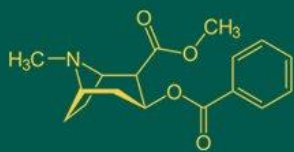


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Effect of foliar application of boron on fruit development, yield and quality of Aonla (*Emblica officinalis*) in Prayagyaj agro-climatic condition

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Abstract

The present investigation entitled “Effect of foliar application of boron on fruit development, yield and quality of Aonla (*Emblica officinalis*) in prayagyaj agro-climatic condition” was conducted at Central Research field, Department of horticulture, Naini agriculture college, SHUATS, Prayagraj (U.P.) during the academic year 2022-24. Micronutrient (Borax, Boron, Nano Boron) include T₀ (Control or Water), T₁ (Borax 0.2%), T₂ (Borax 0.4%), T₃ (Borax 0.6%), T₄ (Borax 0.8%), T₅ (Boric Acid 0.2%), T₆ (Boric Acid 0.4%), T₇ (Boric Acid 0.6%), T₈ (Boric Acid 0.8%) T₉ (Nano Boron 0.2%), T₁₀ (Nano Boron 0.4%), T₁₁ (Nano Boron 0.6%), T₁₂ (Nano Boron 0.8%). The Growth, quality and Yield Parameters of the fruits of each treatment was done up to 90 days and all the observations were recorded at every 30 days interval. The number of primary and secondary branches were recorded highest in the fruits treated borax 0.6% in T₃ during research work which were (10.66) and (13.72) respectively. Total soluble solids and total sugar contents had increasing trend during research period and found highest (11.03) and (6.18) in T₃ treatment respectively at 90 days while ascorbic acid and titratable acidity had decreasing trend and mean value was found highest (504.88) and (1.58) in T₃ treatment respectively. On the basis of the above, findings the present investigation, it is concluded that plants treated with (T₃ Borax @ 0.6%) significantly improved yield and quality parameters of the fruit, titratable acidity (1.58%) were also recorded in fruits produced from the plants treated with (T₃ Borax @ 0.6%). However, maximum TSS (11.03 °Brix) and total sugars (6.18%) contents were obtained from borax @ 0.6% having maximum ascorbic acid (504.88 mg/ 100 g) contents. Followed by the treatment (T₂ Borax @ 0.4%) and B: C Ratio (6.44).

Keywords: Aonla, borax, boron, nano boron fruit quality, yield

Introduction

Aonla (*Emblica officinalis* Gaertn.) belongs to family Euphorbiaceae and subfamily ‘Phyllanthoidae’. It is native of Tropical South-East Asia, particularly in central and southern India. It is being cultivated since long back and occupies an important place among indigenous fruits of India. Aonla being a hardy in nature and it is successfully cultivated in wide range of soil and climatic condition. Aonla is drought hardy fruit crop which is characterized by deep root system and exhibits deciduous nature due to abscission and shedding of determinate shoot during February and March. Crop production under arid environment faces several constraints such as scanty water resources, poor soil condition, extremes of temperature (high and low), desiccated wind, less precipitation rich leads to low productivity. The success of Aonla cultivation under arid ecosystem is largely based on efficient management of available natural resources.

The commercial cultivation of Aonla is in Uttar Pradesh, Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Jharkhand, Chhattisgarh, Andhra Pradesh, Karnataka, Haryana, Punjab, Himanchal Pradesh and Gujarat state of India. In India, it is estimated that Aonla is cultivated in about 0.91 lakh hectares with production of 9.81 lakh MT with an average productivity of 9.90 MT ha⁻¹ (NHB, 2017). In Gujarat, it is estimated that Aonla is cultivated in about 0.085 lakh hectares with production of 0.85 lakh MT and the main cultivated pockets are Kheda, Anand, Vadodara and Panchmahal districts of Gujarat NHB, 2017. Aonla tree is small to medium in size. It is evergreen in tropics and as deciduous in sub-tropical conditions.

