

Original Research Article

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## Effect of Pre-harvest Spray of Nutrients and Growth Regulators on Quality Parameters of Sapota under Hill Zone of Karnataka, India

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### ABSTRACT

#### Keywords

Sapota, Pre-harvest, CaNO<sub>3</sub>, Total soluble solids

#### Article Info

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An experiment was carried out at Department of Fruit science, College of Horticulture-Mudigere, University of Agricultural and Horticultural Sciences, Shivamogga during 2017-18. The objective of this study was to determine the effect of pre-harvest spray of nutrients and growth regulators on quality parameters of sapota under hill zone of Karnataka. This experiment was laid out in randomized complete block design with fifteen treatments and three replications. The chemicals were sprayed on selected sapota trees at two intervals i.e. 1<sup>st</sup> spray at 40 days before the harvest and 2<sup>nd</sup> spray at 20 days after the first spray and the harvested fruits were stored in the laboratory at room temperature. The results revealed that pre-harvest application of CaNO<sub>3</sub> (1%) or CaNO<sub>3</sub> (1.5%) were found effective for increasing total soluble solids, total sugar, reducing sugar, non-reducing sugar, ascorbic acid with minimum acidity of sapota fruits.

### Introduction

Sapota (*Manilkara achras* Mill.) is tropical fruit, belongs to the family sapotaceae. It is popularly known by several names such as chiku in India, sapodilla, zapota or sapodilla plum in different regions of the world. It is native to Mexico and tropical America. India is considered to be the largest producer of sapota in the world and it is mainly cultivated for its delicious fruits. In India, the major sapota growing states are Maharashtra,

Gujarat, Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal, Uttar Pradesh, Punjab and Haryana. Among all the states, Karnataka is the leading sapota producing state and contributes to about 26.5 per cent of the total production in the country (NHB 2016-17). Sapota is a climacteric fruit and exhibits a sudden rise in respiration after harvest (Chundawat, 1998). The shelf life of the sapota fruit deteriorates as soon as the climacteric peak is reached.

Plant growth regulators as pre-harvest treatments have proved to be a useful tool in delaying fruit ripening. Auxins, gibberellins and cytokinins are independently or in combination are known to resist the fruit senescence by interfering the action of ethylene production during ripening (Sacher, 1973). Among various plant nutrients, calcium has its desirable effect in delaying ripening and senescence, increase in firmness, vitamin C and phenolic contents. Potassium has also received considerable attention due to enhanced production of protein, thus it improves the efficiency of nitrogenous fertilizer and increases the ability of plants to withstand stress condition. Boron is another chemical nutrient which plays major role in cell division, cell wall strengthening and development, fruit and seed development. Hence adequate boron nutrition is critical for getting high yield and quality of sapota. Therefore the present investigation was carried out to assess the response of pre-harvest spray of chemicals and plant growth regulators on quality attributes of sapota.

### Materials and Methods

The present investigation was carried out at sapota orchard, College of Horticulture Mudigere, Chikamagalur during 2017-18. The experiment was laid out in randomized complete block design with three replications and fifteen treatments. The uniform sized sapota trees were marked and sprayed with different nutrients and plant growth regulators *viz.*, T<sub>1</sub>- control, T<sub>2</sub>-GA<sub>3</sub> 200ppm, T<sub>3</sub>- GA<sub>3</sub> 300ppm, T<sub>4</sub>- Kinetin 50ppm, T<sub>5</sub>- Kinetin 100ppm, T<sub>6</sub>- 2,4-D 10ppm, T<sub>7</sub>- 2,4-D 20ppm, T<sub>8</sub>- Boron 0.2%, T<sub>9</sub>- Boron 0.4%, T<sub>10</sub>- CaCl<sub>2</sub> 1%, T<sub>11</sub>- CaCl<sub>2</sub> 1.5%, T<sub>12</sub>- Ca(NO<sub>3</sub>)<sub>2</sub> 1%, T<sub>13</sub>- Ca(NO<sub>3</sub>)<sub>2</sub> 1.5%, T<sub>14</sub>- KCl<sub>2</sub> 0.5% and T<sub>15</sub>- KCl<sub>2</sub> 1% at two intervals i.e 40 days before harvest and 20 days after 1<sup>st</sup> spray. The fruits were harvested when colour of the fruit turned to light brown i.e potato colour. The harvested

