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Effect of boron, plant growth regulators and jeevamrit on fruits drop and cracking of bael (*Aegle marmelos* L.) CV. NB-9

Ranjeet Kumar and Sanjay Pathak

Abstract
An experiment was carried out to study the "Effect of boron, plant growth regulators and Jeevamrit on fruits drop and cracking of bael (*Aegle marmelos* L.) cv. NB-9 under sodic soil conditions in the year 2019-20 and 2020-21. The experiment was conducted in simple Randomized Block Design having twelve treatments *viz* T_1 (Control), T_2 (Boric Acid 0.6%),T_3 (NAA 25ppm), T_4 (GA_3 30ppm), T_5 (BA 250 ppm), T_6 (CPPU 100 ppm), T_7 (Jeevamrit 20%), T_8 (Boric Acid 0.6% + NAA 25ppm), T_9 (Boric Acid 0.6% + GA_3 30ppm), T_{10} (Boric Acid 0.6% + BA 250 ppm), T_{11} (Boric Acid 0.6% + CPPU 100 ppm), T_{12} (Boric Acid 0.6% + Jeevamrit 20%)
Results reveal that all the treatments were found superior over control in aspect like fruit drop, fruit retention and fruit cracking. The minimum fruit drop and maximum fruit retention was found with the treatment of T_8 (Boric Acid 0.6% + NAA 25ppm) followed by T_3 (NAA 25 ppm) and T_{11} (Boric Acid 0.6% + CPPU 100 ppm) in both the year of investigation. The minimum fruit cracking was found with the treatment of T_{11} (Boric Acid 0.6% + CPPU 100 ppm) followed by T_{12} (Boric acid 0.6% + Jeevaamrit 20%) and T_{10} (Boric acid 0.6% BA 250 ppm) during both years.

Keywords: Jeevamrit, boric acid, *Aegle marmelos* L, CPPU, NAA

Introduction
The bael (*Aegle marmelos* L.) is an important indigenous fruit of India, which belongs to the family Rutaceae. Bael fruit is highly nutritive with the richest source of riboflavin. Marmelosin ($C_{13}H_{12}O_3$) a resinous substance is most probably the therapeutically active principle of Bael fruits**.** The leaves, bark, roots, fruits, and seeds are used extensively in the Indian traditional system of medicine- Ayurveda and in various folk medicines to treat the myriad ailment. Unripe or half-ripe fruit is regarded as astringent, digestive and stomachic. It is beneficial in cases of diarrhoea and dysentery. Fruits when just begun to ripe are best for medicinal uses. Bael fruits are of dietary use and the fruit is used to prepare delicacies like murrabba, candy, pudding and ripe fruit juice (Sarbat). Its products are sweet, aromatic, and have a cooling effect.
There are no organized orchards of bael in our country; hence exact data on area and production are not available. However, in recent years, many efforts have been made the collection of the superior genotype of bael from all over the country. In Uttar Pradesh bael cultivation in most of the growing districts is in scattered form, now the cultivation of this fruit is being popular day by day. It is being cultivated in limited areas in the Gonda, Basti, Deoria, Mirzapur, and Etawah districts of Uttar Pradesh.
Fruit drop and cracking is the most prevailing problem in the North-India which results in a drastic reduction in the production. It has been observed that maximum fruit drop and cracking during February to May with the sudden rise in temperatures and imbalance of indigenous hormonal level during spring and summer. The intense competition among fruits, roots and new shoots reduces photo synthate buildup, resulting in fruit loss.
CPPU (Sitofex) is a plant growth regulator with a high cytokinin action that promotes fruit setting and reduces fruit drop. The CPPU helps to reinforce the cell wall in the abscission zone by boosting cell division and stimulating protein, RNA, and DNA production.
Benzyl Adenine is highly active cytokinin-like plant growth regulator that promotes chlorophyll biosynthesis, and cell division, which resists the formation of an abscission layer between the peduncle and the fruit.

Naphthalene acetic acid plays an important role in the reduction of flower drop, high flower retention and unripe fruits enlarge fruit size and also increase the yield and quality of many fruits. Gibberellins play an important role in cell elongation, stem elongation, and delay in fruit ripening and senescence along with enhanced quality characteristics in many fruit crops.

Boron helps in preventing fruit cracking by stimulating enzymatic action in the peripheral tissue and synthesis of the cell wall. It also helps to minimize the physical failure of fruit skin in the form of fractures in the cuticle or skin and it also prevents fruit cracking and fruit splitting which are major pre-harvest physio-pathies in many fruit plants.

Jeevamrit is a rich bio-formulation that contains consortia of the beneficial microbes, it is important to provide a congenial environment to the microorganism which helps in making essential nutrients available for the plant growth viz. nitrogen, phosphorus, and potassium. Therefore, it is used for drenching organic waste for faster decomposition, and seed/seedling treatment against the soil-borne disease. It also improves the population of beneficial soil microbes as well as soil fertility which helps in fruit growth and development.

Material and Methods

The present investigation Effect of boron, plant growth regulators and jeevamrit on fruits drop and cracking of bael (*Aegle marmelos* L.) cv. NB-9 under sodic soil condition. Was under taken at Main Experimental Station, Horticulture, A.N.D.U.A.&T., Kumarganj Ayodhya, Uttar Pradesh, India during the year 2019-20 and 2020-2021. Geographically, this area situated in typical saline alkali belt of Indo- gangetic plains of eastern U.P. at 26.47 N latitude, 88.12°E longitudes and at an altitude of 113 meter from mean sea level. The region enjoys sub-humid and subtropical climate receiving a mean annual rainfall of about 1215 mm out of which about 85% is concentrated from mid-June to end of September with an average annual rainfall of 764.01mm and relative humidity of 66.76 per cent.

