



Effect of Foliar Application of Ca EDTA and Boron on Grapes (*Vitis vinifera* L.) cv. Thompson Seedless under Prayagraj Agro Climatic Condition

Vikas Moirangthem Cha ^{a++*}, Vijay Bahadur ^{a#}
and Samir E. Topno ^{bt}

^a Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj – 211007 (U.P.), India.

^b Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj – 211007 (U.P.), India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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⁺⁺ M.Sc. Research Scholar;

[#] Professor and Head;

[†] Assistant Professor;

*Corresponding author: E-mail: Vikas2001army@gmail.com;

ABSTRACT

Grapes (*Vitis Vinifera. L*) is one of the important commercial subtropical crops which is a good source of vitamins and minerals. It is grown throughout the world except the places with extreme temperature and high altitude. So, to find out Effect of foliar application of Ca EDTA and Boron on grapes for growth, yield and quality cv. Thompson Seedless under Prayagraj agro climatic condition; a field experiment was conducted at Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, technology and science, Prayagraj, U.P-211007 during the year 2024-2025. The experiment comprised of 9 different treatments of four different micro nutrients comprising of Ca EDTA@0.5g/L, Ca EDTA@1.0g/L, Boron@2g/L and Boron@4g/L respectively.

Keywords: Boron; Ca EDTA; grapes; Thompson Seedless.

1. INTRODUCTION

Grapes (*Vitis vinifera* L.) are an important and nutritious subtropical fruit grown all over the world, except in places with extreme temperatures or very high altitudes. They have been cultivated for thousands of years, dating back to around 6500 B.C., and their popularity grew especially because of wine production as civilizations spread through Asia and Europe (Wosteoves and Jimkamas, 2009). Grapes are mainly used to make wine, raisins, and are also enjoyed fresh. Besides that, they are used to produce juice, jam, seed oil, and other products. Globally, grapes make up about 16% of the total fruit production, with major producers including countries like Italy, France, Turkey, and India. In India, Maharashtra leads in grape-growing areas, while Tamil Nadu produces the most per hectare (Anonymous, 2018).

Botanically, grapes grow as woody climbing vines and produce small, juicy berries packed with important nutrients like calcium, phosphorus, and Vitamin A. Some popular varieties grown in India include Thompson Seedless and Flame Seedless, which are valued for both local consumption and export. Grapevines need essential micronutrients to stay healthy, and applying these nutrients directly onto the leaves helps plants absorb them better, supporting strong growth and good yields (Janaki *et al.*, 2004; Wassel *et al.*, 2007).

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted at the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, SHUATS Allahabad, (U.P.). The study was aimed to evaluate the effect of foliar application of Ca

EDTA and Boron for the growth, yield and quality.

The experimental field was first ploughed using a tractor-drawn disc plough. This was followed by two rounds of cross harrowing to break up the soil, and then planking to smooth the surface. Finally, the field was carefully leveled with a leveller before marking out the layout. To maintain a weed-free crop, 2–3 weeding operations were implemented and weeding was conducted at monthly intervals. Uniform moisture around the root zone was ensured by administering light irrigation at intervals of 3–6 days.

Fertilizer applications were adjusted based on soil fertility, climate, and season. In general, vermicompost, a nutrient-rich organic fertilizer that is produced through the process of vermicomposting. This process involves using earthworms to break down organic material, such as food scraps, yard waste, and manure, into a rich soil amendment that is high in beneficial microorganisms, enzymes, and nutrients.

Farmyard manure (FYM) is a well-rotted mixture made from cattle dung and urine, along with straw, bedding materials, and leftover fodder. When fully decomposed, FYM typically contains about 0.5% nitrogen, 0.2% phosphorus (as P_2O_5), and 0.5% potassium (as K_2O), according to the *Fundamentals of Soil Science*.

The soil medium was drenched with fungicides to prevent any root infections at 15 days interval for better result. The soil was drenched with insecticide cypermethrin to check the insect incidence and he plants were sprayed with fungicide mancozeb (3ml/lit) and chlorpyrifos 50% EC (3ml/lit) to prevent fungal diseases and to control insect pest incidence.

