



Influence of different plant growth regulators on yield and quality of sapota (*Manilkara achras*) cv. Kalipatti

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ABSTRACT

The present study was carried out at Regional Fruit Research Station, PAU, Ludhiana during the year 2016–17 to investigate the influence of different plant growth regulators on yield and quality of sapota *Sapota* (*Manilkara achras* (Mill) Fosberg) cv Kalipatti. Eight year's old uniformly grown Kalipatti sapota plants planted at 9×9 m spacing were sprayed with plant growth regulators NAA @ 50,75,100 and 125 ppm and GA₃ @ 25,50,75 and 100 ppm keeping two controls, one as water spray and second without any spray in the month of May, August and September during flowering and at pea stage. Sapota fruits were analyzed for physical and chemical parameters. It was concluded that application of NAA @ 125 ppm during flowering and at pea stage resulted in improved fruit quality in terms of maximum fruit size, fruit firmness (4.01 kg/cm²), pulp weight (70.55 g) fruit weight (88.33 g), reducing sugars (9.44%), total sugars (14.39%), TSS (22.2%) with low acidity (0.16%) and higher fruit yield (37.13 kg/tree).

Key words: GA₃, Growth regulators, Kalipatti, NAA, Plant Growth Regulators, Quality, Yield

Sapota (*Manilkara achras* (Mill) Fosberg) is an important evergreen, tropical fruit crop commonly known as chiku in India. It belongs to the family sapotaceae. It is commercially grown in south Indian states like Karnataka, Gujarat, Tamil Nadu, Maharashtra, West Bengal and Orissa. It is also grown successfully under sub-tropical conditions in north India states like Punjab and Haryana. In Punjab, sapota is successfully grown in the sub-mountainous zone including Gurdaspur, Hoshiarpur, Pathankot, Roopnagar, Mohali and Patiala districts (Anon 2018). Sapota is a good source of digestive sugars which ranges from 12-18% and also contains appreciable amount of fat, proteins, fibre and some minerals like calcium, iron and phosphorous (Shanmugavelu and Srinivasan 1973). The area under sapota cultivation is increasing day by day in India due to its continuous fruiting habit throughout the year and its hardy nature against many biotic and abiotic stresses (Chundawat 1998). Sapota produces flowers throughout the year but all the flowers do not develop into fruit and reach maturity. In Punjab, flowering occurs in sapota in April-May and July-August. The flowering of July-August results in more fruit set and main crop is harvested during May-June which fetches good price in market.

To improve quality of fruits and increase the

productivity of existing sapota orchards use of the different growth regulators is one of the best method. Enhanced fruit quality with the application of growth regulators is due to metabolic changes in the fruits leading to conversion of complex polysaccharides into simple sugars. Moreover, the exogenous application of NAA during flowering caused the cell elongation of vacuoles and loosening of cell wall after increasing its plasticity (Rathod 1977). Kalipatti is most popular among various cultivars of sapota and is used for table purpose and moreover found to be the highest yielding among the all other tested cultivars in India (Chundawat and Bhuva 1982). Fruits are oval in shape, gritty flesh, good quality with about 1-4 seeds and average yield of about 166 kg/tree. Plant growth regulators like auxins, gibberellins have been reported to increase flowering, fruit set, fruit retention, fruit development and quality of several fruit crops (Chacko *et al.* 1972, Das and Mahapatra 1975). Under north Indian conditions, no information is available on the effect of plant growth regulators on quality and yield of sapota. Therefore, the present research work was carried out with an objective to study the effect of auxin and gibberellic acid on fruit yield and quality of sapota cv. Kalipatti.

MATERIALS AND METHODS

The present study regarding assessing the effect of auxins and gibberellins on yield and quality of sapota cv. Kalipatti was carried out at Fruit Research Station, Bahadurgarh (Patiala) during the year 2016-17. Eight year's

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old uniformly grown Kalipatti sapota plants planted at 9×9 m spacing were sprayed with plant growth regulators NAA @ 50,75,100 & 125 ppm and GA₃ @ 25,50,75 and 100 ppm keeping two controls, one as water spray and second without any spray in the month of May, August and September during flowering and at pea stage. The experiment was laid out in a randomized block design with 3 replications per treatment and one tree per replication. Sapota fruits were harvested when they had attained marketable size and were ripened naturally at room temperature (30°C-33°C) by wrapping in newspaper and storing in CFB (corrugated fibre board) boxes for four days. After ripening, sapota fruits were analyzed for physical and chemical parameters. Ten randomly selected fruits from each replication were used to assess quality parameters of sapota. Physical parameters like fruit firmness (kg/cm²), fruit weight (g), fruit size in terms of length and breadth (cm), fruit yield (kg/plant), and pulp weight (g) were recorded. Among chemical parameters Total soluble solids (TSS) content was determined with the help of an Erma hand-held refractometer, Japan, and expressed in per cent soluble solids. Acidity was expressed as per cent of malic acid as method given in AOAC (2005)

