



Effect of Boric Acid on Fruit Set, Yield and Fruit Quality of Apple Cv. Royal Delicious

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ABSTRACT

The Krishi Vigyan Kendra, Shimla conducted on farm trial on apple during 2018 and 2019 at five locations Karalash, Bharethly, Gawana, Samala and Annu with the objective to determine the effect of boric acid on fruit set, yield and quality of apple cultivar Royal Delicious. There were five treatments with four replications for each treatment and three trees per replication. The treatments were T1- foliar application of boric acid (0.1%) at pink bud stage, T2- foliar application of boric acid (0.1%) in June (farmer's practice), T3- foliar application of boric acid (0.1%) in May and repeated in June, T4- foliar application boric acid (0.1%) at pink bud and repeated in May and T5- Control (water foliar application). The maximum fruit set, fruit weight, yield, TSS, total and reducing sugars was recorded in tree sprayed with treatment T4 (boric acid (0.1 %) at pink bud stage and repeated in May). The per cent increase in yield over farmer's practice and control was 22.30 and 27.78 per cent, respectively.

Key Words: Apple, Boric acid, fruit set, Quality, Royal Delicious.

INTRODUCTION

Apple is the most important temperate fruit grown worldwide and has emerged as the major remunerative fruit crop of Himachal Pradesh. In Himachal Pradesh, it is commercially grown in high hills of Shimla, Kullu, Kinnaur, Sirmour, Lahaul Spiti and Mandi districts in an area of 1, 12,630 ha with annual production of 4, 46,570 MT (Anon, 2018). There are different cultivars grown in Shimla district, among them Royal Delicious is an important late season cultivar which is cultivated mostly in high hills of the district. In Royal Delicious cultivar, there is a problem of poor fruit set. In many cases, apple tree produced abundant of flowers but fail to set fruits mainly under adverse climatic conditions due to lack of pollination. Inadequate fruit set often associated with low pollen production, failure of transfer and germination of pollen, poor pollen tube development or fertility of the ovule. For enhancing fruit set, boron can play a very important role as it help in the pollen germination and elongation

of pollen tube growth in deciduous fruits (Roy *et al*, 2006). Apple trees are particularly sensitive to low soil moisture, but unfortunately most of the apple production in the district is under rain-fed conditions. The most critical periods of water requirement in apple are April- August and peak water requirement is after fruit set. Dry spell during the critical periods of water requirement can result in poor fruit set, heavy fruit drop, small sized fruits, low production and poor fruit quality which are associated with the unavailability of nutrients during this period especially unavailability of boron. Boron is essential for carbohydrate metabolism and its deficiency causes cracking and internal and external cork development in the fruit which can decrease market value of the produce. Keeping in view the role of boron on physiological attributes, the present investigation was undertaken on Royal Delicious apple with the objective of studying the effect of boric acid on fruit set, yield and fruit quality of apple.

MATERIALS AND METHODS

The on farm trial was conducted at five locations viz. Karalash, Bharethly, Gawana, Samala and Annu in the district Shimla during 2018 and 2019 on 15 yr old Royal Delicious trees on seedling rootstock planted at 5x5 m apart. The experimental location is situated at 31° 12'9.68 North latitude and 77° 45'17.42 East longitude at an elevation of 1554 meters above mean sea level (MSL). The experiment was laid on randomized block design (RBD) with four replications for each treatment and three trees per replication. The treatments were T1- foliar application of boric acid (0.1%) at pink bud stage, T2- foliar application of boric acid (0.1%) in June (farmer's practice), T3- foliar application of boric acid (0.1%) in May and repeated in June, T4- foliar application boric acid (0.1%) at pink bud and repeated in May and T5- Control (water foliar application). The different physical and quality parameters of the apple were recorded as follows:

Fruit set was recorded three weeks after petal fall and per cent fruit set was calculated by formula (Fruit set (%) = Number of fruit set/ Number of flowers cluster × 100) given by Westwood (1993). For obtaining fruit length, the lengths of selected fruit were recorded between calyx and styler end and mean values was worked out and expressed in mm. The breadth of the fruits was measured with the help of Vernier caliper, from the longest dimension perpendicular to the length. Average values were calculated and expressed in mm. The weight of total fruits harvested per tree was recorded for each treatment and the result was expressed as yield per tree. For measuring fruit weight, ten randomly selected fruits from each replication were weighed on a top pan balance and the average fruit weight was calculated and expressed in grams (g).