Treatment Details:

Table 1. Treatment details for Grapes (*Emblica officinalis*)

S. no.	Notation	Treatment
1.	T0	Control
2.	T1	Ca EDTA@0.5g/L
3.	T2	Ca EDTA@1.0g/L
4.	T3	Boron@2g/L
5.	T4	Boron@4g/L
6.	T5	Ca EDTA@0.5g/L+Boron@2g/L
7.	T6	Ca EDTA@0.5g/L+Boron@4g/L
8.	T7	Ca EDTA@1.0g/L+Boron@2g/L
9.	T8	Ca EDTA@1.0g/L+Boron@4g/L

3. RESULTS AND DISCUSSION

3.1 Effect of Growth Parameters

3.1.1 Number of shoots

The data on number of new shoots of grape plant is presented below in the table and graphically depicted in figures. The data on number of new shoots of grape plant showed that there were significant differences among the treatments.

There was a subsequent increase in the number of new shoots grape plant among different treatments, with an increase in months. After analysis, Data enumerated in table varied significantly for foliar application of Ca EDTA and Boron of grape plant in respect to number of new shoots of grape plant in the study. Significantly, the maximum number of new shoots of grapes plant was found in treatment T₈ i.e. 23.50 and followed by T₄ i.e. 21.98 whereas, minimum in treatment T₀ i.e. 16.43.

3.1.2 Number of new leaves per shoots

The data on number of new leaves in grape plant is presented below in the table and graphically depicted in figure. The data on number of new leaves per shoots in grape plant showed that there were significant differences among the treatments.

There was a subsequent increase in the number of new leaves per shoots in grape plant among different treatments, with an increase in months. After analysis, Data enumerated in table varied significantly for foliar application of Ca EDTA and Boron on grapes for the growth, yield and quality in respect to number of new leaves per plants of grape in the study. Significantly, the maximum number of new leaves per shoots in Grapes was found in treatment T₈ i.e. 44.50 and followed by

T₄ i.e. 41.61 whereas, minimum in treatment T₀ i.e. 31.10.

IBA can stimulate the growth and development of new roots and shoots, which can lead to the production of new leaves. Phloroglucinol can induce the formation of adventitious buds, which can potentially grow into new leaves. Seaweed extract contains a variety of plant growth regulators, including auxins, cytokinins, and gibberellins, as well as essential nutrients, such as nitrogen, phosphorus, potassium, iron, and magnesium, which can all contribute to the growth and development of new leaves in plants. Overall, the application of these supplements might have potentially enhanced the over all health and vigour of the plants, promoted the growth of new leaves and ultimately contributed to the overall growth and development of the plant. Similar result was reported by Singh *et al.* (2017) on his air layering studies on Verma and Sahu (2022) on her studies on air layering in acid lime.

3.1.3 Number of primary and secondary branches

The data on number of primary and secondary branches of grape plant is presented below in the table and graphically depicted in figures. The data on number primary and secondary branches of grape plant showed that there were significant differences among the treatments.

It is clearly evident from the table that there are significant differences among the treatments at 120 days after foliar application. Number of primary and secondary branches as influenced by different treatment combinations has been presented in table and graphically illustrated in Fig. The maximum Number of primary and secondary branches counted manually at 120

days was recorded as 33.21 with treatment T8 (Ca EDTA@1.0g/L+Boron@4g/L) and it was followed by 30.53 in T4 (Boran@4g/L). The minimum Number of primary branches of 20.78 are recorded under T0 (control).

The results showed that the highest number of primary branches (12.85) was recorded with the application of 0.6% borax combined with a foliar spray of urea (2%), zinc sulphate (0.4%), and potassium chloride (KCl) at 0.2%. This was

closely followed by the combination of urea (2%) and KCl (0.2%). The increase in the number of primary branches can be attributed to the presence of zinc, boron, and potassium, which play vital roles in plant growth processes such as food translocation and cell elongation. These findings are in line with the results of Singh *et al.* (2007), Ghosh *et al.* (2009), and Shah *et al.* (2021), who reported similar outcomes with foliar sprays of zinc sulphate, borax, and copper sulphate in aonla.

