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RESEARCH ARTICLE

PHYSIOLOGICAL INVESTIGATION ON GROWTH AND YIELD OF SAPOTA [*MANILKARA ACHRAS* (MILL.) FOSBERG].

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Abstract

A study on physiological investigation on growth and yield of sapota [*Manilkara achras* (Mill.) Fosberg] was carried out in the "All India Co-ordinated research project on Fruits", Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka during 2012-2013. Among all the cultivars studied Cv. DHS-1, DHS-2, CO-1 showed maximum vegetative growth, cv. Cricket Ball, PKM-1, PKM-2 and DHS-2 showed best results with respect to physiological characters. Cv. Kirthabharthi, Cricket Ball and DHS-2 were found to be good with respect to bio-chemical characters. Cv. DHS-1, Kalipatti, Tagapampudi, Long Oval, Kirthabharthi, Cricket Ball, PKM-1, Oval and Gavarayya were found to be best with respect to yield and quality parameters. Correlation coefficient studies showed that, positive correlation for relative water content with fruit volume and fruit breadth, light transmission rate with individual fruit weight, fruit breadth and fruit volume. Number of fruits per plant with yield (kg/plant). Individual fruit weight with fruit breadth and fruit volume. Fruit breadth was positively correlated with fruit volume.

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Introduction:-

Sapota [*Manilkara achras* (Mill.) Fosberg] is one of the delicious fruit crop of humid tropical and subtropical regions, belonging to the family Sapotaceae. It is a native of tropical America and has now spread to almost all tropical countries of the world, including Central and South America, the West Indies, India, and Florida in the United States. It is also called by other names, such as chikku, sapota plum or sapodilla. It has been used for many purpose including extraction of latex, fruit and timber. Today sapota is cultivated almost exclusively for commercial fruit production in most of the countries.

In India it has become very popular with farmers as a cash crop and if properly exploited it can become an export commodity also. There is a possibility of extending cultivation of this crop into warm and humid climate of the world. Popularity of this fruit is increasing due to high production per unit area, continuous fruiting throughout the year and very little incidence of disease and pests. Besides it is quite hardy and can tolerate salinity and water stress to a very great extent (Chundawat and Bhuvu, 1982). Due to presence of endogenous phenolic substances sapota is fairly less susceptible to pest and diseases (Lakshminarayana and Subramanyam, 1966).

The economic importance of sapota calls for continuous effort to identify the better genotypes for sustainability and meet ever – changing demands of different agro climatic conditions and the commercial market. In this context an

experiment was carried out in the "All India Co-ordinated research project on Fruits", Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka during 2012-2013 to study the physiological investigation on growth and yield of sapota [*Manilkara achras* (Mill.) Fosberg].

Material and Methods:-

An evaluation of sapota genotypes was initiated in 2012-13 with 14 genotypes of 16-17 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 Physiological parameters like relative water content, it was estimated as per the method of Barrs and Weatherly (1962), stomatal index by xylene method and light transmission rate through lux meter, biochemical parameters like Chlorophyll pigments *viz.*, chlorophyll 'a', 'b' and total chlorophyll contents were determined by di-methyl sulfoxide method (DMSO) of Hiscox and Israelstam (1979). Chlorophyll stability index was worked out by following the method suggested by Dhopte and Livera (1989) Carotenoid content is calculated following the formula (Hendry and Price, 1991), proline content in the leaf tissue was estimated by using the method suggested by Bates *et al.* (1973) and epicuticular wax content was determined by the colorimetric method of Ebercon *et al.* (1977). And morphological parameters were recorded and correlating them with yield and quality for evaluation of different cultivars of sapota. The design adopted for the experiment is randomized block design (RBD) with three replications (three trees per replication).

Results and Discussion:-

Vegetative parameters:-

The data on vegetative parameters of different sapota cultivars (16-17 years old) are presented in Table 1 and 2. Maximum plant height was recorded in DHS-1 during all the different period (6.50 m, 6.60 m and 6.83 m, respectively) followed by CO-1 (6.10 m, 6.20 m and 6.30 m, respectively) while, lowest plant height was recorded in Kalipatti (4.07 m, 4.20 m and 4.33 m, respectively). cv. DHS-2 showed maximum plant spread in both North-South and East-West directions in all the seasons of observation recorded (10.00 m, 10.40 m and 10.67 m in North-South and 10.03 m, 10.33 m and 10.63 m in East-West direction respectively) followed by cv. Long Oval (8.60 m, 8.93 m and 9.2 m in North-South in July, October and January and 8.77 m and 9.00 m in East-West direction in July and October). But during January Kalipatti showed maximum (9.53 m) plant spread with respect to East-West direction. The least plant spread was observed in cv. Tangarampudi (5.40 m in North-South and 4.83 m in East-West). The same trend was followed in October and January 2014.

