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Effect of Plant Growth Regulators and Micronutrients on Fruit Yield and Quality of Mango (*Mangifera indica* L.) cv. Dashehri

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Abstract
The present investigation was conducted in 2024 -25 at Department of Fruit Science, Pt. K.L.S. CHRS, Pendri, Rajnandgaon (C.G.) India to evaluate the effect of plant growth regulators (GA_3 and NAA) and micronutrients ($ZnSO_4$ and Borax) on fruit yield and quality of mango (*Mangifera indica* L.) cv. Dashehri. The experiment comprised fifteen treatments and three replications. Individual, and combined applications of growth regulators and micronutrients, laid out in a randomized block design (RBD). Significant variations were observed among treatments for fruit yield, fruit volume, total soluble solids (TSS), reducing and non-reducing sugars, and titratable acidity. The combined application of NAA @ 20 ppm + Borax @ 0.2% (T_8) recorded the highest fruit yield (69 kg/tree), maximum fruit retention at pea, marble, and pre harvest stages, highest fruit setting percentage (0.7%) and highest number of fruits per panicle (4.93). Whereas maximum fruit weight, TSS, and total sugar content with the lowest acidity recorded under T_{13} (NAA @ 20 ppm + $ZnSO_4$ @ 0.5%). In contrast, the treatment T_0 (control) recorded the minimum values for all parameters. The results suggest that the combined use of growth regulators and micronutrients improves fruit yield and quality attributes of mango cv. Dashehri.

Keywords: Mango, GA_3, NAA, $ZnSO_4$, Borax, Fruit quality, Yield

Introduction
Mango (*Mangifera indica* L.) is one of the most important tropical fruit in India. The diploid chromosome number of mango is 2n = 40. It is called as King of Fruits (Purseglove, 1972). It is originated from the region between Northwestern Myanmar, Bangladesh, and northeastern India. Mango is cultivated widely in India for its delicious taste, high nutritional value, and export potential. Despite its commercial significance, yield and fruit quality are often constrained by irregular flowering, poor fruit set, and fruit drop, which are influenced by hormonal imbalances and micronutrient deficiencies. Plant growth regulators (PGRs) such as gibberellic acid (GA_3) and naphthalene acetic acid (NAA) play vital roles in regulating fruit development, enhancing fruit retention, and improving quality. Similarly, micronutrients like zinc (Zn) and boron (B) are essential for chlorophyll synthesis, pollen viability, and translocation of sugars, all of which influence yield and fruit quality. However, limited studies are available on their combined effect in mango cv. Dashehri under Chhattisgarh conditions. Therefore, the present study was undertaken to assess the effect of PGRs and micronutrients on fruit yield and quality of mango cv. Dashehri.

Materials and Methods
The investigation was carried out during the 2024-25 cropping season at the Horticultural Research Farm, Department of Fruit Science, Mahatma Gandhi University of Horticulture and Forestry, Sankra-Patan (Chhattisgarh). Uniformly healthy 15-year-old mango trees of cv. Dashehri were selected for the study. The experiment was laid out in Randomized Block Design (RBD) with 15 treatments and 3 replications.

Treatments

S.N.	Notations	Treatment Combination
1.	T_0	Control (water spray)
2.	T_1	GA_3 @ 20 ppm
3.	T_2	GA_3 @ 40 ppm
4.	T_3	NAA @ 20 ppm
5.	T_4	NAA @ 40 ppm
6.	T_5	Borax @ 0.2%
7.	T_6	GA_3 @ 20 ppm + Borax @ 0.2 %
8.	T_7	GA_3 @ 40 ppm + Borax @ 0.2 %
9.	T_8	NAA @ 20 ppm + Borax @ 0.2 %
10.	T_9	NAA @ 40 ppm + Borax @ 0.2 %
11.	T_{10}	$ZnSO_4$ @ 0.5 %
12.	T_{11}	GA_3 @ 20ppm + $ZnSO_4$ @ 0.5 %
13.	T_{12}	GA_3 @ 40 ppm + $ZnSO_4$ @ 0.5%
14.	T_{13}	NAA @ 20ppm + $ZnSO_4$ @ 0.5 %
15.	T_{14}	NAA @ 40ppm + $ZnSO_4$ @ 0.5 %

Results and Discussion: The result of the present investigation on "Effect of plant growth regulators and micronutrients on fruit yield and quality of Mango (*Mangifera indica* L.) cv. Dashehri" was conducted in the year 2024-2025, at Horticulture Farm, Bharregaon under Pt. K.L.S. college of Horticulture and Research Station, Rajnandgaon [Mahatma Gandhi University of Horticulture and Forestry Sankra, Durg, (C.G)] are presented and described in this chapter.

