Int.J.Curr.Microbiol.App.Sci (2019) *8*(9): 1705-1710

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 8 Number 09 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.809.193

Evaluation of Different Cultivars of Sapota (*Manilkara achras* L.) under Northern Dry Zone of Karnataka, India

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Keywords

Chikoo, digestible sugar, first plantation, chewing gum

Article Info

Accepted:
18August 2019
Available Online:
10 September 2019

A B S T R A C T

A study on evaluation of 22 and 17 years old sapota cultivars under AICRP on fruits, KRCCH, Arabhavi, Karnataka. The study revealed that among 22 and 17 years old the cvs. DHS-1 and Cricket Ball (ARSA) showed superior results with respect to growth and yield parameters like canopy volume (305.25 m3, 154.90 m3); fruit weight (139.82 g, 102.83 g); fruit yield (156.25 kg/tree, 111.67 kg/tree); fruit volume was more in DHS-1 and Cricket Ball:Udupi (77.40 ml, 84.07 ml) respectively. Among 22 and 17 years old the pulp to peel ratio was more in cvs. CO-1 and Mohangootee (14.62, 12.05); TSS was highest in cvs. Oval and Virudhnagar (24^{o}Brix, 23^{o}Brix); TSS:acid ratio was better in cvs. PKM-2 and Singapore (106.45, 84.06); shelf-life was more in cvs. Cricket Ball and Murabba (6.50 days, 7.00 days) respectively.

Introduction

Sapota (*Manilkara achras* L.) is commonly known as sapodilla, bully, chikoo. It is an economically important species of the sapotaceae family, a long-lived evergreen tree native to southern Mexico, Central America and the Caribbean. Sapota cultivation was started for the first time in Maharashtra in 1898 in a village called Gholwad, but historical evidence showed that first plantation of sapota was done in 20th century in Dahnu taluka of Thane district in Maharashtra and local Parsis, Iranis and Marwari settlers played major role in the commercialization of this sapota crop. It is grown in large quantities in India, Pakistan, Thailand, Malaysia, Cambodia, Indonesia, Vietnam, Bangladesh and Mexico. Latex from sapota tree is used in the manufacture of chewing gum in Tropical America. The pulp of sapota when ripe is soft, granular and very sweet. Sapota is an energy rich fruit with high total soluble solids (20-22%) and good source of digestible sugar and

has an appreciable amount of protein, fat, fiber and minerals like calcium, phosphorous, iron (Shanmugavelu and Srinivasan, 1973). Though the area under cultivating sapota is increasing day by day but this increasing trend failed to meet up the expected level of production in this country due to absence of number of good choice varieties. So, characterization is an important aspect for documentation of the performance of the studied cultivars which subsequently will help to introduce, select and improve existing sapota varieties. That's why this research was undertaken to evaluate different cultivars of sapota for growth, yield and quality parameters under northern dry zone of Karnataka and even to find out suitable cultivar.

Materials and Methods

This study was carried out to evaluate different cultivars of sapota under northern dry zone of Karnataka at AICRP on fruits, KRCCH, Arabhavi, University of Horticultural Sciences, Bagalkot and the duration of the study was June 2018 to May 2019. The evaluation of sapota genotypes was initiated with 21 genotypes (14 genotypes of 22 year old and 7 genotypes of 17 year old). Each genotype was planted in single row with 10 x 10 m spacing on medium black soil. Fertilizers were applied, in ring method around the tree, with the receipt of canal irrigation (GLBC). The crop is under canal irrigation (basin method) for 7-8 months from July to February, while in remaining period (March to June) the crop is without irrigation water because of canal closure. Observation on vegetative growth, yield and quality parameters were recorded during July 2018 in Randomized Complete Block Design (RCBD) with two and three replications respectively. The 22 years old cultivars are DHS-1, DHS-2, PKM-1, PKM-2, PKM-3, CO-1, CO-2, Cricket Ball, Long Oval, Kalipatti, Gavarayya, Oval, Kirthbarthi and Tagarampudi. The 17 years old cultivars are Guthi, Virudhnagar, Singapore, Mohangootee, Murabba, Cricket Ball (ARSA) and Cricket Ball (Udupi).

$$\text{Canopy volume } (m^3) = \frac{\text{Plant spread (N-S)} \times \text{Plant spread (E-W)} \times \text{Plant height}}{4}$$