fruits were brought to the laboratory and two kilograms of sapota fruits for each treatment were kept for observation at room temperature in the laboratory. The fruits were assessed at 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> day of storage for TSS, acidity, total sugar, reducing sugar, non-reducing sugar and ascorbic acid.

### Results and Discussion

Total soluble solids (Table 1) increased initially up to 9<sup>th</sup> day of storage period in all the treatments and later on declined up to end of storage. The maximum TSS (19.67, 21.33, 24.97 and 23.81 °Brix) was recorded by treatment T<sub>12</sub> (CaNO<sub>3</sub> @ 1 %) which was on par with treatment T<sub>13</sub> (CaNO<sub>3</sub> @ 1.5%) i.e. 19.63, 20.97, 24.93 and 23.67 °Brix, respectively at 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> day of storage period. At 9<sup>th</sup> day onwards control fruits showed more shriveling and loss of appearance hence fruits were discarded.

The increase in TSS during initial storage period might be due to hydrolysis of starch into sugar on complete hydrolysis of starch no further increases occur and subsequently decline in TSS is predictable. Similar findings have been reported by Jawandha *et al.*, (2007) and Yadav *et al.*, (2009) in ber, Rajput *et al.*, (2008) in guava, Ramezani *et al.*, (2009) in pomegranate, Bhalerao *et al.*, (2010) in sapota, Karemera and Habimana (2014) in mango and Kirmani *et al.*, (2015) in Plum.

Data on titratable acidity showed non-significant differences among all the treatments of sapota fruit under ambient condition (Table 1). Nevertheless, acidity showed decrease during the storage period, the decline in acidity might be due to the conversion of acid into sugar. The similar result on acidity was also reported by Gupta *et al.*, (1987) in ber, Jayachandran *et al.*, (2005) in guava and Bhalerao *et al.*, (2010) in sapota.

The present investigation exhibited a continuous decline in the ascorbic acid content of fruit with the increased storage duration. Data (Table 2) on ascorbic acid revealed that under ambient condition, the highest ascorbic acid (23.86, 19.11, 15.38 and 9.64 mg /100g pulp) at 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> day of storage period, respectively was recorded in treatment T<sub>12</sub> (CaNO<sub>3</sub> @ 1 %) which, remained at par with treatment T<sub>13</sub>

(CaNO<sub>3</sub> @ 1.5%) i.e. 23.85, 19.07, 13.50 and 9.61 mg /100 g pulp at 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> day of storage period, respectively.

The gradual reduction in ascorbic acid content during entire storage period might be due to its degradation through enzymatic oxidation of L-ascorbic acid to dehydro ascorbic acid during metabolic processes.

**Table.1** Effect of pre-harvest foliar application of nutrients and plant growth regulators on Total soluble solids and Titratable acidity of sapota at different days after harvest