The results pertaining to various characters on yield and yield attributing characters and quality of fruit have been presented in this paper which recorded during the course of investigation and were subjected to statistical analysis. The research results pertaining to each aspect have been presented and described along with statistical inferences under the following heads.

Table 1: Effect of PGRs and micronutrients on fruit yield, fruit set%, Number of fruits per panicle of mango cv. Dashehri

Notations	Yield (kg/ tree)	Fruit Set %	Number of fruits per panicle
T_0	57.92	0.417	2.833
T_1	58.40	0.42	2.967
T_2	60.34	0.46	3.133
T_3	62.32	0.42	2.9
T_4	60.39	0.51	3.5
T_5	64.07	0.49	3.333
T_6	58.37	0.58	3.933
T_7	67.15	0.473	3.267
T_8	69.89	0.707	4.933
T_9	67.66	0.693	4.8
T_{10}	67.42	0.62	4.2
T_{11}	61.50	0.647	3.867
T_{12}	69.41	0.577	3.933
T_{13}	66.56	0.56	4.433
T_{14}	66.90	0.57	4
C.D.	5.77	0.07	0.438
SE(m)	1.982	0.024	0.15
SE(d)	2.802	0.034	0.213
C.V.	5.372	7.635	6.973

From table 1 Comparison between group of combine treatments revealed that maximum fruit set percentage (0.70%) was observed in treatment T_8 *i.e.* NAA 20 ppm + Borax 0.2% which was at par with treatment T_9 (0.69%) followed by T_{11} (0.64 %), T_{10} (0.62%) and T_{14} (0.57%). While the lowest Fruit set percentage (0.41%) recoded under Treatment T_0 (control). Auxin serves a pivotal role in abscission, the natural process of shedding plant organs like leaves, flowers, or fruits. Its primary function lies in sustaining ongoing physiological and biochemical processes within the plant. By steadily moving from the attachment point (subtending organ) to the abscission zone, auxin maintains a state of relative dormancy, inhibiting premature organ detachment. External application of auxin further reinforces this inhibition, prolonging the retention of plant organs. Additionally, auxin acts as a facilitator for nutrient mobilization, promoting the translocation of essential resources to developing fruits and other growing parts of the plant. The results were also in accordance with the findings of Naqvi *et al.* (2004) [39], Gupta and Brahmachari (2004) [8], Vejendla *et. al.* (2008) [64], Sondarva (2009) [61], Rajput *et. al.* (2013) [46] and Dheeraj *et. al.* (2016) [16] in mango. Studies have shown that boron supplementation can enhance the pollen-producing capacity of anthers and increase pollen viability, leading to improved fruit set and quality in various crops, including mangoes. Adequate boron supply is essential during critical stages of flowering and fruiting to ensure optimal reproductive development and maximize yield (Singh *et al.*, 2011) [68]. Similar results were also obtained by Kanapol *et al.* (2002) [2], Bhowmick *et al.* (2011) [11], and Gurjar *et. al.* (2015) [20] in mango.

The plant treated with various concentrations of plant growth regulators and micronutrients showed total number of fruits per panicle varied from 2.833 to 4.933. The maximum number of fruits per panicle (4.9) was recorded in treatment T_8 *i.e.* NAA 20 ppm + Borax 0.2%, which was at par with T_9 (4.8), followed by T_{13} and T_{10} (4.43, and 4.2). All the micronutrients when sprayed alone or in combination involved directly in various physiological processes and enzymatic activity. This might have resulted into better photosynthesis, greater accumulation of starch in fruits. The involvement of zinc in auxin synthesis and boron in translocation of starch to fruits. The balance of auxin in plant regulates the fruit drop or retention in plants, which altered the control of fruit drop and increased the total number of fruits. Similar results were observed by Haidry *et al.* (1997) [23], Shinde *et al.* (2006) [54], Baghel *et al.* (2003) [7], Baghel *et al.* (2004) [8], and Naqvi *et al*. (2004) [39] in mango and Kumar *et al.* (2019) [63] in litchi, Trivedi *et al.* (2012) [46] and Bhoyar and Ramdevputra (2016) [12] in guava.