The winter months prevails from November to March with mild to severe cool temperature ranging from 17.9 to 33.1 ℃. The severe cold temperature 17.9 ℃ was recorded in the month of January and occasionally winter rains and frost was also noticed. The summer months occur from April to June with an average temperature of 39.2 to 41.4 ℃. The dry and hot wind waves were also noticed in the months of mid May and June.

Fourteen years old tree of varietal block of NB-9 was taken up as experimental material. Which are planted at the distance of 8×8m in Square system manure fertilizer and other orchard management practices were followed as per recommended package and Practices for Bael. The NB-9 is a selection of chance seedling from eastern district of U.P. fruits of NB-9 has very smooth skin surface, medium sized and oblong in shape, a smaller number of seeds, fibreless, thin skull, good aroma and flavour and average yielder. Maturity starts from December and fruits attain full maturity in February – March.

The experiment was conducted in simple Randomized Block Design having twelve treatments *viz* T_1 (Control), T_2(Boric Acid 0.6%),T_3 (NAA 25ppm), T_4 (GA_3 30ppm), T_5 (BA 250 ppm), T_6 (CPPU 100 ppm), T_7 (Jeevamrit 20%), T_8 (Boric Acid 0.6% + NAA 25ppm), T_9 (Boric Acid 0.6% + GA_3 30ppm), T_{10} (Boric Acid 0.6% + BA 250 ppm), T_{11} (Boric Acid 0.6% + CPPU 100 ppm), T_{12} (Boric Acid 0.6% + Jeevamrit 20%). The treatment was imposed two times, first at first week of November and second at first week of December. The observations were recorded at monthly interval from January to May during the research on total number of fruits, Number of fruit drop, fruit drop (%), number of Fruit retention, Fruit retention (%), Number of fruit cracked, and Fruit cracking percentage .Statistical analysis of the data obtained in the different sets of experiments were calculated, as suggested by Panse and Sukhatma (1989).

Fruit cracking (%): Intensity of fruit cracking was recorded in at monthly interval by counting total number of fruits per plant and number of fruits cracked per plant. The effect of nutrients on Fruit cracking intensity was recorded by counting the total number of fruits /plant and number of fruits cracked at fifteen days intervals. The percent fruit cracking was calculated by using the following formula.

$$\text{Fruit cracking intensity (\%)} = \frac{\text{Number of fruits cracked}}{\text{Total number of fruit set at the time of spraying}} \times 100$$

Fruit Drop: The data of fruit drop taken at monthly interval during the course of investigation. Manually count the dropped fruit from the first day to the last day of the month in every month from the January to till May in both the year of trail.

Fruit drop (%): Percent of fruit drop was recorded in at monthly interval by counting total number of fruits per plant and number of fruits dropped per plant. The effect of different treatment on fruit dropped was recorded by counting the total number of fruits per plant and number of fruits dropped at monthly intervals. The percent fruit dropping was calculated by using the following formula.

$$\text{Fruit dropped (\%)} \frac{\text{Number of fruit dropped}}{\text{Total number of fruit set at the time of spraying}} \times 100$$

Fruit Retention (%): Fruit retention were recorded in the orchard, five branches on different aspects of the tree were tagged for counting fruit set before spraying. after that the fruit retention was calculated by using the formula given by Westwood (1978)

$$\text{Fruit retention(\%)} \frac{\text{Total number of fruit set at the time of spraying} - \text{Number of fruit dropped}}{\text{Total number of fruit set at the time of spraying}} \times 100$$

Results and Discussion

Effect of different treatments on the fruit drop and cracking of bael fruit

The observations recorded for the fruit cracking, drop and retention showed the response of boron, different plant growth regulators and jeevamrit at the interval of 30 days (from 1st to 31st January; 1st to 28th February; 1st to 31st March; 1st to 30th April and 1st to 31st May on fruit drop and cracking during the years 2019-2020 & 2020- 21

Number of cracked fruits

The results are presented in Table 1 during the month January to May, the plants show a positive response to the application of different treatments in both years. The minimum number of cracked fruits (2.40, 2.20, 3.10,1.20 and 1.01 in each month from January to May in 2019-20 respectively and 1.68, 1.69, 1.5, 1, 1 in each month from January to May respectively in 2020-21) was encoded in treatment T_{11} (Boric Acid 0.6% + CPPU 100 ppm) whereas, the maximum number of cracked fruits (7.98, 9.62, 11.0, 6.80, 4.30 in each month from January to May in 2019-20 respectively and 7.88, 9.78, 10, 7.12, 4.18 in each month from January to May respectively in 2020-21) was recorded in treatment T_1 (control) (water spray) followed by T_5. All the treatments were found significant to each other.

