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EFFECT OF FOLIAR APPLICATION OF ZINC, IRON AND BORON ON GROWTH AND FLOWERING OF CORIANDER (*Coriandrum sativum* L.) IN THE BASTAR PLATEAU

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ABSTRACT

Coriander (*Coriandrum sativum* L.) is an important seed spice crop in which micronutrient availability can influence vegetative growth and flowering. A field experiment was conducted during the Rabi season of 2025–26 at the Research-cum-Instructional Farm, Krantikari Debridhur College of Horticulture and Research Station, Jagdalpur, Bastar (C.G.), to evaluate the effect of foliar application of micronutrients on the growth and flowering of coriander variety Chhattisgarh Shri Chandrahasini Dhaniya-2. The experiment was laid out in a Randomized Block Design with nine treatments replicated three times. The treatments comprised foliar application of Zinc Sulphate ($ZnSO_4$), Ferrous Sulphate ($FeSO_4$) and Borax at 0.4% and 0.5%, applied individually and in combination. The results revealed that the combined application of $ZnSO_4$+ $FeSO_4$ + Borax at 0.5% (T_9) recorded superior growth performance. At harvest, T_9 recorded the highest plant height (86.77 cm), secondary branches per plant (19.90), fresh weight per plant (27.57 g) and dry weight per plant (7.35 g). At 65 DAS primary branches per plant (8.63). T_9 also recorded the maximum number of days to 50% flowering (59.27 days), compared with 56.26 days in the control (T_1), indicating delayed flowering under the combined micronutrient treatment. Overall, foliar application of $ZnSO_4$ + $FeSO_4$ + Borax at 0.5% showed potential for improving vegetative growth and influencing flowering in coriander under the Bastar Plateau conditions of Chhattisgarh.

Key words : Coriander, Micronutrients, Foliar application, Vegetative growth, Flowering.

Introduction

Coriander (*Coriandrum sativum* L.) is an important annual seed spice crop belonging to the family Apiaceae and is widely valued for its aromatic leaves and seeds (Bhandari and Gupta, 1991). Its growth and productivity are influenced by genetic, environmental and nutritional factors, among which balanced micronutrient nutrition plays an important role (Marschner, 2012; Cakmak, 2000). Previous studies have reported beneficial effects of micronutrient application on growth and yield attributes of coriander (Mounika *et al*., 2018).

Zinc, iron and boron are essential micronutrients involved in several physiological and biochemical processes. Zinc plays important roles in enzyme activity, protein synthesis and auxin metabolism (Cakmak, 2000), while iron is essential for chlorophyll formation, electron transport and photosynthetic activity (Marschner, 2012). Boron contributes to cell-wall formation, membrane integrity, carbohydrate metabolism and meristematic growth (Goldbach *et al*., 2001; Haque *et al*., 2011). Foliar application provides a direct route for nutrient delivery to plant tissues and can improve nutrient uptake and growth

performance (Fernández and Eichert, 2009). In coriander, foliar application of zinc and iron has been reported to enhance plant biomass and physiological performance, while boron application has also influenced vegetative growth under different growing conditions (Ali *et al*., 2025).

Therefore, the present investigation was undertaken to evaluate the effect of foliar application of zinc, iron and boron, applied individually and in combination at different concentrations, on the growth and flowering of coriander under the Bastar Plateau conditions of Chhattisgarh.

Materials and Methods

Experimental site and Soil characteristics

The field experiment was executed during the Rabi season of 2025-26 at the Research cum Instructional Farm, Krantikari Debridhur College of Horticulture and Research Station, Jagdalpur, Bastar (C.G.), India. The site is geographically situated at 19°08' N latitude and 82°02' E longitude, at an elevation of 552 meters. The experimental soil was sandy loam in texture with a neutral reaction (pH 6.94), normal electrical conductivity (0.085 dS/m), medium organic carbon (0.74%) and medium available nitrogen (413.95 kg/ha).

Experimental Design and treatments

The trial was structured in a Randomized Block Design (RBD) featuring nine treatments replicated three times on coriander variety 'Chhattisgarh Shri Chandrahasini Dhaniya-2'. Seeds were sown at a spacing of 20 cm × 15 cm in plots measuring 3.0 m × 2.0 m

The foliar treatments included:

T_1: Control; T_2: $ZnSO_4$ @ 0.4%; T_3: $ZnSO_4$ @ 0.5%; T_4: $FeSO_4$ @ 0.4%; T_5: $FeSO_4$ @ 0.5%; T_6: Borax @ 0.4%; T_7: Borax @ 0.5%; T_8: $ZnSO_4$ + $FeSO_4$ + Borax @ 0.4%; T_9: $ZnSO_4$ + $FeSO_4$ + Borax @ 0.5%.