The highest yield (69.891 kg/plant) was recorded in treatment T_8 *i.e.* NAA @ 20 ppm + Borax @ 0.2 % which was at par with T_{10} and T_{14} (68.78, 68.601), followed by T_9, and T_7 (67.66 and 67.15 kg/plant). While lowest yield (57.92 kg/plant) was recorded in treatment T_0 (control). The significant increase in fruit yield per tree is a cumulative effect of increase in number of fruits because of reduction in fruit drop by the direct and indirect effect of foliar spray of plant growth regulators and micronutrients in mango Nkansah *et a*. Promotion of starch formation followed by rapid transportation of carbohydrates in plants activated by micronutrients like zinc and boron are also well established (Nehete *et al.* 2019) [40]. Foliar spray of NAA and borax significantly increased the fruit set in mango which helps in increasing the number of fruits per panicle resulting in higher fruit yield due to the more rapid translocation of sugars from leaves to developing fruits (Dutta. Similar findings were also observed by Banik *et al.* (1997) [71], Banik and Sen (1997) [71], Sanna and Abd-El-Migeed, Nehete *et al.* (2019) [40], Bhowmick *et al.* (2011) [11], Jarande *et al*, Singh *et al.* (2015) [62], Gurjar *et. al.* (2015) [20] and Oosthuyse (2015) [42] in mango.

Table 2: Effect of PGRs and micronutrients on fruit retention percentage of mango cv. Dashehri

Notations	Pea stage*	Marble stage*	Pre harvest stage*
T_0	37.63 (37.31)	29.36 (26.78)	14.44 (6.23)
T_1	39.72 (40.87)	30.88 (26.37)	16.34 (7.93)
T_2	44.31 (48.83)	34.35 (31.86)	16.10 (7.70)
T_3	43.32 (47.10)	36.75 (35.63)	17.0 (8.56)
T_4	40.85 (42.82)	35.85 (34.37)	17.86 (9.42)
T_5	44.70 (49.51)	36.14 (34.82)	17.98 (9.54)
T_6	41.34 (43.66)	30.97 (26.50)	17.04 (8.60)
T_7	43.87 (48.06)	31.21 (26.89)	16.37 (7.95)
T_8	48.60 (56.29)	38.88 (39.44)	19.73 (11.41)
T_9	43.89 (48.10)	37.33 (36.80)	18.29 (9.88)
T_{10}	45.25 (50.46)	35.16 (33.22)	15.25 (6.94)
T_{11}	44.59 (49.32)	35.87 (34.37)	17.23 (8.79)
T_{12}	43.73 (47.83)	35.94 (34.49)	17.91 (9.47)
T_{13}	47.75 (54.83)	37.86 (37.70)	18.40 (9.99)
T_{14}	45.30 (50.57)	35.83 (34.30)	18.31 (9.89)
C.D.	2.856	1.876	0.966
SE(m)	0.981	0.644	0.332
SE(d)	1.387	0.911	0.469
C.V.	3.891	3.205	3.337

1. The Symbol (*) indicates arcsine transformed values.
2. Values in parenthesis ( ) are inverse transformed values, in percent unit corresponding to the arcsine transformed values.

From table 2 it is observed that at pea stage maximum fruit retention percentage (48.60) was recorded in treatment T_8 *i.e.* NAA @ 20 ppm + Borax @ 0.2 % which was at par with T_{13} (47.75), followed by T_{14}, T_{10} and T_{11} (45.30, 45.25, and 44.59%). While lowest Fruit retention percentage (37.63) was observed in treatment T_0 (Control).

At marble stage maximum fruit retention percentage (38.89) was recorded in treatment T_8 *i.e.* NAA @ 20 ppm + Borax @ 0.2 %, followed by T_{13} (37.86) which was at par with T_9 (37.33), followed by T_3 (36.75). While lowest Fruit retention percentage (29.36) observed in treatment T_0 (Control).