Plant exhibits phyllanthoid branching habit producing short determinate and long indeterminate shoots. Flowers are greenish-yellow. Unisexual flowers are produced as axillary cymules on determinate shoots which are very minute with short pedicel. Male flowers appear first in cluster with six perianth, yellowish green to dark pink in colour with valvate aestivation. Female flowers are tiny with green perianth, ovary, hypogynous, carpels three in number, three chambered with axile placentation. The foliar application of macro and micro nutrients has immense important role in improving fruit set, productivity and quality of fruits. It has also beneficial role in recovery of nutritional and physiological disorder in fruit trees. Various experiments have been conducted earlier on soil application and foliar spray of micronutrient in different fruit crops and shown significant response with improvement of yield and quality of fruits. Micronutrient like Ferrous, Zinc, Boron, Copper and manganese play a vital role in plant for various physiological activity. Foliar application of micronutrient is more successful than soil application. Boron is an involved in transportation in carbohydrate in plant. It is also essential for cell division and cell development. Boron symptoms first appear at the growing tips. These result stunted appearance (resetting) barren ears due to poor pollination. Hollow stem and fruit hollow heart and brittle discolored leaves and loss of fruit and nut. Boron is important during blossoming stage in view of its role in reproductive organs (anthers, style, stigma and ovary), ovule development, pollen tube growth and fruit set.

Materials and Methods

The present investigation "Effect of foliar application of boron on fruit development, yield and quality of Aonla (*emblica officinalis*) in prayagyaj agro-climatic condition" was laid out on the experimental site of Department of Horticulture, Sam Higginbottom University of Agriculture Technology & Sciences, Naini, Prayagraj (UP), during 2023-2024. The experiment will be laid out in Randomized Block Design (RBD) with three replications. The treatments in each replication were allotted randomly. Thirteen treatments having one variety were tried in the experimental design. For research purpose, Micronutrient (Borax, Boron, Nano Boron) include T₀ (Control or Water), T₁ (Borax 0.2%), T₂ (Borax 0.4%), T₃ (Borax 0.6%), T₄ (Borax 0.8%), T₅ (Boric Acid 0.2%), T₆ (Boric Acid 0.4%), T₇ (Boric Acid 0.6%), T₈ (Boric Acid 0.8%) T₉ (Nano Boron 0.2%), T₁₀ (Nano Boron 0.4%), T₁₁ (Nano Boron 0.6%), T₁₂ (Nano Boron 0.8%). For 3 months, It's include 3 application 1st application - 2nd week of July. 2nd application - 2nd week of August. 3rd application - 2nd week of September.

Result and Discussion

Number of Primary Branches: The maximum Number of primary branches counted manually at 90 days was recorded as 10.66 with treatment T₃ (Borax 0.6%) and it was followed by 10.58 in T₂ (Borax 0.4%). The minimum Number of primary branches of 10.38 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.

Number of secondary Branches: The maximum Number of secondary branches counted manually at 90 days was recorded as 13.72 with treatment T₃ (Borax 0.6%) and it was followed by 13.68 in T₂ (Borax 0.4%). The minimum Number of secondary branches of 13.49 are recorded under T₀ (control). 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.

Fruit Weight: The maximum Fruit Weight measured on top pan balance individually at 90 days was recorded as 32.56 with treatment T₃ (Borax 0.6%) and it was followed by 31.30 in T₂ (Borax 0.4%). The minimum Fruit Weight of 21.35 are recorded under T₀ (control). These result supported, maximum fruit weight (32.85) 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 material might be responsible to improve fruits weight. These results are in close conformity with the spray of Zinc sulphate, Borax and CuSO₄ in Aonla Ghosh *et al.*, (2009) [14]. Foliar application of boron compounds such as borax, boric acid, and nano boron affects the fruit weight of Aonla fruit differently. Borax at a concentration of 0.6% has shown the most favorable results in increasing fruit weight.

Radial Diameter (cm): The maximum Radial Diameter measured by Vernier Calipers individually at 90 days was recorded as 3.78 with treatment T₃ (Borax 0.6%) and it was followed by 3.65 in T₂ (Borax 0.4%). The minimum Radial Diameter of 3.15 are recorded under T₀ (control). These results are in close conformity with the findings of in Aonla have reported an appreciable increase in fruit size (length and diameter) with the spray of zinc sulphate 0.3% along with borax 0.6% in guava cv. LUCKNOW-49. During Studies on physical properties of Aonla, Radial diameter of the three grades of Aonla were compared and significant differences among them as revealed by multi range Duncan test at 5% level of probability, observed by.

Polar Diameter (cm): The maximum polar Diameter measured by Vernier Calipers individually at 90 days was recorded as 3.15 with treatment T₃ (Borax 0.6%) and it was followed by 3.05 in T₂ (Borax 0.4%). The polar Longitudinal Diameter of 2.57 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 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.