Table 1: Effect of boron, plant growth regulators and jeevaamrit on Number of Fruit Crack

Treatments	Number of Fruit Crack									
	2019-20					2020-21				
	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May
T_1 (CONTROL)	7.98	9.62	11.00	6.80	4.30	7.88	9.78	10	7.12	4.18
T_2 (BORIC ACID 0.6%)	5.10	5.80	6.70	3.82	1.86	3.2	4.36	5.5	3.15	1.21
T_3 (NAA 25PPM)	6.40	8.20	9.10	5.50	3.46	4.89	7.34	7.96	4.12	3.02
T_4 (GA3 30PPM)	6.00	7.80	8.50	5.10	3.21	5.08	6.25	7.8	3.45	2.94
T_5 (BA 250PPM)	7.20	8.90	9.70	5.90	3.51	6.13	6.75	8.24	4.26	3.12
T_6 (CPPU 100 PPM)	5.50	6.40	7.10	4.15	2.89	4.11	5.43	4.23	3.06	1.75
T_7 (JEEVA AMRIT 20%)	5.70	7.20	7.50	4.65	3.00	4.31	5.61	5.33	3.59	2.24
T_8 (BORIC ACID 0.6% + NAA 25PPM)	4.50	4.68	5.80	3.34	1.65	3.75	3.77	4.49	2.51	1.11
T_9 (BORIC ACID 0.6% + GA3 30PPM)	4.10	4.15	5.20	2.90	1.41	3.24	3.32	4.22	2.12	1.16
T_{10} (BORIC ACID 0.6% + BA 250PPM)	4.90	5.10	6.20	3.51	1.74	2.67	4.66	4.87	2.89	1.19
T_{11}(BORIC ACID 0.6% +CPPU 100PPM)	2.40	2.20	3.10	1.20	1.01	1.68	1.9	1.5	1	1
T_{12} (BORIC ACID 0.6% + JEEVA AMRITA 20%)	3.90	3.50	4.10	2.40	1.34	2.65	3.21	3.11	1.89	1.05
S.Em±	0.08	0.09	0.10	0.06	0.04	0.07	0.09	0.08	0.07	0.03
CD or LSD	0.23	0.25	0.29	0.19	0.12	0.20	0.26	0.24	0.20	0.10

Fruit cracking percentage

The results are shown in Table 2 from January to May; the exogenous foliar spraying of Boron and plant growth regulators had a significant influence on reducing the fruit cracking percentage in both the years. All the treatments from January to May during both years (2019-20 and 2020-21) were found statistically superior over the control.

From 1st January to 31st January the maximum fruit cracking percentage (9.73, 12.54 in 2019-20 and 2020-21 respectively) was recorded in the T_1 (water spray) followed by the T_5. The minimum fruit cracking percentage (3.04, 2.04 in 2019-20 and 2020-21 respectively) was recorded in plants treated with T_{11} (Boric Acid 0.6% + CPPU 100 ppm). During year 2019-20 treatments T_2, T_6 and T_8; T_9 and T_{10} were found at par similarly, treatment T_6, T_7; T_8, T_9; T_2 and T_{10} were found at par during the year 2020-21

From 1st February to 28 February, the maximum fruit cracking percentage (11.73, 12.82 in 2019-20 and 2020-21 respectively) was recorded in the T_1 (water spray) which was followed by the T_5. The minimum fruit cracking percentage (2.78, 1.61 in 2019-20 and 2020-21 respectively) was recorded in plants treated with T_{11} (Boric Acid 0.6% + CPPU 100 ppm). Treatment T_9 was found non-significant with T_8 and T_{10}; T_2 was non-significant with T_6 during the years 2019-20 similarly, treatment T_8 was found at par with the treatment T_9 and T_{10} during the experimental year 2020-21

From 1st March to 31st March, the maximum fruit cracking percentage (13.41, 10.10 in 2019-20 and 2020-21 respectively) was observed in the T_1 (water spray) control followed by treatment T_5 whereas, the minimum value (3.92, 1.81 in 2019-20 and 2020-21 respectively) was recorded in the treatment T_{11}(Boric Acid 0.6% + CPPU 100 ppm) during both years. During the first experimental year 2019-20 Treatment T_8 was found at par with T_9 and T_{10} alike, during the second experimental year 2020-21 treatments T_6, T_7; T_8, T_9; T_{10}, and T_{12} were found at par.

From 1st April to 30th April the cracking percentage was reduced in all treatments as compared to the previous months *i.e.* February and March. The maximum value (8.29, 9.13 in 2019-20 and 2020-21 respectively) was recorded in the T_1 (water spray) whereas, the minimum value (1.52, 1.08 in 2019-20 and 2020-21 respectively) was recorded in treatment T_{11} (Boric Acid 0.6% + CPPU 100 ppm) during both experimental years. Treatment T_2 and T_5 were found at par during 2019-20 ditto, the treatment T_2 and T_6; T_4 and T_7 were found at par during year 2020-21

From 1st May to 31st May, the cracking percentage was greatly reduced and the least values among the months were found in every treatment. The maximum values (5.24, 5.36 in 2019-20 and 2020-21 respectively) were found with T_1 (water-spray) which was followed by treatment T_5 whereas, the minimum value (1.28, 1.08 in 2019-20 and 2020-21 respectively) was recorded in treatment T_{11} (Boric Acid 0.6% + CPPU 100 ppm) during both the experimental years. All the treatments were found significant during the first experimental year similarly during the second year of the trial (2020-21) the treatments T_3, T_4; T_2, T_{10}; T_2, and T_9 were found at par.