At pre harvest stage maximum fruit retention percentage (19.74) was recorded in treatment T_8 *i.e.* NAA @ 20 ppm + Borax @ 0.2 %, followed by T_{13} (18.41) which was at par with T_{14} (18.32) and T_9 (18.30). While lowest Fruit retention percentage (14.45 %) observed in treatment T_0 (Control).

The increase in fruit retention by using different growth regulators and micronutrients showed that the combined application of growth regulators and micronutrients was found better rather than applying these chemicals individually.

Auxin acts as a facilitator for nutrient mobilization, promoting the translocation of essential resources to developing fruits and other growing parts of the plant. Studies have also shown that boron supplementation can enhance the pollen-producing capacity of anthers and increase pollen viability, leading to improved fruit set, retention and quality in various crops, including mangoes. Adequate boron supply is essential during critical stages of flowering and fruiting to ensure optimal reproductive development and maximize yield (Singh *et al.*, 2015) [62]. Similar results were also obtained by Kanapol *et al.* (2002) [2], Bhowmick *et al.* (2011) [11], and Gurjar *et. al.* (2015) [20] in mango.

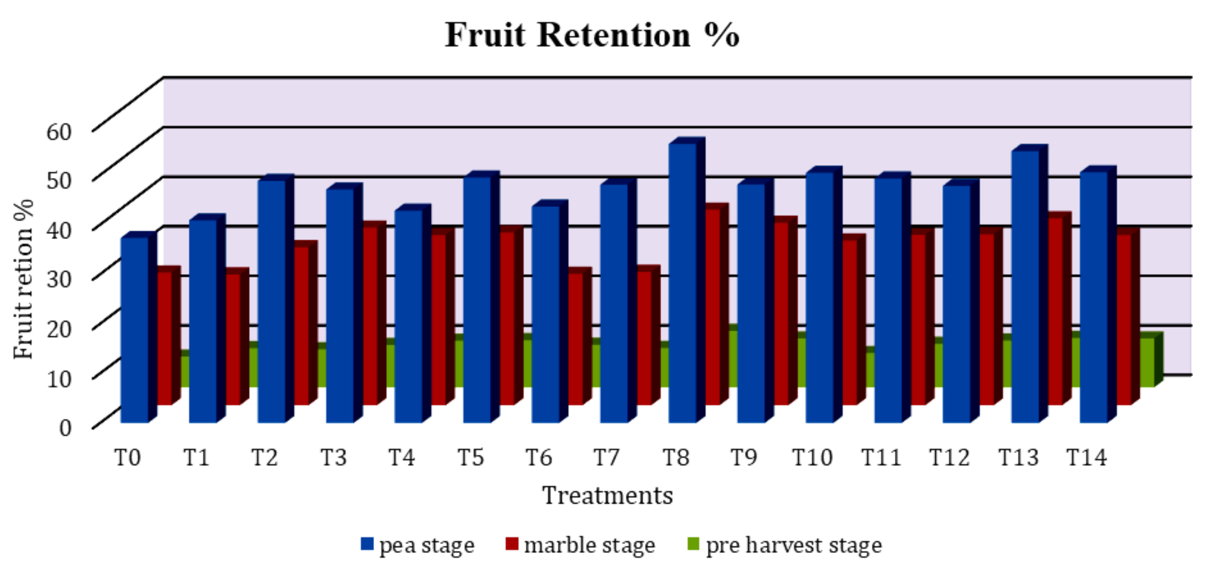

Fig 1: Effect of foliar application of PGR's and micronutrients on fruit retention percentage of mango c.v. Dashehri

Table 3: Effect of PGRs and micronutrients on fruit drop percentage of mango cv. Dashehri

