Sulphur and Boron Improves Yields of Oilseed Sesame in Sandy Loam Soil of Onattukara

By Jeena Mathew and Sumam George

The growing demand for sesame as an edible oil with good export potential provides an opportunity for farmers to take up its cultivation for better economic returns. However, the crop is generally grown under poor soil fertility and low input use conditions resulting in low yields. Our study showed that along with the recommended doses of N, P, and K, applications of S and B helped increase yields of grain and bhusa (i.e. dry weight of plants after harvest of capsules) and as a result, profitability.

Of all the edible oilseeds grown in India, sesame (*sesamum indicum L.*), commonly known as 'Til', is one of the most important. Sesame seed production in India is estimated to be about 800,000 tonnes, and the growing domestic demand for edible oil products coupled with the emergence of sesame as a strong export crop provides good opportunity for farmers. The sandy loam belt of the Onattukara region in Kerala is considered to be the home of sesame and farmers in this region grow sesame as a third crop (summer) in the rice fallows after two crops of paddy. The relative low water requirement and short duration (less than 3 months) make sesame an ideal crop in this area. The region covers the taluks of Karunagappally, Karthikapally and Mavelikara of Kollam, and the Alleppy districts of Kerala. But the gap between the actual and achievable yields for sesame is wide and better nutrient management practices—with special emphasis to secondary and micronutrients like S and B—offers a solution to bridging the yield gap.

Two field experiments were conducted in two consecutive summer seasons of 2008 and 2009 in the paddy fields of the Onattukara Regional Agricultural Research Station, Kayamkulam, Kerala. The area is located at 90° 30' North latitude and 76° 20' East longitude at an altitude of 3.05 m above mean sea level. The experimental soil is characterized by its coarse-texture, low cation exchange capacity, and a predominance of primary and micronutrient deficiencies. Some physical and chemical properties of the surface (0 to 15 cm) soil were determined (**Table 1**) using standard methods as outlined in Jackson (1973).

The experiment was laid out in factorial randomized block design. Treatments (**Table 2**) included four levels each of S and B: S_0 (0 kg S/ha), S_1 (7.5 kg/ha), S_2 (15 kg/ha), and S_3 (30 kg/ha); B_0 (0 kg/ha), B_1 (2.5 kg/ha), B_2 (5.0 kg/ha), and B_3 (7.5 kg/ha). Gypsum (18% S) and borax (11% B) were used as sources of S and B. Nitrogen, P, K, and FYM were applied uniformly in all treatments at 30, 15, 30, and 5,000 kg/ha, respectively, according to university recommendations (Kerala Agricultural University, 2008). The N, P, and K were applied as urea (46% N), bone meal (21% P_2O_5), and potassium chloride (60% K_2O). Bone meal was chosen as a P source to exclude conventional P sources like rock phosphate and superphosphate which contain S in appreciable quantities. The crop received half the N and K as a basal dressing (at sowing) and the remainder was topdressed 15 days after sowing. All P, S, and B were applied basally. Observations were collected on yield parameters for both years and were analysed using standard statistical tools. Data on harvest index and BCR were also reported for each treatment.

Common abbreviations and notes: N = nitrogen; P = phosphorus; K = potassium; S = sulphur; B = boron; FYM = Farmyard manure; BCR = Benefit-to-Cost ratio; C = carbon; Ca = calcium; Mg = magnesium.

Table 1. Some chemical properties of soil at the experimental site

Parameters	Values	Category
pH	5.1	Acidic
EC, dS/m	0.3	Non-saline
Organic C, %	0.3	Low
Available P, kg/ha	6.5	Low
Available K, kg/ha	62	Low
Exchangeable Ca, cmol+/kg	0.48	Low
Exchangeable Mg, cmol+/kg	0.03	Low
Available S, kg/ha	10.2	Low
Available B, ppm	0.18	Low

A close up of sesame in flower. Sesame has developed into the most imported edible oilseed crop for India.

Results

Data on grain and bhusa yields of sesame as influenced by the application of different levels of S and B applications are presented in **Tables 3 and 4**. The maximum grain yield of sesame was recorded with applications of S and B at 30 and 7.5 kg/ha, respectively (**Table 3**). The State recommendation in which only N, P, and K were applied resulted in the lowest grain yield of 562 kg/ha, whereas, application of S and B irrespective of varying rates resulted in an average increase in yield of 87%, respectively. The highest percent increase in yield (155%) was recorded with highest levels of S and B application. This shows that both S and B play an important role in the production of oilseed crops. Sulphur helps in primordial floral initiation resulting in a greater number of capsules per plant and an increasing number of seeds per capsule. Also, S is required for the synthesis of S-containing amino acids and proteins, increases oil content, helps in the

Table 2. Treatment details used in the experiment.