The data on stem girth and canopy volume of 16-17 years old plants showed significant difference among different accessions (Table 2). Significantly maximum stem girth was recorded in cv. DHS-2 (38.54 cm, 38.69 cm and 38.85 cm respectively), followed by cv. DHS-1 (28.72 cm, 28.87 cm and 29.03 cm respectively) during three consecutive growth periods i.e. July, October and January. Minimum stem girth was recorded in cv. Tagarampudi (17.20 cm, 17.46 cm and 17.62 cm respectively). The maximum canopy volume was recorded in cv. DHS-2 (130.82 m³, 154.68 m³ and 170.86 m³) followed by cv. DHS-1 (116.27 m³, 126.38 m³ and 137.79 m³) whereas, minimum canopy volume was recorded in cv. Tagarampudi (32.80 m³, 38.97 m³ and 46.41 m³) during July, October and January respectively). Cultivars *viz.*, DHS-1, DHS-2, CO-2, Cricket Ball and Kalipatti having spreading habit of growth, cultivars *viz.*, PKM-1, PKM-2, PKM-3, CO-1, Oval, Gavarayya and Kirthabharathi having erect growing habit, cultivars *viz.*, Long Oval and Tagarampudi, having drooping nature of growth habit.

The variation was observed with respect to vegetative growth parameters of different sapota cultivars is might be due to difference among cultivars for their genetic constituent and erect growth habit. These results are similar with those done by Saraswathy *et al.* (2010) in sapota under Periakulam conditions.

Physiological parameter:-

The data on physiological parameters of 16-17 years old plant are presented in Table 3. Significantly maximum relative water content was recorded in cv. Cricket Ball (88.64 %) which was on par with Tagarampudi (86.14 %), DHS-1 (85.67 %), Kalipatti (84.45 %), Kirthabhathi (84.09 %), PKM-3 (83.82 %) and Gavarayya (83.14 %) while, minimum relative water content was recorded in cv. CO-2 (79.30 %). The observation revealed that, there was no stomata in abaxial surface of all sapota cultivars studied but there was significant difference among the cultivars with respect to stomatal index on adaxial surface. Significantly maximum number of stomata was recorded in cv.

PKM-1 (66.48 nos. per microscopic view), which was on par with cv. Long Oval (66.48 nos.) and it was least in cv. Gavarayya (44.84 nos.) (Fig.1). This might be due to their genotypic difference. Maximum light transmission into the canopy on top portion was recorded in cv. PKM-2 (1994.33 Lux) which was on par with cv. PKM-3 (1990.67 Lux) and Tangaramapudi (1976.00 Lux), minimum light transmission rate was recorded in cv. Gavarayya (1858.67 Lux). Maximum light transmission at middle portion of the plant was recorded in cv. Long Oval (563.00 Lux) followed by cv. Oval (521.00 Lux) and minimum light transmission was recorded in cv. PKM-3 (72.33 Lux). Maximum light transmission at the bottom portion of plant was recorded in cv. DHS-2 (113.00 Lux) which was on par with CO-2 (105.33 Lux) followed by DHS-1 (93.33 Lux) and it was minimum in cv. PKM-3 (20.00 Lux). This is generally due to their erect, spreading and drooping nature of growth habit.

