



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating: 5.20
www.agronomyjournals.com
2025; 8(7): 376-379
Received: 21-04-2025
Accepted: 23-05-2025

B Rezwana Shahni
M.Sc. Research Scholar,
Department of Horticulture, Naini
Agricultural Institute, Sam
Higginbottom University of
Agriculture, Prayagraj, Uttar
Pradesh, India

Dr. Vijay Bahadur
Professor and Head, Department
of Horticulture, Naini Agricultural
Institute, Sam Higginbottom
University of Agriculture,
Prayagraj, Uttar Pradesh, India

Effect of zinc and boron application on growth, yield and quality of cherry tomato under protected cultivation

B Rezwana Shahni and Vijay Bahadur

DOI: <https://www.doi.org/10.33545/2618060X.2025.v8.i7e.3221>

Abstract

Cherry tomato is a high-value horticultural crop known for its nutritional richness, market appeal and adaptability to protected cultivation systems. Micronutrient deficiencies, particularly of zinc (Zn) and boron (B), can limit the crop's growth, productivity and fruit quality. The present study was conducted during the rabi season of 2024–2025 at the Department of Horticulture, SHUATS, Prayagraj to evaluate the effect of foliar application of zinc and boron on growth, yield and quality of cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) under protected cultivation. The experiment was laid out in a Randomized Block Design with 15 treatments and three replications, comprising individual and combined applications of zinc (30, 60, 90 ppm) and boron (30, 60, 90 ppm). Observations were recorded at regular intervals on various growth parameters (plant height, number of branches), reproductive traits (flowers and fruits per cluster, days to first harvest), yield and quality attributes (fruit weight, yield per plant and per hectare, total soluble solids, and vitamin C content). The results revealed that foliar application of zinc and boron significantly improved all studied parameters compared to the control. Among all treatments studied, the treatment T₁₅ (Zinc @ 90 ppm & Boron @ 90 ppm) recorded the maximum plant height (235.28 cm at 120 DAT), number of branches (33.99), number of flowers per cluster (11.78), number of fruits per cluster (9.24), fruit length (4.87 cm), fruit girth (3.45 cm), average fruit weight (42.63 g), yield per plant (3.45 kg) and yield per hectare (191.67 t/ha), total soluble solids (8.32 °Brix) and vitamin C content (16.98 mg/100g), while also advancing earliness in harvest (80.25 days) followed by the treatment T₁₄ (Zinc 90 ppm & Boron 60 ppm) having 229.47 cm plant height, number of branches (31.06), number of flowers per cluster (10.50), number of fruits per cluster (8.05), fruit length (4.55 cm), fruit girth (3.20 cm), average fruit weight (36.40 g), yield per plant (3.31 kg), earliest days to first harvest (80.47 days), yield per hectare (183.32 t/ha), total soluble solids (8.13 °Brix) and vitamin C content (16.71 mg/100g) and the minimum was found in T₀ control. Thus, the study confirms that the combined foliar application of zinc and boron at higher concentrations enhances vegetative growth, reproductive efficiency, fruit yield, and quality in cherry tomato. These findings support the integration of micronutrient sprays as a cost-effective and efficient strategy for maximizing crop performance in protected environments.

Keywords: Cherry tomato, zinc, boron, foliar application, growth, yield, quality, protected cultivation

Introduction

Cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) is a small-fruited, warm-season crop prized for its sweetness, vibrant color, and rich nutrient profile. It thrives best at average monthly temperatures of 21–23 °C, with environmental factors like humidity and light intensity strongly influencing fruit set and pigmentation (Kusumiyati *et al.*, 2023; Tanksley, 2004)^[11, 22]. Nutritionally, it contains about 94.5% water, with notable amounts of potassium, calcium, vitamins A and C, alongside antioxidants such as lycopene and flavonoids, which contribute to benefits against cardiovascular disease and cancer (Baby *et al.*, 2018; Singh *et al.*, 2017; Collins *et al.*, 2022)^[2, 19, 4].