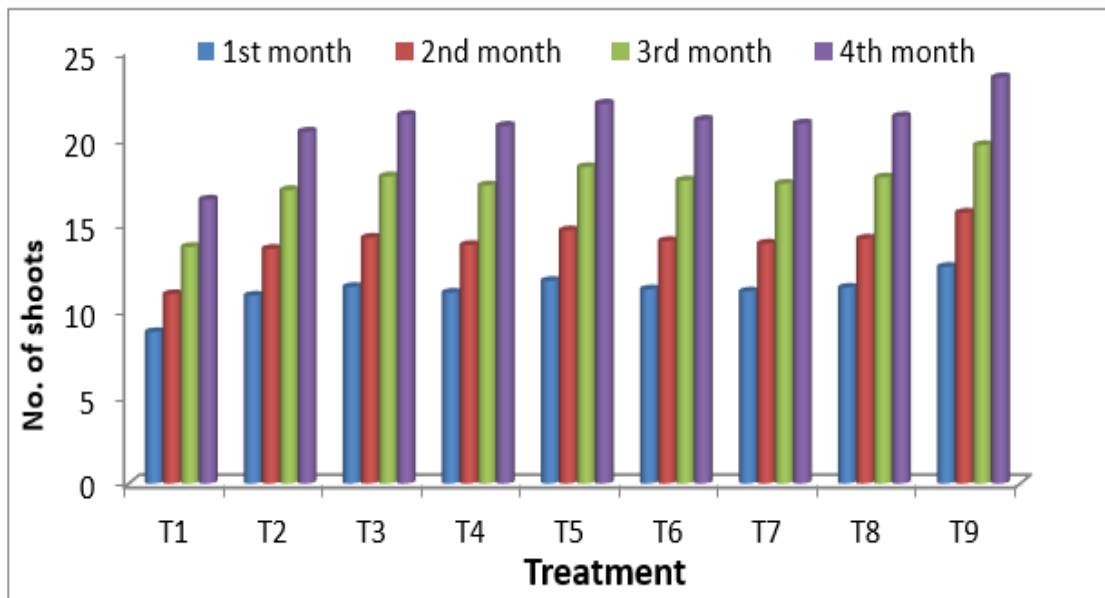


Fig 1a. Effect of foliar application of Ca EDTA and Boron on number of shoots of grapes

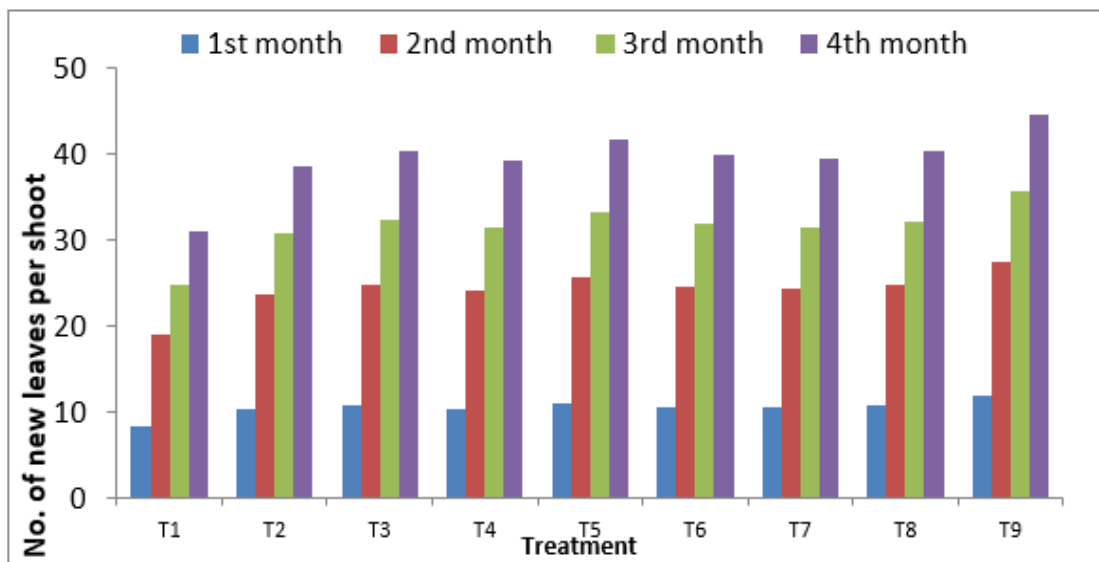


Fig. 1b. Effect of foliar application on number of new leaves per shoot of Grapes (*Vitis vinifera* L.)