Biochemical Parameters:-

The data on biochemical parameters of 16-17 years old plant are presented in Table 4. Significantly maximum chlorophyll 'a' was recorded in cv. PKM-1 (35.19 mg/g), which was on par with cv. PKM-2 (35.07 mg/g), Gavarayya (35.07 mg/g), Long Oval (35.04 mg/g), CO-1 (34.93 mg/g), CO-2 (34.66 mg/g) and Kalipatti (34.12 mg/g). Significantly maximum chlorophyll 'b' was recorded in cv. Kirthabharthi (50.96 mg/g) which was on par with cv. CO-2 (49.48 mg/g) and DHS-2 (46.44 mg/g). Minimum content of both chlorophyll 'a' and 'b' was noticed in cv. Cricket Ball (29.41 mg/g and 16.51 mg/g respectively). Significantly maximum total chlorophyll content was recorded in cv. Kirthabharthi (84.72 mg/g) which was on par with cv. CO-2 (84.12), PKM-1 (80.45 mg/g), Gavarayya (80.34 mg/g), DHS-2 (79.27 mg/g) and PKM-3 (79.14 mg/g) and least was recorded in cv. Cricket Ball (45.91 mg/g) (Fig.2). Increase in chlorophyll content might be due to entering of maximum light in to the canopy, because of their erect growing nature sunlight enters in all portion of canopy which helps in increase of photosynthates which causes of conversion of solar energy in to chemical energy. Cv. PKM-1 was recorded significantly maximum chlorophyll stability index (63.25 %) in heated condition, which was on par with cv. CO-2 (59.24 %) while, the minimum chlorophyll stability index was recorded in cv. DHS-1 (38.06 %), which was on par with cv. Long Oval (42.13 %), Tagaramapudi (42.78 %) and Kalipatti (43.00 %). But in controlled condition cv. Kirthabharthi was recorded maximum (69.61 %) chlorophyll stability index, which was on par with cv. CO-2 (68.99 %) and PKM-1 (67.33 %) while, the minimum was recorded in cv. DHS-1 (45.61 %). This might due to varietal characters and genetic constitutions of the varieties. Maximum carotenoid content was recorded in cv. DHS-1 (6.68 mg/g), which was on par with cv. Cricket Ball (6.68 mg/g) and minimum was recorded in cv. CO-2 (3.56 mg/g). Maximum proline content was recorded in cv. DHS-2 (0.195 µg/g), followed by Cricket Ball (0.157 µg/g) While, the minimum was recorded in cv. PKM-3 (0.003 µg/g). Significantly maximum epicuticular wax content was recorded in cv. Kirthabharthi (0.144 mg/dm²) followed by cv. DHS-1 (0.097 mg/dm²) while, the minimum was recorded in cv. Long Oval (0.010 mg/dm²) (Fig.3). Presence of high epicuticular wax content helps in less water loss through transpiration during summer which helps to withstand drought. This difference is might due to varietal characters and genetic constitutions of the varieties.

Yield and Yield characters:-

The data on yield and yield characters of 16-17 years old plant are presented in Table 5. Among all the cultivars cv. Kalipatti recorded significantly higher number of fruits per tree (2821 nos.) followed by DHS-1 (2623 nos.). The lowest number of fruits per tree was noticed in cv. Tagaramapudi (1240 nos.). Fruit yield per tree and per hectare was recorded in cv. DHS-1 (201.50 kg and 20.15 t/ha respectively) followed by cv. Kalipatti (189.50 kg and 18.95 t/ha respectively). The minimum fruit yield per tree and per hectare was recorded in cv. Tagaramapudi (86.60 kg and 8.66 t/ha respectively). Wide variation was observed among the different genotypes with respect to yield characters and this may be attributed to their genotypic difference. In addition age of the tree is also an important factor which influence the yield. Kadam *et al.* (2005) reported that yield increased in sapota trees up to 30 years of age. Present investigations is in confirmity with the earlier reports of Shirol *et al.* (2009), Sarawathy *et al.* (2010) and Suhasini *et al.* (2012) in sapota.

Physical and Biochemical parameters:-

The data on Physical and Biochemical parameters of 16-17 years old plant are presented in Table 6. Clutivars viz., CO-2. Long Oval, Kirthabharthi, Tagaramapudi, CO-3 and Virudhunagar have Brown Colour pulp. Cultivars viz., PKM-1, PKM-2, Cricket Ball, Kalipatti, PKM-4, Cricket Ball (ARSA), Murabba, French Indo China, Dwarapudi, Cricket Ball (Udupi) and Variegated sapota have light brown colour of pulp. Cvs. DHS-1 and Oval having Orange brown colour of pulp, cv. DHS-2 have Light orange colour of pulp, cvs. PKM-3, Guthi, and Mohanguthi have Buff colour of pulp, cultivars like., Singapore and Pala having medium brown colour pulp, cv. CO-1 have pinkish yellow colour and cv. Gavarayya have yellowish brown colour of pulp. Significantly maximum fruit weight and fruit

volume was recorded in cultivar Tagarampudi (121.67 g and 130.53 ml respectively), which was on par with cv. Kirthabharthi (116.07 g and 121.67 ml respectively) While, the minimum fruit weight and fruit volume was recorded in cv. PKM-1 (77.40 g and 77.87 ml respectively), cv. Long Oval was recorded significantly maximum fruit length (7.27 cm) followed by cv. PKM-3 (6.84 cm). The maximum fruit breadth was observed in cv. Kirthabharthi (6.09 cm) followed by cv. Tagarampudi (5.89 cm). The minimum fruit length was recorded in cv. Cricket Ball (4.90 cm) and minimum fruit breadth was recorded in cv. PKM-1 (4.75 cm). This varietal variation in quality parameters might be due to differences in their genotypic characteristics (Anon., 1998).

