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Study of Response of Zinc and Boron Micronutrients on Growth Parameters of White Sesame (*Sesamum indicum* L.)

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A B S T R A C T

A field experiment was conducted during the Kharif season of 2025 at the Agricultural Farm of Himalayan University, Jollang, Itanagar, Arunachal Pradesh, to evaluate the effect of zinc and boron micronutrients on the growth, yield, and quality of white sesame (*Sesamum indicum* L.). The experiment was laid out in a Randomized Block Design (RBD) with seven treatments and three replications. The treatments included soil and foliar applications of zinc and boron at different levels along with an untreated control. The results revealed significant variations among treatments for growth parameters such as plant height, leaf length, number of leaves, branches per plant, fresh weight, and dry weight. Among the treatments, the combined application of zinc through soil (2 kg ha^{-1}) and foliar spray (3 kg ha^{-1}) (T_3) recorded the highest plant height (78.1 cm), leaf length (13.93 cm), number of leaves per plant (28), branches per plant (5.49), fresh weight (13.93 g), and dry weight (24.10 g) at 90 DAS. In contrast, the control treatment recorded the lowest values for most growth attributes. The study concluded that integrated application of zinc and boron, particularly zinc applied through both soil and foliar methods, significantly improved the growth and productivity of white sesame under the agro-climatic conditions of Arunachal Pradesh.

Introduction

Sesame (*Sesamum indicum L.*) is one of the oldest cultivated oilseed crops in the world, with historical evidence indicating its domestication over 3,000 years ago (Bedigian, 2004). It belongs to the family Pedaliaceae and is widely known as the "Queen of Oilseeds" due to the superior quality, stability, and nutritional richness of its oil (Bisht *et al.,* 1998). Sesame oil is characterized by a high content of unsaturated fatty acids and natural antioxidants, including lignans such as sesamin and sesamol, which enhance its shelf life and confer various health benefits (Anilakumar *et al.,* 2010).

Micronutrients such as zinc and boron are essential for normal plant growth and development. Zinc plays a critical role in enzyme activation, protein synthesis, and the production of growth hormones such as indole acetic acid (IAA). It has been reported that foliar application can be several times more efficient than soil application

under certain conditions (Veeramani *et al.,* 2012). The foliar application of potassium nitrate (2%) along with boric acid (50 ppm) and zinc sulphate (1%) at 30 and 60 DAS significantly enhanced quality parameters such as chlorophyll content, protein, oil content, and yield in soybean. This improvement was attributed to the role of boron and zinc in chlorophyll synthesis and auxin production, which delay senescence and reduce abscission. (Gowthami *et al.,* 2018)

Materials and Methods

Location and experimental Design

The trial was laid out at the Agriculture field of Himalayan University, Jollang, during Kharif season of 2024-2025. The experiment was laid out in a Randomized Block Design (RBD) with six treatment and one control and three replications. The treatments were as follows:

Table.1 Location and experimental Design

T_0	**Control**
T_1	Zn@ 2kg/ha (soil application)
T_2	Zn@ 3kg/ha (Foliar application)
T_3	Zn@ 2kg/ha (soil application) + zinc @ 3kg/ha (Foliar application)
T_4	Boron @ 0.1kg/ha (soil application)
T_5	Boron @0.5 kg/ha (foliar application)
T_6	Boron @0.1 kg/ha (soil application) and Boron @0.5 kg/ha (Foliar application)

NOTE: Fertilizer was applied into the field by the methods of foliar spray

Results and Discussion

Plant Height

The application of zinc and boron significantly influenced plant height. Treatment T3 recorded the highest plant height at all growth stages with 14.5, 47.2, and 78.1 cm at 30, 60, and 90 DAS, respectively. The control treatment recorded the lowest values (10.0, 31.8, and 62.0 cm).