Notations	Pea stage*	Marble stage*	Pre harvest stage*
T_0	52.34 (62.69)	59.07 (73.62)	75.51 (93.76)
T_1	50.23 (59.12)	58.81 (73.22)	73.61 (92.07)
T_2	45.65 (51.17)	55.61 (68.13)	73.86 (92.30)
T_3	46.64 (52.90)	53.21 (64.16)	72.95 (91.43)
T_4	49.10 (57.17)	54.11 (65.67)	72.09 (90.57)
T_5	45.26 (50.48)	53.81 (65.17)	71.97 (90.45)
T_6	48.62 (56.33)	58.99 (73.49)	72.91 (91.40)
T_7	46.09 (51.93)	58.74 (73.11)	73.59 (92.04)
T_8	41.36 (43.70)	51.07 (60.55)	70.22 (88.58)
T_9	46.07 (51.90)	52.63 (63.20)	71.66 (90.11)
T_{10}	44.71 (49.53)	54.80 (66.77)	74.71 (93.05)
T_{11}	45.37 (50.68)	54.09 (65.63)	72.72 (91.20)
T_{12}	46.22 (52.17)	54.01 (65.51)	72.05 (90.53)
T_{13}	42.20 (45.16)	52.1 (62.30)	71.55 (90.01)
T_{14}	44.65 (49.43)	54.13 (65.69)	71.64 (90.11)
C.D.	2.856	1.656	0.966
SE(m)	0.981	0.569	0.332
SE(d)	1.387	0.804	0.469
C.V.	3.669	1.79	0.79

1. The Symbol (*) indicates arcsine transformed values.
2. Values in parenthesis ( ) are inverse transformed values, in percent unit corresponding to the arcsine transformed values.

At pea stage minimum fruit drop percentage (41.36%) was recorded in treatment T_8 *i.e.* NAA @ 20 ppm + Borax @ 0.2 %, which was at par with T_{13} (42.21), followed by T_2, T_{14} and T_{10} (45.65, 44.71 and 44.65%) and the maximum fruit drop percentage (52.34) % was recoded in Control T_0.

At marble stage minimum fruit drop percentage (51.07) was recorded in treatment T_8 *i.e.* NAA @ 20 ppm + Borax @ 0.2 % followed by T_{13} (52.1) which was at par with T_9, T_3 and T_5 (52.63, 53.21, 53.81%) and the maximum fruit drop percentage (59.07) % was recoded in Control T_0.

At pre harvest stage minimum fruit drop percentage (70.22) was recorded in treatment T_8 *i.e.* NAA @ 20 ppm + Borax @ 0.2, % followed by T_5, T_{13}, T_{14}, T_9 (71.97, 71.55, 71.64, 71.66) and the maximum fruit drop percentage (75.51) % was recoded in Control T_0.

From results it can be observed that fruit drop percentage significantly reduced by the application of various plant growth regulators and micronutrients. Auxin acts as a facilitator for nutrient mobilization, promoting the translocation of essential resources to developing fruits and other growing parts of the plant. Studies have also shown that boron supplementation can enhance the pollen-producing capacity of anthers and increase pollen viability, leading to improved fruit set, retention and quality in various crops, including mangoes. Adequate boron supply is essential during critical stages of flowering and fruiting to ensure optimal reproductive development and maximize yield (Singh *et al.*, 2020) [60]. Similar results were also obtained by Kanapol *et al.* (2002) [2], Bhowmick *et al.* (2011) [11], and Gurjar *et. al.* (2015) [20] in mango.