Significantly maximum number of seeds and seed weight per fruit was recorded in cv. Cricket Ball (7.40 nos. and 5.67 g respectively) followed by Tagarampudi (4.93 nos. and 4.67 g respectively) while, maximum peel weight was recorded in cv. Tagarampudi (29.00 g) followed by cv. Cricket Ball (18.93 g). The minimum number of seeds and seed weight per fruit was recorded in cv. Oval (1.93 nos. and 1.77 g respectively) While, minimum peel weight was recorded in cv. PKM-1 (6.93 g). Significantly maximum pulp content was recorded in cv. Long Oval (98.73 g) which was on par with cv. DHS-2 (95.70 g), Kirthabharthi (94.20 g) and PKM-2 (91.47 g) and the minimum pulp content was recorded in cv. PKM-1 (68.07 g). Cv. Oval recorded higher content of total soluble solids (23.80⁰B), followed by Long Oval (22.50⁰B) and maximum acidity was recorded in cv. Gavarayya (0.198 %) which was on par with cv. Tagarampudi (0.197 %), CO-2 (0.196 %) and Kirthabharthi (0.196 %) While, minimum total soluble solids was recorded in cv. Gavarayya (17.10⁰B), and minimum acidity was recorded in cv. CO-1 (0.188 %). Significant difference among varieties in terms of TSS and acidity might be due to varietal characters in combinations with agro-climatic condition of the area.

Correlation studies:-

Among 16-17 year old sapota cultivars genotypic correlation for relative water content was positively and significantly associated with fruit volume (0.588). Light transmission into the canopy at middle portion of the plant was highly significantly and positively correlated with individual fruit weight (0.485), fruit breadth (0.421) and fruit volume (0.447). Light transmission at bottom portion of the plant was positively correlated with fruit breadth (0.421). Number of fruits per plant was positively correlated with yield (kg/plant) (0.787). Individual fruit weight is highly significantly and positively correlated with fruit breadth (0.802) and fruit volume (0.964). Fruit breadth was positively correlated with fruit volume (0.835). Correlation analysis clearly brought out that number of fruits per tree had significant positive correlation with yield indicating that during selection of high yielding trees in sapota, due weightage should be given to trees bearing more number of fruits.

Table 1. Plant height and plant spread of sapota cultivars at different growth periods (16-17 years old).

Cultivars	Plant height (m)			Plant spread (m)					
	July 2013	Oct. 2013	Jan. 2014	July 2013		Oct. 2013		Jan. 2014	
				North-South	East-West	North-South	East-West	North-South	East-West
DHS – 1	6.50	6.60	6.83	8.30	8.60	8.57	8.93	8.80	9.17
DHS – 2	5.20	5.73	6.00	10.00	10.03	10.40	10.33	10.67	10.63
PKM – 1	4.30	4.60	4.90	6.57	6.33	6.77	6.63	6.93	6.83
PKM – 2	4.43	4.73	4.97	7.67	6.87	7.90	7.23	8.10	7.53
PKM – 3	5.20	5.50	5.67	6.43	6.60	6.63	6.90	6.83	7.13
CO – 1	6.10	6.20	6.30	7.80	7.57	8.10	7.93	8.30	8.23
CO – 2	4.93	5.47	5.80	8.23	8.10	8.60	8.73	8.83	8.93
Cricket Ball	4.50	4.70	4.87	7.50	8.13	8.30	8.67	8.67	8.93
Kalipatti	4.07	4.20	4.33	8.07	8.77	8.57	9.13	8.97	9.53
Gavarayya	5.67	6.10	6.37	7.80	7.90	8.17	8.57	8.47	8.90
Oval	4.50	4.77	5.03	6.83	6.63	7.30	7.07	7.60	7.33
Long Oval	5.47	5.83	6.07	8.60	8.77	8.93	9.00	9.20	9.17
Kirthabharthi	4.93	5.33	5.60	6.23	6.23	6.73	6.67	7.13	6.90
Tagarampudi	5.03	5.23	5.47	5.40	4.83	5.73	5.20	6.07	5.60
S. Em ±	0.15	0.15	0.15	0.17	0.18	0.15	0.15	0.17	0.17
C. D. at 5%	0.43	0.43	0.44	0.50	0.51	0.43	0.44	0.50	0.49

Table 2. Stem girth, canopy volume and branching habit of sapota cultivars at different growth periods (16-17 years old).