Five fruits were randomly selected and average weight of fruits was calculated by dividing the total weight of fruits by the total number of fruits taken. Five fruits are randomly taken from the tree. Each fruit in dipped in the vessel containing water up to the edge and the amount of water which flows outside the vessel due to the weight of the fruit is measured using measuring cylinder and average value is calculated. As sapota is climacteric in nature so fruits were harvested when they were fully matured. Number of fruits and fruit weight were recorded at every harvest; the total yield was calculated by adding the values obtained in different harvesting of year and expressed in kilogram per tree per year. Fruit yield per hectare was calculated by multiplying total number of trees in one ha area of sapota orchard with the fruit yield/tree for each cultivar. Total soluble solids (TSS) of the pulp was recorded with the help of hand refractometer and expressed in percentage. The storage of fruits for some days at room temperature till its quality and taste deteriorate.

Results and Discussion

The data on growth and yield parameters of different genotypes of sapota (22 years old) are given in Table 1. Significantly canopy volume was found in DHS-1 (305.25 m^3) followed by Long Oval (241.65 m^3) and DHS-2 (216.99 m^3). The minimum canopy volume was found in PKM-1 (104.56 m^3). The results of canopy volume were higher compare to the findings of Patel *et al.*, (2018) and Shirol *et al.*, (2009). The maximum fruit weight was found in DHS-1 (139.82 g) followed by DHS-

2 (138.66 g) and Kalipatti (136.18 g). The minimum fruit weight was found in Oval (103.02 g). The results were higher compared to the findings of Shakti *et al.,* (2017). The difference in respect of fruit weight recorded in present study indicates that there is variation in different cultivars. The maximum fruit volume was found in DHS-1 (77.40 ml) followed by CO-2 (74.20 ml) and PKM-3 (70.30 ml). The minimum fruit volume was found in Oval (54.24 ml). Jadhav *et al.,* (2018) reported that the volume of the sapota fruits range is 20 to 70 ml, these results were in agreement with the present study. The variation in fruit volume is due to difference in fruit weight, fruit girth and fruit length values. The maximum fruit yield (kg/tree) and (t/ha) was found in DHS-1 (156.25 kg/tree, 15.63 t/ha) followed by DHS-2 (151.25 kg/tree, 15.13 t/ha) and CO-1 (147.75 kg/tree, 14.78 t/ha). The minimum fruit yield (kg/tree) and (t/ha) was found in Kirthbarthi (77.00 kg/tree, 7.70 t/ha). Chavan *et al.,* (2009) recorded the maximum fruit yield per plant in DHS-1 (169.20 kg), this result was in agreement with the present investigation. The variation in yield is due to environmental conditions and better absorption of nutrients from different cultivars. Shirol *et al.,* (2009) reported that the fruit yield per hectare varied from 0.94 t/ha to 5.12 t/ha.

The data on quality parameters of different genotypes of sapota (22 years old) are given in Table 2. Significantly maximum pulp to peel ratio was observed in cv. CO-1 (14.62) followed by Oval (12.89) and DHS-1 (12.65). The minimum pulp to peel ratio was found in PKM-2 (5.96). The maximum TSS was found in Oval (24.00 ^{o}Brix) followed by Kalipatti (23.75 ^{o}Brix) and Long Oval (23.25 ^{o}Brix). The minimum TSS was found in Tagarampudi (19.25 ^{o}Brix). The maximum TSS to acid ratio was found in PKM-2 (106.45) followed by PKM-1 (84.76) and Cricket Ball (84.49). The minimum TSS to acid ratio was found in PKM-3 (60.85). The results for TSS were in accordance with the reports of Siddaramayya (2005) and Shirol *et al.,* (2006). Ankalagi *et al.,* (2017) reported that the TSS to acid ratio varied from 101.50 to 113.64, these results were in accordance with the present study.

The maximum shelf-life of fruit was found in Cricket Ball (6.50 days) followed by DHS-2, PKM-2, Kirthbarthi and Tagarampudi (6.00 days). The minimum shelf-life of fruit was found in Kalipatti (3.50 days), this might be due to more juice content in fruit.

