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Response of boron application on fruit cracking, yield and quality of pomegranate

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ABSTRACT

A field study was carried out to determine the effect of boron sprays on fruit cracking in pomegranates. Different treatments were taken i.e. T1: Single spray of borax (0.3%) in Ist week of May, T2: Two sprays of borax (0.3%) – Ist week of May and first week of June, T3: Three sprays of borax (0.3%) (3rd week of April, Ist week of May and last week of May), T4: Four sprays of borax (0.3%) (3rd week of April, Ist week of May and last week of May and 2nd week of June) and T5: Control (water spray) with four replications under randomized block design. The results of the study revealed a significant increase in yield, TSS, and a decrease in acidity and fruit cracking of pomegranate. However, four sprays of borax (0.3%) during (the 3rd week of April, Ist week of May, and last week of May and 2nd week of June) proved to be the best treatment in reducing the fruit cracking in pomegranate by 73.9% over control. Thus, it can be concluded that the effect of boron on pomegranate not only reduces fruit cracking but improves yield and TSS. The challenges faced during the research work was extreme variations in day and night temperatures.

Keywords: *Pomegranate, Borax, Fruit Cracking, Yield, TSS.*

Introduction

Pomegranate (*Punica granatum* L.) is a member of the monogeneric Punicaceae family and it's origin is Iran. Pomegranate is derived from the Latin name of the fruit, *Malum granatum*, which means "grainy apple." The plant is drought resilient, cold hardy, and thrives well in wet circumstances. Pomegranate is a shrub with a bushy look that naturally has many trunks. The majority of pomegranate types are deciduous. It is a rich source of protein, carbohydrates, minerals, antioxidants, and several vitamins (A, B and C). Its juice is rich in antioxidants like soluble polyphenols, tannins, and anthocyanin content, and also it has anti-atherosclerotic capabilities (Michel *et al*., 2005). It is one of the oldest known edible fruits and can grow in a variety of agro-climatic settings ranging from tropical to subtropical regions (Levin., 2006 Jalikop., 2007). Flowering occurs about one month following bud break on freshly formed branches of the same year, typically on spurs or short branches. Flowers can appear alone in pairs or clusters. The solitary flowers appear on spurs along the branches in most cases, whereas the clusters are terminal. Flowering happens in the northern hemisphere mostly between February-March. However, fruit cracking in pomegranate is a general problem throughout its growing areas, especially in arid regions and it is as high as up to 65% (Prasad *et al.*, 2003). The main reason for fruit cracking of pomegranate in arid regions is due to higher evapotranspiration rate, lower humidity, imbalance of water, and fluctuation of temperature in day and night during the growth and development of pomegranate (Abd and Rahman, 2010). The fruit cracking is more evident especially when the fruits are at the maturity stage. Boron is a micronutrient that is required in the fertilization process because of its role in reproductive organs (anthers, style, and ovary), pollen germination, and expansion of the pollen tube during the blossoming stage. Boron is essential for cell division in the meristematic tissues of growth points and cambial activity. Boron is also beneficial for flowering, fruit setting, and seed development. It is also essential for nitrogen metabolism and hormone transport activity. Apart from this, fruit biochemical parameters viz. TSS, sugar, and acid content are also enhanced by the application of boron in pomegranate fruits. An increase in TSS content with these B may be attributed to an improved source-sink relationship. Keeping this in view, this experiment has been planned to study the "Response of boron application on fruit cracking, yield and quality of pomegranate" to improve the fruit cracking, yield, and quality of pomegranate.

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Materials and Methods

The present investigation was conducted at the Experimental orchard of the Department of Horticulture, CCS Haryana Agricultural University, Hisar during the year 2018-21 and the pooled data was taken. Four cultivars (Ganesh, Mridula, Bhagwa, and Kandhari) were selected as experimental materials to examine the effect of boron sprays on fruit cracking in pomegranates. The experiment comprised of total 5 treatments i.e. T_1: Single spray of borax (0.3%) in Ist week of May, T_2: Two sprays of borax (0.3%) – in Ist week of May and the first week of June, T_3: Three sprays of borax (0.3%) (3rd week of April, Ist week of May and last week of May), T_4: Four sprays of borax

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(0.3%) (3rd week of April, Ist week of May and last week of May and 2nd week of June) and T_5: Control (water spray) with three replications under randomized block design. The treated fruits were analyzed for Fruit cracking (%), Yield (kg/plant), Juice content (%), TSS (ºBrix), and Acidity (%).