Treatments	Total soluble solids ( <sup>o</sup> Brix)				Titratable acidity (%)			
	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	12 <sup>th</sup> day	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	12 <sup>th</sup> day
T <sub>1</sub> - Control	16.57	18.17	22.10	--	0.24	0.19	0.14	--
T <sub>2</sub> - GA <sub>3</sub> at 200 ppm	18.27	19.93	23.47	21.24	0.19	0.16	0.11	0.08
T <sub>3</sub> - GA <sub>3</sub> at 300 ppm	17.93	19.70	23.30	20.32	0.14	0.16	0.11	0.08
T <sub>4</sub> - Kinetin at 50 ppm	17.73	19.43	22.73	20.23	0.21	0.19	0.13	0.06
T <sub>5</sub> - Kinetin at 100 ppm	16.83	19.40	22.40	19.25	0.21	0.19	0.13	0.08
T <sub>6</sub> - 2,4-D at 10 ppm	18.63	20.03	24.03	--	0.19	0.14	0.11	--
T <sub>7</sub> - 2,4-D at 20 ppm	18.53	20.00	23.87	--	0.19	0.16	0.11	--
T <sub>8</sub> - Boron at 0.2%	19.13	20.63	24.27	--	0.16	0.13	0.08	--
T <sub>9</sub> - Boron at 0.4%	18.83	20.40	24.26	--	0.16	0.13	0.08	--
T <sub>10</sub> - CaCl <sub>2</sub> at 1%	19.47	20.67	24.77	23.53	0.14	0.11	0.08	0.05
T <sub>11</sub> - CaCl <sub>2</sub> at 1.5%	19.37	20.65	24.30	22.87	0.16	0.11	0.08	0.05
T <sub>12</sub> - CaNO <sub>3</sub> at 1%	19.67	21.33	24.97	23.81	0.13	0.11	0.08	0.05
T <sub>13</sub> - CaNO <sub>3</sub> at 1.5%	19.63	20.97	24.93	23.67	0.14	0.11	0.08	0.05
T <sub>14</sub> - KCl <sub>2</sub> at 0.5%	18.77	20.30	23.93	--	0.16	0.13	0.11	--
T <sub>15</sub> - KCl <sub>2</sub> at 1%	18.70	20.17	23.97	--	0.19	0.14	0.12	--
S.Em ±	0.57	0.43	0.09	0.30	0.00	0.01	0.01	0.00
C.D at 1%	2.23	1.69	0.34	1.19	NS	NS	NS	NS

Note: -- Termination of shelf life

**Table.2** Effect of pre-harvest foliar application of nutrients and plant growth regulators on Ascorbic acid and Total sugar content of sapota at different days after harvest

<i>Treatments</i>	Ascorbic acid (mg/100g pulp)				Total sugar (%)			
	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	12 <sup>th</sup> day	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	12 <sup>th</sup> day
<b>T<sub>1</sub>- Control</b>	14.20	12.60	09.38	--	11.46	14.92	18.05	--
<b>T<sub>2</sub>- GA<sub>3</sub> at 200 ppm</b>	19.03	16.53	10.83	9.48	15.11	16.97	21.84	19.76
<b>T<sub>3</sub>- GA<sub>3</sub> at 300 ppm</b>	19.02	16.51	10.76	9.44	13.87	16.63	21.58	19.45
<b>T<sub>4</sub>- Kinetin at 50 ppm</b>	14.51	13.31	10.64	7.25	13.21	16.19	21.25	17.76
<b>T<sub>5</sub>- Kinetin at 100 ppm</b>	14.26	12.77	10.56	6.14	12.89	15.79	20.91	16.93
<b>T<sub>6</sub>- 2,4-D at 10 ppm</b>	19.06	17.13	10.90	--	15.40	17.86	22.51	--
<b>T<sub>7</sub>- 2,4-D at 20 ppm</b>	19.04	16.81	10.88	--	14.95	17.23	22.39	--
<b>T<sub>8</sub>- Boron at 0.2%</b>	19.13	17.89	12.51	--	16.89	19.35	22.93	--
<b>T<sub>9</sub>- Boron at 0.4%</b>	19.12	17.74	11.55	--	16.55	18.55	22.87	--
<b>T<sub>10</sub>- CaCl<sub>2</sub> at 1%</b>	23.78	18.83	12.87	9.57	18.34	19.93	23.31	22.40
<b>T<sub>11</sub>- CaCl<sub>2</sub> at 1.5%</b>	19.14	18.26	12.75	9.56	17.93	19.77	23.25	22.09
<b>T<sub>12</sub>- CaNO<sub>3</sub> at 1%</b>	23.86	19.11	15.38	9.64	20.06	21.16	23.65	22.42
<b>T<sub>13</sub>- CaNO<sub>3</sub> at 1.5%</b>	23.85	19.07	13.50	9.61	19.25	20.09	23.50	21.75
<b>T<sub>14</sub>- KCl<sub>2</sub> at 0.5%</b>	19.12	17.72	11.23	--	16.15	18.03	22.64	--
<b>T<sub>15</sub>- KCl<sub>2</sub> at 1%</b>	19.06	17.59	11.11	--	15.49	18.01	22.57	--
<b>S.Em ±</b>	0.06	0.13	0.17	0.24	0.64	0.57	0.64	0.50
<b>C.D at 1%</b>	0.22	0.51	0.67	0.93	2.52	2.27	2.51	1.95

