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Studies in genetic variability of sapota (*Acharas sapota* L.) germplasm

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Abstract
A study was carried out to find out the variability among the 19 sapota genotypes at Department of Fruit Science, Horticultural College and Research Institute, Periyakulam. Observations on various morphological, physiological and biochemical characters were recorded. The results revealed that Genotypic and Phenotypic Coefficients noticed for tree height, stem girth, canopy spread and yield which indicates the variability among the genotypes. The results of the variability and correlation analysis indicated that canopy spread, tree height and stem girth were significant and positively correlated with yield, fruit length, fruit diameter, fruit weight, pulp and number of fruits per shoots. Hence, these characters should be considered for selection of genotypes in further crop improvement programme.

Keywords: Correlation, sapota, germplasm, genetic variability

Introduction
Sapota (*Acharas sapota* L.) also known as "Chickle" tree is an economically important species of the Sapotaceae family native to tropical America (Mexico). As a rainforest tree, it has a long history of human use (Simpson and Ogorzaly, 1995) [14]. It has been used for many purposes ie., Fruit, latex and timber. The name Sapota is derived from the Spanish word sapodilla, meaning "small sapote." It is a popular fruit crop and widely cultivated in the most of the tropical countries across the globe. Sapota is considered as natural energy booster as it contains fructose and sucrose. Many numbers of processed food products such as canned slices are made from the ripe fruit. It is an important adjunct in ice cream and milk shakes in its fresh form. It is mainly consumed in a fresh state as a table purpose fruit in many countries (Kute and Shete, 1995) [8]. The latex of sapota has been employed as the chief ingredient in chewing gum. It contains high levels of polysaccharides, phytochemical constituents like saponin, myricetin-3-O-α-L-rhamnoside, ascorbic acid, polyphenols and other secondary metabolites, which have medicinal benefits. It can be used as medicine for fever, antibiotics and antimicrobial (Chanda and Nagani, 2010) [3].
Traditionally, it is used as a diuretic, expectorant and in ophthalmology (Parle milind and Preeti, 2015) [9]. In normal, the sapota fruit requires from 100 to 165 days to mature after anthesis, depending on the cultivar, the agro climatic location and the temperature of the environment (Sulladmath *et al.*, 2004) [16]. However, since the tree bears flowers throughout year, fruits of all stages of maturity can be found on the tree at the same time, making it difficult to determine the optimum maturity date for harvesting. The evaluation is an important aspect for documentation of the performance of the sapota genotypes which subsequently will help to introduce, select and improve existing sapota varieties. It is based on the characterization of genotypes to helpful improving for quality and quantity characters. The preference of a particular cultivar in sapota varies based on the fruit shape, size and yield characters. In some areas, the consumers prefer oval or egg-shaped fruits while in other parts of India, round and bigger sized fruits are preferred. The current study was a proposed to gather information on genetic variability, heritability, and genetic advance among the important genotypes of sapota and this variability studies can be utilized for future breeding programmes.

Materials and Methods
The study was carried out at the Department of Fruit Science, Horticultural College and Research Institute, Periyakulam during 2019-2020 with 19 genotypes of 16-30 year old were maintained at the Central Block of HC&RI was used. The experiment was carried out in Randomized Block Design in three replications. Observations on physiological character *viz*., tree height (metre), trunk girth (cm), tree growth habit, canopy spread (m^2), Fruit characters

viz., fruit shape, fruit weight (g), fruit length (cm), fruit width (cm) and biochemical characters *viz.*, total soluble solids (TSS) (˚Brix), total sugars (%), reducing sugar, titratable acidity and ascorbic acid (mg/100 g) were recorded. The difference exhibited by the genotypes for various characters were studied and tested for significance by using analysis of variance technique (Snedecor and Cochran, 1967). The morphological characters were recorded and correlate with quality and yield for characterization of different genotypes of sapota. The genotypic (GCV) and phenotypic (PCV) coefficient of variation were be calculated by the formulae suggested by Burton (1952) [2] and classified by Sivasubramanian and Madhamenon (1973) [15]. As Heritability percentage in broad sense has calculated by using the formula proposed by Johnson *et al.* (1995) [6].

