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EFFECT OF PLANT GROWTH REGULATORS ON QUALITY-ATTRIBUTING CHARACTERS OF SAPOTA [MANILKARA ACHRAS (MILL.) FORSBERG] CV. CRICKET BALL UNDER AGRO-CLIMATIC CONDITIONS OF CHHATTISGARH PLAINS

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ABSTRACT
The experiment were carried out during the years 2020-21 and 2021-22 at the experimental field of the Horticulture Instructional Farm, Department of Fruit Science, College of Agriculture, IGKV, Raipur (C.G.). The experiment was laid out in a Randomized Block Design with twenty-five treatment combinations, each replicated thrice. The results were observed during both years of consecutive experiment and data on chemical parameters such as, total soluble solids (21.65 ^{0}Brix), total sugar (16.80%), reducing sugar (10.40%), non-reducing sugar (6.40%), ascorbic acid content (13.43 mg/100g), fruit moisture (75.41%), pH (5.39) and pulp/ Seed ratio (24.96) of sapota fruits were proved maximum values with the applications of NAA @ 200 ppm. However, the acidity content (0.112%) of sapota fruit was observed the minimum with the applications of NAA @ 200 ppm.

KEYWORDS: Manilkara achras, NAA, GA_3, total soluble solids, chemical parameters

1. INTRODUCTION
Sapota (Manilkara achras (Mill.) Farsberg, syn. Linn.) .) belongs to the family Sapotaceae and is a native of Mexico. It is known by several names in different regions, such as Chiku, Sapodilla, Zapata, and Sapodilla plum. It has also taken root in India's coastal tropics, where it is sometimes considered a native crop. Sapota's chromosome number is 2n=26. The Sapotaceae family, which comprises 50 genera and 1200 species, is tropical. (Armstrong et al. 2012).. Probably, the first seedling plantation of sapota in India was evident in Gholwad village of Dahnu taluk, Thane district, Maharashtra in 1898 (Chundawat, 1998). Base material for chewing gum, i.e. Chickle gum, is also extracted from the bark of the sapota tree, which is also used in dental surgery. It is a good source of digestible sugar, which ranges from 12 to 18 per cent. The composition of ripe sapota per 100 g of edible portion is moisture 73.7 g, energy Kcal 98, carbohydrates 21.4 g, protein 0.7 g, fat 1.1 g, calcium 28.0 mg, iron 1.3 mg and phosphorus27.0 mg. These are the major chemical and nutritional compounds of sapota fruits as reported by Kulkarni et al. (2007). It is a climacteric fruit and perishable in nature. The fruit is taken only when fully ripe, when it is delightful and sweet, as it is not edible when it is immature. India is the leading producer of sapota. The area under sapota in India is 1,07,000 ha and production is 12,94,000 MT (Anon., 2019). The area is increasing due to continuous fruiting throughout the year in a humid climate and the hardy nature of the crop against biotic and abiotic stresses. Therefore, it becomes the most popular fruit crop of the coastal region of the states of Gujarat, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh and Kerala.
In Chhattisgarh, the total area under sapota is 340 hectares with an annual production of 1578 metric tonnes (Anon., 2019). Sapota bears heavy flushes all over the year in the Indian subcontinent, but not all the flowers develop into fruit, and not all the fruits reach maturity. Wind plays a main role in pollination and affects the drop of flowers and fruits at various stages of development, starting from flowering to fruit set and maturity. This may be due to several reasons, particularly low auxin levels in the ovary just after fruits set or due to unexpected changes in temperatures, low temperatures (December) and high temperatures (May-June). Growth-regulating chemicals regulate all the developmental stages of the crop from seed germination to maturity and ripening of fruits. (Panigrahi et al. 2011).