Balanced nutrition is vital: while macronutrients support structural growth, micronutrients particularly zinc (Zn) and boron (B) are essential for enzymatic regulation, hormone balance, pollen viability, sugar transport, and overall yield (Hamzah *et al.*, 2018; Day & Aasim, 2020; Nadeem *et al.*, 2018)^[8, 5, 14]. Foliar application offers rapid absorption, bypassing soil-related uptake barriers (Gupta *et al.*, 2005; Fageria *et al.*, 2002)^[7, 6]. Application of micronutrients has emerged as an efficient and responsive method to supply micronutrients directly to the plant

Corresponding Author:
B Rezwana Shahni
M.Sc. Research Scholar,
Department of Horticulture, Naini
Agricultural Institute, Sam
Higginbottom University of
Agriculture, Prayagraj, Uttar
Pradesh, India

canopy. This approach bypasses soil-related nutrient fixation issues and facilitates rapid nutrient uptake through leaf stomata and cuticular pores (Gupta *et al.*, 2005) ^[7]. Moreover, micronutrients application ensures better nutrient use efficiency, particularly in conditions where soil pH or moisture content might limit root absorption (Fageria *et al.*, 2002) ^[6].

Combined foliar application of Zn and B has shown particularly strong effects. For example, in cherry tomato, the most effective treatment—2.0 g/L each of ZnSO₄ and B boosted plant height (>148 cm), clusters per plant (>16), fruit count (>244), yield (~4.98 t/ha), TSS (13.1 °Brix), and vitamin C content (~14.1 mg/100 g). Similarly, in other tomato varieties, combined sprays around 0.1–0.2% improved plant vigor, flower set, fruiting, stem girth, and early flowering. Despite these promising results, there remains a gap in region-specific trials investigating combined Zn and B foliar applications in cherry tomato. This study aims to evaluate individual and combined effects of Zn and B sprays on growth, yield, and fruit quality under our local agro-climatic conditions, with the goal of optimizing treatment strategies for improved productivity and nutritional value.

Materials and Methods

The present investigation entitled “Effect of Zinc and Boron on Growth, Yield and Quality of Cherry Tomato (*Solanum lycopersicum* var. *cerasiforme*) under Protected Condition” was conducted during the rabi season of 2024-2025 at the Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology And Sciences, under protected conditions. The experiment was laid out in a Randomized Block Design (RBD) with 15 treatments, each replicated thrice. Healthy seeds of cherry tomato were sown in pro trays containing a sterilized potting mixture of cocopeat, vermiculite, and perlite in a 3:1:1 and thirty days old seedlings was transplanted in raised beds within the polyhouse, following recommended spacing and standard agronomic practices. Before transplanting, well-decomposed farmyard manure (FYM) was incorporated into the beds at the rate of 12 tonnes per hectare. Application of zinc and boron was done after transplanting using analytical-grade zinc sulphate (ZnSO₄) and boric acid (H₃BO₃). The treatments were as follows: T₀ (Control), T₁ (Boron @ 30 ppm), T₂ (Boron @ 60 ppm), T₃ (Boron @ 90 ppm), T₄ (Zinc @

30 ppm), T₅ (Zinc @ 60 ppm), T₆ (Zinc @ 90 ppm), T₇ (Zinc @ 30 ppm & Boron @ 30 ppm), T₈ (Zinc @ 30 ppm & Boron @ 60 ppm), T₉ (Zinc @ 30 ppm & Boron @ 90 ppm), T₁₀ (Zinc @ 60 ppm & Boron @ 30 ppm), T₁₁ (Zinc @ 60 ppm & Boron @ 60 ppm), T₁₂ (Zinc @ 60 ppm & Boron @ 90 ppm), T₁₃ (Zinc @ 90 ppm & Boron @ 30 ppm), T₁₄ (Zinc @ 90 ppm & Boron @ 60 ppm), and T₁₅ (Zinc @ 90 ppm & Boron @ 90 ppm). Observations on growth parameters, yield and quality was recorded and all the recorded data were statistically analysed using the method of analysis of variance (ANOVA) as suggested by Panse and Sukhatme (1985) ^[15], with the significance of treatment effects evaluated at the 5% level of probability.