Leaf Length

Leaf length increased significantly due to micronutrient application. Treatment T3 produced the longest leaves (5.86, 8.46 and 13.93 cm at 30, 60 and 90 DAS respectively), whereas the control showed the shortest leaves.

Number of Leaves per Plant

The highest number of leaves per plant was observed in T3 with 9, 17, and 28 leaves at 30, 60, and 90 DAS, respectively. The lowest number of leaves was recorded under control treatment.

Branches per Plant

The number of branches per plant was significantly influenced by zinc and boron application. Treatment T3 recorded the highest number of branches (4.83, 5.05, and 5.49 at 30, 60, and 90 DAS, respectively), while the control treatment recorded the lowest values.

In conclusion, the study demonstrated that zinc and boron significantly improved the growth performance of white sesame. Among the treatments, combined application of zinc through soil and foliar methods (T3) proved most effective, resulting in maximum plant height, leaf length, number of leaves, and branches per plant.

This enhancement is also supported from foliar application of 1% urea (two sprays) in combination with zinc at 1 ppm (one spray) which significantly improved plant height, number of branches, number of leaves, and grain yield (6.06 q ha^{-1}) in sesame variety JTS-8 compared to nitrogen and zinc applied individually (Dwivedi *et al.,* 2020). Therefore, integrated zinc application can be recommended for improving vegetative growth and crop vigor in white sesame under the agro-climatic conditions of Arunachal Pradesh.

Table.2 Effect of Zinc and Boron on Plant Height (cm) of White Sesame

Treatment	30 DAS	60 DAS	90 DAS
T0	10.0	31.8	62.0
T1	11.1	43.6	73.3
T2	12.5	40.2	74.3
T3	14.5	47.2	78.1
T4	11.5	39.2	76.7
T5	12.8	41.3	74.8
T6	12.9	43.8	75.2