No.	Details†
T_1	$N_{30}P_{15}K_{30}S_0B_0$
T_2	$N_{30}P_{15}K_{30}S_0B_{2.5}$
T_3	$N_{30}P_{15}K_{30}S_0B_5$
T_4	$N_{30}P_{15}K_{30}S_0B_{7.5}$
T_5	$N_{30}P_{15}K_{30}S_{7.5}B_0$
T_6	$N_{30}P_{15}K_{30}S_{7.5}B_{2.5}$
T_7	$N_{30}P_{15}K_{30}S_{7.5}B_5$
T_8	$N_{30}P_{15}K_{30}S_{7.5}B_{7.5}$
T_9	$N_{30}P_{15}K_{30}S_{15}B_0$
T_{10}	$N_{30}P_{15}K_{30}S_{15}B_{2.5}$
T_{11}	$N_{30}P_{15}K_{30}S_{15}B_5$
T_{12}	$N_{30}P_{15}K_{30}S_{15}B_{7.5}$
T_{13}	$N_{30}P_{15}K_{30}S_{30}B_0$
T_{14}	$N_{30}P_{15}K_{30}S_{30}B_{2.5}$
T_{15}	$N_{30}P_{15}K_{30}S_{30}B_5$
T_{16}	$N_{30}P_{15}K_{30}S_{30}B_{7.5}$

†Subscripted numbers following each nutrient refer to rates (kg/ha) of N, P_2O_5, K_2O, S, and B. FYM was applied to all treatments at 5 t/ha.

formation of chlorophyll, biotin and thiamine, and plays an important role in the metabolism of carbohydrates, proteins, and fats. On the other hand, B is needed for carbohydrate transport as well as cellular differentiation and development. It also enhances pollen-producing capacity of anthers, viability of pollen tubes, pollen germination, and pollen tube growth.

As with grain yield, S and B also had a significant effect on the bhusa yield (**Table 4**). However, unlike the grain yield response, bhusa yield was highest with relatively lower levels of B and S. Sulphur, like N, improves cell division and cell elongation and has a favourable influence on chlorophyll synthesis. This might have contributed to the increased bhusa yield. The positive influence of S and B in improving yield and yield attributes of sunflower was reported earlier by Shekawat and Shivay (2008). Harvest Index was also significantly influenced by S and B applications at varied levels (**Table 5**).

The economics of sesame cultivation was evaluated via BCR. Results indicated that plots receiving nutrients as per the State recommendation generated less favourable economic returns when compared with treatments using varying levels of S and B. A highest BCR of 4.5 was observed with application of 30 kg S/ha and 2.5 kg B/ha, but this was on par with the treatment providing 30 kg S/ha and 7.5 kg B/ha.

Conclusion

Inclusion of S and B at 30 and 2.5 kg/ha, respectively, within the State fertiliser recommendation has the potential to improve yield, harvest index, and economics of growing sesame in Kerala. BC-SA

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Application of S and B is traditionally ignored in sesame crops, but the practice offers a significant opportunity to its growers.

Table 3. Effect of treatment on grain yield† of sesame (kg/ha).

Treatment	S_0	$S_{7.5}$	S_{15}	S_{30}	Mean
B_0	562	734	1,008	951	814
$B_{2.5}$	1,109	1,026	1,017	1,275	1,107
$B_{5.0}$	1,056	954	1,128	895	1,008
$B_{7.5}$	980	1,088	1,032	1,434	1,134
Mean	927	950	1,046	1,139	
CD (p = 0.05) (S) = 15		(B) = 15		(S x B) = 30	

†Data is the average for 2 years (2008 and 2009).

Table 4. Effect of treatment on bhusa† yield of sesame (t/ha).

Treatment	S_0	$S_{7.5}$	S_{15}	S_{30}	Mean
B_0	13.6	14.72	22.48	17.63	16.63
$B_{2.5}$	19.6	14.65	14.02	25.92	19.04
$B_{5.0}$	22.8	14.99	23.30	15.0	18.54
$B_{7.5}$	13.7	21.59	18.27	19.93	21.61
Mean	15.2	17.49	20.52	22.62	
CD (p = 0.05) (S) = 7		(B) = 7		(S x B) = 14	

†Bhusa refers to dry weight of plant after harvest of capsules.

Table 5. Effect of treatment on the harvest index of sesame (%).

Treatment	S_0	$S_{7.5}$	S_{15}	S_{30}	Mean
B_0	4.0	4.8	4.3	5.1	4.6
$B_{2.5}$	5.4	6.5	6.8	4.7	5.8
$B_{5.0}$	4.4	6.0	4.6	5.6	5.2
$B_{7.5}$	6.7	4.8	5.3	6.7	5.9
Mean	5.1	5.5	5.2	5.5	

Table 6. Effect of treatment on the economics (benefit-to-cost ratio) of sesame cultivation.

Treatment	S_0	$S_{7.5}$	S_{15}	S_{30}	Mean
B_0	2.05	2.36	2.56	3.28	2.56
$B_{2.5}$	3.68	2.38	3.24	4.52	3.46
$B_{5.0}$	3.36	2.64	3.55	2.81	3.09
$B_{7.5}$	2.86	2.88	3.11	4.38	3.31
Mean	2.99	2.57	3.12	3.75	
CD (p = 0.05) (S) = 0.24		(B) = 0.24		(S x B) = 0.49	

Input prices (INR) were: urea = 6/kg, bone meal = 20/kg, potassium chloride (KCl) = 6/kg, gypsum = 6/kg, borax = 55/kg. Sesame seed was valued at INR 90/kg.

References

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