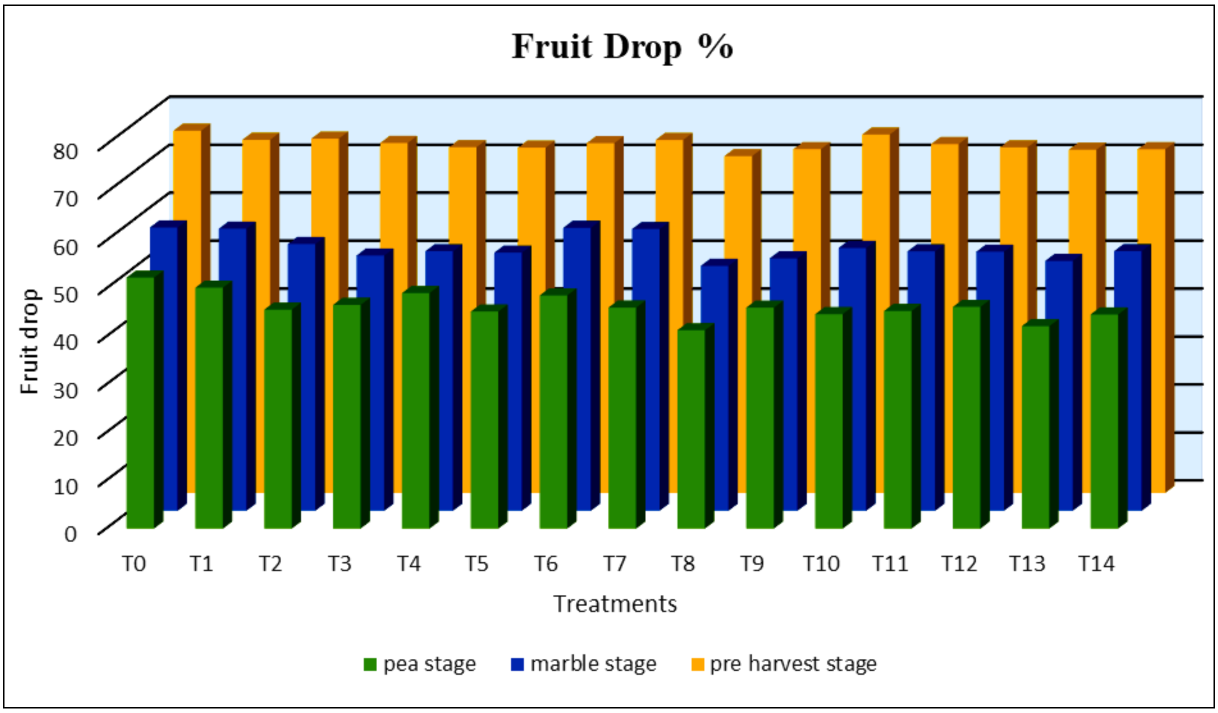

Fig 2: Effect of foliar application of PGR's and micronutrients on fruit drop percentage of mango c.v. Dashehri

Table 4: Effect of PGRs and micronutrients on fruit weight, fruit volume and specific gravity of mango cv. Dashehri

Notations	Fruit weight (g)	Fruit volume (cc)	Specific gravity (g/cc)
T_0	135.74	134.75	1.01
T_1	142.79	137.47	1.04
T_2	143.22	140.44	1.02
T_3	147.13	144.98	1.02
T_4	150.14	147.20	1.02
T_5	146.23	144.17	1.01
T_6	153.66	150.65	1.02
T_7	153.82	152.44	1.01
T_8	159.73	153.61	1.04
T_9	161.65	154.46	1.04
T_{10}	163.37	157.16	1.04
T_{11}	167.93	162.52	1.03
T_{12}	169.49	162.97	1.04
T_{13}	179.06	171.08	1.04
T_{14}	171.46	162.79	1.05
C.D.	2.897	10.921	N/A
SE(m)	0.995	3.75	0.024
SE(d)	1.407	5.304	0.034
C.V.	1.102	4.28	3.983

The maximum fruit weight (179.06 g) was recoded in T_{13} *i.e.* NAA @ 20ppm + $ZnSO_4$ @ 0.5 % followed by T_{14} (171.46), which was at par with T_{12} and T_{11} (169.49 and 167.93). While lowest fruit weight (135.74) was observed under control T_0. This increment in fruit weight due to application of growth regulators NAA can be attributed to the involvement of PGRs in cell division, cell expansion and increased volume of intercellular spaces in mesocrapic cells. It could also be due to higher mobilization of food and minerals from other plant parts towards the developing fruits that are extremely active metabolic sink. The application of NAA might have a role in increasing the auxin level of fruits which in turn helped in the development of fruit components as there is direct correlation between auxin content and fruit growth in several plants. The involvement of zinc in auxin synthesis and boron in translocation of starch to fruits improves fruit length and diameter. The results were also in accordance with the findings of Tsomu T. *et al*. (2019) [72], Haidry *et al.* (1997), Shinde *et al.* (2006) in mango.