2. MATERIAL AND METHODS
2.1 Experimental Set Up - The experiment was conducted on twenty-year-old, healthy, vigorous and uniformly grown sapota trees of cv. Cricket Ball spaced at 10 x 10 metres. The spraying was done in the third week of August at 50 per cent flowering stage and in the last week of September at pea stage in both the years. All the plants were nourished uniformly by providing similar cultural practices such as ploughing, harrowing, fertilisation, irrigation and plant

protection measures during the entire period of studies. The required volume of cycocel was taken and mixed in distilled water, whereas GA and NAA were prepared by dissolving 0.1g of PGR's in a small quantity of ammonia solvent, and the volume was made up to 1 litre by adding water to obtain a concentration of 100 ppm required quantity of solution was taken from the stock solution for preparing different concentrations of plant growth regulator solutions. The treatments consisted of different concentrations of plant growth regulators, as shown below (Table no. 1):

Treatments	PGRs and its Concentrations	Spraying at stages
T_0	control	--------
T1	NAA @ 100 ppm	at 50 per cent flowering stage
T2	NAA @ 100 ppm	at pea stage
T3	NAA @ 100 ppm	at 50 per cent flowering + pea stage
T4	NAA @ 200 ppm	at 50 per cent flowering stage
T5	NAA @ 200 ppm	at pea stage
T6	NAA @ 200 ppm	at 50 per cent flowering + pea stage
T7	GA_3 @ 100 ppm	at 50 per cent flowering stage
T8	GA_3 @ 100 ppm	at pea stage
T9	GA_3 @ 100 ppm	at 50 per cent flowering + pea stage
T10	GA_3 @ 150 ppm	at 50 per cent flowering stage
T11	GA_3 @ 150 ppm	at pea stage
T12	GA_3 @150 ppm	at 50 per cent flowering + pea stage
T13	Ethrel @ 500 ppm	at 50 per cent flowering stage
T14	Ethrel @ 500 ppm	at pea stage
T15	Ethrel @ 500 ppm	at 50 per cent flowering + pea stage
T16	Ethrel @ 1000 ppm	at 50 per cent flowering stage
T17	Ethrel @ 1000 ppm	at pea stage
T18	Ethrel@ 1000 ppm	at 50 per cent flowering + pea stage
T19	Cycocel @ 200 ppm	at 50 per cent flowering stage
T20	Cycocel @ 200 ppm	at pea stage
T21	Cycocel @ 200 ppm	at 50 per cent flowering+ pea stage
T22	Cycocel @ 400 ppm	at 50 per cent flowering
T23	Cycocel @ 400 ppm	at pea stage
T24	Cycocel @ 400 ppm	at 50 per cent flowering + pea stage

2.2 Statistical Analysis - For recording of data, the fruits of different treatments were harvested at marketable size, and various parameters were analysed by following a Randomised Block Design for each year and ultimately the pooled estimates for both the years were worked out, having twenty-five treatments, which were replicated thrice. The statistical analysis was carried out for each observed character under the study using MS-Excel, Operational Statistics. The data were analysed as per the book by Gomez and Gomez (1984).

2.3 Tree Characters - For biochemical analysis, fruits were peeled, and flesh was homogenised in a blender. Biochemical analysis of the fresh fruit pulp was carried out. A hand refractometer was used to determine the total soluble solids (^{0}Brix), acidity (%), total sugar (%), reducing sugar (%), non-reducing sugar (%), ascorbic acid (mg/100g), fruit moisture (%), pH, andpulp/ seed ratio were also recorded as per protocol. All data were subjected to statistical analysis as per methods advocated by Gomez and Gomez (1984).

2.4 Biochemical analysis-

Total soluble solids (^{0}Brix): The pulp was extracted and filtered through muslin cloth and pressed to drop a drop on the glass of the instrument. Total soluble solids of five randomly selected fruits were measured by using a hand refractometer. The total soluble solids were directly read from the refractometer.

Acidity (%): Acidity of fruit pulp was calculated by titrating the diluted pulp against standard 0.1 N NaOH solution using phenolphthalein as an indicator. The end point appeared as a light pink colour and was expressed in percentage as per the procedure given by Ranganna (1997).

$$\text{Acidity (\%)} = \frac{\text{Titre of alkali} \times \text{Normality} \times \text{Volume made up} \times \text{Equivalent wt. of acid} \times 100}{\text{Volume of sample taken for estimation} \times \text{Wt. or volume of sample taken} \times 1000}$$

