Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-6: 962-967

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7692 **Special Issue-6 pp. 962-967**
Journal homepage: http://www.ijcmas.com

Original Research Article

Effect of 28-Homobrassinolide, CPPU, GA_3 and Humic Acid on Quality and Shelf-Life of Sapota (*Manilkara achras*) CV. Kalipatti Harvested in Winter

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Keywords

Sapota, *Manilkara achras*, 28-Homobrassinolide, CPPU, Humic acid, GA3, Shelf life and Physiological Loss in weight

A B S T R A C T

An experiment was undertaken to work out the effect of 28-Homobrassinolide (0.50 and 0.75 ppm), CPPU (4 and 6 ppm), GA_3 (100 ppm) and Humic Acid (1 and 2 %) on physical, chemical and physiological parameters of sapota cv. Kalipatti harvested in November and observed significantly higher number of fruit per tree, yield per tree and hectare basis, fruit weight (g), fruit firmness (fourth day after harvest), total soluble solids (^{0}Brix), total sugar (%), ascorbic acid (mg/100g pulp) and shelf life (days) and lower titratable acidity (%) and physiological loss in weight (%) with foliar application of 6ppm CPPU (T_4). The pulp content and pulp/peel ratio were shows higher values with GA_3 @100 ppm (T_7). However, application of 28-Homobrassinolide @ 0.75 ppm (T_2) reported lowest fruit firmness and shelf life with highest physiological loss in weight. The treatments reported non-significant effect on ripening percent and non-reducing sugar content of sapota fruits.

Introduction

Sapota [*Manilkara achras* (Mill) Fosberg] commonly known as '*chiku'* is an evergreen fruit tree native of Tropical America. In India, it was introduced probably in 1898 at Gholwad in Maharashtra and occupied a significant position among the fruit crop. It has emerged as an important fruit crop of costal India especially the region between Mumbai and Surat in Gujarat (Chundawat, 1998). India is considered to be the largest producer of sapota in the world. The sapota fruit is highly delicious in taste and good source of digestible sugar (12 to 18 %) and has appreciable quantities of protein, fat, fibre and minerals like potassium, calcium and iron (Chundawat, 1998). The sapota growers facing many problems such as lowering productivity year by year, hindrance in distant transportation due to short shelf life and increased labour cost which decreases profit. To overcome this problem there is need of increasing productivity with bigger sized quality fruits with higher shelf life for fetching higher returns. Hence there is requirement of exploit any technique which may help to overcome lower productivity and short shelf-life. The use of novel growth regulators and some chemicals is one of the choice. The 28-Homobrassinolide and CPPU are the novel growth regulators which are not tested in sapota and the humic acid which is not applied as foliar. Hence it is decided to conduct an experiment with use of above chemicals to increase yield, quality and shelf life for higher profit.

Materials and Methods

The present investigation was carried out simultaneously at two locations *i.e.* Agriculture Experimental Station (AES), Paria and Umarsadi village, Tq. Pardi Dist. Valsad (Gujarat) during the year 2014-15. The experiment conducted on 15 years old sapota tree with eight treatments in Randomized Block Design which replicated thrice. The treatments were T_1- 0.50 ppm 28-Homobrassinolide, T_2 -0.75 ppm 28-Homobrassinolide, T_3 -4.00 ppm CPPU, T_4 -6.00 ppm CPPU, T_5 -1 % Humic acid, T_6 -2 % Humic acid, T_7 -100 ppm GA_3 and T_8 -Control. The 28-Homobrassinolide, CPPU and Humic acid were sprayed twice *i.e.* in November 2014 and January 2015 whereas GA_3 was sprayed thrice *i.e.* in November, December 2014 and January 2015. For application of 28-Homobrassinolide, CPPU, GA_3 and Humic acid the Diamore Combine (28-Homobrassinolide 0.03 % W/W), Sitofex (CPPU 0.1 % W/V), Jai Gibb ($GA_3$90 % w/w) and as Pick Up (Humic acid 98 %) were used. The observations related to physical, chemical and physiological parameters were taken by selecting randomly five fruits from harvested matured fruits. The pulp content was calculated by subtracting peel and seed weight from fruit weight in percentage. Fruit firmness was calculated 4^{th} day after harvest. And for ripening percent calculation hundred fruits were kept in ambient temperature for observations.

