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# Effect of zinc and boron on physical parameters of fruit, seed and quality of Jamun (*Syzygium cumini* Skeels)

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**Abstract**
The present investigation was aimed to study the effect of foliar application of zinc and boron on the physical parameters (fruit, seed) and quality of jamun (*Syzygium cumini* Skeels.) cv. Chintamani, at Regional Horticultural Research and Extension Centre, University of Horticultural Sciences Campus, Bengaluru during 2017-18 to improve the physical parameters and enhancing the fruit quality through foliar application of micronutrients in Jamun. The study revealed that the foliar spray of micronutrient combination of zinc and boron showed significant difference in fruit weight, fruit length, seed weight, reducing sugars, non reducing sugars and total sugars. Foliar spray of micronutrient combination of 0.50% $ZnSO_4$ + 0.20% Boran ($T_9$) had increased fruit weight (12.88 g), fruit length (25.88 mm), seed weight (2.55 g) and reducing sugar (6.54%). Maximum non reducing sugar (1.72%) and total sugars (8.16%) was obtained in $T_5$ treatment (micronutrient application of 0.20% Boron) compared to other treatment combinations.

**Keywords:** Jamun, zinc, boron, quality

## Introduction

Jamun (*Syzygium cumini* Skeels.) is an under exploited indigenous fruit tree of India. It is a hardy crop and can tolerate drought as well as heavy rainfall conditions. It is widely grown in larger parts of India from Indo-gangetic plains in the north to Tamil Nadu in the south (Singh and Srivastava, 2000) [12]. It produces purple, delicious fruits with prominent seeds. Because of its medicinal value and suitability for planting as wind break, its demand is increasing day by day and that will require selected plants of superior quality and high yield potential. Jamun plant parts exhibit many pharmacological properties, contains wonderful anti hyperglycemic properties, but it has also proven to possess antioxidant, antibacterial, antigen toxic, anti-inflammatory and anti-HIV properties (Sagrawat *et al.*, 2006) [11]. The seeds are claimed to contain alkaloid, jambosine, and glycoside jambolin or antimellin (Swamy *et al.*, 2012) [15]. Flowering and fruiting seasons seen in March- April and bearing of fruits takes place from May to July. Inflorescences arise from the leaf axils of branchlets. Flowers exhibit bisexual nature and light yellow in colour. Some jamun varieties put forth the same to second season in October. Jamun is a cross pollinated tree. It is observed that fruit drop in jamun starts just after fruit set and continues up to maturity. Only 15-30% fruits reach maturity.

The micronutrients like boron and zinc play a vital role in fruit growth and development and their application is found effective to improve physical parameters of fruits, seeds and enhance the quality of jamun. Keeping this in mind the present study was conducted to evaluate the response of foliar application of micronutrients on physical parameter and quality of jamun.

## Materials and Methods

The experiment was carried out during 2017-18 at Regional Horticulture Research and Extension Centre, University of Horticultural Sciences, GKVK campus, Bengaluru, Karnataka-560 065. Seven year old uniform plants of jamun were used which are spaced at 6 m x 6 m (277 plants/ha). The layout of experimental design was Randomized Complete Block Design (RCBD) with 9 treatments and 3 replications *i.e.*, $T_1$: Control, $T_2$: 0.25% $ZnSO_4$, $T_3$: 0.50% $ZnSO_4$, $T_4$: 0.10% Boron, $T_5$: 0.20% Boron $T_6$: 0.25% $ZnSO_4$+ 0.10% Boron, $T_7$: 0.25% $ZnSO_4$ + 0.20% Boron, $T_8$:0.50% $ZnSO_4$ + 0.10% Boron and $T_9$: 0.50% $ZnSO_4$ + 0.20% Boron.

The each treatment was imposed at the time of emergence of new flush, flowering and fruit set stages. The micronutrients (zinc and boron) at required concentration was dissolved in the water and sprayed to jamun plants. The observations recorded are seed weight, seed length, seed diameter, pulp to seed ratio, TSS, reducing sugar, non reducing sugar, total sugars, titratable acidity, anthocyanin content and ascorbic acid.

The fruit length was measured from tip to the bottom of the fruit by using digital vernier caliper and average taken was recorded in millimeter. The weight of fruit was recorded by using electronic balance and average of 10 fruits weight recorded and expressed in grams. The fruit breadth was measured using digital vernier caliper at the point where the breadth was maximum and expressed in millimeter. The volume of fruits was recorded by using water displacement method and average of 10 fruits volume was recorded and expressed in milliliter. The Seed weight was recorded by electronic balance and average of 10 seed weight was recorded and was expressed in gram. The seed length was measured from tip to the bottom of seed by using digital vernier caliper and average was expressed in millimeter. The seed breadth was measured by using vernier caliper at a point where the breadth was larger and average was expressed in millimeter.