Total sugar (%): For estimation of total sugar, 5 ml each of Fehling's A and Fehling's B solution were taken in a 250 ml conical flask, followed by addition of 40 ml of distilled water and then heated over flame. When the first bubble appeared, it was titrated against the sapota Juice (taken in the burette) after adding 2 to 3 drops of methylene blue indicator. The content was titrated till a brick red colour was obtained (Ranganna, 1997). The total sugar was expressed in per cent and calculated by the following formula:

$$\text{Total sugar (\%)} = \frac{\text{Mg of Invert sugar x Dilution x 100}}{\text{Titre x Wt or volume of the sample taken x 100}}$$

Reducing sugar (%): The reducing sugar, when heated with an alkaline cupric hydroxide present in Fehling's solution, reduces the copper from the cupric to cuprous state and thus cuprous oxide is formed as precipitate (brick red colour). Formation of the coloured precipitate indicates the presence of reducing sugar in the solution. For estimation of reducing sugar, 10 ml freshly extracted filtrate juice was taken in a 100 cc volumetric flask, and the volume was made up to 100 ml by adding the required amount of distilled water. The entire content was then transferred to a 100 ml burette. In a 250 ml capacity conical flask, 5 ml each of Fehling solution A and B solution were taken, and 40 ml distilled water was added to it. Then the contents were mixed thoroughly. After thorough mixing, the flask was put over a gas burner for heating. When the first bubbles came out, 2 to 3 drops of methylene blue indicator were added to it. Then it was titrated against the sample in the burette till the end point came to a brick red colour (Ranganna, 1997). The reducing sugar was expressed in per cent and calculated by the following formula:

$$\textbf{Reducing sugar (\%)} = \frac{\text{Mg of Invert sugar x Dilution x 100}}{\text{Titre x Wt or volume of the sample taken x 100}}$$

Non-reducing sugar (%): Non-reducing sugar was determined by subtracting the value of reducing sugar from total sugar, and the final value was calculated.

Ascorbic acid (mg/100g): 5 mL L-ascorbic acid solution with the same amount of HPO_3 was titrated against 2, 6-dichlorophenol-indophenol. The end point was judged by a light pink colour. The dye factor was determined as follows:

$$\text{Dye factor} = \frac{0.5}{\text{Titre}}$$

Standard ascorbic acid solution with HPO_3 solution was titrated against the dye solution till the pink colour appeared.

3. RESULTS AND DISCUSSION

Biochemical attributes of fruit

Total soluble solids (^{0}Brix):

Results based on pooled data (Table 2), the maximum total soluble solids (21.65 °Brix) was noticed under the superiority of treatment T6 (NAA @ 200 ppm at 50 per cent flowering + pea stage), which was found non-significant differences with the treatments T12, T9, T3, T4, T7, T8, T5, T2, T1, T11, T24, T18, T10, T22 and T23 having total soluble solids 21.38, 21.33, 21.25, 21.23, 21.16, 21.15, 21.13, 21.12, 21.12, 21.10, 21.08, 20.78, 20.75, 20.69 and 20.66 °Brix, respectively under the present investigation. Similarly, the treatments T16, T17, T13, T14 & T15 having respective total soluble solids 19.11, 19.27, 19.27, 19.29 & 19.54 °Brix, were also recorded statistically similar at 5% level of significance under the present trial. The minimum total soluble solids (18.43 °Brix) were observed under the treatment T_0 (control). The increased total soluble solids might be the result of more accumulation of metabolites and quick conversion of starch into soluble sugars during fruit development in response to GA_3 and NAA. The above results were in agreement with those of Chavanet al. (2009), Agrawal and Dikshit (2010), Vidhya et al. (2017), Sahu et al. (2018) and Singh et al. (2020) in sapota, Shikhamany and Reddy (2000) in grape, Singh et al. (2012) in litchi, Anawal et al. (2015) in pomegranate and Sweety et al. (2018) in sweet orange.