Fruit set (%): The maximum Fruit set was recorded as 78.59 with treatment T₃ (Borax 0.6%) and it was followed by 75.67 in T₂ (Borax 0.4%). The minimum Fruit set of 67.82 are recorded under T₀ (control).

Conducted an experiment on effect of foliar application of micronutrient on quality attribute of Aonla cv .NA-7 at Kanpur during the year 2012. They found that the foliar application of 0.1 % ZnSO₄ + 0.6 % borax was most effective treatment and it was recorded significantly maximum fruit set percent (51.71 %).

These results are in close conformity with the findings of in Aonla have reported an appreciable increase in fruit set percentage with the spray of zinc sulphate 0.3% along with borax 0.6 % in guava cv. LUCKNOW-49. During Studies on physical properties of Aonla.

Number of Flower: The maximum Number of flowers was recorded as 554.10 with treatment T₃ (Borax 0.6%) and it was followed by 489.60 in T₂ (Borax 0.4%). The minimum Number of flowers of 257.23 are recorded under T₀ (control) carried out an experiment on effect of micronutrient foliar feeding on growth and yield of Aonla cv. NA-7 at Jhalawar during the year 2018. They observed that the significantly maximum flower (409.58), have reported an appreciable increase in number of flowers with the spray of zinc 0.3% along with borax 0.6 % in Aonla cv.NA-7. During Studies on physical properties of Aonla.

Fruit Yield per plant (kg/plant): The highest Fruit yield/Plant was recorded as 180.65 with treatment T₃ (Borax 0.6%) and it was followed by 176.85 in T₂ (Borax 0.4%). The lowest Fruit yield/ Plant of 93.18 are recorded under T₀ (control).

However, the promoting effect was observed by most of the micro-nutrient spray over control. It might be due to combination of manganese with copper and boron which is believed to function in chlorophyll formation, caused rapid vegetative growth by which plant growth was promoted rapidly which increased fruiting height and depth of fruit setting. Many review reports have indicated that significant effect of micro- nutrients on initial fruit set, fruit retention, and fruit drop.

T.S.S (oBrix): The higher TSS (11.030Brix) were produced from the plants treated with treatment T₃ (Borax 0.6%) followed by treatment T₂ (Borax 0.4%) having TSS of (10.980Brix). The minimum in T₀ (control) with TSS (10.030Brix).

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 agree with the finding of in papaya. Likewise, the sprays of micro-nutrients in guava have also been reported to increase TSS of fruit.

Ascorbic Acid (mg/g): The maximum Ascorbic acid was recorded as 504.88 with treatment T₃ (Borax 0.6%) and it was followed by 493.03 in T₂ (Borax 0.4%). The minimum Ascorbic acid of 467.48 are recorded under T₀ (control)

conducted an experiments on effect of micronutrients on yield and quality of guava cv. L-49. They observed that the foliar application of 0.4 % borax + 0.4 % FeSO₄ treatment recorded ascorbic acid (210.86 mg/100 g) and minimum acidity (0.20%) as compared to another treatment.

Titration Acidity (%): The maximum Titration Acidity was recorded as 1.58 with treatment T₃ (Borax 0.6%) and it was followed by 1.50 in T₂ (Borax 0.4%). The minimum Titration Acidity of 1.21 are recorded under T₀ (control).

These findings align with previous studies such as in Aonla, in foliar application of borax 0.6% and urea ,other micronutrients in pomegranate fruit. The foliar application of micronutrients borax 0.25, 0.6, 0.50 percentage ,zinc and KCL After 90 days of foliar application and after harvesting maximum fruit acidity was recorded, whereas minimum was in untreated fruits.

Total sugar content (%): The maximum Total sugar content was recorded as 6.18 with treatment T₃ (Borax 0.6%) and it was followed by 5.93 in T₂ (Borax 0.4%). The minimum Total sugar content of 3.78 are recorded under T₀ (control).

Among the various micronutrient foliar application of boron during treatments, fruits which plant treated with boroax 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.

Conclusion

On the basis of the above, findings the present investigation, it is concluded that plants sprayed with Borax @ 0.6% (T₃) significantly improved yield and quality parameters of the fruit, titratable acidity (1.58%) were also recorded in fruits produced from the plants treated with (T₃ Borax @ 0.6%). However, maximum TSS (11.03 °Brix) and total sugars (6.18%) contents were obtained from borax @ 0.6% having maximum ascorbic (504.88 mg/ 100 g) contents. Followed by the treatment (T₂ Borax @0.4%) and B: C Ratio (6.44).

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