**Original Research Article**

**Effect of foliar application of Ca EDTA and Boron on grapes**

**(*Vitis vinifera L.*) cv. Thompson Seedless under Prayagraj agro climatic condition**

**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 treatment 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: Ca EDTA, Boron, 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).

## 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 prepared by ploughing with a tractor-drawn disc plough, followed by two rounds of cross harrowing and subsequent planking. The field was then thoroughly leveled using a leveller before 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 decomposed mixture of cattle dung and urine with straw and litter used as bedding material and residues from the fodder fed to cattle. Well- decomposed FYM contains 0.5%N, 0.2%P2O5 and 0.5% K2O (Fundamental 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 chlorpyriphos 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](mailto:EDTA@0.5g/L) |
| 3. | T2 | Ca [EDTA@1.0g/L](mailto:EDTA@1.0g/L) |
| 4. | T3 | Boron@2g/L |
| 5. | T4 | Boron@4g/L |
| 6. | T5 | Ca [EDTA@0.5g/L+Boron@2g/L](mailto:EDTA@0.5g/L+Boron@2g/L) |
| 7. | T6 | Ca [EDTA@0.5g/L+Boron@4g/L](mailto:EDTA@0.5g/L+Boron@4g/L) |
| 8. | T7 | Ca [EDTA@1.0g/L+Boron@2g/L](mailto:EDTA@1.0g/L+Boron@2g/L) |
| 9. | T8 | Ca [EDTA@1.0g/L+Boron@4g/L](mailto:EDTA@1.0g/L+Boron@4g/L) |

1. **Results and Discussion**

**Effect of growth parameter.**

* + 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.

**FIG 1a. Effect of foliar application of Ca EDTA and Boron on no. of shoots of grapes.**

* + 1. **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 figures. The data on number of new leaves per shoots in grape plantst 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 Guava and **Bhumika *et al* (2022)** on her studies on air layering in acid lime.

**Fig 1b. Effect of foliar application on no. of new leaves per shoot of Grapes *(Vitis vinifera* L.)**

* + 1. **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).

These result supported, maximum number of branches (12.85) was observed with the borax 0.6% and combined spray of Urea (2%) + Zinc sulphate (0.4%) + KCl (0.2%) followed by Urea (2%) + KCl (0.2%). The present of Zinc, boron and potassium directly in growth through translocation of food, cell elongation might be responsible to increasing number of primary branches. These results are in close conformity with the spray of Zinc sulphate, Borax and CuSO4 in aonla **Singh et al., (2011), Ghosh et al., (2009), Yadav et al., (2018)**

The reason for increase in number of secondary branches with spraying of zinc, urea and borax. It could be attributed to effective absorption and consequently more luxuriant vegetative growth. In Plant metabolism is influenced by the initial stages of its growth. It was attributed to better branches development. Application of zinc sulphate and urea also increased the number of branches in aonla cv. NA-6 (Khan et al., 2009). And similarly result found in number of secondary branches was improved by all the nutrients over control. Maximum branches (13.18) were observed with combined spray of Urea (2%) + Zinc sulphate (0.4%) + borax (0.6%). The result is in closely conformity with the finding of **Kumar (2004), Dutta and Banik (2007).**

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

**iv) 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 l o w e s t Fruit yield/ Plant of 9.22 are recorded under T0 (control).

Among the various micronutrient foliar application of boron during treatments, fruits which plant treated with borax 0.6% (T3) exhibited the highest positive value for total sugars after harvesting. This peak in total sugars could be attributed to several factors, including the conversion of polysaccharides into soluble sugars, dehydration, transformation of certain cell wall materials such as hemicelluloses and pectins, and a decrease in ascorbic acid content. These outcomes align with the findings of **Kumar and Chauhan (1990) in mandarins and Haikerwal (2001)** in Jaffa sweet oranges. **Rao and Shivashankara (2015)** observed that unwrapped mango fruit registered the higher soluble solids and sugars percentage in contrast to plant fruit treated with borax 0.6%.

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

**v) 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 has been presented in table. 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).

The reason for increase in fruit size with spraying of zinc, urea and KCl It could be attributed to effective absorption and consequently more luxuriant vegetative growth In Plant metabolism is influenced by the initial stages of its growth It was attributed to better fruit development. Application of zinc sulphate and urea also increased the fruit size of aonla cv. NA-6 **(Khan et al., 2009).** And similarly result found in Fruit size was improved by all the nutrients over control. Maximum fruit length (3.18cm) and width (3.71cm) was observed with combined spray of Urea (2%) + Zinc sulphate (0.4%) + KCl (0.2%). The result is in closely conformity with the finding of **Kumar (2004), Dutta and Banik (2007).**

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

**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 has been presented in Table. and graphically illustrated in Fig.

It is depicted from table that fruits of significantly higher TSS (22.72Brix) 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 (22.54Brix). The minimum in T0 (control) with TSS (21.42Brix).