Acidity (%):

The data presented in Table 2 revealed that results of acidity followed the same trend in the light of pooled data showing the minimum acidity (0.112%) was noticed under the superiority of treatment T6 (NAA @ 200 ppm at 50 per cent flowering + pea stage), which also showed non-significant differences with the treatment T12, T9, T10, T3, T24, T18, T5, T17, T11, T8, T1, T4, T21, T15, T7, T2, T23, T16, T19, T22, T13, T14, T20 and T0 having respective acidity 0.118, 0.122, 0.125, 0.125, 0.128, 0.128, 0.128, 0.133, 0.135, 0.135, 0.135, 0.137, 0.138, 0.138, 0.138, 0.138, 0.143, 0.145, 0.147, 0.148, 0.152, 0.157, 0.150 and 0.163 per cent, were also recorded statistically at par at 5% level of significance under the present trial. The maximum acidity (0.163%) was noticed under the treatment T_0 (control). The decrease in acidity due to application of growth regulators may also be attributed to early maturity and rapid utilisation of organic acids during respiration after harvesting. The above findings are in close conformity with the results of Chavan et al. (2009), Harsimrat et al. (2016), Sahu et al. (2018), Kavyashree et al. (2018), Singh et al. (2020) in sapota, Hazarika et al. (2016) and Dubey et al. (2020) in papaya.

Total sugar (%)

As per the result of the pooled data (Table 2) is concerned, the maximum total sugar (16.80%) was noticed under the superiority of treatment T6 (NAA @ 200 ppm at 50 per cent flowering + pea stage), which was found non-significant differences with the treatments T12, T14 and T13 with total sugar 16.43, 16.20 and 15.98 14.15, respectively under the

present investigation. Similarly the treatments T17, T15, T23, T8, T4, T7, T11, T22, T21, T5, T10, T9 & T18 and T14, T13, T20, T19, T1, T16, T2 & T17 having respective total sugar 14.36, 14.43, 14.44, 14.62, 14.78, 14.82 & 14.87 14.15, were also recorded statistically similar at 5% level of significance under the present trial. The minimum total sugars (13.38%) were observed under the treatment T_0 (control). The data revealed that total sugar increased with increasing levels of NAA and GA_3. The possible reason for increased total sugar content by use of NAA and GA_3 might be due to faster conversion of starch into simple sugars and their mobilisation during fruit development. The increased level of sugar was also possibly due to ripening of fruits, which is associated with high metabolic changes in fruit leading to conversion of complex polysaccharides into simple sugars. Similar findings have also been obtained by Sharma and Tiwari (2015), Jain et al. (2020) and Akshay et al. (2020) in sapota, Gurjar et al. (2017) in mango, Prajapati and Singh (2019) in guava and Anawal et al. (2015) in pomegranate.

Reducing sugar (%):
Findings obtained based on pooled data (Table 2), the maximum reducing sugar (10.40%) was registered under the treatment T6 (NAA @ 200 ppm at 50 per cent flowering + pea stage), which was found significantly at par with the treatments T24, T12, T3, T5, T18, T9, T10 and T23 having respective reducing sugar 10.26, 10.20, 9.98, 9.98, 9.89, 9.80, 9.80 and 9.78 per cent under the present investigation. Similarly the treatments T14, T20, T19, T13, T16, T1, T4, T15, T17, T2, T7, T11, T21, T22, T8 & T23 having respective reducing sugar 9.04, 9.10, 9.16, 9.27, 9.32, 9.34, 9.44, 9.47, 9.48, 9.49, 9.56, 9.58, 9.59, 9.63, 9.66 & 9.78 per cent, were also recorded statistically similar at 5% level of significance under the present investigation. The minimum reducing sugar (8.74%) was noticed under the treatment T_0 (control). This might be due to the use of GA_3 and NAA, which accelerates the hydrolysis of starch into simple sugars faster and their mobilisation during fruit development. The above findings are in close conformity with the results of Kulkarni et al. (2007), Chavan et al. (2009), Barkule et al. (2017), Garhwal (2015) and Jain et al. (2020) in sapota, Karole and Tiwari (2016) in ber and Garasiya et al. (2013) in guava.