Fruit cracking (%): The total number of fruits as well as cracked fruits were counted from the tagged branches of each quarter of the plant. The fruit cracking was observed visually from distal to the proximal end or in a circular pattern at the top of pomegranate fruits or ringing at the stem end. The percent of cracked fruit was calculated as:

$$\text{Fruit cracking (\%)} = \frac{\text{Number of cracked fruits}}{\text{Total no. of harvested fruits}} \times 100$$

Yield (kg/plant) : To calculate total fruit yield, the total number of fruits per tree was multiplied by average fruit weight, and the value was expressed in kilograms (kg/tree).

Juice content (%): The juice from the arils of fruits was extracted by squeezing the arils in muslin cloth. The percentage of juice was calculated concerning the weight of fruit for each treatment using the below formula.

$$\text{Juice content (\%)} = \frac{\text{Total juice weight (g)}}{\text{Total weight of fruit (g)}} \times 100$$

TSS (ºBrix) : The total soluble solids (TSS) was measured by hand refractometer.

Acidity (%) : Acidity was estimated by using the method given in A.O.A.C. (1990).
The method is as follows :

Reagents prepared
The following reagents were prepared for further use:
1. Sodium hydroxide 0.1 N
2. Phenolphthalein indicator 1 per cent

Procedure
Five grams of fruit pulp was mashed in a pestle mortar using a small amount of distilled water. Two ml of filtrate was pipetted out into a beaker and titrated against N/10 sodium hydroxide using phenolphthalein as an indicator. The appearance of a light pink color at least for 15 seconds was the endpoint of the titration. Acidity was expressed in terms of percent citric acid equivalent after applying the following formula:

$$\text{Acidity (\%)} = \frac{\text{Titrate value x Normality of NaOH x Equivalent weight of citric acid}}{\text{The volume of juice taken (ml) x 1000}} \times 100$$

Table 1. Effect of foliar spray of borax on fruit cracking (%) of different cultivars of pomegranate

Sr. No.	Treatments (T)	Ganesh	Mridula	Bhagwa	Kandhari	Mean
1.	Single Spray of borax (0.3%) 1st week of May.	25.6	28.3	27.0	26.3	26.8
2.	Two sprays of borax (0.3%) – 1st week of May and first week of June	14.0	17.6	18.3	16.6	16.6
3.	Three sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May)	12.6	16.3	13.0	12.3	13.5
4.	Four sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May and 2nd week of June)	12.3	11.6	9.6	10.0	10.9
5.	Control (water spray)	41.0	41.3	42.6	43.0	41.9
	Mean	21.3	23.6	22.1	21.6	
	CD (p=0.05)	Variety (V)		Treatment (T)		V x T
		N.S		2.2		N.S

Table 2. Effect of foliar spray of borax on yield (kg/tree) of different cultivars of pomegranate

Sr. No.	Treatments(T)	Ganesh	Mridula	Bhagwa	Kandhari	Mean
1.	Single Spray of borax (0.3%) 1st week of May.	22.3	22.6	27.6	15.0	21.8
2.	Two sprays of borax (0.3%) – 1st week of May and first week of June	27.6	25.0	28.6	19.3	25.1
3.	Three sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May)	26.3	23.6	30.0	17.0	24.2
4.	Four sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May and 2nd week of June)	27.3	27.0	32.0	18.3	26.1
5.	Control (water spray)	20.3	20.6	22.6	13.3	19.2
	Mean	24.7	23.7	28.1	16.5	
	CD (p=0.05)	Variety (V)		Treatment (T)		V x T
		2.9		NS		N.S

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Table 3. Effect of foliar spray of borax on juice (%) of different cultivars of pomegranate