The increase in the number of secondary branches observed with the application of zinc, urea, and borax could be due to better nutrient absorption, leading to more vigorous vegetative growth. Early stages of plant development are crucial, as they significantly influence plant metabolism and branching. Zinc sulphate and urea application have previously been reported to enhance branch production in aonla cv. NA-6 (Khan et al., 2009). Similarly, all nutrient treatments in the current study improved secondary branch development compared to the control. The highest number of secondary branches (13.18) was noted with the combined spray of urea (2%), zinc sulphate (0.4%), and borax (0.6%), which supports the findings of Dutta and Banik (2005); Kumar and Sharma (2004)

3.1.4 Fruit yield per plant

It is clearly evident from the table that there are significant differences among the treatments at 120 days after foliar application. Fruit yield/ Plant as influenced by different treatment combinations has been presented in Table. and graphically illustrated in Fig 3. According to their data. It is clear from the table that there are significant differences among the treatments at 120 days after foliar application. According to their data. The highest Fruit yield/ Plant was recorded as 13.19 with treatment T₈ (Ca EDTA@1.0g/L+Boron@4g/L) and it was followed by 12.34 in T₄(Boran@4g/L). The lowest Fruit yield/ Plant of 9.22 are recorded under T₀ (control).

Among the different micronutrient foliar treatments, the application of 0.6% borax (T₃) led to the highest total sugar content in the harvested fruits. This increase in sugar levels can be attributed to several factors, such as the breakdown of complex carbohydrates into simple sugars, dehydration, and the transformation of certain cell wall components like hemicellulose and pectin. A reduction in ascorbic acid content may also play a role. These results are consistent with earlier studies by Surinder Kumar and Chauhan (1990) in Mandarins and Haikerwal (2001) in Jaffa sweet oranges. However, Sudhakar Rao and Shivashankara (2015) noted that unwrapped mango fruits had a higher percentage of soluble solids and sugars compared to those treated with borax at 0.6%.

3.1.5 Fruit diameter

It is clearly evident from the table that there are significant differences among the treatment at 120 days after foliar application. Yield (kg/vine) as influenced by the different treatment combination and graphically illustrated in fig. among the treatment at 120 days after foliar application. According to the data. The maximum fruits Diameter measured by Vernier Calipers individually at 120 days was recorded as 36.93 with treatment T₈ (Borax 0.6%) and it was followed by 34.54 in T₄ (Boran@ 4g/L). The minimum Longitudinal Diameter of 25.82 are recorded under T₀ (control).

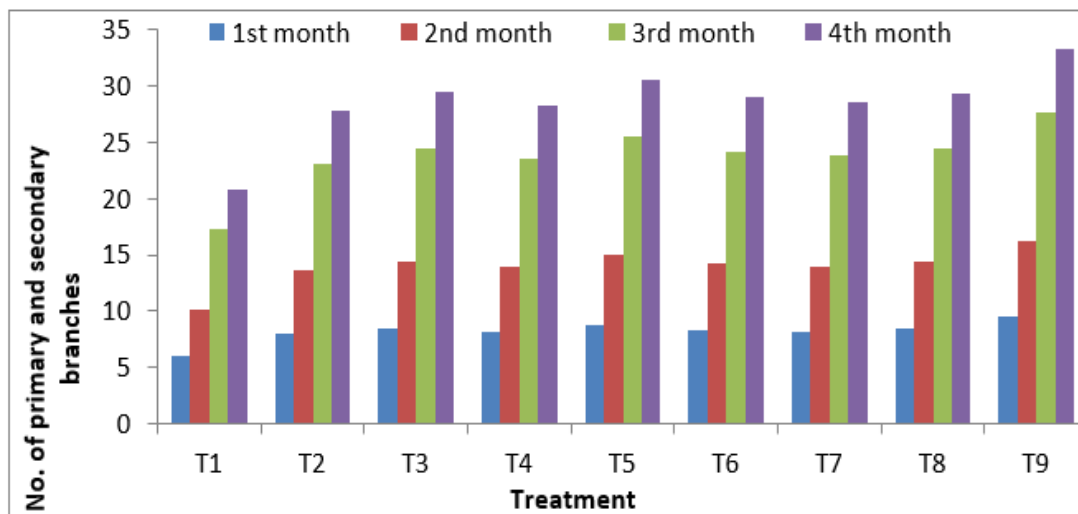


Fig. 2. Effect of Micro Nutrients on no. of primary and secondary branches of Grapes (*Vitis vinifera* L.)