Non-reducing sugar (%):
Results about non-reducing sugar followed the same trend in the light of pooled data (Table 2) showing maximum (6.40%) was noticed under the treatment T6 (NAA @ 200 ppm at 50 per cent flowering + pea stage), which was found non-significant with the treatments T12, T21, T3, T24, T9, T10, T18, T22, T11, T4, T5, T7 and T15 having respective non-reducing sugar 6.23, 6.02, 6.00, 5.94, 5.92, 5.89, 5.88, 5.85, 5.85, 5.78, 5.70, 5.67 & 5.64 per cent under the present investigation. Similarly the treatments T14, T19, T1, T20, T2, T17, T23, T16, T8, T15, T7, T5, T4, T11, T22, T18, T10 & T9 having respective non-reducing sugar 5.10, 5.27, 5.28, 5.32, 5.32, 5.41, 5.41, 5.46, 5.55, 5.64, 5.67, 5.70, 5.78, 5.85, 5.85, 5.88, 5.89 & 5.92 per cent, were also recorded statistically similar at 5% level of significance under the present trial. The minimum non-reducing sugar (4.63%) was observed under the treatment T_0 (control). It might be due to a rapid increase in total sugar (starch), a simultaneous decrease in non-reducing sugar (Sucrose) and a progressive rise in the content of reducing sugars. Similar findings have also been obtained by Garhwal (2015) and Kavyashree et al. (2018) in sapota, Sharma and Tiwari (2015) in guava, Neware et al. (2015) in sweet orange, Kishor et al. (2016) in pomegranate and Gami et al. (2019) in ber.

Ascorbic acid (mg/100g):
As per the result of the pooled data (Table 3) is concerned, the maximum ascorbic acid (13.43 mg/100g) was noticed under the superiority of treatment T6 (NAA @ 200 ppm at 50 per cent flowering + pea stage), which was found significantly at par with the treatments T3 having respective ascorbic acid (13.21 mg/100g) under the present trial. Similarly the treatments T21, T18, T9, T2, T24, T1, T4, T5 & T12 and T19, T16, T20, T17, T22, T15, T7, T23, T8, T10 & T11 having respective ascorbic acid 12.16, 12.33, 12.40, 12.46, 12.47, 12.53, 12.65, 12.67 & 12.73 and 11.40, 11.51, 11.53, 11.55, 11.71, 11.72, 11.73, 11.83, 11.83, 11.89 & 11.99 mg/100g, were also recorded statistically similar at 5% level of significance under the present study. The minimum ascorbic acid (11.25 mg/100g) was registered under the treatment T0 (control). The possible reason for increased ascorbic acid by use of NAA and GA_3 might be due to perpetual synthesis of glucose-6-phosphate throughout the growth and development of fruit, which is thought to be a precursor of vitamin C. Secondly NAA and GA_3 increased cell size and intercellular spaces coupled with accumulation of water, sugar and other soluble solids in greater amount as a result of translocation of metabolites towards the fruits which ultimately enhanced ascorbic acid content in fruit. The above findings are in close conformity with the results of Agrawal and Dikshit (2010) and Sahu et al. (2018) in sapota, Garasiya et al. (2013) in guava, Singh et al. (2018) in papaya, Prajapati and Singh (2019) in guava and Gami et al. (2019) in ber.

Fruit moisture (%)
Findings obtained based on pooled data (Table 3), the maximum fruit moisture (75.41%) was registered under the treatment T9 -GA_3 @ 100 ppm at 50 % flowering + pea stage, which also showed statistically at par with the treatment T12, T6, T3, T11 and T7 having respective specific gravity 74.69, 73.88, 73.42, 73.38and 73.34per cent, were also recorded statistically similar at 5% level of significance under the present study, while the minimum fruit moisture 68.54%, were observed under control. The increased total soluble solids might be the result of more accumulation of metabolites and quick conversion of starch into soluble sugars during fruit development in response to GA_3 and NAA. The above results were in agreement with those of Panigrahi et al. (2011) and Singh et al. (2020) in sapota.

pH :

Based on pooled data (Table 3), the maximum pH 5.39 was noticed under the superiority of treatment T6 -NAA @ 200 ppm at 50 % flowering + pea stage, which was found to have non-significant differences with the treatments T3, T15, T4, T16, T5, & T7 having reducing sugar 5.385, 5.383, 5.373, 5.363, respectively. However, the minimum pH 5.07 was registered under control. The present findings are in close conformity with the results of Kulkarni et al. (2007) in sapota.