Cultivars	Stem girth (cm)			Canopy volume (m ³)			Branching habit
	July 2013	Oct. 2013	Jan. 2014	July 2013	Oct. 2013	Jan. 2014	
DHS – 1	28.72	28.87	29.03	116.27	126.38	137.79	Spreading
DHS – 2	38.54	38.69	38.85	130.82	154.68	170.86	
PKM - 1	18.52	18.74	18.95	44.80	51.68	58.06	Erect
PKM - 2	24.31	24.79	25.00	58.53	67.71	75.85	
PKM - 3	20.01	20.22	20.54	55.36	63.09	69.17	
CO – 1	27.34	27.49	27.65	90.01	99.58	107.61	Spreading
CO – 2	20.59	20.91	21.13	82.45	103.11	114.75	
Cricket Ball	24.10	24.26	24.47	68.78	84.60	94.24	Erect
Kalipatti	28.34	28.61	28.87	68.67	82.07	92.47	
Gavarayya	26.43	26.75	27.34	87.28	106.86	120.07	Drooping
Oval	20.38	20.59	20.86	51.03	61.54	70.14	
Long Oval	28.50	28.87	29.09	98.61	117.46	128.02	Erect
Kirthabharthi	17.20	17.68	18.26	47.93	59.99	68.90	Drooping
Tagarampudi	17.20	17.46	17.62	32.80	38.97	46.41	-
S. Em ±	0.91	0.90	0.90	4.31	4.88	4.95	-
C. D. at 5%	2.64	2.61	2.63	12.51	14.17	14.38	-

Table 3. Physiological parameters of sapota cultivars (16-17 years old).

Cultivars	Relative water content (%)	Stomatal index (per microscopic view Adaxial surface)	Light transmission rate (Lux)		
			Top portion	Middle portion	Bottom portion
DHS – 1	85.67	57.64	1884.00	234.00	93.33
DHS – 2	81.90	61.18	1898.67	189.00	113.00
PKM – 1	81.73	66.48	1935.67	141.33	65.33
PKM – 2	82.38	53.54	1994.33	277.00	35.67
PKM – 3	83.82	49.42	1990.67	72.33	20.00
CO – 1	81.74	54.40	1960.33	262.67	60.67
CO – 2	79.30	60.70	1949.33	345.00	105.33
Cricket Ball	88.64	50.53	1880.00	111.33	90.00
Kalipatti	84.45	59.44	1904.00	216.67	47.33
Gavarayya	83.14	44.84	1858.67	196.00	78.33
Oval	80.76	44.99	1925.67	521.00	86.00
Long Oval	80.76	66.48	1920.00	563.00	71.67
Kirthabharthi	84.09	52.81	1954.33	445.67	87.33
Tagarampudi	86.14	57.03	1976.00	389.33	44.00
S. Em ±	1.94	0.92	9.38	14.35	4.72
C. D. at 5%	5.63	2.66	27.25	41.68	13.73

Table 4. Biochemical parameters of sapota cultivars (16-17 years old).

Cultivars	Chlorophyll content (mg/g)			Chlorophyll stability index (%)		Carotenoid (mg/g)	Proline ($\mu\text{g/g}$)	Epicuticular wax content (mg/dm^2)
	Chlorophyll 'a'	Chlorophyll 'b'	Total Chlorophyll	Heated	Control			
DHS – 1	32.58	21.67	54.23	38.06	45.61	6.68	0.013	0.097
DHS – 2	32.85	46.44	79.27	55.08	65.77	6.16	0.195	0.095
PKM – 1	35.19	45.29	80.45	63.25	67.33	6.39	0.019	0.047
PKM – 2	35.07	41.68	76.72	53.83	63.99	6.21	0.026	0.052
PKM – 3	33.74	45.42	79.14	52.13	62.40	6.17	0.003	0.042
CO – 1	34.93	29.76	64.67	53.10	62.55	5.49	0.117	0.062
CO – 2	34.66	49.48	84.12	59.24	68.99	3.56	0.148	0.063
Cricket Ball	29.41	16.51	45.91	52.28	61.34	6.68	0.157	0.015
Kalipatti	34.12	44.45	78.55	43.00	59.28	6.34	0.145	0.020
Gavarayya	35.07	45.30	80.34	51.00	61.71	6.28	0.015	0.038
Oval	33.67	32.16	65.80	45.32	52.12	4.63	0.004	0.039
Long Oval	35.04	42.46	77.47	42.13	50.22	6.25	0.121	0.010
Kirthabharthi	33.79	50.96	84.72	54.62	69.61	4.40	0.004	0.144
Tagarampudi	32.90	29.15	62.03	42.78	51.27	4.43	0.007	0.073
S. Em \pm	1.31	1.84	2.09	2.53	2.55	0.16	0.004	0.002
C. D. at 5%	3.80	5.35	6.08	7.37	7.41	0.46	0.011	0.005