Note: -- Termination of shelf life

**Table.3** Effect of pre-harvest foliar application of nutrients and plant growth regulators on Reducing sugar and Non-reducing sugar content of sapota at different days after harvest

Treatments	Reducing sugar (%)				Non-reducing sugar (%)			
	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	12 <sup>th</sup> day	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	12 <sup>th</sup> day
<b>T<sub>1</sub>- Control</b>	05.49	08.07	09.06	--	5.97	6.85	8.99	--
<b>T<sub>2</sub>- GA<sub>3</sub> at 200 ppm</b>	07.98	09.78	12.58	11.51	7.13	7.19	9.26	8.25
<b>T<sub>3</sub>- GA<sub>3</sub> at 300 ppm</b>	07.60	09.37	12.25	11.25	6.27	7.26	9.33	8.20
<b>T<sub>4</sub>- Kinetin at 50 ppm</b>	06.84	08.63	12.17	09.64	6.37	7.56	9.08	8.12
<b>T<sub>5</sub>- Kinetin at 100 ppm</b>	06.77	08.60	11.56	09.57	6.12	7.19	9.35	7.36
<b>T<sub>6</sub>- 2,4-D at 10 ppm</b>	08.20	10.07	13.04	--	7.2	7.79	9.47	--
<b>T<sub>7</sub>- 2,4-D at 20 ppm</b>	08.18	10.01	12.60	--	6.77	7.22	9.79	--
<b>T<sub>8</sub>- Boron at 0.2%</b>	09.74	11.26	13.35	--	7.15	8.09	9.58	--
<b>T<sub>9</sub>- Boron at 0.4%</b>	09.56	11.18	13.16	--	6.99	7.37	9.71	--
<b>T<sub>10</sub>- CaCl<sub>2</sub> at 1%</b>	10.72	11.41	13.46	12.47	7.62	8.52	9.85	9.93
<b>T<sub>11</sub>- CaCl<sub>2</sub> at 1.5%</b>	10.19	11.29	13.44	12.45	7.74	8.48	9.81	9.64
<b>T<sub>12</sub>- CaNO<sub>3</sub> at 1%</b>	11.73	12.51	13.72	12.90	8.33	8.65	9.93	9.52
<b>T<sub>13</sub>- CaNO<sub>3</sub> at 1.5%</b>	11.08	11.47	13.63	12.51	8.17	8.62	9.87	9.24
<b>T<sub>14</sub>- KCl<sub>2</sub> at 0.5%</b>	08.89	10.81	13.14	--	7.26	7.22	9.50	--
<b>T<sub>15</sub>- KCl<sub>2</sub> at 1%</b>	08.80	10.38	13.12	--	6.69	7.63	9.45	--
<b>S.Em ±</b>	0.52	0.46	0.44	0.36	0.08	0.03	0.03	0.03
<b>C.D at 1%</b>	2.05	1.81	1.73	1.41	0.33	0.10	0.11	0.10

Note: -- Termination of shelf life

Similar observations was also recorded by Jawandha *et al.*, (2007) and Yadav *et al.*, (2009) in ber, Rajput *et al.*, (2008) and Bisen *et al.*, (2014) in guava, Ramezianian *et al.*, (2009) in pomegranate, Lal *et al.*, (2011) in apricot and Kirmani *et al.*, (2015) in Plum.