The fruit cracking might be caused because of the low level of translocation of photosynthetic material; the boron helps in

the better translocation of photosynthates material and may reduce the cracking in bael. The higher cracking in bael was generally observed in February and March afterwards greatly reduced in April and May which might be because of the prominent variation in the temperature and sunshine hours from cold winter in January to spring as well as the hormonal imbalance in the plants which can be improved through the exogenous application. The synergetic effect of the application of boric acid and CPPU was observed which greatly reduced the cracking of fruits, maybe because CPPU has been linked with steady cell division, and cell wall, influencing the mechanical properties of plant tissues and nutritional balance through the application of Boron. The present findings were also in agreement with the findings of Banyal *et al.* (2013) [5], and Khemnar *et al.* (2019) [16] in pomegranate. Mishra *et al.* (2017) described the beneficial role of benzyl adenine in the reduction of cracking of litchi cv. Rose Scented. Singh *et al.* (2003) controlled the fruit cracking and its intensity during different pickings in pomegranate var. Jalore Seedless is grown in an arid ecosystem. The least cracking was obtained with the application of boron at 0.2%. Lal *et al.* (2017) proved the correlation between the temperature fluctuations and cracking in the litchi fruits. Bhatt *et al.* (2016) also proved the least fruit cracking in the plants sprayed with NAA 25 ppm.

Table 2: Effect of boron, plant growth regulators and jeevaamrit on Fruit cracking (%)

Treatments	Fruit Cracking (%)									
	2019-2020					2020-2021				
	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May
T_1 (CONTROL)	9.73	11.73	13.41	8.29	5.24	12.54	12.82	10.10	9.13	5.36
T_2 (BORIC ACID 0.6%)	6.54	7.44	8.59	4.90	2.38	5.01	6.32	3.68	3.62	1.39
T_3 (NAA 25PPM)	8.10	10.38	11.52	6.96	4.38	8.25	8.94	5.49	4.63	3.39
T_4 (GA3 30PPM)	7.41	9.63	10.49	6.30	3.96	7.27	9.07	5.91	4.01	3.42
T_5 (BA 250PPM)	9.23	11.41	12.44	7.56	4.50	8.04	9.81	7.30	5.07	3.71
T_6 (CPPU 100 PPM)	6.63	7.71	8.55	5.00	3.48	6.24	4.86	4.72	3.52	2.01
T_7 (JEEVA AMRIT 20%)	7.04	8.89	9.26	5.74	3.70	6.30	5.99	4.84	4.03	2.52
T_8 (BORIC ACID 0.6% + NAA 25PPM)	5.63	5.85	7.25	4.18	2.06	4.28	5.10	4.26	2.85	1.26
T_9 (BORIC ACID 0.6% + GA3 30PPM)	5.54	5.61	7.03	3.92	1.91	4.10	5.21	4.00	2.62	1.43
T_{10} (BORIC ACID 0.6% + BA 250PPM)	5.90	6.14	7.47	4.23	2.10	5.12	5.35	2.93	3.18	1.31
T_{11}(BORIC ACID 0.6% +CPPU 100PPM)	3.04	2.78	3.92	1.52	1.28	2.04	1.61	1.81	1.08	1.08
T_{12} (BORIC ACID 0.6% + JEEVA AMRITA 20%)	5.13	4.61	5.39	3.16	1.76	3.65	3.53	3.01	2.15	1.19
S.Em±	0.10	0.11	0.15	0.06	0.05	0.12	0.09	0.10	0.06	0.04
CD or LSD	0.29	0.32	0.43	0.17	0.14	0.34	0.26	0.29	0.16	0.11

Number of fruits dropped

It is obvious from the data in table 3 showed that foliar spraying of Boron and plant growth regulators has significantly influenced the number of fruits dropped from January to May. All the treatments from January to May during both the years (219-20 and 2020-21) were observed significantly superior over the T_1 (Control)

From 1st January to 31st January the maximum number of fruit drops (11, 12 in 2019-20 and 2020-21 respectively) was counted in the T_1 (water spray) which was followed by the T_3 and T_7 (2019-20) whereas T_4 during the year 2020-21. The minimum number of fruits dropped (4, 2 in 2019-20 and 2020-21 respectively) was recorded in plants treated with T_8 (Boric Acid 0.6% + NAA 25ppm). During 2019-20 treatments T_4 and T_9 were found at par similarly, during the year 2020-21 treatments T_5, T_6, T_7 and T_8, T_9 and T_{10}, T_{12}, and T_{11} were found at par.

From 1st February to 28 February, the maximum number of dropped fruit (20, 18 in 2019-20 and 2020-21 respectively) was recorded in the T_1 (water spray) followed by T_6 in both experimental years (2019-20 and 2020-21). The minimum number of fruits dropped (3, 1 in 2019-20 and 2020-21 respectively) was recorded in plants treated with T_8 (Boric Acid 0.6% + NAA 25ppm). Treatment T_6 and T_7 was found non-significant during the year 2019-20 whereas T_6, T_{10}; T_7 T_9 was recorded as non-significant during the experimental year 2020-21

From 1st March to 31st March the maximum number of fruit drops (14, 15 in 2019-20 and 2020-21 respectively) was counted in T_1 (water spray) followed by T_5 in both the years (2019-20 and 2020-21); However, the minimum fruit (2, 1 in 2019-20 and 2020-21 respectively) was found in T_8 (Boric Acid 0.6% + NAA 25ppm). Treatment T_3 and T_9 was found at par during the year 2019-20 alike treatment T_4 and T_{10} were found at par during 2020-21