Table 5. Yield and yield characters of sapota cultivars (16-17 years old).

Cultivars	Number of fruits/ plant	Weight of fruits (kg/plant)	Fruit yield (t/ha)
DHS – 1	2623	201.50	20.15
DHS – 2	2010	178.00	17.80
PKM - 1	2560	128.00	12.80
PKM - 2	1715	120.00	12.00
PKM - 3	2146	161.50	16.15
CO – 1	1612	176.20	17.62
CO – 2	2604	190.50	19.05
Cricket Ball	1418	112.60	11.26
Kalipatti	2821	189.50	18.95
Gavarayya	2384	174.60	17.46
Oval	1601	110.50	11.05
Long Oval	1464	101.80	10.18
Kirthabharthi	1600	108.80	10.88
Tagarampudi	1240	86.60	8.66
S. Em ±	39.10	1.73	0.43
C. D. at 5%	113.58	5.01	1.24

Table 6. Physical and Biochemical parameters of sapota cultivars (16-17 years old).

Cultivars	Colour of pulp	Individual fruit wt. (g)	Fruit length (cm)	Fruit breadth (cm)	Fruit volume (ml)	Number of seeds/ fruit	Seed wt. (g)	Peel wt. (g)	Total pulp content (g)	TSS (^o B)	Acidity (%)
DHS – 1	Orange brown	95.47	5.06	5.63	101.87	3.00	3.00	10.60	81.87	20.07	0.193
DHS – 2	Light orange	108.87	6.01	5.81	109.33	2.93	2.50	10.67	95.70	19.53	0.192
PKM - 1	Light brown	77.40	6.42	4.75	77.87	2.80	2.40	6.93	68.07	21.20	0.194
PKM - 2	Light brown	104.67	6.03	5.68	105.07	4.00	3.87	9.33	91.47	19.40	0.192
PKM - 3	Buff colour	85.47	6.84	4.81	90.53	2.60	2.13	14.53	68.80	21.40	0.193
CO – 1	Pinkish yellow	105.07	6.15	5.60	108.07	2.47	2.37	15.60	87.10	20.50	0.188
CO – 2	Brown	89.20	4.98	5.56	90.73	4.13	2.73	12.80	73.67	19.37	0.196
Cricket Ball	Light brown	106.67	4.90	5.61	110.93	7.40	5.67	18.93	85.87	18.80	0.193
Kalipatti	Light brown	85.53	5.47	5.30	94.67	2.60	2.30	13.07	70.17	20.60	0.192
Gavarayya	Yellowish brown	96.40	6.09	5.37	105.53	3.73	2.57	12.40	81.43	17.10	0.198
Oval	Orange brown	90.33	5.77	5.34	97.93	1.93	1.77	15.67	72.90	23.80	0.191
Long Oval	Brown	116.80	7.27	5.43	112.83	2.00	2.00	15.13	98.73	22.50	0.192
Kirthabharthi	Brown	116.07	5.25	6.09	121.67	4.87	2.93	16.07	94.20	17.77	0.196
Tagarampudi	Brown	121.67	6.38	5.89	130.53	4.93	4.67	29.00	88.00	17.27	0.197
S. Em ±	-	3.08	0.10	0.10	3.40	0.49	0.38	1.65	3.36	0.32	0.001
C. D. at 5%	-	8.95	0.30	0.30	9.88	1.41	1.10	4.78	9.75	0.94	0.003

Table 7. Correlation co-efficients of physiological parameters with yield and quality characters of 16-17 year old sapota cultivars.

