7.1), low in Organic carbon (0.38%), medium available N (225 kg ha^{-1}), higher available P (19.50 kg ha^{-1}) and medium available K (213.7 kg ha^{-1}). In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it after harvest several yield parameters were recorded those parameters are growth parameters, plant height, plant dry weight are recorded. The yield parameters like Capsules/plant, Seeds/capsule, Test weight, Seed yield and stover yield were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez K.A. and Gomez A.A. 1984).

Results and Discussion

Growth attributes

Plant height

Significantly highest plant height (96.22 cm) was observed in the treatment with 30 kg/ha Sulphur + 2 kg/ha Boron over all the other treatments. However, the treatments with application of 20 kg/ha Sulphur + 2 kg/ha Boron (95.46 cm) and 30 kg/ha Sulphur + 1.5 kg/ha Boron (95.73 cm) which were found to be at par with treatment 30 kg/ha Sulphur + 2 kg/ha Boron as compared to all the treatments.

The presence of sulphur plays a vital role photosynthetic process of plant which has a direct bearing on plant growth and development. The similar results observed by **Yadav *et al*. 2008.**

The increase in plant height might be due to the involvement of Boron in different physiological processes like enzymes activation, electron transport, chlorophyll formation, stomatal regulation, etc. which gradually increased plant height. The results were found in accordance with **Choudhary *et al.* (2000).**

Plant dry weight (g/plant)

Treatment with 30 kg/ha Sulphur + 2 kg/ha Boron was recorded with significantly maximum dry weight (17.24 g/plant) over all the treatments. However, the treatments with 20 kg/ha Sulphur + 2 kg/ha Boron (17.06 g/plant) and 30 kg/ha Sulphur + 1.5 kg/ha Boron (16.95 g/plant) which were found to be statistically at par 30 kg/ha Sulphur + 2 kg/ha Boron.

The presence of sulphur plays a vital role photosynthetic process of plant which has a direct bearing on plant growth and development. The similar results observed by **Yadav *et al*. 2008.** The application of boron generally influences cell division and nitrogen absorbtion from soil might enhanced plant growth reflects in terms of plant dry weight. The findings were in harmony with **Mamatha *et al* (2016).**

Yield attrubutes and Yield

Capsules/plant

Significantly Maximum No. of capsules/plant (52.88) was recorded with the treatment of application of 30 kg/ha Sulphur + 2 kg/ha Boron over all the treatments. However, the treatments 20 kg/ha Sulphur + 2 kg/ha Boron (51.93) and 30 kg/ha Sulphur + 1.5 kg/ha Boron (52.43) which was found to be statistically at par with 30 kg/ha Sulphur + 2 kg/ha Boron.

Seeds/capsule

Significantly Highest No. of Seeds/capsule (61.26) was recorded with the treatment of application of 30 kg/ha Sulphur + 2 kg/ha Boron over all the treatments. However, the treatment 20 kg/ha Sulphur + 2 kg/ha Boron (59.77) and 30 kg/ha Sulphur + 1.5 kg/ha Boron (60.54) which were found to be statistically at par with 30 kg/ha Sulphur + 2 kg/ha Boron.

The presented result revealed that sulphur application @ 30 kg/ha Sulphur recorded significantly at harvest, number of capsules/plant and number of seeds/capsule. The present findings are close agreement with those reported **Sriramchandrasekharan (2004); Bhosale *et al.*, (2011).**

The application of boron to sesame generally improves capsule growth by synthesizing tryptophan and auxin. The enhancement effect on capsules/plant, seeds per capsule attributed to the favorable influence of boron application to crops on nutrient metabolism, biological activity and growth parameters which in turn influenced higher enzyme activity which in turn encouraged more capsules/plant and seeds/capsule. Similar findings were observed by **Yadav *et al* (2016).**

Test weight

Significantly highest Test weight (3.29 g) was recorded with the treatment application of 30 kg/ha Sulphur + 2 kg/ha Boron over all the treatments. However, the treatment with (3.05 g) in 20 kg/ha Sulphur + 2 kg/ha Boron and 30 kg/ha Sulphur + 1.5 kg/ha Boron (3.15 g) which were found to be statistically at par with 30 kg/ha Sulphur + 2 kg/ha Boron.

Increasing levels of Sulphur fertilization up to 30 kg/ha significantly increased the number of capsules/plant, and test weight in sesame while the number of seeds/capsules increased significantly up to 30 kg S/ha. Similar results obtained by **Shinde *et al*. (2011).**

Seed yield (t/ha)

Significantly highest Seed yield (1.35 t/ha) was recorded with the treatment application of 30 kg/ha Sulphur + 2 kg/ha Boron over all the treatments. However, the treatments with (1.14 t/ha) in 20 kg/ha Sulphur + 2 kg/ha Boron and 30 kg/ha Sulphur + 1.5 kg/ha Boron (1.25 t/ha) which were found to be statistically at par with 30 kg/ha Sulphur + 2 kg/ha Boron.

