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Effect of pre-harvest sprays on fruit yield and associated traits of sapota [*Manilkara achras* (Mill.) Fosberg] cv. Kalipatti

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Abstract
An experiment was conducted at Instructional farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India during 2018-2019 to study the effect of pre-harvest sprays on fruit yield and associated traits in sapota cv. Kalipatti. The experiment was laid out in a Completely Randomized Design comprising of six treatments namely T_1- Control, T_2- GA_3 100 ppm, T_3- Novel 1%, T_4- $Ca(NO_3)_2$ 5000 ppm, T_5- $CaCl_2$ 5000 ppm and T_6- Potassium silicate 4 ml/l. Sapota trees were sprayed in the months of January, May and October during 2018 and 2019 and each treatment was repeated thrice. Experimental results indicated that pre-harvest spray of GA_3 at 100 ppm recorded significantly the maximum fruit weight (83.11, 85.24 and 84.17 g), fruit volume (78.07, 80.06 and 79.06 cc) and fruit yield [(163.86, 171.22 and 167.54 kg/tree) and (16.39, 17.12 and 16.75 t/ha)] during 2018, 2019 and in pooled data, respectively.

Keywords: Sapota, pre-harvest sprays, GA_3, fruit weight, fruit yield

Introduction
Sapota [*Manilkara achras* (Mill.) Fosberg] commonly known as chiku in India, is an evergreen tree, belonging to the family Sapotaceae and a native of Tropical America. It comprises of 40 genera and about 600 species, distributed in the tropics (Sutaria, 1966) [21]. In India, it was first introduced at Gholwad village of Dhanu taluka in Thane district of Maharashtra state in 1898 (Chadha, 1992) [6].

Popularity of this fruit is on increase due to continuous fruiting throughout the year and very little incidence of disease and pests. The fully ripe fruit is delicious, sweet (contains about 12 to 18 per cent sugar) and chiefly used for fresh table purpose. Sapota is mainly grown in India, Philippines, Malaysia, Indonesia, Guatemala, Mexico and Sri Lanka. India is the largest producer of sapota in the world and it is commercially grown in states like Maharashtra, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu. While in South Gujarat, its cultivation is concentrated mainly in Navsari, Valsad and Surat districts (Anon., 2020) [4].

'Kalipatti' is the most popular cultivar in Gujarat state of India, accounting for about 99 per cent of acreage. It also appears to be the highest yielding cultivar of those tested and therefore, will likely continue to be the most widely planted (Chundawat and Bhuva, 1982) [7]. Trees have spreading branches with broad, thick and dark leaves. Fruits are of oval shape, good quality, mellow flesh and sweet with mild fragrance. Sapota produces a large number of flowers throughout the year in different flushes. But flowers and fruits tends to drop in different stages of development right from its setting maturity. However, incompatibility, low fertility and low fruit set reduces the yield.

Gibberellins are the hormones which develop naturally and play a major role in stimulating the reaction of auxins thereby helping in growth regulation (Singh *et al*., 2018) [20]. GA_3 is known to induce mitotic cellular division in fruits and stimulate growth which results in increased size (Gondaliya *et al*., 2017) [10]. Novel Organic Liquid Nutrients contains a fair amount of essential macro nutrients (N, P, K, Mg and S), micro nutrients (Mn, Cu, Zn and Fe) and secondary metabolites like gibberellins and cytokinin. (Anon., 2014) [3]. Calcium being a divalent caution readily enters the apoplast and is bound in exchangeable form to cell wall and exterior surface of the plasma membrane. Nontoxic even at high concentration, it serves as detoxifying agent typing up toxic compounds and maintaining the cation-anion balance in the vacuole (Rajput *et al*., 2008) [17]. Calcium helps in structural integrity of both cell wall and plasma membrane which delays ripening and extends storage life.

Potassium silicate is a source of highly soluble potassium and silicon and is used in agricultural production system (Epstein, 1999) [9]. Potassium is a macro nutrient which is very important for basic physiological functions (Abbas and Fares, 2008) [1]. Silicon is considered as an excellent growth promoting agent, it increases plant growth and stimulates productivity in crops like mango (Rahmani *et al.*, 2017) [16]. It was therefore felt necessary to assess the suitability of GA_3, Novel, $Ca(NO_3)_2$, $CaCl_2$ and Potassium silicate as pre-harvest sprays in enhancing productivity of sapota cv. Kalipatti fruits at NAU, Navsari.