Pulp/ Seed ratio:

As per the result of the pooled data (Table 3), the maximum pulp/ Seed ratio of 24.96 was registered under the superiority of treatment T12 -GA_3 @ 150 ppm at 50 % flowering + pea stage, which was found statistically on par with the treatment T9 having a respective pulp/ seed ratio of 23.98 under the present investigation. The minimum pulp/ Seed ratio of 15.44 was noticed under control. The possible reason for the increased pulp/ Seed ratio by use of NAA and GA_3 might be due to perpetual synthesis of glucose-6-phosphate throughout the growth and development of fruit, which is thought to be a precursor of vitamin C. The above findings are in close conformity with the results of Agrawal and Dikshit (2010) and Sahu et al. (2018) in sapota.

Table. 2: Effect of foliar spray of different concentrations of plant growth regulators based on pooled data of total soluble solids (^{0}Brix), acidity (%), total sugar (%), reducing sugar (%) and non-reducing sugar (%)of sapota cv. Cricket Ball.

Treatments	Total soluble solids (^{0}Brix)	Acidity (%)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)
T_0 - Control (water spray)	18.43	0.16	13.38	12.32	87.47
T1 - NAA @ 100 ppm at 50% flowering stage	21.12	0.13	14.62	21.43	78.56
T2 - NAA @ 100 ppm at pea stage	21.12	0.13	14.82	20.49	79.50
T3 -NAA @ 100 ppm at 50% flowering + pea stage	21.25	0.12	15.98	24.83	75.13
T4 -NAA @ 200 ppm at 50% flowering stage	21.23	0.13	15.22	23.45	76.46
T5 -NAA @ 200 ppm at pea stage	21.13	0.12	15.68	23.61	77.31
T6 -NAA @ 200 ppm at 50% flowering + pea stage	21.65	0.11	16.80	26.34	74.13
T7 - GA_3 @ 100 ppm at 50% flowering stage	21.16	0.13	15.23	18.49	81.88
T8 -GA_3 @ 100 ppm at pea stage	21.15	0.13	15.22	18.38	81.69
T9 -GA_3 @ 100 ppm at 50% flowering + pea stage	21.33	0.12	15.73	20.13	80.10
T10 -GA_3 @ 150 ppm at 50% flowering stage	20.75	0.12	15.69	18.84	80.95
T11 -GA_3 @ 150 ppm at pea stage	21.10	0.13	15.44	18.50	81.24
T12 -GA_3 @ 150 ppm at 50% flowering + pea stage	21.38	0.11	16.43	20.29	79.06
T13 -Ethrel @ 500 ppm at 50% flowering + pea stage	19.27	0.15	14.36	13.53	86.37
T14 -Ethrel @ 500 ppm at pea stage	19.29	0.15	14.14	12.97	85.85
T15 -Ethrel @ 500 ppm at 50% flowering + pea stage	19.54	0.13	15.11	14.61	86.24
T16 -Ethrel @ 1000 ppm at 50% flowering stage	19.11	0.14	14.78	13.24	85.63
T17 -Ethrel @ 1000 ppm at pea stage	19.27	0.13	14.87	13.53	86.23
T18 -Ethrel @ 1000 ppm at 50% flowering + pea stage	20.78	0.12	15.78	15.14	84.87
T19 -Cycocel @ 200 ppm at 50% flowering stage	20.58	0.14	14.44	15.75	84.59
T20 -Cycocel @ 200 ppm at pea stage	20.57	0.15	14.43	14.90	85.09
T21 -Cycocel @ 200 ppm at 50% flowering+ pea stage	20.59	0.13	15.61	16.76	83.27
T22 -Cycocel @ 400 ppm at 50% flowering stage	20.69	0.1	15.49	15.87	84.13
T23 -Cycocel @ 400 ppm at pea stage	20.66	0.14	15.20	15.37	84.62
T24 -Cycocel @ 400 ppm at 50% flowering + pea stage	21.08	0.12	16.20	17.82	82.17
SE(m)±	0.27	0.004	0.23	0.42	0.55
CD at 5%	0.77	0.012	0.66	1.20	1.59

The superscript letter indicates that the treatment means with same letters are at par at 5% level of significance, while the means with different letters are significantly different at 5% level. These letters have been affixed based on CD-value comparison of treatment means.