The data on growth and yield parameters of different genotypes of sapota (17 years old) are given in Table 3. Significantly canopy volume was found in cv. Cricket Ball: ARSA (154.90 m^3) followed by Singapore (95.66 m^3) and Cricket Ball: Udupi (77.84 m^3). The minimum canopy volume was found in Murabba (55.79 m^3). The results for canopy volume were higher compare to the findings of Patel *et al.,* (2018) and Shirol *et al.,* (2009). The variation might be due to different genetic stock used in the study. The maximum fruit weight was found in Cricket Ball: ARSA (102.83 g) followed by Cricket Ball: Udupi (98.89 g) and Guthi (75.89 g). The minimum fruit weight was found in Mohangootee (59.81 g). The results for fruit weight were higher compare to the findings of Shakti *et al.,* (2017). The maximum fruit volume was found in Cricket Ball: Udupi (84.07 ml) followed by Cricket Ball: ARSA (77.13 ml) and Singapore (61.07 ml).

The minimum fruit volume was found in Mohangootee (43.47 ml). The maximum fruit yield (kg/tree) and (t/ha) was found in Cricket Ball: ARSA (111.67 kg/tree, 11.17 t/ha) followed by Virudhnagar (99.00 kg/tree, 9.90 t/ha) and Singapore (80.00 kg/tree, 8.00 t/ha). The minimum fruit yield (kg/tree) and (t/ha) was found in Mohangootee (47.83 kg/tree, 4.77 t/ha) respectively.

Table.1 Growth and yield parameters of different cultivars of sapota (22 years old tree)

Cultivars	Canopy volume (m^3)	Fruit weight (g)	Fruit volume (ml)	Fruit yield (kg/tree)	Fruit yield (t/ha)
T_1:DHS-1	305.25	139.82	77.40	156.25	15.63
T_2:DHS-2	216.99	138.66	63.30	151.25	15.13
T_3:PKM-1	104.56	104.36	63.45	97.50	9.75
T_4:PKM-2	114.04	120.10	64.50	88.50	8.85
T_5:PKM-3	152.84	133.10	70.30	95.00	9.50
T_6:CO-1	189.80	118.58	64.50	147.75	14.78
T_7:CO-2	197.41	126.10	74.20	98.25	9.83
T_8:Cricket Ball	177.93	118.60	64.80	84.75	8.48
T_9:Long Oval	241.65	135.90	53.90	81.25	8.13
T_{10}:Kalipatti	192.49	136.18	66.45	122.75	12.28
T_{11}:Gavarayya	192.62	122.64	65.10	87.75	8.78
T_{12}:Oval	121.54	103.02	54.24	80.50	8.05
T_{13}:Kirthbarthi	118.92	124.54	66.49	77.00	7.70
T_{14}:Tagarampudi	122.19	113.48	61.32	86.50	8.65
S.Em±	13.57	5.50	2.32	3.92	0.39
CD(5%)	41.44	16.81	7.08	11.98	1.20
CV (%)	10.97	6.28	5.04	5.34	5.34

Table.2 Quality parameters of different cultivars of sapota (22 years old tree)

Cultivars	Pulp to peel ratio	TSS (^{o}Brix)	TSS : acid ratio	Shelf-life (days)
T_1:DHS-1	12.65	21.00	77.67	5.50
T_2:DHS-2	6.35	20.50	67.29	6.00
T_3:PKM-1	6.16	20.50	84.76	4.50
T_4:PKM-2	5.96	21.25	106.45	6.00
T_5:PKM-3	6.59	19.50	60.85	5.50
T_6:CO-1	14.62	20.00	64.69	5.50
T_7:CO-2	8.72	22.50	83.65	5.00
T_8:Cricket Ball	8.47	21.50	84.49	6.50
T_9:Long Oval	10.38	23.25	71.72	4.50
T_{10}:Kalipatti	11.26	23.75	74.95	3.50
T_{11}:Gavarayya	6.27	22.25	76.79	4.00
T_{12}:Oval	12.89	24.00	64.95	5.50
T_{13}:Kirthbarthi	7.30	20.75	64.88	6.00
T_{14}:Tagarampudi	6.98	19.25	67.69	6.00
S.Em±	1.26	0.85	6.50	0.51
CD(5%)	3.83	2.60	19.87	1.55
CV (%)	19.95	5.62	12.26	13.60

Table.3 Growth and yield parameters of different cultivars of sapota (17 years old tree)