Material and Methods

The present experiment was conducted during the year 2018 and 2019 at Instructional Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India. Uniform trees of sapota cv. Kalipatti were selected for experimentation and treated with respect to fertilizers, irrigation and plant protection measures during the course of investigation as recommended by NAU, Navsari. The experiment was laid out in Completely Randomized Design with six treatments comprising of T_1- Control, T_2- GA_3 100 ppm, T_3- Novel 1%, T_4- $Ca(NO_3)_2$ 5000 ppm, T_5- $CaCl_2$ 5000 ppm and T_6- Potassium silicate 4 ml/l which were repeated thrice. Foliar sprays were imposed on sapota trees during the months of January, May and October- 2018 and 2019.

Methodology

Fruit weight (g)

Five fruits were selected from the non-destructive sample and weighed individually with the help of digital weighing balance. Their average value was worked out which was expressed as fruit weight in gram (g).

Fruit volume (cc)

A measuring cylinder of 5 litre capacity was employed for measuring fruit volume in which 500 ml water was poured. Five fruits were taken from each treatment and individual fruits were dipped in water. This lead to upward displacement of water and the new volume was subtracted from the initial volume (500 cc). The average volume of fruits was computed and expressed as cubic centimeter.

Number of fruits per tree

The total number of fruits harvested from each experimental tree were counted. The average was worked out and expressed as number of fruits per tree.

Specific gravity

Five selected fruits from each treatment were used to work out specific gravity. It was calculated using the following formula,

$$\text{Sp. Gr.} = \frac{\text{Fruit weight}}{\text{Fruit volume}}$$

Fruit Yield (Kg/tree)

The total produce per tree was weighed at harvest and noted treatment wise for each experimental tree. This result was expressed in kg/ tree.

Fruit Yield (t/ha)

Fruit yield per hectare was calculated by multiplying the average yield of fruits per plant (kg/tree) with the total number of plants per hectare and divided by 1000.

Results and Discussion

Fruit Weight and Fruit Volume

There was a significant impact of pre-harvest sprays on fruit weight and fruit volume of sapota cv. Kalipatti (Table-1). The maximum fruit weight (83.11, 85.24 and 84.17 g) was recorded in treatment T_2 (GA_3 100 ppm) during 2018, 2019 and in pooled data. Further, treatment T_3 (80.72, 81.02 and 80.87 g) and T_6 (79.88, 80.99 and 80.44 g) were found statistically at par with treatment T_2. With regard to fruit volume, GA_3 100 ppm (T_2) registered the maximum values (78.07, 80.06 and 79.06 cc) during 2018, 2019 and in pooled data which was statistically at par with treatment T_3 (75.98, 76.47 and 76.22 cc) and T_6 (75.53, 76.52 and 76.03 cc) throughout the study. Whereas, treatment T_4 (71.16 and 74.03 cc) was found at par with treatment T_2 in the first and second year (Table 1).

The increase in fruit weight and fruit volume by the foliar application of GA_3 at 100 ppm was probably due to rapid cell division, cell expansion and increase in the volume of intercellular spaces, mesocarp cells and accumulation of water and nutrients in these intercellular spaces. The above findings are in agreement with the results of Agrawal and Dikshit (2008) [2], Joshi *et al.* (2016) [12], Desai *et al.* (2017) [8], Gondaliya *et al.* (2017) [10] and Jain *et al.* (2020) [11] in sapota; Bhowmick and Banik (2011) [5], Taduri *et al.* (2017) [22], Parauha and Pandey (2019) [14] and Singh *et al.* (2021) [19] in mango and Kumar *et al.* (2011) [13] in banana.

Number of Fruits per Tree and Specific Gravity

Different pre-harvest spray treatments failed to elicit a significant response with regard to number of fruits per tree in 2018, 2019 and pooled data (Table 1). The number of fruits per tree varied from 1886.67 to 1980.49 in 2018; from 1907.33 to 1998.71 in 2019 and from 1897.00 to 1989.60 in pooled data. A perusal of data presented in Table 2 revealed that treatments did not have a significant influence on specific gravity during both years and pooled analysis.

