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Effect of foliar application of boron and terminal bud clipping on growth, yield and economics of sesame (*Sesamum indicum* L.)

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Abstract

A field experiment was carried out at college farm of N. M. College of Agriculture, Navsari Agricultural University, Navsari to study the "Influence of foliar application of boron and terminal bud clipping on growth, yield and quality of sesame (*Sesamum indicum* L.)" during summer season of 2023. The experiment was laid out in factorial randomized block design (FRBD) with three replications. The results revealed that foliar application of boron @ 150 mg/l + terminal bud clipping at 35 DAS recorded significantly higher plant height at harvest, number of branches/ plants, no. of capsule/plant, seed yield and stalk yield. The lowest values for yield and yield attributes were found with no application of boron + no clipping treatment. The experiment results showed that foliar application of boron @ 150 mg/l + terminal bud clipping at 35 DAS are promising for optimum yield and higher economic returns.

Keywords: Boron; Sesame; Terminal bud clipping; Oilseed crop; De-topped

1. Introduction

Sesame (*Sesamum indicum* L.) is the oldest spice in the world and an ancient oilseed crop that was first farmed about 3000 years ago. It is primarily valued for its oil content (48–55%) and protein content (25%). Of the several species in the genus, the majority of wild species were indigenous to Sub-Saharan Africa, whereas S.indicum, the cultivated species, originated in India. Sesame was first domesticated on the Indian subcontinent about 5500 years ago, according to archeological remains. It goes by the name "Queen of oilseeds" as well. Many types of soil have been adapted to by sesame cultivars. The finest soils for high-yielding crops are medium-textured, neutral-pH, well-drained, and fertile. These, however, do not do well in highly salted or wet soil environments. Sesame crops grown for commercial purposes need 90–120 frost-free days. Warm temperatures above 23 °C (73 °F) promote yields and growth also in quality in some extent. Although sesame crops can be grown in unfavorable soils, farms with enough fertilizer provide the highest yields. Gujarat is one of the top states in India. According to the Directorate of Agriculture's third advance estimate, the state's cultivated area for sesame reported about 1.508 lakh hectares, production estimates of sesame are 125.38 thousand tonnes. (Anonymous, 2022). One of the seven vital micronutrients needed for the majority of plants to grow normally is boron. The significance of B as a nutrient for plants has increased dramatically. The synthesis of oilseeds, which carry out numerous physiological processes such cell wall synthesis, root elongation, glucose metabolism, nucleic acid synthesis, lignification, and tissue differentiation, depends heavily on boron (Sillanpa 1982). The most common micronutrient deficiency in the world, a deficiency in boron affects large amounts of crop production in both quantitative and qualitative terms. It is linked to factors such as the anther's ability to produce pollen, the viability of the pollen tubes, the germination of the pollen tubes, and the growth of the pollen tubes. A decrease in boron availability lowers oil production and degrades oil quality. In sesame, the apical meristem produces Indole Acetic Acid(IAA), which inhibits the growth of auxiliary buds. One or more of these lower auxiliary buds will start to develop out if the shoot apex is later severed (also known as clipping), which releases apical dominance (Cline, 1997). Lateral branching

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accelerates if the apical meristem is destroyed, which eliminates the auxin source. Additionally, terminal clipping raises the rate of net assimilation. The development of lateral branches improves both the amount of surface area available for photosynthesis and the amount of dry matter produced. clipping of sesame terminal bud stimulates lateral buds, which leads to the production of additional branches in the plant, as noted by Ramanathan and Chandrashekharan (1998). Singh et al. (2013) observed an increase in the number of primary branches per plant of sesame when the plants were de-topped at various stages.

2. Materials and methods

The experiment was carried out during the summer season of 2023 at the college farm, N. M. College of Agriculture, Navsari Agricultural University,Navsari, Gujarat. The soil of the experimental field was heavy black with pH 7.21, medium in organic carbon (0.42%), low in available nitrogen (250.31 kg/ha) and high in phosphorus (50.10 kg/ha), potassium (553.16 kg/ha) and boron (0.337 ppm). The climate of this region is characterized by three well defined seasons: a moderately hot summer, moderately cold winter and warm humid monsoon. The total annual rainfall received during monsoon was 2714 mm in 2023. The mean maximum and minimum temperature ranged between 29.3°C to 39.3°C and 13.5°C to 27.9°C, respectively. The maximum and minimum relative humidity ranged between 68 to 98 percent and 20 to 93 percent, respectively. The experiment consisted of 9 treatment combinations viz., T1: 0 mg/l boron + no clipping; T2: 0 mg/l boron + clipping at 25 DAS; T3: 0 mg/l boron + clipping at 35 DAS; T4: 100 mg/l boron + no clipping; T5: 100 mg/l + clipping at 25 DAS; T6: 100 mg/l boron + clipping at 35 DAS; T7: 150 mg/l boron + no clipping; T8: 150 mg/l boron + clipping at 25 DAS; T9: 150 mg/l boron + clipping at 35 DAS which were replicated three times and were laid out in Factorial Randomized Block Design (FRBD). Recommended dose of fertilizers (50:25:25) applied before sowing. Nitrogen, phosphorus and potassium were applied through urea, SSP and MoP, respectively. Following it, the sesame seeds were sown in furrows and covered with soil. The sesame variety 'Gujarat Til- 3' was sown at 22nd February at the seed rate of 2.5 kg/ha and inter-row spacing of 45 cm. The gross plot size was 4.0 m x 3.6 m and the net plot size was 3.6 m x 2.7 m. In order to maintain weed-free condition pre-emergence spray pendimethalin 30% EC and one hand weeding was done at 30 days after sowing. Five plants were tagged in each plot and the growth and yield attributes were recorded from them. The seed and stover yield were recorded from the net plot area and were converted into kilogram per hectare.