The maximum fruit volume (171.08 cc) was recoded in T_{13} *i.e.* NAA @ 20ppm + $ZnSO_4$ @ 0.5 % followed by T_{12} (162.97), which was at par with T_{14} (162.80) and T_{11} (162.52). While the lowest fruit volume recorded (134.75 cc.) in control T_0. The reason behind this is NAA can be attributed to the involvement of PGRs in cell division, cell expansion and increased volume of intercellular spaces in mesocarpic cells. It could also be due to higher mobilization of food and minerals from other plant parts towards the developing fruits that are extremely active metabolic sink. The application of NAA might have a role in increasing the auxin level of fruits which in turn helped in the development of fruit components as there is direct correlation between auxin content and fruit growth in several plants. The results were also in accordance with the findings of Tsomu T. *et al*. (2019) [72], Haidry *et al.* (1997) [23], Shinde *et al.* (2006) [54] in mango.

From the observations it can be concluded that the specific gravity of mango fruits was not significantly influenced by any treatment under investigation. highest specific gravity (1.05 g/cc) was found under T_{13} (NAA @ 20ppm + $ZnSO_4$ @ 0.5 %) and lowest (1.01 g/cc) was noticed under T_0 (control).

Table 4: Effect of PGRs and micronutrients on Quality parameters of mango cv. Dashehri

Notations	TSS	Acidity %	Ascorbic acid (mg/100 g)	Reducing Sugar %	Non Reducing Sugar %	Total Sugar %
T_0	15.8	0.34	39.11	4.46	9.89	14.42
T_1	17.3	0.33	43.08	4.75	10.96	15.72
T_2	17.5	0.32	41.79	4.92	10.16	15.09
T_3	19.03	0.31	40.34	5.5	10.94	16.44
T_4	17.36	0.31	47.09	5.15	9.62	14.77
T_5	18.33	0.28	45.86	4.65	11.52	16.17
T_6	16.83	0.28	44.70	4.55	10.9	15.45
T_7	19.16	0.27	48.01	5.62	11.05	16.68
T_8	19.7	0.25	50.75	4.82	12.22	17.04
T_9	16	0.24	49.62	5.7	12.72	18.42
T_{10}	17.4	0.24	51.85	5.32	12.41	17.74
T_{11}	18.33	0.22	54.12	5.04	13.03	18.08
T_{12}	16.46	0.22	54.60	5.4	11.95	17.35
T_{13}	20.06	0.20	57.19	5.8	13.31	19.11
T_{14}	19.33	0.20	55.84	5.25	13.56	18.81
C.D.	0.362	0.014	0.756	0.045	0.138	0.118
SE(m)	0.124	0.005	0.26	0.015	0.047	0.04
SE(d)	0.176	0.007	0.367	0.022	0.067	0.057
C.V.	1.203	3.105	0.932	0.523	0.704	0.418

From table 4 the highest TSS recorded (20.06) in treatment T_{13} *i.e.* NAA @ 20ppm + $ZnSO_4$ @ 0.5 % which was at par with treatment T_8 and T_{14} (19.7, 19.3), followed by T_7 which is similar to T_3 (19). While lowest TSS (15.8) was recorded in treatment T_0 (control). The increase in TSS may be assigned to hydrolysis of starch content of the fruits in the presence of enzymes, viz., α -amylase, β -amylase and starch phosphorylase, resulting in general increase in TSS (Salisbury and Ross,) and Bhullar *et al*.

The highest acidity percentage (0.34%) was recorded in treatment T_0 (Control). The lowest acidity percentage (0.20) was found in T_{13} *i.e.* NAA @ 20ppm + $ZnSO_4$ @ 0.5 %. Which is similar to T_{14} *i.e*. NAA @ 40ppm + $ZnSO_4$ @ 0.5 %. The reason behind is that utilizing plant growth regulators and micronutrients reduced the titratable acidity content of fresh fruits. This could result from an increase in the metabolic conversion of acids to sugars by the reversal reaction of the glycolytic pathway, which is used in numerous physiological functions, as well as an increase in the translocation of photosynthates (carbohydrates). The similar results were reported by Gupta *et al*. (2022) [69] in litchi, Tripathi (2020) [36] in Aonla.