Cultivars	Canopy volume (m^3)	Fruit weight (g)	Fruit volume (ml)	Fruit yield (kg/tree)	Fruit yield (t/ha)
T_1:Guthi	59.75	75.89	51.87	67.33	6.73
T_2:Virudhnagar	76.95	72.75	53.27	99.00	9.90
T_3:Singapore	95.66	74.72	61.07	80.00	8.00
T_4:Mohangootee	58.00	59.81	43.47	47.83	4.77
T_5:Murabba	55.79	72.15	54.00	68.00	6.80
T_6:Cricket Ball (ARSA)	154.90	102.83	77.13	111.67	11.17
T_7:Cricket Ball (Udupi)	77.84	98.89	84.07	76.67	7.67
S.Em±	5.90	7.38	6.05	2.66	0.27
CD(5%)	18.18	22.73	18.63	8.20	0.82
CV (%)	12.36	16.06	17.25	5.86	5.87

Table.4 Quality parameters of different cultivars of sapota (17 years old tree)

Cultivars	Pulp to peel ratio	TSS (^{o}Brix)	TSS : acid ratio	Shelf-life (days)
T_1:Guthi	7.12	19.50	55.36	5.67
T_2:Virudhnagar	10.08	23.00	75.01	5.67
T_3:Singapore	11.36	22.67	84.06	6.00
T_4:Mohangootee	12.05	20.17	58.84	5.33
T_5:Murabba	9.08	21.83	60.97	7.00
T_6:Cricket Ball (ARSA)	9.99	20.17	59.09	5.67
T_7:Cricket Ball (Udupi)	8.18	16.83	55.58	6.67
S.Em±	0.81	0.81	2.74	0.33
CD(5%)	2.49	2.49	8.44	1.01
CV (%)	14.46	6.80	7.40	9.51

Saraswathy *et al.,* (2010) reported that the highest yield of 139.00 kg/tree was recorded in PKM-4 followed by Virudhunagar local which recorded a yield of 135.75 kg/tree.

The variation in yield is due to more number of fruits per plant and environmental conditions. Shirol *et al.,* (2009) reported that the fruit yield per hectare varied from 0.94 t/ha to 5.12 t/ha.

The data on quality parameters of different genotypes of sapota (17 years old) are given in Table 4. Significantly maximum pulp to peel ratio was observed in cv. Mohangootee (12.05) followed by Singapore (11.36) and Virudhnagar (10.08). The minimum pulp to peel ratio was found in Guthi (7.12). Pulp to peel ratio noticed in accordance with Ramadoss and Arivazhagan (2016). The maximum TSS was found in Virudhnagar (23.00 ^{o}Brix) followed by Singapore (22.67 ^{o}Brix) and Murabba (21.83 ^{o}Brix). The minimum TSS was found in Cricket Ball: Udupi (16.83 ^{o}Brix). The maximum TSS to acid ratio was found in Singapore (84.06) followed by Virudhnagar (75.01) and Murabba (60.97). The minimum TSS to acid ratio was found in Guthi (55.36). Among the 19 sapota germplasm at Periyakulum, Virudhnagar recorded highest TSS (24.82°Brix) which was reported by (Anon.,

2019). Significant difference among varieties in terms of TSS might be due to varietal characters in combination with agro-climatic condition of the area. The maximum shelf-life of fruit was found in Murabba (7.00 days) followed by Cricket Ball: Udupi (6.67 days) and Singapore (6.00 days). The minimum shelf-life of fruit was found in Mohangootee (5.33 days).

Among 22 years old sapota cultivars, DHS-1 followed by DHS-2 showed better results for growth parameters. DHS-1 followed by CO-2 showed better results for yield, but for quality attributes the cultivar Long Oval followed by Oval showed better results compared to other cultivars. Among 17 years old sapota cultivars, Cricket Ball (ARSA) followed by Cricket Ball (Udupi) showed better results for growth, yield parameters and for quality attributes Cricket Ball (ARSA) followed by Murabba compared to other cultivars.

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How to cite this article:

Rashmi Ingalagavi, S. N. Patil, Kulapati Hipparagi, Mallikarjun Awati and Kantharaju V. 2019. Evaluation of Different Cultivars of Sapota (Manilkara achras L.) under Northern Dry Zone of Karnataka, India. *Int.J.Curr.Microbiol.App.Sci.* 8(09): 1705-1710.
doi: https://doi.org/10.20546/ijcmas.2019.809.193