Fruit Yield (Kg/tree and t/ha)

Fruit yield was significantly influenced by the pre-harvest treatments applied in the study (Table 2). The highest fruit yield [(163.86, 171.22 and 167.54 kg/tree) and (16.39, 17.12 and 16.75 t/ha)] was observed under the pre-harvest spray of GA_3 100 ppm (T_2) during 2018, 2019 and in pooled analysis. Treatment T_3 [(157.17, 161.36 and 159.27 kg/tree) and (15.72, 16.14 and 15.93 t/ha)] and T_6 [(155.30, 160.44 and 157.84 kg/tree) and (15.53, 16.04 and 15.79 t/ha)] was found statistically at par with treatment T_2. Whereas, treatment T_4 [(148.24 and 151.12 kg/tree) and (14.82 and 15.11 t/ha)] was statistically at par in first and second year.

Exogenous application of Gibberellic acid (GA_3) increases cell size and intercellular spaces coupled with more accumulation of water and nutrients in greater amount. This may have improved the fruit size and weight which ultimately enhanced yield. The above results were in accordance with Agarwal and Dikshit (2008) [2], Joshi *et al.* (2016) [12] and Sahu *et al.* (2018) [18] in sapota; Bhowmick and Banik (2011) [5], Parauha and Pandey (2019) [14] in mango and Singh *et al.* (2021) [19] and Purohit *et al.* (2019) [15] in guava.

Table 1: Effect of pre-harvest sprays on fruit weight, fruit volume and number of fruits per tree of sapota cv. Kalipatti

Treatments	Fruit weight (g)			Fruit volume (cc)			Number of fruits per tree		
	2018	2019	Pooled	2018	2019	Pooled	2018	2019	Pooled
T_1	67.24	69.67	68.45	64.43	66.37	65.40	1886.67	1907.33	1897.00
T_2	83.11	85.24	84.17	78.07	80.06	79.06	1980.49	1998.71	1989.60
T_3	80.72	81.02	80.87	75.98	76.47	76.22	1963.50	1986.95	1975.22
T_4	75.08	78.07	76.57	71.16	74.03	72.59	1940.00	1965.75	1952.88
T_5	73.56	75.74	74.65	70.35	71.23	70.79	1915.00	1936.96	1925.98
T_6	79.88	80.99	80.44	75.53	76.52	76.03	1960.00	1980.00	1970.00
S.Em. ±	2.43	2.54	1.61	2.27	2.39	1.51	73.55	78.05	48.78
C.D. at 5%	7.51	7.85	4.67	7.02	7.38	4.38	NS	NS	NS
S.Em. ± (Y X T)			2.73			2.33			75.83
C.D. at 5% (YX T)			NS			NS			NS
C.V.%	5.52	5.63	5.57	5.44	5.60	5.52	6.56	6.89	6.73

Table 2: Effect of pre-harvest sprays on fruit yield and specific gravity of sapota cv. Kalipatti

Treatments	Fruit yield						Specific gravity		
	(kg/tree)			(t/ha)					
	2018	2019	Pooled	2018	2019	Pooled	2018	2019	Pooled
T_1	126.47	133.80	130.14	12.65	13.38	13.01	1.04	1.05	1.04
T_2	163.86	171.22	167.54	16.39	17.12	16.75	1.06	1.06	1.06
T_3	157.17	161.36	159.27	15.72	16.14	15.93	1.06	1.06	1.06
T_4	148.24	151.12	149.68	14.82	15.11	14.97	1.05	1.05	1.05
T_5	142.33	145.34	143.84	14.23	14.53	14.38	1.04	1.06	1.05
T_6	155.30	160.44	157.87	15.53	16.04	15.79	1.06	1.06	1.06
S.Em. ±	6.23	6.75	4.20	0.62	0.67	0.42	0.05	0.03	0.03
C.D.at 5%	19.21	20.81	12.15	1.92	2.08	1.21	NS	NS	NS
S.Em. ± (Y X T)			6.50			0.65			0.04
C.D. at 5% (YX T)			NS			NS			NS
C.V.%	7.26	7.60	7.44	7.27	7.63	7.46	9.42	5.47	7.71

Conclusion

Based on the two years investigation, it can be concluded that pre-harvest application of GA_3 at 100 ppm in the months of January, May and October were most effective for improving fruit weight and yield in sapota cv. Kalipatti.

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