Results and Discussion

Results regarding the influence of boron and zinc on growth, yield and quality of cherry tomato have been recorded, interpreted in Table 1 in light of the impact of different treatments during the experimentation and are discussed under the following heads:

Growth Parameters

The foliar application of boron and zinc significantly influenced all the growth parameters at each observation intervals (30, 60, 90 and 120 DAT). Among all the treatments, T₁₅ (Zinc @ 90 ppm & Boron @ 90 ppm) recorded the maximum plant height across all intervals, 47.59 cm at 30 DAT, 114.19 cm at 60 DAT, 190.94 cm at 90 DAT and 235.28 cm at 120 DAT followed closely by T₁₄ (Zinc 90 ppm & Boron 60 ppm) having 46.58 cm, 111.80 cm, 186.29 cm and 229.47 cm at 30, 60, 90 and 120 DAT respectively. The control treatment T₀ exhibited the least growth performance recording 32.59 cm, 78.22 cm, 130.37 cm and 162.45 cm at 30, 60, 90 and 120 DAT respectively. This improvement in plant height with increasing concentrations of zinc and boron might be attributed to their roles in enhancing enzymatic activities, promoting cell elongation, and stimulating hormone synthesis. Zinc is known to influence auxin production, while boron plays a pivotal role in cell wall formation and nutrient translocation (Vera-Maldonado *et al.*, 2024) ^[23]. These findings are supported by Sultana *et al.*, 2016 ^[21] and Vera- Saha *et al.*, 2023 ^[16], who reported significant growth responses in tomato to zinc and boron micronutrient applications.

Table 1: Effect of foliar application of Zinc and Boron on growth parameters in cherry tomato

Treatments	Plant Height (cm) 30 DAT	Plant Height (cm) 60 DAT	Plant Height (cm) 90 DAT	Plant Height (cm) 120 DAT	No. of Branches 30 DAT	No. of Branches 60 DAT	No. of Branches 90 DAT	No. of Branches 120 DAT
T ₀	32.59	78.22	130.37	162.45	6.17	11.57	15.43	18.03
T ₁	33.55	80.65	134.34	167.28	6.50	12.17	16.24	18.95
T ₂	34.53	83.01	138.35	172.07	6.82	12.80	17.05	19.88
T ₃	35.51	85.42	142.36	176.86	7.14	13.41	17.86	20.80
T ₄	36.55	87.81	146.33	181.51	7.48	14.02	18.68	21.73
T ₅	37.56	90.21	150.36	186.23	7.80	14.64	19.50	22.66
T ₆	39.52	95.01	162.31	200.45	8.45	15.85	21.13	24.42
T ₇	42.50	102.21	170.35	210.46	9.44	17.69	23.60	27.27
T ₈	38.53	92.61	154.37	191.22	8.13	15.24	20.33	23.44
T ₉	41.64	101.19	171.40	211.74	9.34	17.34	23.67	27.41
T ₁₀	43.52	104.61	174.55	216.01	9.78	18.31	24.42	28.27
T ₁₁	44.51	107.07	178.34	220.48	10.10	18.91	25.23	29.18
T ₁₂	40.54	97.43	162.62	201.00	8.78	16.47	21.96	25.12
T ₁₃	45.59	109.40	182.33	224.83	10.43	19.53	26.05	30.13
T ₁₄	46.58	111.80	186.29	229.47	10.75	20.14	26.86	31.06
T ₁₅	47.59	114.19	190.94	235.28	11.08	20.76	27.67	33.99
F-Test	S	S	S	S	S	S	S	S
S.Ed (±)	0.66	1.96	2.90	3.47	0.23	0.42	0.51	0.45
CD _{0.05}	1.35	4.03	5.95	7.13	0.47	0.87	1.05	0.93

Similarly, the number of branches increased significantly with combined micronutrient applications. T₁₅ (Zinc 90 ppm & Boron 90 ppm) exhibited the highest number of branches having 11.08, 20.76, 27.67 and 33.99 at 30, 60, 90 and 120 DAT followed by treatments T₁₄ (Zinc 90 ppm & Boron 60 ppm) with 10.75, 20.14, 26.86 and 31.06 at 30, 60, 90 and 120 DAT respectively. This can be ascribed to improved nutrient uptake and utilization, which facilitates greater vegetative development and canopy expansion, ultimately contributing to improved photosynthesis and plant vigour (Akanksha and Dhillon 2022) ^[1]. The additive and synergistic effects of combined zinc and boron applications are evident from the progressive increase in plant height and branching in integrated treatments compared to sole applications. These results affirm with the findings of Singh *et al.*, 2017 ^[19] and Sandilya *et al.*, 2023 ^[17] on the efficacy of micronutrient integration for optimizing cherry tomato growth.