Results and Discussion

The study conducted on 19 accessions showed that wide variation occurred in various morphological growth (Table.1) and biochemical characters (Table 2). The higher estimates of genotypic and phenotypic coefficient of variation and medium difference between GCV and PCV were given for tree girth, tree height, canopy spread and yield (Table 3). Goenaga and Jenkins (2012) [5] reported that similar variation of sapota grown on Ultisol and Oxisol soils at Corozal and Isabel. Medium GCV and PCV were recorded for fruit length, fruit width, fruit weight, number of fruit, seed weight, seed length, pulp seed ratio and similar findings were also reported by Ponnuswami and Irulappan (1989) [10]. The lowest GCV and PCV were recorded in seed width, pulp (%), TSS, total sugar, titrable acidity, ascorbic acid and phenols similar findings were reported by Rekha *et al.*, 2011 and Arivazhagan (2019) [11, 1]. The growth of the variety was depends on genetic constituent of the individual genotype, environment factors and their interactions. Highest genetic advance (%) mean was noticed in tree height, trunk girth, canopy spread, fruit weight, number of fruit, seed weight, yield and seed length. Moderate genetic advance was recorded in fruit length, fruit width, pulp seed ratio and lower genetic advance were estimated in seed width, pulp (%), TSS, Total sugar, titrable acidity, ascorbic acid and phenols as showed in Table 3. The correlation coefficients revealed that environmental effect enhanced the correlation between GCV and PCV to become higher at phenotypic level (Kadam *et al*., 2005) [7]. The study of correlation among yield and yield contributing traits suggests that plant height, stem girth and canopy spread. The highest yield was recorded in PKM 1 might be due to better adoptability with wide canopy spread (Shirol *et al.*, (2009) [13]. Similarly, variability of correlation findings were recorded. Saraswathy *et al*., (2010) [12] was reported that the fruit yield was correlated by its age and environment.

Table 1: Growth and yield characters of sapota germplasm under Periyakulam conditions

Genotype Name	Tree height (m)	Trunk girth (cm)	Canopy spread (m)	Number of fruit per shoots	Yield per tree	Seed weight (g)	Seed-width (cm)	Seed length (cm)	Pulp (%)	Pulp-seed ratio
PKM-1	7.30	65.60	6.80	3.95	101.55	2.60	0.92	2.65	86.86	23.4
PKM-2	7.05	60.25	6.67	3.65	98.45	3.42	1.05	2.70	86.5	19.72
PKM-3	6.70	57.10	6.63	3.47	98.65	2.50	0.93	2.12	86.52	18.8
PKM-4	6.70	54.60	6.78	3.70	125.25	3.45	1.02	3.53	87.30	21.25
PKM-5	6.95	50.15	6.18	3.51	101.12	3.40	1.01	3.05	87.28	18.99
CO-1	13.50	110.70	12.35	3.38	89.24	2.47	0.89	3.32	82.39	19.61
CO-2	10.85	108.05	9.98	3.41	97.52	3.65	1.03	3.01	85.36	19.4
CO-3	10.05	100.20	8.68	2.85	52.12	3.05	1.01	2.90	87.24	25.65
DHS-1	6.75	51.55	5.75	3.61	86.45	3.06	0.94	2.85	74.96	23.42
DHS-2	6.70	49.90	6.05	3.65	88.28	2.93	0.95	2.83	84.56	26.42
OVAL	7.05	55.30	6.63	2.99	64.82	1.90	0.79	2.25	79.55	22.09
Kirthabarthi	7.20	68.50	8.33	2.75	70.42	3.71	1.04	2.98	83.98	16.15
Guthi	6.05	46.95	6.13	3.71	96.26	3.12	1.04	2.67	81.85	19.48
Cricket Ball	13.45	136.10	10.80	2.48	96.45	4.51	1.06	3.62	86.71	18.06
Dwarampudi	7.10	55.20	8.80	2.46	72.15	2.90	0.93	2.15	83.02	23.06
Pala	6.95	42.50	6.65	3.32	66.25	2.98	0.92	2.21	85.93	25.27
Kalipatti	6.55	50.20	6.05	3.28	77.68	3.04	0.96	2.65	81.27	21.38
Thagarampudi	7.25	47.80	6.85	2.28	68.97	3.84	0.99	3.10	85.8	20.42
Gavaraya	7.05	48.50	7.23	2.22	67.82	3.40	1.02	3.02	85.04	21.26
SEd	0.1728	1.4514	0.2204	0.0408	1.7313	0.0651	0.0213	0.0459	1.9197	0.4908
CD (0.05)	0.3499**	2.9382**	0.4613**	0.0826**	3.5049**	0.1318**	0.0431**	0.0929**	3.8863**	0.9935**