Ascorbic acid content of sapota juice was expressed in mg/100g of pulp and was estimated using 2, 6-dichlorophenol indophenol dye using visual titration method (AOAC 2005). The pH of the fresh sapota juice was measured using digital pH meter calibrated with standard buffer pH 7. The reducing sugars and total sugars expressed in percentage was estimated by method suggested by AOAC (2005). The data was analyzed statistically according to Randomized Block Design (RBD) as described by Singh *et al.* (1998). The maximum temperature ranged from 33.6 to 39.3°C, minimum ranged from 23.7 to 27.5°C and relative humidity ranged from 49.55 to 81.68%.

RESULTS AND DISCUSSION

In present study, fruit length of sapota varied from (5.44-6.11 cm) and fruit diameter varied from (4.94-5.38 cm) (Table 1) which is in line with Chavan *et al.* (2009),

Patil (2006) and Patil *et al.* (2010) in sapota. Maximum fruit length (6.11 cm) and diameter (5.38 cm) was recorded in NAA @ 125 ppm and the minimum fruit length (5.44 cm) and diameter (4.94 cm) was recorded in control. However, statistically nonsignificant results were recorded in fruit length and diameter in different treatments. The maximum fruit weight (88.33 g) was recorded in NAA @ 125 ppm which was at par with all other treatments of NAA. All the treatments of NAA were significantly better than control, water spray and GA₃ treatments. The results were in close confirmation with findings of Rathod (1977) who reported the increased fruit weight in sapota cv. Kalipatti with the application of NAA @ 50 ppm and 100 ppm. Agarwal and Dikshit (2010) also noticed similar results in Sapota cultivar Cricket Ball. The increase in fruit weight with the application of NAA was more as compared to GA application. The reason behind the increase in fruit weight could be due to the exogenous application of NAA during flowering which might have caused the cell elongation of vacuoles and loosening of cell wall after increasing its plasticity.

The data on fruit firmness depicts maximum (4.01) values in NAA @ 125 ppm which shows significantly better results as compared to control and it was statistically at par with NAA @ 75 ppm and GA₃ @ 50ppm. The results are in close conformity with Mandal *et al.* (2012) in guava and Martinsson *et al.* (2006) in strawberry. The increase in fruit firmness might be due to delaying senescence, preserving cellular organization and retarding respiration rate. The maximum pulp weight (70.55 g) was recorded in NAA @ 125 ppm and the minimum (46.94 g) in control treatment. NAA @ 125 ppm was significantly better than control and all other nine treatments. The maximum number of fruits per tree (420.36) was also observed in NAA @ 125 ppm which was statistically at par with NAA @ 100 ppm and minimum fruit number (277.30) was recorded in NAA @ 75 ppm which was statistically at par with control. The results were in accordance with Patil *et al.* (2011) who reported the highest fruit number with the application of NAA @ 150 ppm. Similarly, Kadam *et al.* (2005) and Bhujbal *et al.*

Table 1 Effect of plant growth regulators on physical parameters of sapota cv. Kalipatti

	Treatment	Fruit size		Fruit weight (g)	Fruit firmness (kg/cm ²)	Pulp weight (g)	No. of fruits/ tree	Yield (kg/tree)
		Length (cm)	Diameter (cm)					
T ₁	NAA @ 50ppm	5.77	5.16	81.11	2.36	58.33	308.22	25.00
T ₂	NAA @ 75ppm	5.89	5.22	82.22	2.87	56.67	277.30	22.80
T ₃	NAA @ 100ppm	5.61	5.33	83.89	3.69	55.28	407.80	34.21
T ₄	NAA @ 125ppm	6.11	5.38	88.33	4.01	70.55	420.36	37.13
T ₅	GA ₃ @ 25ppm	5.66	4.99	72.22	3.66	51.11	309.47	22.35
T ₆	GA ₃ @ 50ppm	5.89	5.05	76.66	3.15	55.55	298.20	22.86
T ₇	GA ₃ @ 75ppm	5.89	5.00	72.22	3.30	54.99	315.15	22.76
T ₈	GA ₃ @ 100ppm	5.83	4.99	74.99	3.36	48.33	358.85	26.91
T ₉	Water spray	5.50	4.94	66.66	3.42	48.05	333.78	22.25
T ₁₀	Control	5.44	4.94	66.11	3.10	46.94	289.82	19.16
	CD (P=0.05)	NS	NS	12.50	0.35	5.34	22.82	3.75

Table 2 Effect of plant growth regulators on chemical parameters of sapota cv. Kalipatti