Yield and Quality Parameters

The data on yield and quality traits of cherry tomato revealed that the application of zinc and boron had a marked effect on improving reproductive flowering and fruit quality and is

represented in Table 2. The yield parameters and yield per hectare is illustrated in 1 and 2 respectively. Treatment T₁₅ (Zinc @ 90 ppm & Boron @ 90 ppm) was found most effective in enhancing yield attributes such as number of flowers per cluster (11.78), number of fruits per cluster (9.24), fruit length (4.87 cm), fruit girth (3.45 cm), average fruit weight (42.63 g), yield per plant (3.45 kg), earliest days to first harvest (80.25 days) and yield per hectare (191.67 t/ha) followed by the treatments T₁₄ (Zinc 90 ppm & Boron 60 ppm) having number of flowers per cluster (10.50), number of fruits per cluster (8.05), fruit length (4.55 cm), fruit girth (3.20 cm), average fruit weight (36.40 g), yield per plant (3.31 kg), earliest days to first harvest (80.47 days) and yield per hectare (183.32 t/ha) and the minimum number of flowers per cluster (6.80), number of fruits per cluster (3.75), fruit length (1.98 cm), fruit girth (1.56 cm), average fruit weight (15.55 g), yield per plant (1.35 kg), longest days to first harvest (91.49 days) and yield per hectare (75.34 t/ha) was found in T₀ control. This enhancement in yield can be attributed to the positive effects of zinc and boron in flower induction, fruit set, and improved metabolic activities including sugar accumulation and nutrient translocation. These findings align with the result of Islam *et al.*, 2017 ^[9] and Shnain *et al.*, 2017 ^[18] in cherry tomato.

Table 2: Effect of foliar application of Zinc and Boron on yield and quality traits in cherry tomato

Treatments	Flowers per Cluster	Fruits per Cluster	Days to First Harvest	Fruit Length (cm)	Fruit Girth (cm)	Avg. Fruit Wt. (g)	Yield per Plant (kg)	Yield per Hectare (t/ha)	TSS (°Brix)	Vit. C (mg/100 g)
T ₀	6.80	3.75	91.49	1.98	1.56	15.55	1.35	75.34	5.05	10.21
T ₁	7.05	3.95	90.67	2.10	1.65	16.10	1.44	80.86	5.27	10.72
T ₂	7.30	4.13	89.85	2.22	1.73	16.65	1.59	86.11	5.49	11.25
T ₃	7.54	4.36	89.03	2.35	1.83	17.20	1.68	91.66	5.71	11.70
T ₄	7.87	4.54	88.21	2.47	1.92	17.75	1.75	97.22	5.93	12.21
T ₅	8.05	4.78	87.39	2.60	2.01	18.30	1.85	102.77	6.15	12.73
T ₆	8.50	5.10	85.75	3.00	2.19	20.05	2.13	116.67	6.59	13.75
T ₇	8.99	5.65	83.29	3.45	2.45	22.16	2.48	133.33	7.25	15.23
T ₈	8.25	5.20	86.57	2.80	2.10	19.50	2.22	122.22	6.37	13.27
T ₉	8.86	5.57	84.55	3.31	2.42	22.15	2.41	132.61	7.25	15.01
T ₁₀	9.25	5.80	82.47	3.55	2.60	23.75	2.63	144.44	7.47	15.74
T ₁₁	9.50	6.05	81.65	3.75	2.80	25.01	2.80	155.56	7.68	16.21
T ₁₂	8.61	5.30	85.03	2.90	2.15	19.80	2.14	119.43	6.81	14.23
T ₁₃	10.05	7.05	80.83	4.14	3.00	30.12	3.00	166.67	7.91	16.45
T ₁₄	10.50	8.05	80.47	4.55	3.20	36.40	3.31	183.32	8.13	16.71
T ₁₅	11.78	9.24	80.25	4.87	3.45	42.63	3.45	191.67	8.32	16.98
F-Test	S	S	S	S	S	S	S	S	S	S
S.Ed (±)	0.17	0.12	1.87	0.09	0.06	0.62	0.06	3.18	0.15	0.28
CD _{0.05}	0.34	0.25	3.84	0.20	0.12	1.28	0.12	6.52	0.31	0.59