	Relative water content	Stomatal Index	Light transmission			No. of fruits/plant	Individual fruit wt.	Fruit length	Fruit breadth	Fruit volume	Yield (Kg/plant)
			Top portion	Middle portion	Bottom portion						
Relative water content	1.000	-0.391	-	-	-	-0.307	0.375*	-	0.295	0.588**	-0.265
Stomatal Index		1.000	0.314	0.648	0.276	0.234	0.035	0.226	-	-	0.052
Top portion			1.000	0.173	-0.63	-0.324	0.110	0.361*	-	0.045	-0.338
Middle portion				1.000	0.196	-0.46	0.485*	0.13	0.438**	0.447**	-0.482
Bottom portion					1.000	0.099	0.116	-	0.421**	0.072	0.217
No. of fruits/plant						1.000	-0.807	0.265	-0.49	-	0.787*
Individual fruit wt.							1.000	0.112	0.802**	0.964**	-0.518
Fruit length								1.000	-	-	-0.316
Fruit breadth									1.000	0.835**	-0.172
Fruit volume										1.000	-0.476
Yield (Kg/plant)											1.000

Critical r value= 0.3043 at 5% and 0.3931 at 1% Significant at 1% level

* Significant at 5% level **

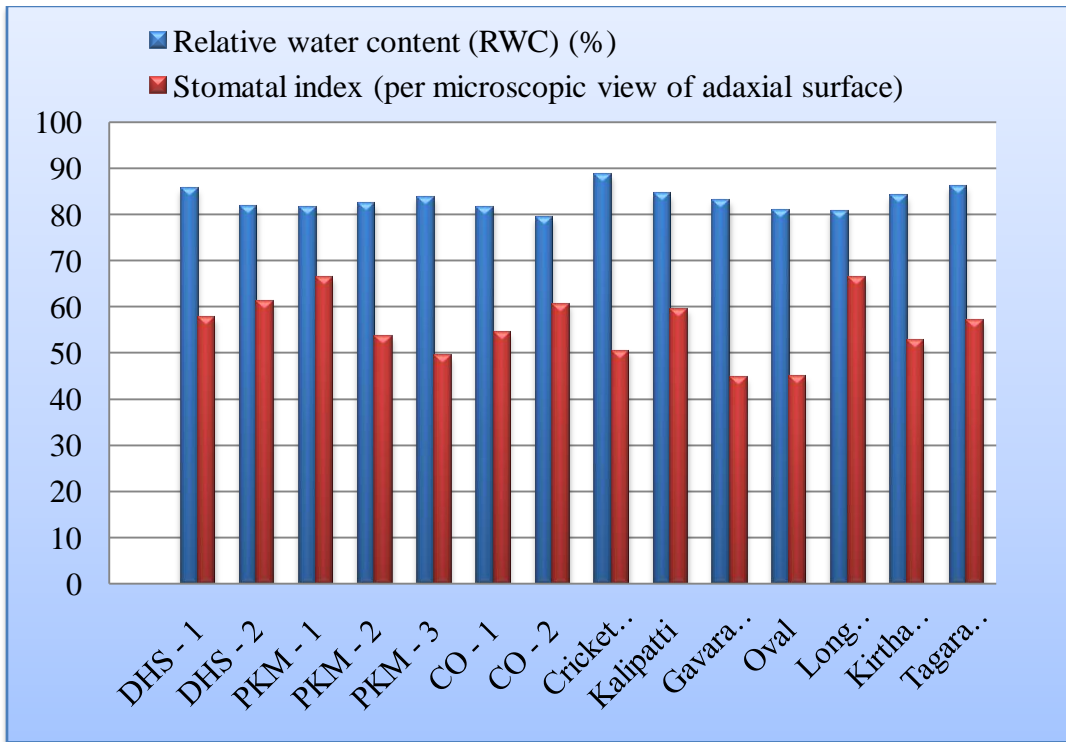


Fig 1: Relative water content and stomatal index of 16-17 years old sapota cultivars