The content of total soluble solids (TSS) was determined with the help of digital hand refractometer (Atago®; pocket refractometer) and expressed as degree brix (°Brix). Care was taken to wash the prism of the refractometer with distilled water followed by wiping with dry tissue before recording every reading. The total sugars present in the jamun fruit samples were estimated, following the method described by Ranganna (1986) [10] and expressed in percentage. The reducing sugars present in jamun samples were estimated as suggested by Lane and Eynon described by Ranganna (1977) [9] with some modifications. The content of non- reducing sugars was calculated by subtracting reducing sugars from total sugars (Ranganna, 1986) [10].

For anthocyanine estimation, Ten gram of jamun pulp was taken and crushed using little quantity of ethanolic HCl and transferred to 100 ml volumetric flask and volume made up to 100 ml and stored overnight in refrigerator at 4°C, later filtered through Whatman No.1 filter paper and optical density (O.D.) of the filtrate was recorded at 535nm using spectrophotometer (Make: SYSTRONICS, Model: UV/VIS Spectrophotometer 117). Whereas for anthocyanin extract, 0.5ml extract was made up to 100 ml using distilled water and optical density (O.D.) of the filtrate was recorded at 535nm using spectrophotometer. The ethanolic HCl solution was prepared by mixing 95 per cent ethanol and 1.5N HCl in the ratio of 85:15. The ascorbic acid content of jamun fruit was determined by 2, 6-dichlorophenol indophenols visual titration method described by Ranganna (1986) [10].

The total titratable acidity of samples were determined by visual titration method (Ranganna, 1986) [10] where Ten gram of the sample was taken and blended with distilled water and it was filtered and volume was made to 50ml. An aliquot of 10ml was taken from this filtrate and titrated with 0.1N NaOH using phenolphthalein as indicator. The appearance of light pink colour was marked as the end point. Acidity was computed and expressed as percent citric acid.

## Results and Discussion

### Physical parameters of fruit

The data on fruit physical parameters such as fruit weight, fruit length, fruit diameter and volume showed significant variations due to treatment of zinc and boron and are presented in table 1.

The results on fruit weight revealed that the highest fruit weight (12.88 g) and fruit length (25.88 mm) was recorded (Table 1) in $T_9$ (0.50% $ZnSO_4$ + 0.20% Boron). The increase in physical attributes might be due to the combined effect of zinc and boron, where in boron as a constituent of cell membrane is essential for cell division and elongation and zinc being an essential trace element for plants is involved in many enzymatic reactions and is necessary for good growth and development. These findings are in agreement with the observations of Babu and Singh (2001) who reported that increased fruit size and weight might be due to increased rate of cell division and cell enlargement leading to accumulation of more metabolites in the fruit in litchi. The similar conformational statements were also being given by Ghosh *et al.* (2009) [6] who have also reported that foliar spray of zinc sulphate increased the fruit weight of aonla, while Singh *et al.* (2012) [13] found similar effect with combined application of boron, zinc and copper in aonla fruit *cv*. Banarasi. Further, similar findings were reported in guava (Goswami *et al*., 2012) [7] and mango (Banic *et al*., 1997) [4] where translocation of food material from source to sink under the influence of micronutrients like boron and zinc increased the size of the fruit.

The fruit diameter and fruit volume in jamun were not affected by foliar application of zinc and boron at various concentrations (Table 1). Whereas, higher fruit diameter (17.41 mm) and fruit volume (10.31 ml) is observed in $T_9$ (0.50% $ZnSO_4$ + 0.20% Boron) compared to control.

The data on physical parameters of seed *viz*., seed weight, seed length and diameter, and pulp to seed ratio were found to be differed due to treatments. The results on seed weight revealed (Table 2) that the highest seed weight (2.81 g) was recorded in $T_7$ (0.25% $ZnSO_4$ + 0.20% Boron). The increase in seed weight might be due to acceleration in biochemical activities and accumulation of metabolites in plant parts including fruits, which is probably due to synergistic effect of zinc on conversion and translocation of total sugars and minerals during the process of fruit development and fruit maturation (Chandra and Singh, 2015) [5]. Further, role of boron in cell division and cell elongation leading to higher fruit weight in well-established plants and similar observations were reported by Singh *et al.* (1993) in aonla.

The physical parameters of seed *viz*., seed length and seed diameter (Table 2) was not altered by the foliar application of zinc and boron at different concentration in jamun. Higher seed length (16.9 mm) and seed diameter (4.87 mm) were recorded in $T_5$(0.20% Boron) compare to control.