Table. 3: Effect of foliar spray of different concentrations of plant growth regulators based on pooled data of ascorbic acid (mg/100g), fruit moisture (%), pH and pulp/ seed ratio of sapota cv. Cricket Ball.

Treatments	Ascorbic acid (mg/100g)	Fruit moisture (%)	pH	Pulp/ Seed ratio
T_0 - Control (water spray)	11.29	68.54	5.07	15.44
T1 - NAA @ 100 ppm at 50% flowering stage	12.53	72.32	5.35	21.76
T2 - NAA @ 100 ppm at pea stage	12.46	71.85	5.34	21.70
T3 -NAA @ 100 ppm at 50% flowering + pea stage	13.21	73.42	5.38	23.42

T4 -NAA @ 200 ppm at 50% flowering stage	12.65	71.74	5.37	23.02
T5 -NAA @ 200 ppm at pea stage	12.67	72.43	5.36	22.94
T6 -NAA @ 200 ppm at 50% flowering + pea stage	13.43	73.88	5.39	23.27
T7 - GA_3 @ 100 ppm at 50% flowering stage	11.73	73.34	5.36	23.21
T8 -GA_3 @ 100 ppm at pea stage	11.83	72.67	5.31	22.48
T9 -GA_3 @ 100 ppm at 50% flowering + pea stage	12.40	75.41	5.35	23.98
T10 -GA_3 @ 150 ppm at 50% flowering stage	11.89	72.67	5.34	23.59
T11 -GA_3 @ 150 ppm at pea stage	11.99	73.38	5.33	23.62
T12 -GA_3 @ 150 ppm at 50% flowering + pea stage	12.73	74.69	5.35	24.96
T13 -Ethrel @ 500 ppm at 50% flowering + pea stage	11.26	70.18	5.31	17.81
T14 -Ethrel @ 500 ppm at pea stage	11.32	69.47	5.30	17.99
T15 -Ethrel @ 500 ppm at 50% flowering + pea stage	11.72	71.36	5.38	19.24
T16 -Ethrel @ 1000 ppm at 50% flowering stage	11.51	69.54	5.37	18.78
T17 -Ethrel @ 1000 ppm at pea stage	11.55	70.36	5.32	18.83
T18 -Ethrel @ 1000 ppm at 50% flowering + pea stage	12.33	71.58	5.35	21.27
T19 -Cycocel @ 200 ppm at 50% flowering stage	11.40	71.24	5.30	18.71
T20 -Cycocel @ 200 ppm at pea stage	11.53	70.63	5.29	19.22
T21 -Cycocel @ 200 ppm at 50% flowering+ pea stage	12.16	72.27	5.33	20.10
T22 -Cycocel @ 400 ppm at 50% flowering stage	11.71	70.64	5.32	19.55
T23 -Cycocel @ 400 ppm at pea stage	11.83	71.25	5.31	20.48
T24 -Cycocel @ 400 ppm at 50% flowering + pea stage	12.47	72.43	5.34	21.56
SE(m)±	0.10	0.03	0.009	0.53
CD at 5%	0.30	0.08	0.026	1.51

The superscript letter indicates that the treatment means with same letters are at par at 5% level of significance, while the means with different letters are significantly different at 5% level. These letters have been affixed based on CD-value comparison of treatment means.

4. CONCLUSION

The experiment clearly demonstrated that sprays of plant growth regulators could influence the biochemical constituents in sapota cultivar Cricket Ball. viz., total soluble solids, total sugar, reducing sugar, non-reducing sugar, ascorbic acid, fruit moisture (%), pH and Pulp/ Seed ratio were also found significantly influenced by the application of NAA @ 200 ppm at 50 per cent flowering + pea stage of fruit development as compared to control. However, the acidity content of sapota fruit was significantly reduced under the same treatments. An intensive study should be made on the effect of different concentrations of plant growth regulators on biochemical parameters of fruit. The most appropriate concentration and their time of application should be standardised for different cultivars of sapota.

DISCLAIMER (ARTIFICIAL INTELLIGENCE):

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS:

Authors have declared that no competing interests exist.

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