The fruit drop from 1st April to 30th April was reduced as compared to drop in February and March. The maximum fruit drop (12, 10 in 2019-20 and 2020-21 respectively) was recorded in plants sprayed with T_1 (water spray) followed by T_5 and minimum fruit drop (1, 1 in 2019-20 and 2020-21 respectively) in the plants treated with treatment T_8 (Boric Acid 0.6% + NAA 25ppm) in both the years (2019-20 and 2020-21). Treatment T_3, T_9; T_4, T_6; T_7, and T_{10} were found at par during the year 2019-20 similarly, during the years 2020-21 T_3, T_8; T_6, and T_{10} were non-significant

The fruit drop during the May month was a postmature drop. The maximum fruit drop (9, 7 in 2019-20 and 2020-21 respectively) was counted in treatment T_1 (water spray) followed by the treatment T_5 during 2019-20 and T_2 in 2020-21 whereas, the minimum value (1, 1 in 2019-20 and 2020-21 respectively) was counted in plants treated with treatment T_8 (Boric Acid 0.6% + NAA 25ppm) in both the years. T_3, T_8; T_4, T_6; T_9, T_{11}. T_{12} during the year 2019-20 were found at par alike during 2020-21 treatment T_3, T_8, and T_{11} were the same; T_4, T_{11} and T_{10}, and T_{12} were found at par

Table 3: Effect of boron, plant growth regulators and jeevaamrit on Number of Fruits drop

Treatments	Number of Fruits drop									
	2019-20					2020-21				
	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May
T_1 (CONTROL)	11	20	14	12	9	12.00	18.00	15.00	10.00	7
T_2 (BORIC ACID 0.6%)	7	12	11	9	5	6.00	10.00	12.00	8.00	6
T_3 (NAA 25PPM)	6	5	5	2	1	4.00	3.00	3.00	1.00	1
T_4 (GA3 30PPM)	9	10	9	8	4	8.00	7.00	7.00	6.00	3
T_5 (BA 250PPM)	7	14	12	10	7	5.00	12.00	9.00	8.00	5
T_6 (CPPU 100 PPM)	8	11	9	7	4	5.00	8.00	6.00	4.00	2
T_7 (JEEVA AMRIT 20%)	9	11	8	5	3	5.00	7.00	5.00	5.00	3
T_8 (BORIC ACID 0.6% + NAA 25PPM)	4	3	2	1	1	2.00	1.00	1.00	1.00	1
T_9 (BORIC ACID 0.6% + GA3 30PPM)	5	6	5	3	2	3.00	5.00	5.00	2.00	2
T_{10} (BORIC ACID 0.6% + BA 250PPM)	7	10	8	6	3	5.00	8.00	7.00	4.00	3
T_{11}(BORIC ACID 0.6% +CPPU 100PPM)	8	8	6	4	2	5.00	6.00	5.00	3.00	1
T_{12} (BORIC ACID 0.6% + JEEVA AMRITA 20%)	6	4	4	2	2	5.00	2.00	3.00	2.00	2
S.Em±	0.09	0.17	0.15	0.08	0.03	0.09	0.10	0.13	0.07	0.05
CD or LSD	0.27	0.50	0.43	0.24	0.08	0.25	0.29	0.37	0.22	0.14

Fruit drop percentage

The data regarding the fruit drop percentage was shown in table 4 and graphically presented in Fig. 4.4 revealed the exogenous application of different plant growth regulators on Jeeva-amrit in November significantly reduce the drop. The most fruit drop % was observed in February and March combinedly accounting for 41.46% fruit drop in 2019-20 and 42.31 in the fruits sprayed with water and 6.25% and 2.28% in the plants foliar sprayed with Boric acid and Naphthalic acetic acid. All the treatments from January to May during both the years (219-20 and 2020-21) were observed significantly superior over the T_1 (Control)

From 1st January to 31st January, the maximum fruit drop percentage (13.41, 15.38 in 2019-20 and 2020-21 respectively) was recorded in the T_1 (water spray) followed by the T_4. The minimum fruit drop percentage (5.00, 2.17 in 2019-20 and 2020-21 respectively) was recorded in plants treated with T_8 (Boric Acid 0.6% + NAA 25ppm) during both years (2019-20 and 2020-21). During 2019-20 treatments T_2 and T_5 were found at par similarly during the year 2020-21 treatments T_6, T_5 and T_{10}, and T_{11} were found at par.

From 1st February to 28 February the maximum fruit drop percentage (24.39, 23.08 in 2019-20 and 2020-21 respectively) was recorded in the T_1 (water spray) which was followed by the T_5. The minimum fruit drop percentage (3.75, 1.14 in 2019-20 and 2020-21 respectively) was recorded in plants treated with T_8 (Boric Acid 0.6% + NAA 25ppm). Treatment T_4 was found non-significant with T_{10} in the year 2019-20 whereas treatment T_{11} was found at par with the treatment T_7 and T_9 during the experimental year 2020-21

From 1st March to 31st March the maximum fruit drop percentage (17.07, 19.23 in 2019-20 and 2020-21 respectively) was observed in the T_1 (water spray) followed by treatment T_5 in 2019 and T2 in 2020-21whereas the minimum value (2.50, 1.14 in 2019-20 and 2020-21 respectively) was recorded in the treatment T_8 (Boric Acid 0.6% + NAA 25ppm) during both years. During the first experimental year, 2019-20 Treatment T_4 was found at par with T_6 similarly during the second experimental year 2020-21 treatment T_3 and T_{12} were found at par.