Table 2: Quality parameters of sapota germplasm under Periyakulam conditions

Genotype Name	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Total soluble sugars (°brix)	Total sugars (%)	Titrable acidity (%)	Ascorbic acid content (mg/100g)	Phenol (mg/100g)
PKM-1	85.32	7.20	6.90	21.80	10.10	0.18	9.19	132.51
PKM-2	84.28	6.70	6.90	21.50	10.25	0.16	9.12	128.70
PKM-3	83.15	6.90	6.80	22.40	10.95	0.18	9.01	128.10
PKM-4	98.80	8.50	6.60	21.05	10.15	0.17	9.11	130.42
PKM-5	88.11	7.30	7.10	21.55	10.70	0.18	8.95	127.54
CO-1	101.10	7.15	7.40	19.55	10.40	0.17	8.92	129.62
CO-2	103.30	7.30	7.40	21.10	10.35	0.18	8.88	128.52
CO-3	98.80	6.90	6.50	21.30	10.55	0.18	8.94	129.83
DHS-1	80.50	6.20	7.40	22.65	11.95	0.18	8.96	127.42
DHS-2	81.30	6.30	7.00	22.20	10.62	0.17	8.83	127.54
OVAL	76.30	7.90	6.70	22.20	10.30	0.17	8.09	124.14
Kirthabarthi	84.50	6.10	8.70	21.42	9.50	0.19	9.09	130.75

Guthi	68.65	6.00	5.80	20.90	9.75	0.17	9.18	129.34
Cricket Ball	120.88	7.20	9.80	21.30	9.90	0.18	9.25	133.85
Dwarampudi	69.83	6.20	6.00	21.15	10.15	0.16	8.65	125.82
Pala	68.63	5.80	5.90	21.88	9.95	0.16	8.61	125.91
Kalipatti	80.12	6.70	6.40	21.10	11.04	0.17	8.64	126.82
Thagarampudi	78.98	6.10	6.40	21.70	10.85	0.16	8.95	123.58
Gavaraya	83.65	6.40	6.10	21.50	11.60	0.15	8.71	122.82
SEd	1.8233	0.106	0.1536	0.4987	0.2241	0.0053	0.173	2.6814
CD (0.05%)	3.6912**	0.2145**	0.3110**	1.0095**	0.4536**	0.0107**	0.3502**	5.4282*

Table 3: Phenotypic and genotypic co-efficient of variation of various characters in sapota

	Character	Mean	Range		Co-efficient of variation (%)		GA (%) Mean
			Low	High	GCV	PCV	
1	Tree Height	7.95	6.05	13.50	28.4289	28.4406	58.5393
2	Trunk Girth	66.27	42.50	136.10	40.317	40.3171	83.0528
3	Canopy Spread	7.54	5.75	12.35	24.1171	24.1271	49.6607
4	Fruit Length	6.78	5.80	8.50	10.3238	10.3277	21.259
5	Fruit Width	6.93	5.80	9.80	13.9591	13.9647	28.7442
6	Fruit Weight	86.01	68.63	120.88	15.3626	15.3624	31.6473
7	Number Of Fruit	3.19	2.22	3.95	16.7443	16.7508	34.4801
8	Seed Weight	3.15	1.90	4.51	18.4488	18.4561	37.9896
9	Seed Width	0.97	0.79	1.06	7.0428	7.0428	14.5081
10	Seed Length	2.82	2.12	3.62	15.3053	15.3134	31.5124
11	Pulp (%)	84.32	74.96	87.38	3.815	3.8147	7.8597
12	Pulp Seed Ratio	21.25	16.15	26.42	12.8892	12.8948	26.5401
13	TSS	21.48	19.55	22.65	3.1555	3.1572	6.4969
14	Total sugar	10.47	9.50	11.95	5.8349	5.8378	12.014
15	Titrable acidity	0.17	0.15	0.19	5.9127	5.9126	12.1803
16	Ascorbic acid	8.89	8.09	9.25	3.079	3.0799	6.3409
17	Phenol	128.06	122.82	133.85	2.2454	2.2468	4.6227
18	Yield	86.54	52.12	125.25	22.7782	22.7782	46.9229

Conclusion

The findings revealed that sapota cultivar PKM-4 was vigorous and recorded highest fruit yield (125.25 kg/tree/year), fruit length (8.50cm) and pulp percentage (87.30%) whereas, fruit weight (120.88g), Phenol (mg /100g) and ascorbic acid (9.25 mg/ 100g) content higher in cultivar Cricket Ball. TSS and Total sugars was highest (22.65 °brix) and (11.95%) in DHS-1. Overall this study conducted revealed that genotypes PKM-4, PKM-5, PKM-1, DHS-1 and Cricket ball are promising genotypes with respect to yield and other characters. A wide variability exists among the genotypes of Sapota and that variability could be used for future breeding program of Sapota. Further molecular of Sapota germplasm should be continued for getting more variability in respect of desired traits. This variability can also utilize for selection of superior germplasm for cultivation at farmer's level as well as future breeding program of Sapota in India.

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