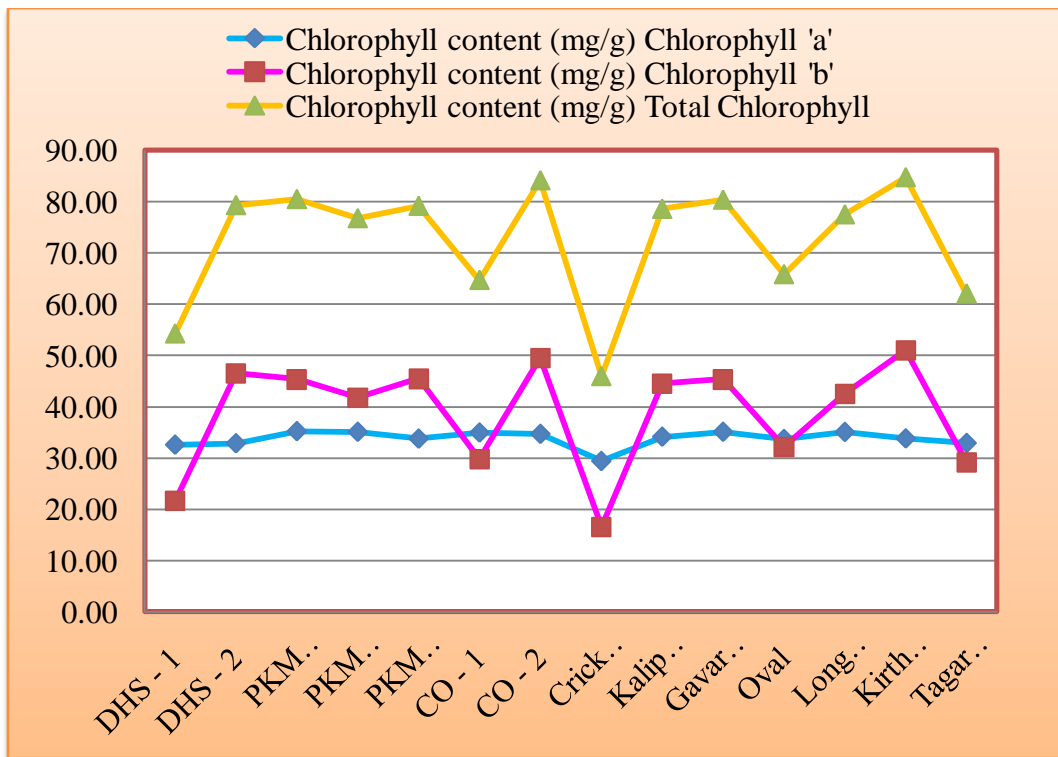


Fig 2: Chlorophyll content of 16-17 years old sapota cultivars

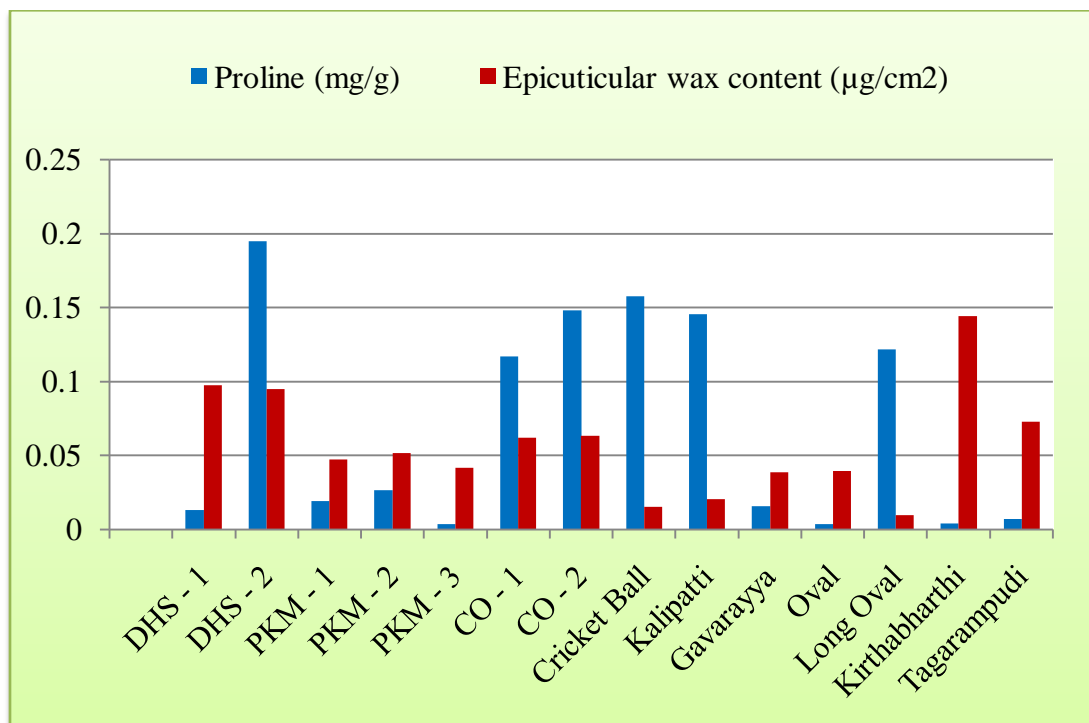


Fig 3: Proline and epicuticular wax content of 16-17 years old sapota cultivars

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