From 1st April to 30th April. The maximum fruit drop percentage (14.63, 12.82 in 2019-20 and 2020-21 respectively) was recorded in the T_1 (water spray) whereas, the minimum value (1.25, 1.14 in 2019-20 and 2020-21 respectively) was recorded in treatment T_8 (Boric Acid 0.6% + NAA 25ppm) during both experimental years. Treatment T_4 and T_{12} were found at par with each other during year 2019-20 alike the treatment T_9 and T_{12} were found at par during year 2020-21

From 1st May to 31st May maximum fruit drop percentage (10.98, 8.97 in 2019-20 and 2020-21 respectively) was recorded in T_1 (water spray) which was followed by treatment T_5 whereas, the minimum value (1.25, 1.14 in 2019-20 and 2020-21 respectively) was recorded in treatment T_8 (Boric Acid 0.6% + NAA 25ppm) during both the experimental years. During the first experimental year of treatment (2019-20) T_4, T_6; T_7, T_{10}; T_9 T_{11} T_{12} were found at par similarly during the second year of trial (2020-21) the treatment T_4, T_7; T_6, T_{12}were found at par.

Fruit drop is a common occurrence. A lack of auxins, gibberellins, and cytokinin plays a vital part in fruit drop. This deficit, together with a high amount of the growth inhibitors abscisic acid and ethylene, causes massive fruit loss. Exogenous NAA raises its concentration in the panicle and counteracts the negative effects of endogenous inhibitors, preventing the establishment of the panicle's abscission layer. On apple trees, El-Sabagh (2002) [9] and Guirguis *et al*. (2003) [11] found that CPPU had a substantial effect on increasing fruit set. This could be due to CPPU's ability to mobilize and assimilate to metabolic active areas like fruits, which are responsible for improving fruit set and final fruit retention. It also helps to reinforce cell walls in the abscission layer by stimulating cell division and activating protein, RNA, and DNA production, which reduces fruit shedding (Nickell, 1985) [18]. Another cause for the decrease in fruit drops could be related to CPPU, a powerful cytokinin that promotes fruit setting and reduces fruit drops (Lei and Hongxian, 2011) [17]. The application of NAA and CPPU in different concentrations and at various periods proved beneficial impact in enhancing fruit set and, ultimately, fruit retention (Guirguis *et al.* 2010) [12].

Table 4: Effect of boron, plant growth regulators and Jeevaamrit on Fruits drop (%)

Treatments	Fruits drop (%)									
	2019-20					2020-21				
	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May
T_1 (CONTROL)	13.41	24.39	17.07	14.63	10.98	15.38	23.08	19.23	12.82	8.97
T_2 (BORIC ACID 0.6%)	8.97	15.38	14.10	11.54	6.41	6.90	11.49	13.79	9.20	6.90
T_3 (NAA 25PPM)	7.59	6.33	6.33	2.53	1.27	4.49	3.37	3.37	1.12	1.12
T_4 (GA3 30PPM)	11.11	12.35	11.11	9.88	4.94	9.30	8.14	8.14	6.98	3.49
T_5 (BA 250PPM)	8.97	17.95	15.38	12.82	8.97	5.95	14.29	10.71	9.52	5.95
T_6 (CPPU 100 PPM)	9.64	13.25	10.84	8.43	4.82	5.75	9.20	6.90	4.60	2.30
T_7 (JIVA AMRIT 20%)	11.11	13.58	9.88	6.17	3.70	5.62	7.87	5.62	5.62	3.37
T_8 (BORIC ACID 0.6% + NAA 25PPM)	5.00	3.75	2.50	1.25	1.25	2.27	1.14	1.14	1.14	1.14
T_9 (BORIC ACID 0.6% + GA3 30PPM)	6.76	8.11	6.76	4.05	2.70	3.70	6.17	6.17	2.47	2.47
T_{10} (BORIC ACID 0.6% + BA 250PPM)	8.43	12.05	9.64	7.23	3.61	5.49	8.79	7.69	4.40	3.30
T_{11}(BORIC ACID 0.6% +CPPU 100PPM)	10.13	10.13	7.59	5.06	2.53	5.38	6.45	5.38	3.23	1.08
T_{12} (BORIC ACID 0.6% + JEEVA AMRITA 20%)	7.89	5.26	5.26	2.63	2.63	5.68	2.27	3.41	2.27	2.27
S.Em±	0.16	0.22	0.12	0.11	0.05	0.08	0.21	0.10	0.12	0.06
CD or LSD	0.46	0.64	0.36	0.33	0.14	0.23	0.62	0.29	0.37	0.18

Fruit retention

Table 5 shows that data collected on fruit retention owing to foliar treatment of boron, plant growth regulators, and Jeeva-amrit. According to the analyzed data, these foliar sprays appear to have a substantial effect in boosting fruit retention on the tree from January to May. All the treatments from January to May during both the years (2019-20 and 2020-21) were found significantly superior over the T_1 (Control)

The largest number of retained fruit (76, 86 in 2019-20 and 2020-21, respectively) was counted in the T_8 (Boric Acid 0.6 per cent + NAA 25ppm) and T_6 treatments from January 1 to January 31, followed by T_6 (2019-20) and T_{11} in 2020-21. Plants treated with treatment T_9 in 2019-20 and T_1 (water spray) during 2020-21 had the lowest number of fruits maintained (69, 66 in 2019-20 and 2020-21 respectively). T_4 and T_7 were determined to be on par during 2019-20 similarly, T_6 and T_7 were found to be at par during 2020-21.