A basal application of Farmyard Manure (15 t/ha) and a recommended fertilizer dose of 80:60:40 kg $N:P_2O_5:K_2O$ per hectare were applied uniformly plots.

Data collection and Statistical analysis

Five randomly selected plants were tagged in each plot to record time-series biometric observations. Plant height, and secondary branches were measured at 45 DAS, 65 DAS and at final harvest. Primary branches were measured at 45DAS and 65 DAS. Fresh and dry biomass weights were calculated at 60 DAS and at harvest, while days to 50% flowering were recorded based on plot-wide visual observations. The generated data were subjected to Analysis of Variance (ANOVA) for RBD as described by Panse and Sukhatme (1985), with Critical Difference (CD) evaluated at a 5% probability level.

Results and Discussion

Growth parameters

Plant height (cm)

The foliar application of micronutrients significantly influenced plant height across all growth stages (Table 1). The maximum plant height (38.76 cm at 45 DAS, 70.24 cm at 65 DAS, and 86.77 cm at harvest) was recorded under T9 ($ZnSO_4$ + $FeSO_4$ + Borax @ 0.5%), which was statistically on par with T8 at all stages. The minimum plant height was consistently observed in the untreated control (T_1). The profound increase in apical growth under T9 is attributed to the synergistic action of Zn, Fe and B. Zinc directly stimulates auxin (IAA) synthesis for internodal elongation, while Iron and Boron support continuous cell division and structural integrity. These findings are in strong conformity with Pandey *et al*. (2023) and Tania *et al*. (2018).

Primary and Secondary Branches per plant

Branching architecture was significantly enhanced by combined micronutrient feeding. Treatment T_9 recorded the maximum number of primary branches (6.03 at 45 DAS; 8.63 at 65 DAS) and secondary branches (8.70 at 45 DAS; 15.87 at 65 DAS; 19.90 at harvest). The lowest branching metrics were recorded in T_1. Boron plays a fundamental role in meristematic activity and lateral bud initiation, which, when combined with the enzymatic activation provided by Zinc and Iron, effectively breaks apical dominance to promote a dense, bushy canopy. Similar improvements in coriander branching were documented by Tania *et al*. (2018) and Pandey *et al*. (2023).

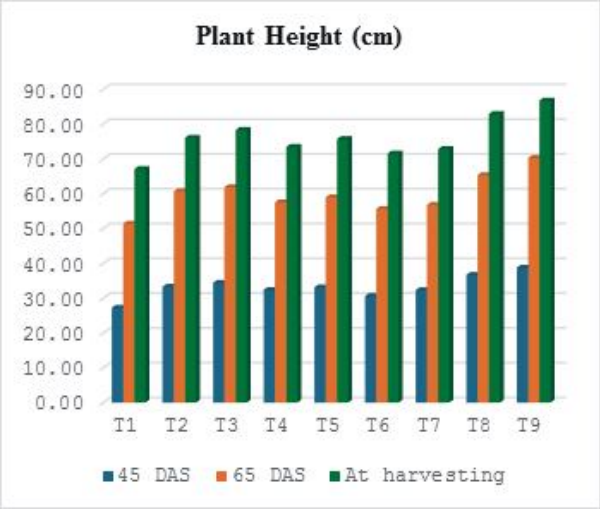


Fig. 1 : Effect of micronutrients on plant growth (cm).

Table 1 : Effect of foliar micronutrients on plant height, primary branches and flowering of coriander.

Treatment		Plant height (cm)			Primary branches		Days of 50% flowering
		45 DAS	65 DAS	At harvest	45 DAS	65 DAS	
T_1	Control	27.23	51.37	67.10	4.40	5.90	56.26
T_2	$ZnSO_4$ @ 0.4%	33.26	60.68	76.07	5.17	7.43	57.47
T_3	$ZnSO_4$ @ 0.5%	34.39	61.83	78.33	5.37	7.76	57.85
T_4	$FeSO_4$ @ 0.4%	32.36	57.50	73.47	4.93	7.27	56.98
T_5	$FeSO_4$ @ 0.5%	33.10	58.93	75.73	5.17	7.47	57.36
T_6	Borax @ 0.4%	30.63	55.64	71.57	4.73	6.50	56.86
T_7	Borax @ 0.5%	32.25	56.77	72.83	4.83	6.93	57.14
T_8	$ZnSO_4$ + $FeSO_4$ + Borax @ 0.4%	36.63	65.33	82.93	5.70	8.27	58.59
T_9	$ZnSO_4$ + $FeSO_4$ + Borax @ 0.5%	38.76	70.24	86.77	6.03	8.63	59.27
SE(m)±		1.46	2.93	3.22	0.24	0.39	0.56
CD(p=0.05)		4.43	8.86	9.75	0.73	1.18	1.71
C.V. (%)		7.65	8.49	7.32	8.14	9.23	1.70