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 **Ghanta 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).**

**Fig 4b. Total sugar content**

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 micronutrient foliar application of boron during treatments, fruits which plant treated with borax 0.6% (T3) exhibited the highest positive value for total sugars after harvesting. This peak in total sugars could be attributed to several factors, including the conversion of polysaccharides into soluble sugars, dehydration, transformation of certain cell wall materials such as hemicelluloses and pectins, and a decrease in ascorbic acid content. These outcomes align with the findings of **Kumar and Chauhan (1990)** in **mandarins and Haikerwal (2001)** in Jaffa sweet oranges. **Rao and Shivashankara (2015)** observed that unwrapped mango fruit registered the higher soluble solids and sugars percentage in contrast to plant fruit treated with borax 0.6%. Table 2 Effect of Ca EDTA and Boron on TSS (°Brix), and Total sugars (%) of Grapes *(Vitis vinifera* L.)*.*

**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 |

**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 qulity of grapes.

Treatment T8 had the highest benefit cost ratio with 3.37.

COMPETING INTERESTS DISCLAIMER:

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.

**REFERENCE**

**Abu-Zahra, T. R. (2010).** Berry size of Thompson seedless as influenced by the application of gibberellic acid and cane girdling. *Pak. J. Bot*, **42**(3), 1755-1760.

**Bonomelli, Claudia & Ruiz, Rafael. (2010).** Effects of foliar and soil calcium applicaton on yield and quality of table grape Cv.'Thompson seedless'.*Journal of Plant Nutrition-PlantNutr.*33. 299-314.10.1080/01904160903470364.

**Christensen, L. P., R.H. Beede and W.L. Peacock (2006).** Fall foliar sprays prevent boron deficiency symptoms in grapes. California Agriculture, 60: 2. http: /calag.ucop. edu/0602AMJ/pdfs/9-FoliarSprays.pdf.

**Cocco A, Mercenaro L, Muscas E, Mura A, Nieddu G, Lentini A. (2021)** Multiple Effects of Nitrogen Fertilization on Grape Vegetative Growth, Berry Quality and Pest Development in Mediterranean Vineyards. Horticulturae. 2021; 7(12):530.

**Ghosh. S. N. Bera, B., Roy. S. Kundu, A. & Roy, S. D. (2009).** Effect of nutrients and plant growth regulators on fruit retention, yield and physico-chemical characteristics in aonla cv. NA-10. J. Horti. Sci. 4(2), 164-166.

**James, A., Mahinda, A., Mwamahonje, A., Rweyemamu, E. W., Mrema, E., Aloys, K., ... & Massawe, C. (2023).** A review on the influence of fertilizers application on grape yield and quality in the tropics. *Journal of Plant Nutrition*, *46*(12), 2936-2957.

**Janaki, D., V. Velu and P. Savithri (2004).** Influence of boron sprays on grape yield (Vitis vinifera) cv. Muscat in Thondamuthur block of Coimbatore district. Madaras Agric., 91: 261-265.

**Khalil, Aroosa & Nazir, Nowsheen & Din, Shaila & Sharma, M. & Kumar, Amit. (2021). Effect** of Fertilizer and Micronutrients on Leaf and Fruit Mineral Status of Grapes cv. Sahebi. 270.

**Khilari, J. &Ramteke, S. &Bhagwat, Sharad&Kalbhor, Jeevan &Shelake, T. &Bhange, M.. (2020).** Effect of Foliar Application of Micronutrient on Quality and Shelf Life in Table Grapes under Tropical Conditions of India. *International Journal of Current Microbiology and Applied Sciences.* 9. 532-542. 10.20546/ijcmas.2020.903.062.

**Khan, Ahmad Sattar & Ibrahim, Muhammad & Basra, Shahzad & Ali, Sajid & Almas, Munawar & Azam, Muhammad & Anwar, Raheel & Hasan, Mahmood. (2020).** Post-Bloom Applied Moringa Leaf Extract Improves Growth,Productivity and Quality of Early-Season Maturing Grapes (Vitis vinifera). *International Journal of Agriculture and Biology.* 24. 1217-1225. 10.17957/IJAB/15.1552.

**Kashyap,C., Bainade, S.P., Kumar, V. and Singh, A.(2022)** Foliar application of macro and micronutrient in field crops and their effect on growth, yield, quality and economics. *The Pharma Innovation Journal* 2022; SP-11(5): 970-976

**Meena, V. S., Nambi, V. E., Vishawakarma, R. K.,Gupta,R.K., &Nangare,D. D. (2012).** Effect of gibberellic acid on fruit quality and storability of grapes in semi-arid region of Punjab. *Agricultural Science Digest*, **32**(4).

**Patil, V. N., Chauhan, P. S., Shivankar, R. S., Vilhekar, S. H., & Waghmare, V. e-wruiopS. (2001).** Effect of plant growth regulators on survival and vegetative growth of grape vinecuttings. *Agric. Sci. Digest*, **21**(2), 97-99.

**Singh, J. K. Prasad, J. & Singh, H. K. (2007).** Effect of micronutrients and plant growth regulators on yield and physic-chemical characteristics of aonla fruits in cv. Narendra Aonla-10. Indian J. Hort., 64 (2), 216-218.