Results and Discussion

The Table 1 indicated that the different chemical substances significantly influenced the growth and yield parameters of sapota fruits cv. Kalipatti. The incremental tree height (cm) and incremental tree canopy spread (cm) in East-West and North-South directions were obtained highest (57.75, 58.17 and 58.31 cm) with treatment T_7 (GA_3 @ 100 ppm) as compared with control (24.83, 29.67and 31.19 cm), respectively. This might be due to tendency to increase both cell elongation and cell division as evidenced by increases in cell length and cell number in response to applications of gibberellin. The activity of some cell wall enzymes has been correlated with gibberellin-induced growth and cell wall loosening which resulted in maximum incremental tree height and canopy spread. Similar results were recorded by Rafaat *et al.,* (2012) in grape and Syamal *et al.,* (2010) in papaya.

The highest number of fruits per tree (1860.71) and yield per tree (153.19kg) and per hectare (15.32 t) were noticed with treatment T_4 (CPPU @ 6 ppm) while lowest with control (T_8), respectively.

The higher number of fruit production and fruit weight might be due to that CPPU (a synthetic cytokinin of the phenyl urea group) increases fruit set and significantly decreases fruit drop with ample supply of metabolites for its normal growth and development. This finding was in tune with Kassem *et al.,* (2011) in grape and Nimbolkar *et al.,* (2016) in pear.

The Table 2 indicated that the different chemical substances significantly influenced the physical and physiological parameters of sapota fruits cv. Kalipatti. The fruit weight was obtained highest (89.41 g) with application of CPPU @ 6 ppm (T_4) as compared with control (75.70 g). It might be due to influence of CPPU (a cytokinin type growth regulator) which positively encourage movement of nutrients towards leaves from other parts of tree this phenomenon known as cytokinin-induced mobilization, ultimately helps in increasing production of more photosynthates.

Table.1 Effect of 28- Homobrassinolide, CPPU, GA_3 and Humic Acid on physical and physiological parameters of sapota fruit cv. Kalipatti harvested in February

Treatments	Incremental tree height (cm)	Incremental canopy spread (cm)		Number of fruits per tree	Yield (kg/tree)	Yield (t/ha)
		East- West direction	North-South direction			
T_1	46.92	47.33	47.39	1524.42	116.97	11.70
T_2	50.50	50.42	50.58	1604.01	124.80	12.48
T_3	29.50	31.42	33.07	1809.14	147.81	14.78
T_4	34.08	35.17	36.29	1860.71	153.19	15.32
T_5	38.67	39.17	40.16	1330.52	99.11	9.91
T_6	41.75	42.08	43.46	1396.11	104.28	10.43
T_7	57.75	58.17	58.31	1668.45	131.73	13.17
T_8	24.83	29.67	31.19	1275.64	90.36	9.04
S. Em ±	1.47	1.55	1.64	59.86	4.66	0.47
CD at 5%	4.26	4.48	4.74	173.41	13.49	1.35
S. Em ± (L X T)	2.08	2.19	2.32	84.65	6.59	0.66
CD at 5% (LX T)	NS	NS	NS	NS	NS	NS
CV %	8.89	9.08	9.43	9.41	9.43	9.43

Table.2 Effect of 28- Homobrassinolide, CPPU, GA_3 and Humic Acid on physical and physiological parameters of sapota fruit cv. Kalipatti harvested in November

Treatments	Fruit weight (g)	Fruit firmness (kg/cm^2)	Pulp content (%)	Peel content (%)	Pulp/peel ratio	Ripening (%)	Shelf life (days)	P L W (%)
T_1	87.45	4.06	90.98	9.02	10.10	95.71	8.19	7.81
T_2	87.56	3.94	91.48	8.52	10.74	95.29	8.15	7.85
T_3	89.33	5.38	92.46	7.55	12.26	96.55	13.15	5.62
T_4	89.41	5.45	91.82	8.03	11.46	96.97	13.38	5.58
T_5	76.74	4.44	90.01	9.99	9.01	94.44	8.75	7.66
T_6	77.14	4.64	90.50	9.50	9.53	94.86	8.85	7.62
T_7	88.03	5.30	92.95	7.06	13.18	96.13	11.08	6.82
T_8	75.70	4.24	89.52	10.48	8.54	94.02	8.27	7.76
Mean (C)	83.92	4.68	91.22	8.77	10.60	95.50	9.98	7.09
S. Em ±	2.44	0.15	0.38	0.38	0.56	1.92	0.44	0.19
CD at 5%	7.06	0.42	1.11	1.11	1.62	NS	1.28	0.56
CV %	7.11	7.64	1.03	10.69	12.89	4.93	10.81	6.63