	Treatment	TSS (%)	Acidity (%)	TSS/Acid ratio	Ascorbic acid (mg/100g pulp)	Reducing sugars (%)	Total sugars (%)
T1	NAA @ 50ppm	21.10	0.21	99.06	7.99	7.97	13.33
T2	NAA @ 75ppm	21.67	0.21	101.73	7.71	8.72	13.60
T3	NAA @ 100ppm	22.13	0.18	122.27	7.71	8.86	13.95
T4	NAA @ 125ppm	22.20	0.16	138.75	7.70	9.44	14.39
T5	GA ₃ @ 25ppm	18.80	0.29	63.09	8.56	6.81	11.13
T6	GA ₃ @ 50ppm	19.67	0.25	76.84	8.55	7.36	12.53
T7	GA ₃ @ 75ppm	19.93	0.24	81.35	8.56	7.31	11.35
T8	GA ₃ @ 100ppm	20.47	0.21	96.10	8.81	8.10	13.06
T9	Water spray	18.70	0.28	64.58	8.54	7.23	11.02
T10	Control	18.60	0.29	62.42	8.67	6.28	9.77
	CD (P=0.05)	2.15	0.27	14.58	0.74	0.80	1.19

(2013) also observed similar results in sapota.

The maximum number of fruits per tree with the application of NAA might be due to the highest fruit set and fruit retention achieved by NAA. The maximum fruit yield (37.13 kg/tree) was recorded in NAA @ 125 ppm and the minimum yield (19.16 kg/tree) was recorded in control. NAA @ 125 ppm was significantly better than control and all other treatments. Fruit number and yield of sapota also illustrated in Table 1. The results were in close confirmation with Chavan *et al.* (2009), Patil *et al.* (2011) and Bhujbal *et al.* (2012) in sapota cultivar Kalipatti. The improvement in fruit yield was also due to increase in yield related components which includes fruit weight, fruit size and fruit number.

The data pertaining to the effect of auxins and gibberellins on chemical parameters of sapota is presented in Table 2. The application of NAA at different concentrations significantly increased the TSS per cent as compared to control and all other treatments. The maximum TSS content (22.2%) was recorded in NAA@125 ppm whereas, the minimum (18.6%) was recorded in control. The results were in confirmatory with the finding of Bhujbal *et al.* (2013) and Chavan *et al.* (2009). They also noticed maximum TSS with the application of NAA as compared to GA. It was due to accumulation of metabolites and quick conversion of starch into sugars during the fruit development. The minimum acidity (0.16%) was recorded in NAA @ 125 ppm followed by NAA @ 100 ppm, whereas the maximum acidity (0.29%) was recorded in control and GA₃ 25 ppm. Similar results were observed by Agrawal and Dikshit (2010) and Chavan *et al.* (2009). The application of NAA @ 125 ppm also recorded the highest TSS/acid ratio (138.75) whereas minimum TSS/acid ratio (62.42) was recorded in control. Chavan *et al.* (2009), Agrawal and Dikshit (2010) also noticed maximum TSS/acid ratio with the application of NAA as compared to GA₃ and control, in sapota cv. Kalipatti.

The application of GA₃ at different concentrations significantly increased the ascorbic acid content over control and NAA treatments. The maximum ascorbic acid (8.81

mg/100g) was recorded in GA₃ @ 100 ppm, whereas the minimum (7.70 mg/100g) was recorded in NAA@ 125 ppm. These results are in accordance with the findings of Agrawal and Dikshit (2010) and Garhwal (2015). They also noticed maximum ascorbic acid content with the application of GA₃ as compared to NAA. The possible reason for increased ascorbic acid content with the application of GA₃ might be due to catalytic influence of growth regulators on its bio-synthesis from its precursor glucose-6-phosphate or inhibition of its conversion to dehydro ascorbic acid by the enzyme ascorbic oxidase. The application of NAA at different concentrations has increased the reducing sugars and total sugar content as compared to control and GA₃ treatments. The highest reducing sugars (9.44%) were recorded in NAA @ 125 ppm which is followed by NAA @ 75 ppm and 100 ppm. The highest total sugar content (14.39%) was recorded in NAA @ 125 ppm which was followed by NAA @ 100 ppm. Various scientists reported similar findings of increased reducing and total sugar content with the application of NAA. The increase in sugars with the application of NAA might be due to ripening of fruits and accelerated activities of hydrolytic enzymes.

From the present study, it was concluded that foliar application of NAA @ 125 ppm during flowering and pea stage resulted in improvement in quality of sapota cv. Kalipatti. in terms of maximum fruit size, fruit firmness, pulp weight, fruit weight, reducing sugars, total sugars, TSS with low acidity and higher fruit yield.

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