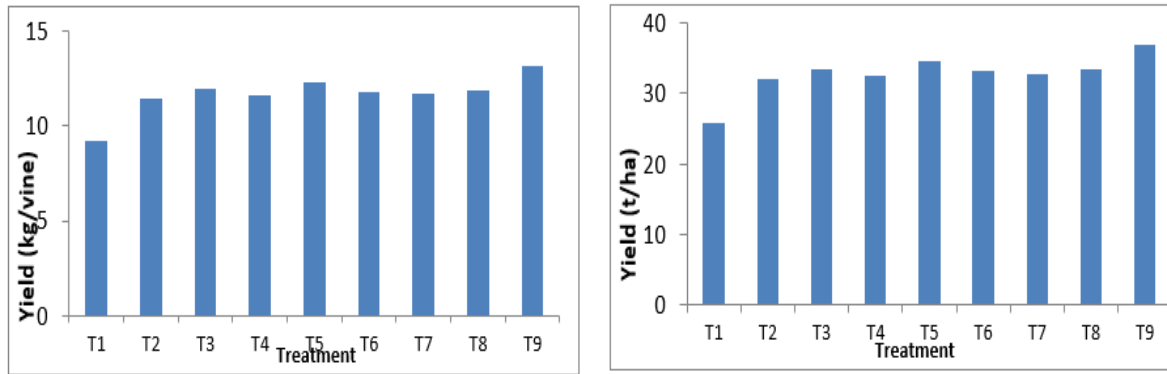


Fig. 3. Effect of foliar application of Ca EDTA and Boron on Yield (kg/vine) and Yield (t/ha) of Grapes (*Vitis vinifera* L.)

The increase in fruit size observed with the foliar application of zinc, urea, and potassium chloride (KCl) can be attributed to better nutrient absorption, which promotes more vigorous vegetative growth. Since early plant development plays a crucial role in influencing overall metabolism, it directly contributes to improved fruit development. Similar findings were reported by Khan *et al.* (2009), who observed an increase in fruit size in aonla cv. NA-6 with the application of zinc sulphate and urea.

largest fruits—measuring 3.18 cm in length and 3.71 cm in width—were recorded with the combined foliar spray of urea (2%), zinc sulphate (0.4%), and KCl (0.2%). These results are in close agreement with those reported by Dutta and Banik (2005); Kumar and Sharma (2004)

In the present study, all nutrient treatments improved fruit size compared to the control. The

3.1.6 Measuring of T.S.S (°Brix)

It is clearly evident from the table that there are significant differences among the treatments at 120 days after foliar application. TSS as influenced by different treatment combinations and graphically illustrated in Fig.