Total sugar (Table 2) content of sapota fruit at different stages of ripening increased

significantly from mature to ripe stage with as slight decline at overripe stage. In ambient storage the total sugar increase up to 9<sup>th</sup> day of storage period and then after it started declining. The maximum total sugar (20.06, 21.16, 23.65 and 22.42 %) was observed in treatment T<sub>12</sub>(CaNO<sub>3</sub> @ 1 %) at 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> day of storage period, respectively which, remained at par with treatment T<sub>13</sub>

(CaNO<sub>3</sub> @ 1.5%) i.e. 19.25, 20.09, 23.5 and 21.75 % at 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> day of storage period, respectively.

The increase in total sugar during initial storage period might be due to hydrolysis of starch into sugar as on complete hydrolysis of starch no further increase occurs and subsequently a decline in total sugar is predictable. The present investigation is in conformity with the results reported by, Rajkumar *et al.*, (2006) in papaya, Yadav *et al.*, (2009) in ber, Bhalerao *et al.*, (2010) in sapota, Lal *et al.*, (2011) in apricot, Alila and Achumi (2012) in litchi, Karemera and Habimana (2014) in mango, Bisen *et al.*, (2014) in guava and Kirmani *et al.*, (2015) in Plum.

Accumulation of reducing sugar was gradually increased with a slight decline at the end of storage period in ambient condition (Table 3). The maximum reducing sugar (11.73, 12.51, 13.72 and 12.90 %) was observed in treatment T<sub>12</sub> (CaNO<sub>3</sub> @ 1%) at 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> day of storage period respectively, followed by treatment T<sub>13</sub> (CaNO<sub>3</sub> @ 1.5%) i.e. 11.08, 11.47, 13.63 and 12.51 % at 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> day of ambient storage period, respectively. The increase of reducing sugar content by calcium application might be due to the less utilization of sugar during respiration and conversion of starch in to sugar, while the subsequent decline was perhaps due to consumption of sugar for respiration during storage. The present investigation is in conformity with the results reported by Yadav *et al.*, (2009) in ber, Bhalerao *et al.*, (2010) in sapota, Alila and Achumi (2012) in litchi, Bisen *et al.*, (2014) in guava and Kirmani *et al.*, (2015) in Plum.

Significant difference was observed among all the treatments with respect to non-reducing sugar. Under ambient storage, highest non-reducing sugar (8.33, 8.65, 9.93 and 9.52 %)

at 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> day of storage period, respectively was found in treatment T<sub>12</sub> (CaNO<sub>3</sub> @ 1 %) which, remained at par with treatment T<sub>13</sub> (CaNO<sub>3</sub> @ 1.5 %) i.e. 8.17, 8.62, 9.87 and 9.24 %, respectively (Table 3).

The increase in non-reducing sugar during storage was due to the conversion of starch into sugar, while, the subsequent decrease in sugar was might be due to consumption of sugar for respiration during storage period. These results are in accordance with the findings of Bhalerao *et al.*, (2010) in sapota, Alila and Achumi (2012) in litchi, Bisen *et al.*, (2014) in guava, Karemera and Habimana (2014) in mango and Kirmani *et al.*, (2015) in plum.

The present study clearly indicated that pre-harvest spraying of CaNO<sub>3</sub> at (1%) or CaNO<sub>3</sub> at (1.5%) is effective and found promising for maintaining quality attributes viz. TSS, acidity, total sugar, reducing sugar, non-reducing sugar and ascorbic acid under ambient storage.

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