Therefore, 40 kg/ha sulphur was found a suitable for getting higher yield of sesame. **Yadav *et al*. (1996); Jadav *et al*. (2010)** observed that the seed and stover yield of sesame increased with application of sulphur. The higher and positive response to added sulphur may be assigned to low to medium status of available S of the soil under study and due to the stimulating effect of applied S in the synthesis of chloroplast and greater photosynthesis efficiency, resulted in increase in dry matter yield of plant.

Boron plays the vital role in increasing because it takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhanced seed yield, **Mallik and Raj (2015).**

Stover yield (t/ha)

Significantly highest Stover yield (6.24 t/ha) was recorded with the treatment application of 30 kg/ha Sulphur + 2 kg/ha Boron over all the treatments. However, the treatments with (5.88 t/ha) in 20 kg/ha Sulphur + 2 kg/ha Boron and 30 kg/ha Sulphur + 1.5 kg/ha Boron (6.11 t/ha) which were found to be statistically at par with 30 kg/ha Sulphur + 2 kg/ha Boron.

The increase in stover yield might due to Sulphur plays important role in balanced nutrition, photosynthetic process of plant which has a direct bearing on plant growth and development. The results corroborate to the findings of **Yadav *et al*., 2008.**

The higher levels of boron attributed to best results because boron might attributed to the favorable influence of them on plant metabolism and biological process activity and their stimulating effect on photosynthetic pigments and enzyme activity which in turn encouraged vegetative growth and higher biomass accumulation. The results were found similar with **Ravichandra *et al.* (2015).**

Harvest index (%)

Significantly highest Harvest index (17.77 %) was recorded with the treatment application of 30 kg/ha Sulphur + 2 kg/ha Boron over all the treatments. However, the treatments with (16.18 %) in 20 kg/ha Sulphur + 2 kg/ha Boron and 30 kg/ha Sulphur + 1.5 kg/ha Boron (17.00 %) which were found to be statistically at par with 30 kg/ha Sulphur + 2 kg/ha Boron.

CONCLUSION

It is concluded that application of treatment 30 kg/ha Sulphur + 2 kg/ha Boron was recorded significantly higher Grain yield (1.35 t/ha), as compared to other treatments. Since, the findings based on the research done in one season.

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Table 1: Effect of Sulphur and Boron on growth attributes of Seasame

Treatments	Plant height (cm)	Dry weight (g/plant)
1. 10 kg/ha Sulphur + 1 kg/ha Boron	91.88	15.43
2. 10 kg/ha Sulphur + 1.5 kg/ha Boron	92.33	15.65
3. 10 kg/ha Sulphur + 2 kg/ha Boron	93.83	16.10
4. 20 kg/ha Sulphur + 1 kg/ha Boron	93.32	15.89
5. 20 kg/ha Sulphur + 1.5 kg/ha Boron	94.10	16.33
6. 20 kg/ha Sulphur + 2 kg/ha Boron	95.46	16.95
7. 30 kg/ha Sulphur + 1 kg/ha Boron	94.78	16.75
8. 30 kg/ha Sulphur + 1.5 kg/ha Boron	95.73	17.06
9. 30 kg/ha Sulphur + 2 kg/ha Boron	96.22	17.24
F- test	S	S
S. EM (±)	0.29	0.11
C. D. (P = 0.05)	0.86	0.33

Table 2. Effect of Sulphur and Boron on Yield attributes and Yield of Sesame

Treatments	Capsules/plant	Seeds/Capsule	Test Weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
1. 10 kg/ha Sulphur + 1 kg/ha Boron	48.67	55.87	2.33	0.75	4.82	13.47
2. 10 kg/ha Sulphur + 1.5 kg/ha Boron	49.68	56.79	2.44	0.80	4.92	13.97
3. 10 kg/ha Sulphur + 2 kg/ha Boron	50.54	57.82	2.75	0.93	5.15	15.28
4. 20 kg/ha Sulphur + 1 kg/ha Boron	50.30	57.23	2.56	0.88	4.96	15.03
5. 20 kg/ha Sulphur + 1.5 kg/ha Boron	51.09	58.71	2.83	1.03	5.42	15.92
6. 20 kg/ha Sulphur + 2 kg/ha Boron	51.93	59.77	3.05	1.14	5.88	16.18
7. 30 kg/ha Sulphur + 1 kg/ha Boron	51.49	59.36	2.96	1.06	5.74	15.57
8. 30 kg/ha Sulphur + 1.5 kg/ha Boron	52.43	60.54	3.15	1.25	6.11	17.00
9. 30 kg/ha Sulphur + 2 kg/ha Boron	52.88	61.26	3.29	1.35	6.24	17.77
F test	**S**	**S**	**S**	**S**	**S**	**S**
S. EM (±)	0.33	0.55	0.10	0.07	0.12	0.54

CD (P = 0.05)	0.98	1.65	0.30	0.22	0.37	1.61