Fruit quality attributes, such as the highest total soluble solids (8.32 °Brix) and vitamin C content (16.98 mg/100g) were noted highest in the same treatment T₁₅ (Zinc @ 90 ppm & Boron @ 90 ppm), followed by T₁₄ (Zinc 90 ppm & Boron 60 ppm) with total soluble solids (8.13 °Brix) and vitamin C content (16.71 mg/100g) and the minimum total soluble solids (5.05 °Brix) and vitamin C content (10.21 mg/100g) was found in T₀ control. These quality enhancements suggest a cumulative effect of both micronutrients in improving biochemical traits through enzymatic activities and physiological processes (Sturiao *et al.*, 2020) ^[20]. The results are consistent with findings of Milagres *et al.*, 2019 ^[13] and Singh and Kaur *et al.*, 2024 ^[10], who reported significant improvements in yield and quality traits of cherry tomato with foliar applications of zinc and boron.

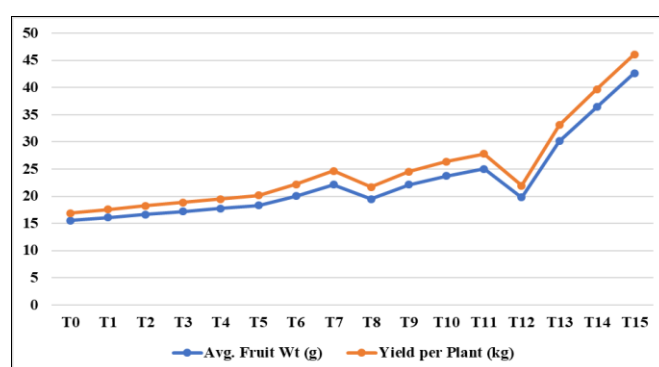


Fig 1: Graphical representation on the effect of zinc & boron on Yield parameters of cherry tomato

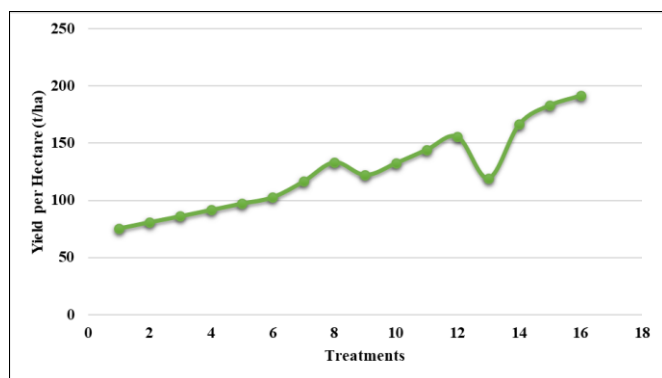


Fig 2: Graphical representation on the effect of zinc & boron on Yield per Hectare of cherry tomato

Conclusion

The present investigation clearly demonstrated that the application of zinc and boron, particularly in combined forms, had a significant positive influence on the growth, yield and quality traits of cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) under protected cultivation. Among all the treatments, T₁₅ (Zinc @ 90 ppm & Boron @ 90 ppm) emerged as the most effective, resulting in the highest values for plant height, number of branches, number of flowers and fruits per cluster, fruit weight, and total yield per plant and per hectare. This treatment also improved fruit quality traits such as total soluble solids and vitamin C content, while reducing the days to first harvest, thereby promoting earliness. Therefore, it can be concluded that foliar application of zinc and boron in combination, particularly at 90 ppm each, is a viable strategy to enhance both productivity and fruit quality in cherry tomato under protected cultivation. Adoption of such micronutrient management practices can play a pivotal role in sustainable intensification and nutritional enhancement of tomato production systems.