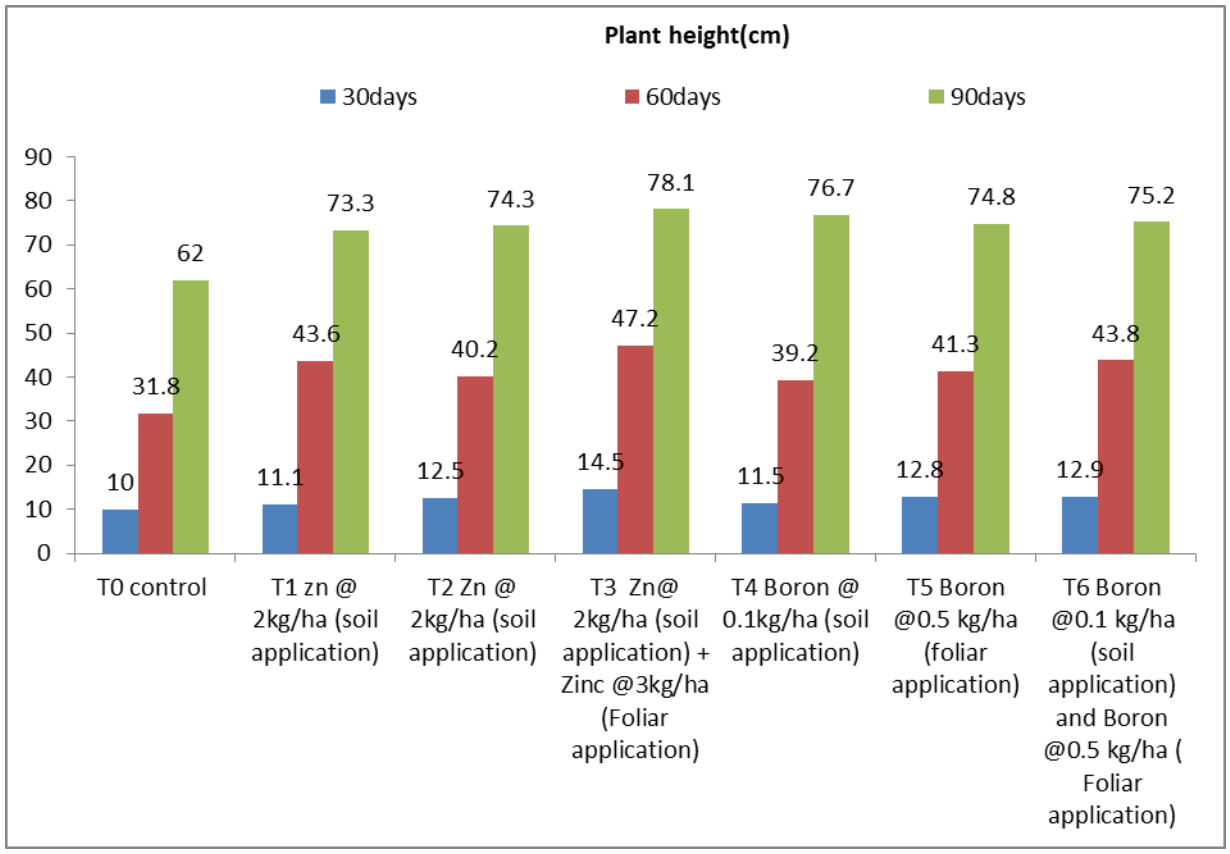


Table.3 Effect of Zinc and Boron on Leaf Length (cm) of White Sesame

Treatment	30 DAS	60 DAS	90 DAS
T0	4.63	6.13	11.20
T1	5.13	7.13	13.13
T2	4.56	7.76	12.93
T3	5.86	8.46	13.93
T4	4.36	7.53	13.60
T5	4.50	7.50	12.96
T6	5.13	8.00	12.40