The results on pulp: seed ratio was not altered by foliar application of zinc and boron at different concentration in jamun (Table 2). However maximum pulp: seed ratio (4.88) was recorded in $T_9$ (0.50% $ZnSO_4$+ 0.20% Boron) compare to control (4.13).

### Biochemical parameters of Seed

The biochemical parameters of seed such as TSS, RS, NRS and total sugars, titratable acidity, anothocyanin and ascorbic acid contents showed significant variations due to treatments as seen in tables 3 and 4.

The foliar application of zinc and boron spray did not have any influence on total soluble solids content and titrable acidity of jamun fruits (Table 3). The application of micronutrient (zinc and boron) did not affect TSS (°B) and titratable acidity (%) in jamun. This indicates that different treatments of micronutrient had no significant influence on TSS (°B) and titratable acidity (%) of jamun fruits. Similar results were reported by Arshad *et al.* (2016) [2] in guava and Ghosh *et al.* (2009) [6] and Abhijith *et al*. (2018) [1] in aonla.

The reducing sugar content was significantly influenced by foliar spray of zinc and boron (Table 3). The highest content of reducing sugars (6.54%) was recorded in $T_9$ (0.50% $ZnSO_4$ + 0.20% Boron). Increase in reducing sugars have direct link with beneficial effect of micronutrients on conversion of polysaccharides to simple sugars. The results are substantiated by the opinion of Kumar and Shukla (2005) [8] in ber *cv*. Gola, who reported direct and indirect effects of micronutrients on quality of fruits. On the other hand, the highest non reducing sugar (1.73%) was recorded in ($T_4$) with application of Boron 0.10% (Table 3). The dual effect of these micronutrients on per cent non reducing sugars was mainly attributed to increased translocation of polysaccharides in mature fruits. These results are in close conformity with the findings of Singh *et al*. (2012) [13] in aonla *cv*. Banarasi.

The non-reducing sugar content in fruits of jamun was significantly influenced by foliar application of zinc and boron (Table 3). Among different treatments, the highest content of non-reducing sugars (1.73%) was recorded in $T_4$ (Borax 0.10%).

The maximum amount of total sugar content (8.16%) was recorded in $T_7$ (0.25% $ZnSO_4$ + 0.20% Boron) and $T_5$ (0.20% Boron) (Table 3). The increase in total sugars of fruit was may be due to significant action of micronutrients on translocation of carbohydrates and photosynthates. The similar conformational statements were also being given by Singh *et al.* (2002) [14] in guava *cv*. Allahabad safeda and Singh *et al.* (2012) [13] in aonla *cv*. Banarasi, who reported that increase in sugars fraction by the foliar feeding of zinc and boron might be due to their involvement in photosynthesis of metabolites and rapid translocation of sugars from other part of the plants to developing fruits.

The anthocyanin content in fruits of jamun was also not affected by foliar spray of zinc and boron at different concentrations (Table 4). The application of micronutrient (zinc and boron) did not influence the ascorbic acid content in jamun (Table 4). But, when compared with the control fruits, micronutrient (zinc and boron) sprayed trees showed significantly higher anthocyanin content. These results are in close conformity with the findings of Waskela *et al.* (2013) [16].

## Conclusions

The study involving the foliar application of boron and zink had showed significant improvements in physiological growth and quality parameters of jamoon. The foliar spray of micronutrient combination of 0.50% $ZnSO_4$ + 0.20% Boran had increased fruit weight (12.88 g), fruit length (25.88 mm), seed weight (2.55 g) and reducing sugar (6.54%). Whereas the maximum non reducing sugar (1.72%) and total sugars (8.16%) was obtained in treatment, micronutrient application of 0.20% Boron.

**Table 1:** Effect of zinc and boron on physical parameters of jamunfruits

| Treatment | Fruit weight (g) | Fruit length (mm) | Fruit diameter (mm) | Fruit volume (ml) |
|---|---|---|---|---|
| $T_1$: Control | 10.29 | 19.55 | 14.18 | 6.74 |
| $T_2$: 0.25% $ZnSO_4$ | 9.92 | 21.30 | 14.87 | 7.87 |
| $T_3$: 0.50% $ZnSO_4$ | 10.18 | 22.17 | 14.98 | 8.84 |
| $T_4$: 0.10% Boron | 10.38 | 21.56 | 14.81 | 9.48 |
| $T_5$: 0.20% Boron | 10.54 | 23.02 | 14.80 | 10.15 |
| $T_6$: 0.25% $ZnSO_4$+ 0.10% Boron | 11.32 | 23.55 | 14.58 | 8.19 |
| $T_7$: 0.25% $ZnSO_4$ + 0.20% Boron | 11.53 | 24.61 | 15.74 | 10.31 |
| $T_8$: 0.50% $ZnSO_4$ + 0.10% Boron | 12.30 | 23.03 | 17.14 | 9.02 |
| $T_9$: 0.50% $ZnSO_4$ + 0.20% Boron | 12.88 | 25.88 | 17.41 | 10.31 |
| S. Em± | 0.49 | 0.94 | 1.14 | 0.80 |
| CD @ 5% | 1.48 | 2.81 | NS | NS |