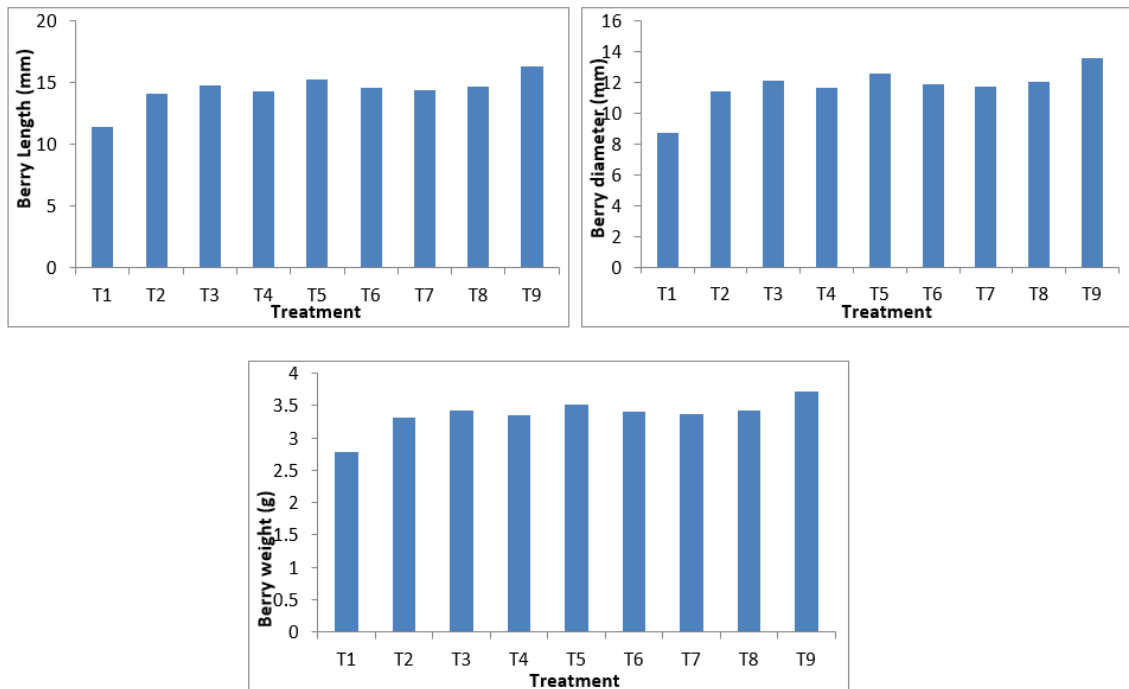


Fig. 4a. Effect of Ca EDTA and Boron on Berry weight (g), Berry diameter (mm) and Berry weight (g) of Grapes (*Vitis vinifera* L.)