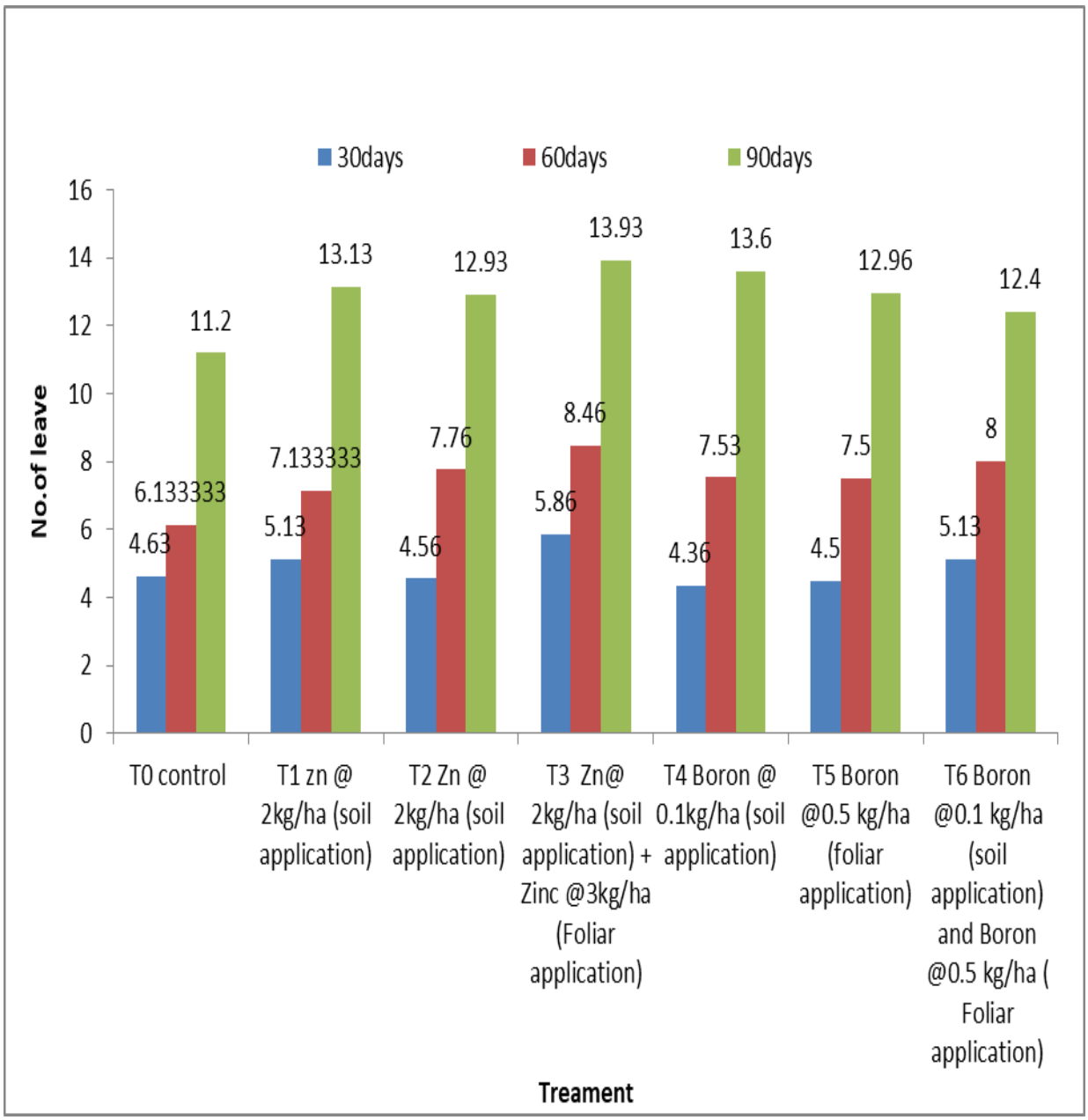


Table.4 Effect of Zinc and Boron on Number of Leaves per Plant

Treatment	30 DAS	60 DAS	90 DAS
T0	6	12	20
T1	8	14	24
T2	8	16	25
T3	9	17	28
T4	9	15	25
T5	7	14	23
T6	8	16	26