From 1st February to 28 February the maximum fruit retention (73, 85 during 2019-20 and 2020-21 respectively) was recorded in the T_8 (Boric Acid 0.6% + NAA 25ppm) followed by T_3 during both experimental years. The minimum number of fruits retained (51, 48 in 2019-20 and 2020-21 respectively) was recorded in plants that had water spray (T_1). Treatment T_4 T_6, T_7, T_9, T_{10}, T_{11}, and T_{12}, were found non-significant during the years 2019-20 whereas T_8 and T_{12} were recorded as non-significant with each other during the experimental years 2020-21

From 1st March to 31st March the maximum fruit retention (71, 84 in 2019-20 and 2020-21 respectively) was counted in T_8 (Boric Acid 0.6% + NAA 25ppm) followed by T_3 in both the years; However, the minimum fruit retention (37, 33 in 2019-20 and 2020-21 respectively) was found in T_1 (water spray); treatment T_4, T_6 and T_7 were found at par during the year 2019-20 similar trend of treatment T_7 and T_9 were found at par during 2020-21

The fruit retention from 1st April to 30th April was recorded and found maximum value (70,83 in 2019-20 and 2020-21 respectively) in plants sprayed with T_8 (Boric Acid 0.6% + NAA 25ppm) followed by T_5 and minimum fruit retention (1, 1 in 2019-20 and 2020-21 respectively) in the plants sprayed with water T_1 (water spray) in both the years. Treatment T_6 and T_7; T_9, and T_{10} were found at par during the year 2019-20 whereas during the year 2020-21 T_7, T_9, and T_{10} were non-significant

From 1st May to 31st May the fruit retention was recorded and found maximum value (69,82 in 2019-20 and 2020-21 respectively) in treatment T_8 (Boric Acid 0.6% + NAA 25ppm) followed by T_5 and minimum fruit retention (16 in both the years) in the plants sprayed with water T_1 (water spray) during both the years. Treatment T_6 and T_7 were found at par during the year 2019-20 whereas during years 2020-21 T_7, T_9, and T_{10} were non-significant.

Table 5: Effect of boron, plant growth regulators and jeevaamrit on Fruit Retention

Treatments	Fruit Retention									
	2019-20					2020-21				
	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May
T_1 (CONTROL)	71.00	51.00	37.00	25.00	16.00	66.00	48.00	33.00	23.00	16.00
T_2 (BORIC ACID 0.6%)	71.00	59.00	48.00	39.00	34.00	81.00	71.00	59.00	51.00	45.00
T_3 (NAA 25PPM)	73.00	68.00	63.00	61.00	60.00	85.00	82.00	79.00	78.00	77.00
T_4 (GA3 30PPM)	72.00	62.00	53.00	45.00	41.00	78.00	71.00	64.00	58.00	55.00
T_5 (BA 250PPM)	71.00	57.00	45.00	35.00	28.00	79.00	67.00	58.00	50.00	45.00
T_6 (CPPU 100 PPM)	75.00	64.00	55.00	48.00	44.00	82.00	74.00	68.00	64.00	62.00
T_7 (JEEVA AMRIT 20%)	72.00	61.00	53.00	48.00	45.00	84.00	77.00	72.00	67.00	64.00
T_8 (BORIC ACID 0.6% + NAA 25PPM)	76.00	73.00	71.00	70.00	69.00	86.00	85.00	84.00	83.00	82.00
T_9 (BORIC ACID 0.6% + GA3 30PPM)	69.00	63.00	58.00	55.00	53.00	78.00	73.00	68.00	66.00	64.00
T_{10} (BORIC ACID 0.6% + BA 250PPM)	76.00	66.00	58.00	52.00	49.00	86.00	78.00	71.00	67.00	64.00
T_{11}(BORIC ACID 0.6% +CPPU 100PPM)	71.00	63.00	57.00	53.00	51.00	88.00	82.00	77.00	74.00	73.00
T_{12} (BORIC ACID 0.6% + JEEVA AMRITA 20%)	70.00	66.00	62.00	60.00	59.00	83.00	81.00	78.00	76.00	74.00

S.Em±	1.08	1.08	0.81	0.79	0.60	1.34	1.29	0.99	0.98	0.79
CD or LSD	3.16	3.16	2.38	2.33	1.75	3.94	3.77	2.90	2.89	2.33

Fruit retention percentage

The data derived on fruit retention were analyzed statically. The mean values are presented in Table 6. It indicates that the application of boron, different plant growth regulators and Jeeva amrit has significantly influenced retention percentage in bael fruits. All the treatments from January to May during both the years (219-20 and 2020-21) were found significantly superior over the T_1 (Control)

From 1st January to 31st January the maximum fruit retention percentage (95%, 97.73% during 2019-20 and 2020-21 respectively) was noticed in the T_8 (Boric Acid 0.6% + NAA 25ppm) followed by the T_9 during both the years. The minimum fruit retention percentage (86.59%, 84.62% in 2019-20 and 2020-21 respectively) was recorded in plants sprayed with water T_1 (water spray). During 2019-20 treatments T_2, T_3, T_5, T_6, T_9, T_{10}, and T_{12} were statistically at par similarly, during the experimental year 2020-21 treatments T_5, T_6, T_7, T_{10}, T_{11}, T_{12} were found at par