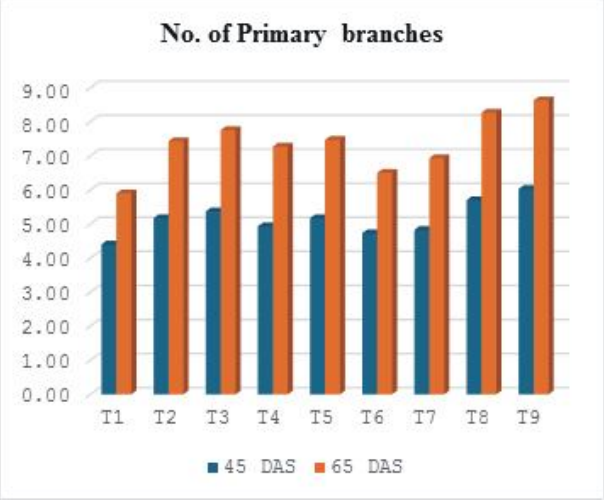


Fig. 2 : Effect of micronutrients on number of primary branches.

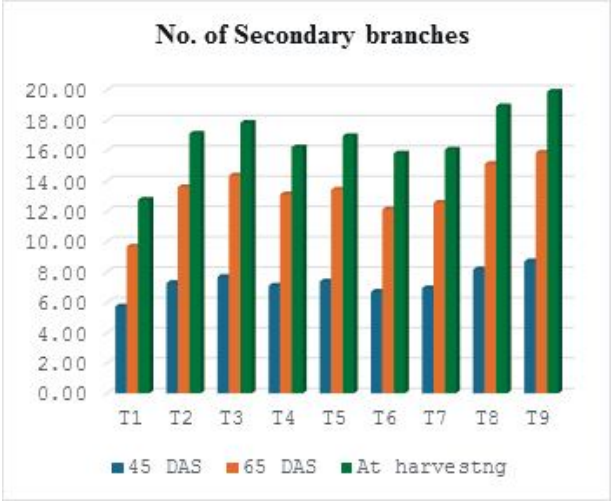


Fig. 3 : Effect of micronutrients on number of secondary branches.

Fresh and Dry weight of plant (g)

Biomass accumulation reflects the ultimate efficiency of the plant's photosynthetic machinery. The highest fresh weight (13.71 g at 60 DAS; 27.57 g at harvest) and dry weight (3.63 g at 60 DAS; 7.35 g at harvest) were achieved under T_9 ($ZnSO_4$ + $FeSO_4$ + Borax @ 0.5%), significantly outperforming the control (T_1), which yielded merely 5.62 g of dry matter at harvest. The robust dry matter accumulation in T_9 stems from Iron-mediated chlorophyll biosynthesis coupled with Boron-assisted carbohydrate translocation, ensuring that assimilated photosynthates are efficiently converted into structural tissues. Similar improvement in fresh weight and dry weight production was reported by Pandey *et al.* (2023) and Mounika *et al.* (2018).

Days to 50% flowering

The application of micronutrients significantly prolonged the vegetative phase of the crop. The maximum days to 50% flowering (59.27 days) was recorded in T_9, whereas the control (T_1) transitioned to the reproductive phase significantly earlier (56.26 days). The delayed flowering in T9 is a positive indicator of optimal nutritional status, allowing the crop to accumulate maximum vegetative biomass and structural framework before shifting metabolic energy toward floral initiation. Similar variation in days to 50% flowering due to micronutrient

Table 2 : Effect of foliar micronutrients on secondary branches, fresh weight, and dry weight of coriander.