References

1. Akanksha KA, Dhillon NS. Estimation of yield and quality traits of cherry tomato under the influence of micronutrients in protected condition. *Pharma Innov*. 2022;11(3):629-32.
2. Baby R, Saravanan S, Prasad VM, Baby S, Geethu BL. Effect of GA3 and NAA on plant growth and yield of cherry tomato (*Lycopersicon esculentum* var. *cerasiforme*) under polyhouse condition. *Pharma Innov J*. 2018;7(7):79-82.
3. Chatterjee S, Mukherjee D, Sharma S, Choudhuri P. Managing boron and zinc deficiency in vegetable crops. *Innov Farming*. 2018;3(2):72-6.
4. Collins EJ, Bowyer C, Tsouza A, Chopra M. Tomatoes: An extensive review of the associated health impacts of tomatoes and factors that can affect their cultivation. *Biology*. 2022;11(2):239.
5. Day S, Aasim M. Role of boron in growth and development of plant: Deficiency and toxicity perspective. In: *Plant Micronutrients: Deficiency and Toxicity Management*. 2020. p. 435-53.
6. Fageria NK, Baligar VC, Clark RB. Micronutrients in crop production. *Adv Agron*. 2002;77:185-268.
7. Gupta N, Yadav KK, Kumar V, Kumar S, Chadd RP, Kumar A. Trace elements in soil-vegetables interface: translocation, bioaccumulation, toxicity and amelioration – a review. *Sci Total Environ*. 2019;651:2927-42.
8. Hamzah S, Usman K, Rizwan M, Al Jabri H, Alsafran M. Functions and strategies for enhancing zinc availability in plants for sustainable agriculture. *Front Plant Sci*. 2022;13:1033092.
9. Islam MZ, Mele MA, Baek JP, Kang HM. Cherry tomato qualities affected by foliar spraying with boron and calcium. *Hortic Environ Biotechnol*. 2016;57:46-52.
10. Kaur A, Dhillon NS, Verma LK, Singh AS. Influence of foliar application of micronutrients on vegetative growth of cherry tomato in naturally ventilated polyhouse. *Plant Arch*. 2024;24(2).
11. Kusumiyati K, Ahmad F, Khan MR, Soleh MA, Sundari RS. Productivity of cherry tomato cultivars as influenced by watering capacities and microclimate control designs. *Open Agric J*. 2023;17(1).
12. Meena DC, Maji S, Meena JK, Kumawat R, Meena KR, Kumar S, Sodh K. Improvement of growth, yield and quality of tomato (*Solanum lycopersicum* L.) cv. Azad T-6 with foliar application of zinc and boron. *Int J Bio-Resour Stress Manag*. 2015;6(5).
13. Milagres CDC, Maia JTLS, Ventrella MC, Martinez HEP. Anatomical changes in cherry tomato plants caused by boron deficiency. *Braz J Bot*. 2019;42:319-28.
14. Nadeem F, Hanif MA, Majeed MI, Mushtaq Z. Role of macronutrients and micronutrients in the growth and development of plants and prevention of deleterious plant diseases – a comprehensive review. *Int J Chem Biochem Sci*. 2018;13:31-52.
15. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. 4th ed. New Delhi: Indian Council of Agricultural Research; 1985. p. 349.
16. Saha B, Saha S, Kumar J, Bairwa R. Nutritional enrichment of tomato (*Lycopersicon esculentum* L.) through zinc (Zn) and boron (B) fertilization. *J Plant Nutr*. 2023;46(9):2155-66.
17. Sandilya A, Prasad VM, Bahadur V, Singh D, Singh YK. Response of different level of zinc and boron on growth, flowering, yield and quality of cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) cv. 'Pusa Cherry-1'. *Int J Environ Clim Change*. 2023;13(10):1889-97.
18. Shnain RS, Prasad VM, Saravanan S. Effect of zinc and boron on growth of tomato (*Lycopersicon esculentum* MILL.) CV. Heem Sohna, under protected cultivation. *Allahabad Farmer*. 2017;73(1).
19. Singh B, Kasera S, Mishra SK, Roy S, Rana S, Singh D. Growth, yield and quality of cherry tomato (*Lycopersicon esculentum* var. *cerasiforme*) as influenced by foliar application of zinc and boron. *J Pharmacogn Phytochem*. 2017;6(6S):911-4.
20. Sturiao WP, Martinez HEP, Milagres CDC, Lopes IPDC, Clemente JM, Ventrella MC, Cecon PR. Boron lack affects the anatomy of leaf, stem and root of cherry tomato. *Braz J Bot*. 2020;43:247-55.
21. Sultana S, Naser HM, Akhter S, Begum RA. Effectiveness of soil and foliar applications of zinc and boron on the yield of tomato. *Bangladesh J Agric Res*. 2016;41(3):411-8.
22. Tanksley SD. The genetic, developmental, and molecular bases of fruit size and shape variation in tomato. *Plant Cell*. 2004;16(Suppl 1):S181-9.
23. Vera-Maldonado P, Aquea F, Reyes-Díaz M, Cárcamo-Fincheira P, Soto-Cerda B, Nunes-Nesi A, et al. Role of boron and its interaction with other elements in plants. *Front Plant Sci*. 2024;15:1332459.