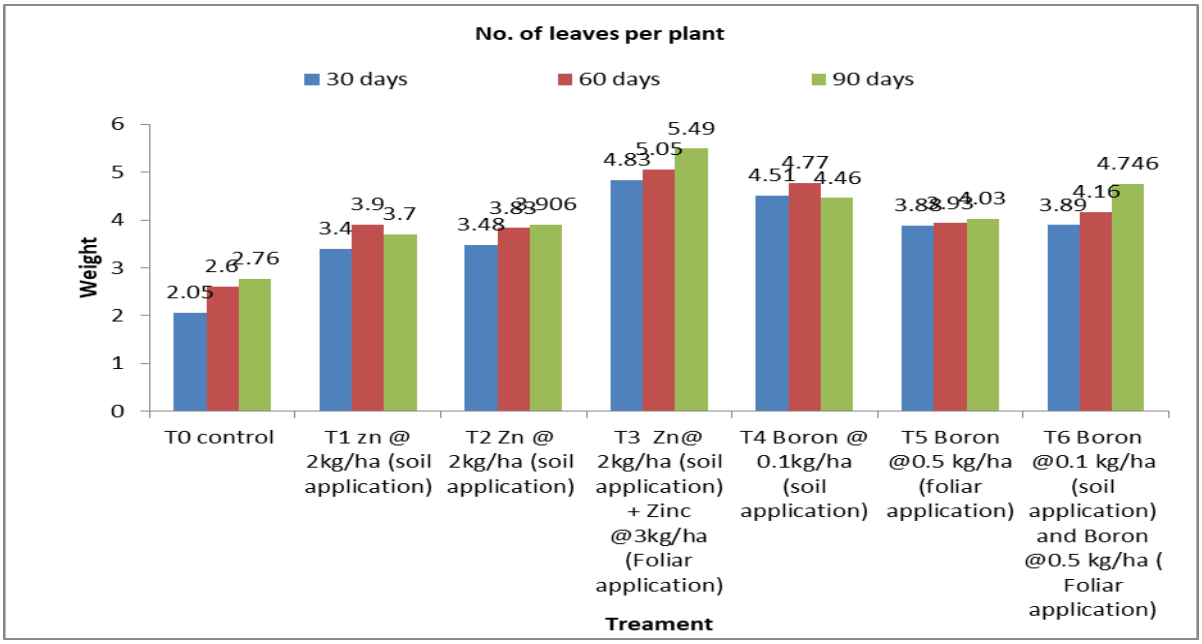
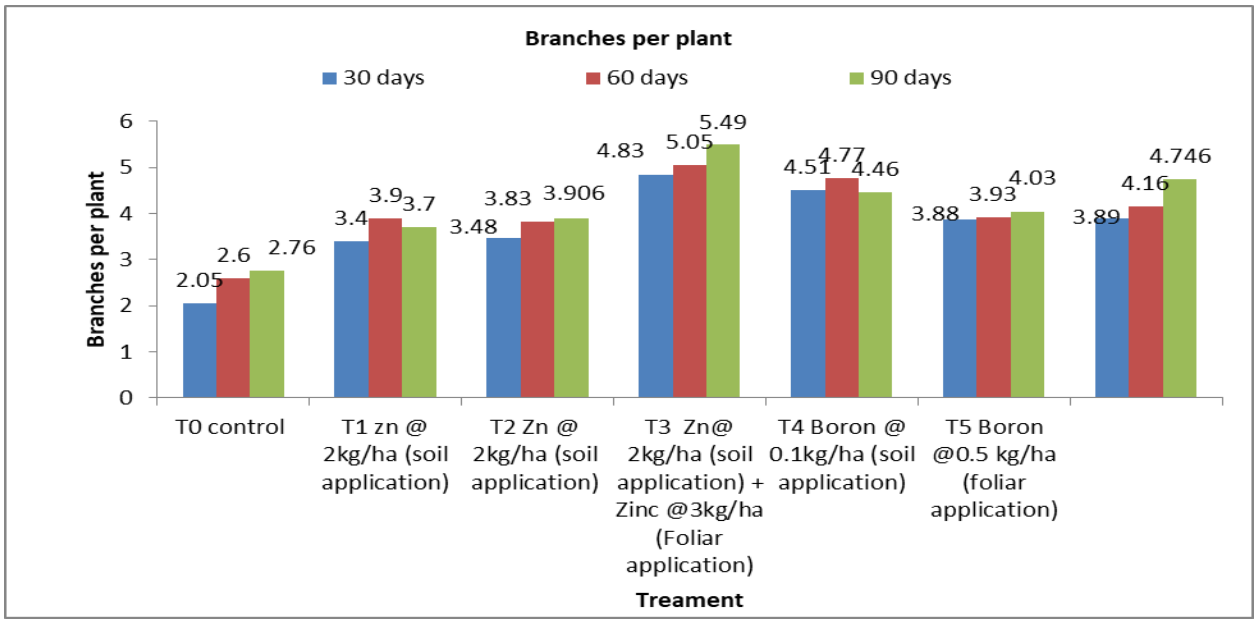


Table.5 Effect of Zinc and Boron on Branches per Plant

Treatment	30 DAS	60 DAS	90 DAS
T0	2.05	2.60	2.76
T1	3.40	3.90	3.70
T2	3.48	3.83	3.91
T3	4.83	5.05	5.49
T4	4.51	4.77	4.46
T5	3.88	3.93	4.03
T6	3.89	4.16	4.75



Author Contributions

Raju Mugli: Investigation, formal analysis, writing—original draft. Kasinam Doruk: Validation, methodology, writing—reviewing. Lipi Rina:—Formal analysis, writing—review and editing. Dorjee Gyachen Jairy: Investigation, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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