From 1st February to 28 February the maximum fruit retention percentage (91.25%, 96.59% in 2019-20 and 2020-21 respectively) was recorded in the T_8 (Boric Acid 0.6% + NAA 25ppm) treatment followed by the T_3 and T_{12} in both experimental years. The minimum fruit retention percentage (62.20%, 61.54% in 2019-20 and 2020-21 respectively) was recorded in plants that had water spray (T_1). Treatment T_2, T_4, and T_7 were statistically at par during the year 2019-20 whereas T_6, T_7, T_{10}, and T_{11}, were also found statistically non-significant during the experimental year 2020-21

From 1st March to 31st March the maximum fruit retention percentage (88.75%, 95.45% in 2019-20 and 2020-21 respectively) was counted in T_8 (Boric Acid 0.6% + NAA 25ppm) followed by T_{12} in 2019-20 and T_3 and T_{12} in 2020-21; However, the minimum fruit retention percentage (45.12%, 61.54% in 2019-20 and 2020-21 respectively) was found in T_1 (water spray). Treatments T_3 T_4 T_6 were at par during the year 2019-20 similarly treatments T_9, T_{11} and T_3, T_{12} were also found at par during 2020-21

From 1st April to 30th April the fruit retention percentage was recorded and found maximum value (87.50%, 94.32% in 2019-20 and 2020-21 respectively) in plants sprayed with T_8 (Boric Acid 0.6% + NAA 25ppm) followed by T_{12} during 2019-20 and T_3 which is at par with T_{12} 2020-21. The minimum fruit retention percentage (19.51% in 2019-20 and 20.51% during 2020-21) was noted in the plants sprayed with water T_1 (water spray) during both years. Treatment T_4 and T_6 were statistically at par during the year 2019-20 similarly, during the years 2020-21 T_6 and T_7, were also statistically non-significant.

From 1st May to 31st May the maximum fruit retention percentage was noticed (86.25%, 93.18% in 2019-20 and 2020-21 respectively) in plants sprayed with T_8 (Boric Acid 0.6% + NAA 25ppm) followed by T_{12} during the experimental year 2019-20 whereas, T_3 which was statistically at par with T_{12} during the experimental year 2020-21 and minimum fruit retention percentage (19.51%, 20.51% in 2019-20 and 2020-21 respectively) in the plants sprayed with water T_1 (water spray) during both the years. Treatment T_6 and T_7 were found at par during the year 2019-20 similarly, during the year 2020-21 T_6, T_7, and T_{10} were non-significant with each other.

The statistically significant results demonstrated that foliar application of NAA considerably lowers premature and post mature fruit drop, eventually improving the fruit retention of bael fruits. The results are quite similar to those published by Saraswat *et al*. (2010), who found that using NAA in conjunction with zinc improved fruit retention in lichi. The favorable effect of NAA in conjunction with GA3 in the ber cv. Banarsi karaka Pandey *et al.* (2011). Trueman (2010) [21] discovered that benzyl adenine delayed the abscission of immature Macadamia fruit and increased fruit retention. NAA application at 25 ppm resulted in considerably increased fruit set and retention, resulting in increased fruit yield Ghosh *et al.* (2009).

Table 6: Effect of boron, plant growth regulators and jeevaamrit on Fruit Retention (%)

Treatments	Fruit Retention (%)									
	2019-20					2020-21				
	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May	1-31 January	1-28 February	1-31 March	1-30 April	1-31 May
T_1 (CONTROL)	86.59	62.20	45.12	30.49	19.51	84.62	61.54	42.31	29.49	20.51
T_2 (BORIC ACID 0.6%)	91.03	75.64	61.54	50.00	43.59	93.10	81.61	67.82	58.62	51.72
T_3 (NAA 25PPM)	92.41	86.08	79.75	77.22	75.95	95.51	92.13	88.76	87.64	86.52
T_4 (GA3 30PPM)	88.89	76.54	65.43	55.56	50.62	90.70	82.56	74.42	67.44	63.95
T_5 (BA 250PPM)	91.03	73.08	57.69	44.87	35.90	94.05	79.76	69.05	59.52	53.57
T_6 (CPPU 100 PPM)	90.36	77.11	66.27	57.83	53.01	94.25	85.06	78.16	73.56	71.26
T_7 (JEEVA AMRIT 20%)	88.89	75.31	65.43	59.26	55.56	94.38	86.52	80.90	75.28	71.91
T_8 (BORIC ACID 0.6% + NAA 25PPM)	95.00	91.25	88.75	87.50	86.25	97.73	96.59	95.45	94.32	93.18
T_9 (BORIC ACID 0.6% + GA3 30PPM)	93.24	85.14	78.38	74.32	71.62	96.30	90.12	83.95	81.48	79.01
T_{10} (BORIC ACID 0.6% + BA 250PPM)	91.57	79.52	69.88	62.65	59.04	94.51	85.71	78.02	73.63	70.33
T_{11}(BORIC ACID 0.6% +CPPU 100PPM)	89.87	79.75	72.15	67.09	64.56	94.62	88.17	82.80	79.57	78.49
T_{12} (BORIC ACID 0.6% + JEEVA AMRITA 20%)	92.11	86.84	81.58	78.95	77.63	94.32	92.05	88.64	86.36	84.09
S.Em±	1.41	0.99	1.22	0.98	0.84	1.35	1.10	1.10	1.26	0.74
CD or LSD	4.13	2.90	3.57	2.88	2.47	3.97	3.22	3.24	3.70	2.17

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