Treatment		Secondary branches			Fresh weight (g)		Dry weight (g)	
		45 DAS	65 DAS	At harvest	60 DAS	At harvest	60 DAS	At harvest
T_1	Control	5.73	9.67	12.77	9.91	20.13	2.04	5.62
T_2	$ZnSO_4$ @ 0.4%	7.27	13.60	17.13	12.09	25.30	2.95	6.70
T_3	$ZnSO_4$ @ 0.5%	7.68	14.37	17.84	12.51	25.74	3.13	6.78
T_4	$FeSO_4$ @ 0.4%	7.10	13.12	16.23	11.67	23.71	2.58	6.38
T_5	$FeSO_4$ @ 0.5%	7.37	13.43	16.97	11.88	24.39	2.75	6.52
T_6	Borax @ 0.4%	6.70	12.13	15.83	11.19	22.08	2.38	5.93
T_7	Borax @ 0.5%	6.93	12.57	16.07	11.52	23.22	2.44	6.23
T_8	$ZnSO_4$ + $FeSO_4$ + Borax @ 0.4%	8.17	15.13	18.93	13.23	26.69	3.41	7.10
T_9	$ZnSO_4$ + $FeSO_4$ + Borax @ 0.5%	8.70	15.87	19.90	13.71	27.57	3.63	7.35
SE(m)±		0.42	0.80	0.84	0.38	0.60	0.13	0.28
CD(p=0.05)		1.28	2.44	2.56	1.16	1.81	0.39	0.86
C.V. (%)		10.05	10.50	8.73	5.58	4.28	8.05	7.57

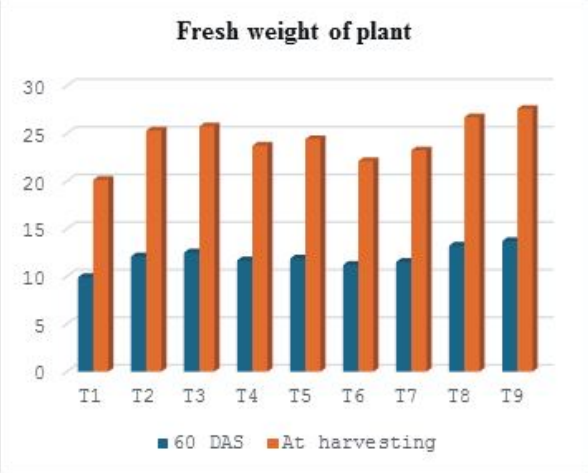


Fig. 4 : Effect of micronutrients on fresh weight of plant.

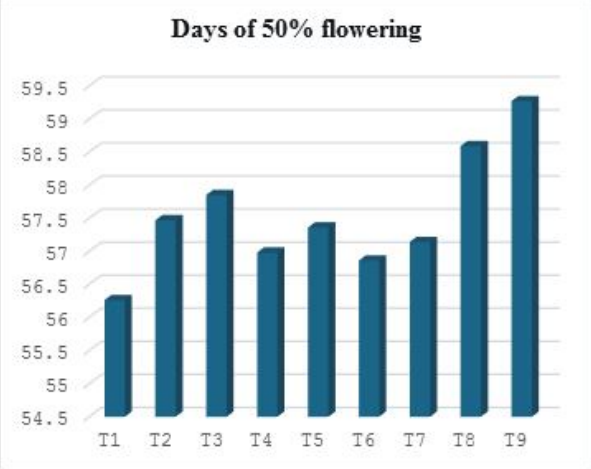


Fig. 6 : Days taken to 50% flowering.

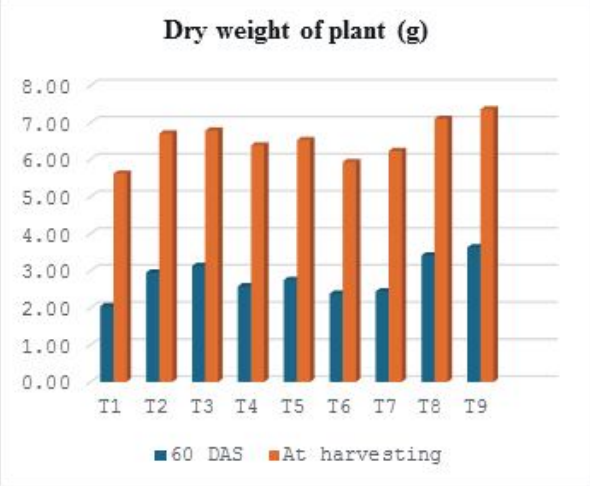


Fig. 5 : Effect of micronutrients on dry weight of plant (g).

application has been reported by Kalidasu *et al.* (2008) and Vats *et al.* (2023).

Conclusion

Based on the field trial results, it is concluded that the combined foliar application of Zinc, Iron and Boron significantly enhances the structural canopy and vegetative vigor of coriander under Bastar Plateau conditions. Treatment T_9 ($ZnSO_4$ + $FeSO_4$ + Borax @ 0.5%) proved to be the most highly effective formulation, registering the absolute maximums for plant height, lateral branch proliferation, and total dry matter accumulation while optimally extending the vegetative growth window. Therefore, a 0.5% foliar spray of this micronutrient consortium is recommended as an ideal agronomic

practice for maximizing the vegetative framework of coriander.

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