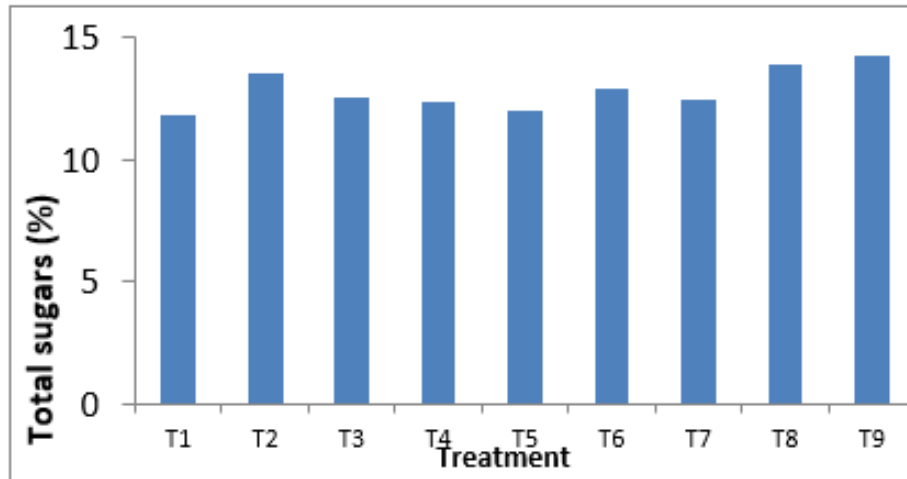


Fig. 4b. Total sugar content

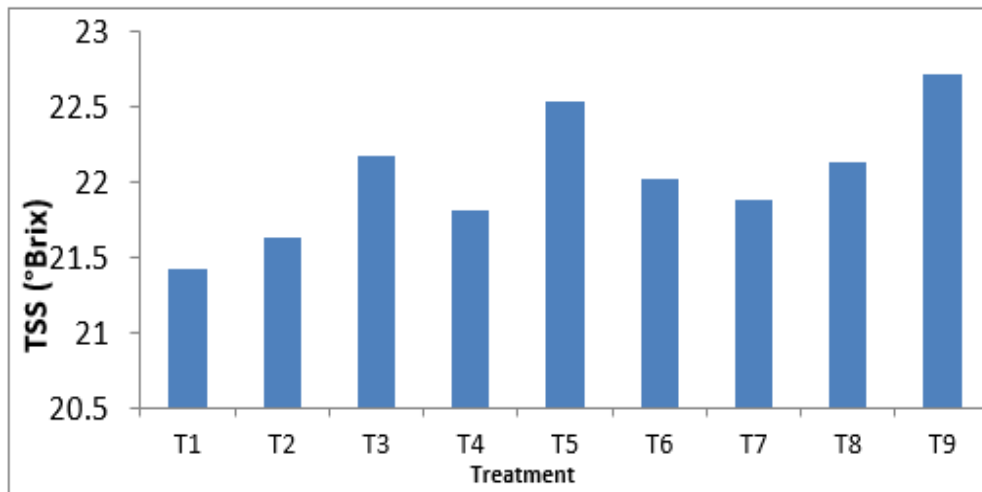


Fig. 5. Effect of Ca EDTA and Boron on TSS (°Brix), and Total sugars (%) of Grapes (*Vitis vinifera* L.)

Table 2. Cost of cultivation, gross return and benefit cost ratio of of Grapes (*Vitis vinifera* L.)

Treatments	Cost of cultivation (Rs/ha)	Total yield (t/ha)	Gross return (Rs/ha)	Net return Rs./ha)	Benefit cost ratio
T0	1,09,511	25.82	258200	148690	1.36
T1	1,09,511	32.02	320200	210690	2.92
T2	1,09,511	33.52	335200	225690	3.06
T3	1,09,511	32.53	325300	215790	2.97
T4	1,09,511	34.54	345400	235890	3.15
T5	1,09,511	33.08	330800	221290	3.02
T6	1,09,511	32.73	327300	217790	2.99
T7	1,09,511	33.40	334000	224490	3.05
T8	1,09,511	36.94	369400	259890	3.37

It is depicted from table that fruits of significantly higher TSS (22.72°Brix) were produced from the plants treated with treatment T8 (Ca EDTA@1.0g/L+Boron@4g/L) followed by

treatment T4 (Boran@2g/L) having TSS of (22.54°Brix). The minimum in T0 (control) with TSS(21.42°Brix).

However, the promoting effect was also observed by all micro-nutrients and their combinations except, copper sulphate borax 0.25, 0.6 percent. This is possibly due to combined synergetic effect of these micro-nutrients. Borax is believed to stimulate the function of numbers of enzymes and manganese is responsible for accumulation of carbohydrates from photosynthesis process where boron is believed to increase the translocation of food material in plant system. These results are in agreement with the finding of Bisht *et al.* (2012) in papaya. Likewise, the sprays of micro-nutrients in guava have also been reported to increase TSS of fruit (Ali et al., 2011).

It is clearly evident from the table that there are significant differences among the treatments at 120 days after foliar application. Total sugar content as influenced by different treatment combinations has been presented in Table. and graphically illustrated in Fig. It is clear from the table that there are significant differences among the treatments at 120 days after foliar application. According to the data. The maximum Total sugar content was recorded as 14.19 with treatment T₈ (Ca EDTA@1.0g/L+Boran4g/L) and it was followed by 13.86 in T₇ (Ca EDTA@1.0g/L+Boran@2g/L). The minimum Total sugar content of 11.80 are recorded under T0(control).

Among the various foliar applications of micronutrients, the treatment with 0.6% borax (T₃) resulted in the highest total sugar content in the harvested fruits. This increase in sugars can be linked to several physiological changes, such as the breakdown of complex carbohydrates (polysaccharides) into simple soluble sugars, moisture loss (dehydration), changes in cell wall components like hemicellulose and pectin, and a reduction in ascorbic acid levels. These findings are consistent with the results reported by Kumar and Chauhan (1990) in Mandarins and Haikerwal (2001) in Jaffa sweet oranges.

However, contrasting results were observed by Sudhakar Rao and Shivashankara (2015), who found that unwrapped mango fruits had a higher content of soluble solids and sugars compared to fruits treated with 0.6% borax.

Table 2 Effect of Ca EDTA and Boron on TSS (°Brix), and Total sugars (%) of Grapes (*Vitis vinifera* L.).

4. CONCLUSION

Based on the recent investigation it is concluded that foliar application of treatment T8, Ca EDTA@1.0g/L and Boron @4g/L resulted in better vegetative growth, yield and quality of grapes. Treatment T8 had the highest benefit cost ratio with 3.37.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTEREST

Authors have declared that they have no known competing financial interests OR non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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