3. Results and discussion

3.1. Growth attributes

Observations of growth attributes viz., plant height, number of branches per plant at harvest were presented in (Table 1). Table 1 details the data on plant height as influenced by foliar application of boron and terminal bud clipping at different DAS. Sesame crop shows highest plant height at harvest (101.17 cm) with treatment of foliar application of boron @ 150 mg/l (B1) which at par with B2. Boron improves root growth, cell multiplication, elongation and cell expansion which ultimately results in highest plant height (Mathew et al.(2013), Hamideldin et al.(2013)) and with no clipping treatment (C1) highest plant height at harvest (102.54 cm) found which is superior over other treatments. This is similar with the findings of Duary et al. (2019) and Patel et al. (2016). Significantly highest number of branches per plant found with foliar application of boron @ 150 mg/l (B3) (4.9) and terminal bud clipping at 35 DAS (C3) (4.7) this might be due to terminal bud clipping arrests terminal growth and activates the dormant lateral bud to produce a higher number of branches. (Singh et al.,2013, Korhale et al.,2012 and Shinde and Shihare, 2015).

3.2. Yield attributes

The yield attributes i.e., no. of capsule per plant (59.38), seed yield (890 kg/ha) and stover yield (1730 kg/ha) found significantly higher with foliar application of boron @ 150 mg/l (B3). As detailed in (Table 1) significantly highest seed and stover yield (905 kg/ha and 1739 kg/ha, respectively) with terminal bud clipping at 35 DAS (C3) over control. Weight of seed per plant (g), no. of seeds per capsule found higher with boron spray @150 mg/l and terminal bud clipping at 35 DAS (Table 1). Yield attributed were higher due to increase in no. of branches and no. of capsules per plant with boron spray and terminal bud clipping practices. The present findings are found in agreement with Yadav et al. (2016), Shamsuzzoha et al. (2019) and Shiny et al. (2021).

Table 1 Effect of foliar spray of boron and terminal bud clipping on growth, and yield parameters

Treatment	Plant height at harvest (cm)	No. of branches per plant	No. of capsule per plant	Weight of seed per plant (g)	No. of seeds per capsule	Seed yield (kg/ha)	Stover yield (kg/ha)
Foliar application of boron							
B1	94.51	3.25	52.43	12.13	50.81	738.27	1438.98
B2	99.89	3.94	54.70	12.40	52.21	860.29	1647.00
B3	101.17	4.98	59.38	13.00	54.57	890.04	1730.62
S.Em	1.85	0.12	0.90	0.36	1.10	15.93	42.79
CD at 5%	5.55	0.37	2.68	NS	NS	47.75	128.28
Terminal bud clipping							
C1	102.54	3.47	52.09	11.93	51.03	750.91	1455.42
C2	97.44	3.93	54.51	12.41	52.56	831.92	1621.43
C3	95.59	4.77	59.92	13.19	54.00	905.77	1739.75
S.Em	1.85	0.12	0.90	0.36	1.10	15.93	42.79
CD at 5%	5.55	0.37	2.68	NS	NS	47.75	128.28
Interaction							
CD at 5%	NS	0.64	4.65	NS	NS	82.71	222.19
CV %	5.64	9.13	4.84	8.64	6.26	5.76	7.99

3.3. Economics

The data in Table 2 reflected that maximum gross return (₹ 88,870), net return (₹ 66,369) and B:C ratio (2.95) were achieved with foliar application of boron @ 150 mg/l. Results accordance with Mallick and Raj (2015) and Dhaliwal et al. (2021). The highest gross return, net return and BCR found with terminal bud clipping treatment at 35 DAS (₹ 90,386, ₹66,985 and 2.86, respectively) which were accordance with Kamble et al. (2015).

Table 2 Effect of foliar spray of boron and terminal bud clipping on economics

Treatments	Gross return (₹/ha)	Net return (₹/ha)	BCR
Foliar application of boron			
B1	73,811.1	52,078	2.40
B2	85,748.1	63,359	2.83
B3	88,870.4	66,369	2.95
Terminal bud clipping			
C1	74,991.6	53,259	2.45
C2	83,051.9	59,651	2.55
C3	90,386.1	66,985	2.86

4. Conclusion

Based on one year field experiment, it can be concluded that sesame *cv.* GT 3 fetched appreciably higher growth, yield and economic returns when foliar application of boron @ 150 mg/l at flowering stage with terminal bud clipping at 35 DAS applied on crop.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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