Sr. No.	Treatments(T)	Ganesh	Mridula	Bhagwa	Kandhari	Mean
1.	Single Spray of borax (0.3%) 1st week of May.	39.4	40.5	40.7	40.0	40.1
2.	Two sprays of borax (0.3%) – 1st week of May and first week of June	39.5	41.9	42.7	41.6	41.4
3.	Three sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May)	40.6	42.2	43.4	42.7	42.2
4.	Four sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May and 2nd week of June)	39.2	42.3	44.5	44.4	42.6
5.	Control (water spray)	35.7	38	40	39.8	38.3
	Mean	38.8	40.9	42.2	41.7	
	CD (p=0.05)	Variety (V)		Treatment (T)		V x T
		NS		NS		NS

Table 4. Effect of foliar spray of borax on TSS (0Brix) of different cultivars of pomegranate

Sr. No.	Treatments(T)	Ganesh	Mridula	Bhagwa	Kandhari	Mean
1.	Single Spray of borax (0.3%) 1st week of May.	12.6	11.9	11.5	12.2	12.0
2.	Two sprays of borax (0.3%) – 1st week of May and first week of June	13.2	12.8	12.3	13.3	12.9
3.	Three sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May)	13.7	12.8	13.5	13.8	13.4
4.	Four sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May and 2nd week of June)	14.3	13.2	14.8	14.1	14.1
5.	Control (water spray)	12.5	10.2	10.6	12.2	11.3
	Mean	13.2	12.1	12.5	13.1	
	CD (p=0.05)	Variety (V)		Treatment (T)		V x T
		NS		NS		NS

Table 5. Effect of foliar spray of borax on Acidity (%) of different cultivars of pomegranate

Sr. No.	Treatments (T)	Ganesh	Mridula	Bhagwa	Kandhari	Mean
1.	Single Spray of borax (0.3%) 1st week of May.	1.13	1.12	1.14	1.14	1.13
2.	Two sprays of borax (0.3%) – 1st week of May and first week of June	1.11	1.12	1.13	1.13	1.12
3.	Three sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May)	1.1	1.11	1.09	1.13	1.10
4.	Four sprays of borax (0.3%) (3rd week of April, 1st week of May and last week of May and 2nd week of June)	1.11	1.08	1.1	1.1	1.09
5.	Control (water spray)	1.13	1.14	1.13	1.13	1.13
	Mean	1.11	1.11	1.11	1.12	
	CD (p=0.05)	Variety (V)		Treatment (T)		V x T
		0.02		NS		NS

Results and Discussion

Borax spray was found effective in reducing fruit cracking significantly among all the cultivars (Table 1). The minimum fruit cracking (10.9%) was recorded in the plants sprayed borax four times i.e. T_4 which is significantly lower than all other treatments and the maximum (41.9%) in the control. Among the cultivars, minimum fruit cracking (21.3%) was observed in Ganesh followed by Kandhari. Due to significant interaction, minimum fruit cracking (9.6%) was observed in the cultivar Bhagwa sprayed borax four times (T_4). Maximum fruit yield (26.1 kg /plant) was recorded in the plants sprayed borax four times i.e. T_4 and minimum (19.2 kg/plant) in the control (Table 2). Among the cultivars, the maximum fruit yield (28.1 kg/plant) was found in Bhagwa followed by Ganesh. The foliar application of borax has no significant effect on the juice content of all cultivars (Table 3). The minimum acidity (1.11 %) in cultivars Ganesh, Mridula, and Bhagwa (Tables 4 and 5). The increase in fruit yield with the foliar application of borax may be attributed to an increased number of fruits, fruit weight, and a decrease the fruit cracking. It may be due to the improved physico-chemical quality of fruits. The reduction in fruit cracking may be attributed to the physiological role of borax in the synthesis of pectic substances in the cell wall, which strengthened the tissues and prevented fruit cracking. Similar findings were reported by Sharma *et al.* (2020), Korkmaz N *et al.* (2015;2016), Khurshid *et al.* (2019), and Sheikh and Manjula (2012).

Conclusion

Plant nutrients like borax play an important role in growth, fruit retention, and development and cause efficient yield

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improvement. Results revealed that four sprays of borax (0.3%) during (the 3rd week of April, the fir st week of May, and last week of May, and 2nd week of June) reduced fruit cracking in pomegranate by 73.9% over control. So, there is a need to disseminate the improved technologies of pomegranate among the farmers with effective extension methods like front-line demonstration and others, etc.

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