Total soluble solids were calculated by using a hand refractometer. For determining titratable acidity in fruit juice, twenty five gram of fruit flesh was taken in a warring blender, homogenized in distilled water and the volume was made up to 250 ml. The contents were filtered through Whatman No. I filter paper. Twenty five ml of extract

was titrated against 0.1 N NaOH solution using phenolphthalein as an indicator. The appearance of pink colour indicated the end point. The total titratable acidity was calculated on the basis of 1 ml of 0.1 N NaOH equivalent to 0.0067 gram of anhydrous malic acid. The results were expressed as percentage of titratable acids on fresh fruit weight basis. Total sugars and reducing sugars were determined according to AOAC (1980). The data recorded for different parameters of both the years was pooled and average mean is presented in the Table (1 & 2).

RESULTS AND DISCUSSION

The data (Table 1) revealed that there was a significant variation among the treatments for fruit set, fruit size and yield per tree. The highest fruit set (33.64%) was recorded in tree sprayed with treatment T4 (boric acid @ 0.1 % at pink bud stage and repeated in May) which was closely followed by the trees sprayed with treatment T1 (boric acid @ 0.1 % at pink bud stage). These treatments were significantly at par with each other for the trait fruit set. The increase in fruit set was attributed to the fact that application of boron helps in the pollen germination and elongation of pollen tube growth in deciduous fruits (Roy *et al*, 2006). The data recorded under study are in agreement with the study of Wojcik *et al*, (2008) who reported increased fruit set with the pre bloom or after harvest foliar application of boron.

The trees sprayed with boric acid @ 0.1 % at pink bud stage and repeated spray in May attained maximum fruit length (74.0 mm), breadth (83.0 mm) and weight (183.0g). The important role of boron in enhancing cell division, cell enlargement building and transporting the organic foods could explain their effects in improving physical fruit quality parameter of apple (Wojcik, *et al*, 1999). The highest fruit yield (46.78 kg/tree) was recorded in trees sprayed with two spray of boric acid (0.1%) first at pink bud stage and second spray in the month of May. Results obtained under study were in line

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Table 1. Effect of different treatments of boric acid on physical characteristics of apple.

Treatment	Fruit set (%)	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (g)	Fruit Yield (kg/tree)
T1	33.60	70.53	79.40	174.00	40.83
T2	26.77	67.33	77.00	169.00	38.25
T3	27.06	68.67	78.00	172.00	39.17
T4	33.64	74.00	83.00	183.00	46.78
T5	26.39	61.33	71.33	160.17	36.61
CD _{0.05}	5.05	3.19	3.57	06.18	5.07

with the findings of Asgharzade *et al* (2012) and Wojcik *et al* (2008) who reported that pre bloom or after harvest foliar application of boron resulted in increased fruit set and yield apple.

Foliar application of boric acid has significant effect on total soluble solids, titratable acidity and sugars of apple. The maximum total soluble solids (14.67 °B), titratable acidity (0.26 %), total sugars (11.17 %) and reducing sugars (6.57 %) was recorded under treatment T4 (spray of boric acid @ 0.1 % at pink bud stage and repeated in May). The minimum total soluble solids (12.59 °B), titratable acidity (0.19 %), total sugars (10.17 %) and reducing sugars (6.19 %) were recorded under treatment T5 (control). This study is in line with the study of Ganai *et al* (2018) who reported that foliar application of boric acid at 0.15 per cent resulted in maximum TSS. Higher TSS tempted by boric acid treatment might be due to lesser utilization of sugars in metabolic processes

as a result of reduced respiration. The reduced rate of respiration could also cause accumulation of organic acids which have oxidized at slower rate. Increase in sugar content and acidity may be attributed to translocation of sugars (Davenport and Peryea, 1990) and transportation of higher amount of assimilates into fruit tissues (Wojcik *et al*, 2008) which is enhanced with boron application.

CONCLUSION

Boron plays an important role in improving fruit set, yield and quality of apple cultivar Royal Delicious. Our results revealed that spraying apple trees with boric acid @ 0.1 % had a positive effect on fruit set, yield and fruit quality. However, it could be concluded that the promising treatment is spraying boric acid @ 0.1% at pink bud stage and repeated in the month of May since it gave the highest values concerning fruit set, yield, and quality parameters of apple.

Table 2. Effect of different treatments of boric on fruit quality of apple .

Treatment	TSS (°B)	Titratable acidity (%)	Total sugars (%)	Reducing sugars (%)
T1	14.50	0.21	10.89	6.41
T2	12.83	0.23	10.33	6.22
T3	13.67	0.25	10.50	6.39
T4	14.67	0.26	11.17	6.57
T5	12.59	0.19	10.17	6.19
CD _{0.05}	0.57	0.04	0.49	0.11

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