Ascorbic acid (57.17 mg/100g) was recorded highest under the treatment in T_{13} *i.e.* NAA @ 20ppm + $ZnSO_4$ @ 0.5 %. lowest ascorbic acid content found in T_0 (Control) that is 39.11 mg/100g, which is statistically par with T_3 (40.34) and T_2 (41.79). All other treatments were significantly different from each other. The increase in ascorbic acid might be due to the catalytic influence of growth regulators on its bio-synthesis from its precursor glucose-6-phosphates throughout the development of fruit which is thought to be the precursor of vitamin C. During ripening ascorbic acid in general progressively decreases with an increase in the storage period on account of oxidation of ascorbic acid. The higher value of ascorbic acid content with treatment boron 0.2% might be due to higher level of sugars in boron treated fruit, which increased the content of ascorbic acid, since ascorbic acid is synthesized from sugar. Similar result was observed by Sankar *et al.* (2013) [73] in mango. The results are in accordance with findings of Srivastava and Jain (2013) [46] in mango, Shukla *et al*.

The maximum reducing sugar percentage (5.8) was recorded under treatment T_{13} *i.e.* NAA @ 20ppm + $ZnSO_4$ @ 0.5 %. followed by T_9, T_7, T_3 and T_{12} (5.7, 5.623, 5.5 and 5.4). while lowest reducing sugar percentage (4.46%) recorded under T_0 (Control). Kahlon and Uppal suggested that conversion of starches and polysaccharides into simple sugars with the advancement of storage was responsible for the increase of reducing sugar and onward decline was due to the utilization of sugar in evapotranspiration and other bio chemical activities in mango fruits. These results are in conformity with the findings of Banik *et al.* (1997) [71], Negi and Nkansah *et al.* in mango.

Non-reducing sugar percentage (13.56) was recorded highest under T_{14} (NAA @ 40ppm + $ZnSO_4$ @ 0.5 %). Which was at par with T_{13} and T_{11} (13.31, 13.03), followed by T_9 and T_8 (12.72, 12.22). The lowest non-reducing sugar percentage 9.89 was reported under T_0 (control). Sugar content might be Increased due to degradation of polysaccharides into simple sugars by metabolic activities, conversion of organic acids into sugars, and loss of moisture which subsequently increases total soluble solids. The observations showed that the non-reducing sugar was significantly influenced by various concentration of plant growth regulators as compared with control. The observations are similar with the research work done by Maurya *et al.* (1973) [34] and Singh *et al.* (1979) [63] and Shrivastava and jain (2013) [46].

The highest Total sugar percentage (19.11) was recorded under treatment T_{13} *i.e.* NAA @ 20ppm + $ZnSO_4$ @ 0.5 %. Which was at par with treatment T_{14}, (18.81%) followed by T_{11}, T_9 and T_{10} (18.42, 18.08 and 17.74). While lowest total sugar percentage (14.42) was recorded under treatment T_0 (control). Sugar content might be Increased due to degradation of polysaccharides into simple sugars by metabolic activities, conversion of organic acids into sugars, and loss of moisture which subsequently increases total soluble solids. The observations showed that the non-reducing sugar was significantly influenced by various concentration of plant growth regulators as compared with control. The observations are similar with the research work done by Maurya *et al*. (1973) [34] and Singh *et al.* (1979) [63] and Shrivastava and jain (2013) [46].

Conclusion

Conclusions of the present research work are drawn on the basis of results obtained, which is summarized below:

The foliar application of NAA @ 20 ppm + Borax @ 0.2 % at full bloom, pea and marble stage of mango fruit growth and development significantly enhanced fruit set percentage, fruit retention percentage, minimized the fruit drop percentage and known to gave maximum fruits per panicle and maximized the total yield. The foliar application of NAA @ 20ppm + $ZnSO_4$ @ 0.5 % enhanced fruit length, diameter, weight, and volume of fruit. NAA @ 20ppm + $ZnSO_4$ @ 0.5 % also enhanced pulp weight, peel weight and stone weight of mango c.v. Dashehri. Different qualitative characters like Total soluble solids and ascorbic acid, reducing sugar % and total sugar % enhanced with foliar application of NAA @ 20ppm + $ZnSO_4$ @ 0.5 %. Whereas acidity % of fruit found to be minimum with the spray of NAA @ 20ppm + $ZnSO_4$ @ 0.5 %. By all investigations it can be concluded that the foliar application of NAA @ 20 ppm + Borax @ 0.2 % and NAA @ 20ppm + $ZnSO_4$ @ 0.5 % were found to be optimum concentrations which showed best results by increasing yield and physico-chemical properties of mango fruit cv. Dashehri.

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