**Table 2:** Effect of zinc and boron on physical parameters of seeds in jamun

| Treatment | Seed weight (g) | Seed length (mm) | Seed diameter (mm) | Pulp to seed ratio |
|---|---|---|---|---|
| $T_1$: Control | 1.68 | 16.31 | 4.83 | 4.13 |
| $T_2$: 0.25% $ZnSO_4$ | 1.96 | 16.09 | 4.57 | 4.26 |
| $T_3$: 0.50% $ZnSO_4$ | 1.97 | 15.80 | 4.56 | 4.75 |
| $T_4$: 0.10% Boron | 2.01 | 15.70 | 4.67 | 4.30 |
| $T_5$: 0.20% Boron | 2.05 | 16.91 | 4.87 | 4.87 |
| $T_6$: 0.25% $ZnSO_4$+ 0.10% Boron | 2.16 | 16.70 | 4.80 | 4.62 |
| $T_7$: 0.25% $ZnSO_4$ + 0.20% Boron | 2.81 | 16.64 | 4.47 | 4.56 |
| $T_8$: 0.50% $ZnSO_4$ + 0.10% Boron | 2.34 | 16.40 | 4.43 | 4.37 |
| $T_9$: 0.50% $ZnSO_4$ + 0.20% Boron | 2.55 | 16.29 | 4.41 | 4.88 |
| S. Em± | 0.09 | 1.47 | 0.66 | 0.29 |
| CD @ 5% | 0.28 | NS | NS | NS |

**Table 3:** Effect of zinc and boron on chemical quality parameters of fruit in jamun

| Treatment | TSS (°B) | Reducing sugar (%) | Non reducing sugar (%) | Total sugar (%) |
|---|---|---|---|---|
| $T_1$: Control | 12.66 | 6.33 | 1.70 | 8.03 |
| $T_2$: 0.25% $ZnSO_4$ | 12.75 | 6.43 | 1.65 | 8.07 |
| $T_3$: 0.50% $ZnSO_4$ | 12.76 | 6.45 | 1.62 | 8.06 |
| $T_4$: 0.10% Boron | 12.76 | 6.43 | 1.73 | 8.14 |
| $T_5$: 0.20% Boron | 12.81 | 6.44 | 1.72 | 8.16 |
| $T_6$: 0.25% $ZnSO_4$+ 0.10% Boron | 12.64 | 6.44 | 1.64 | 8.08 |
| $T_7$: 0.25% $ZnSO_4$ + 0.20% Boron | 12.74 | 6.48 | 1.68 | 8.16 |
| $T_8$: 0.50% $ZnSO_4$ + 0.10% Boron | 12.59 | 6.48 | 1.64 | 8.12 |
| $T_9$: 0.50% $ZnSO_4$ + 0.20% Boron | 12.81 | 6.54 | 1.61 | 8.14 |
| S. Em± | 0.06 | 0.02 | 0.01 | 0.01 |
| CD @ 5% | NS | 0.06 | 0.03 | 0.03 |

**Table 4:** Effect of zinc and boron on chemical quality parameters of fruit in jamun

| Treatment | Titratable acidity (%) | Anthocyanin (mg/100g) | Ascorbic acid (mg/100g) |
|---|---|---|---|
| $T_1$: Control | 2.06 | 200.93 | 24.20 |
| $T_2$: 0.25% $ZnSO_4$ | 1.91 | 204.32 | 23.57 |
| $T_3$: 0.50% $ZnSO_4$ | 1.78 | 201.13 | 23.43 |
| $T_4$: 0.10% Boron | 1.90 | 203.33 | 23.93 |
| $T_5$: 0.20% Boron | 1.89 | 204.37 | 23.27 |
| $T_6$: 0.25% $ZnSO_4$+ 0.10% Boron | 1.86 | 201.75 | 23.73 |
| $T_7$: 0.25% $ZnSO_4$ + 0.20% Boron | 1.90 | 202.14 | 24.20 |
| $T_8$: 0.50% $ZnSO_4$ + 0.10% Boron | 1.92 | 204.38 | 24.20 |
| $T_9$: 0.50% $ZnSO_4$ + 0.20% Boron | 1.91 | 203.34 | 24.40 |
| S. Em± | 0.16 | 1.36 | 2.20 |
| CD @ 5% | NS | NS | NS |

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