Table.3 Effect of 28-Homobrassinolide, CPPU, GA_3 and Humic Acid on chemical parameters of sapota fruit cv. Kalipatti harvested in November

Treatments	TSS (^oB)	Reducing Sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Titratable Acidity (%)	Ascorbic acid (mg/100 g pulp)
T_1	23.14	10.21	8.69	18.90	0.0546	23.90
T_2	23.30	10.23	8.74	18.97	0.0541	24.17
T_3	23.76	10.32	8.78	19.10	0.0529	24.76
T_4	23.94	10.42	8.73	19.14	0.0525	25.02
T_5	20.20	8.93	7.97	16.90	0.0591	20.08
T_6	20.64	9.06	7.96	17.02	0.0581	20.25
T_7	23.46	10.30	8.76	19.06	0.0534	24.42
T_8	19.66	8.80	8.03	16.83	0.0598	19.84
Mean (C)	22.26	9.78	8.46	18.24	0.0556	22.81
S. Em ±	0.59	0.27	0.45	0.46	0.0013	0.84
CD at 5%	1.71	0.79	NS	1.35	0.0036	2.43
CV %	6.50	6.87	13.09	6.24	5.53	9.01

This treatment increases the ability of the fruits to attract carbohydrates and the plant is able to allocate a higher amount of photosynthetic products to the fruits which helps in gaining weight of fruits. Similar results were reported by Hassan *et al.,* (2009) in banana and Rafaat *et al.,* (2012) in grape.

The highest fruit firmness (5.45 kg/ cm^2) was reported with treatment T_4 while lowest fruit firmness (3.94 kg/ $cm^{2)}$ was exhibited by treatment T_2 (28-Homobrassinolide @.75 ppm) which was lower than control.

The higher fruit firmness by foliar application CPPU may be due to reduced rate of respiration ultimately loss of weight percentage was less with maximum fruit firmness which was also reported by Hua Huang and Yueming Jiang (2012) in banana. While application of 28-Homobrassinolide @ 0.75 ppm (T_2) may be enhance rate of ethylene biosynthesis with more respiration rate turned to become more soften, ripe fruits faster ultimately decrease firmness of fruits.

The higher pulp content (%) and pulp /peel ratio with lower peel (%) content (92.95%, 13.18 and 7.06 %) were reported by treatment T_7 (100 ppm GA_3), respectively as compared to control. It might be due to higher accumulation and translocation of extra metabolites from other parts of the tree towards developing fruits. Similar finding is noted by Mulagund *et al.,* (2015) in banana.

The maximum shelf life and minimum physiological loss in weight (13.38 days and 5.58 %) were obtained in treatment T_4 (CPPU @ 6 ppm). It might be due to anti senescence role of CPPU which lowered rate of respiration and retard the activity of enzymes responsible to ripening which slow down process of senescence and deterioration to extend shelf life. These findings are close conformity with Al-Obeed (2011) in grape. However, the ripening and non-reducing sugar percentage were reported non- significance effect.

The data presented in Table 3. Reported that, The total soluble solids (23.94^{o}Brix) was obtained higher in application of 6 ppm

CPPU (T_4). The total sugar and reducing sugar (16.14 and 10.42 %) were also seen higher in treatment T_4.The upper values of total soluble solids, reducing and total sugar (in CPPU application) might be due to production of higher number of leaves with much more amount of chlorophyll content which produces more metabolites by photosynthesis process and accelerated flow of photosynthetic products (mainly carbohydrates) towards fruits resulted by CPPU foliar spray. This carbohydrates mainly contains sugar as major part of soluble solids and due to source to sink relationship, higher percentage of total soluble solids, reducing and total sugar may found in treated fruits. These results corroborate with the findings of Al-Obeed (2011), Kassem *et al.,* (2011), Khot (2015) in grape.

The lower titratable acidity (0.0525 %) and higher ascorbic acid (25.02 mg/ 100g pulp) were exhibited with treatment T_4 (CPPU @ 6 ppm). The minimum acidity content in fruits might be due to the metabolic changes with fast conversation of organic acids into sugars and their derivatives by the reactions involving reversal of glycolytic pathway or be used in respiration. The present findings are in agreement with those reported by Kim *et al.,* (2006) in kiwi fruits. The ascorbic acid content found higher, it may be due to production of higher metabolites in tree which sent towards developing fruits ultimately increase content of ascorbic acid in fruits of treated tree. The present findings are in agreement with those reported by Agrawal and Dikshit (2010) in sapota.

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