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Research Article

Studies on performance of certain indigenous and exotic coconut genotypes [*Cocos nucifera* L.]

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Abstract
A performance evaluation study was undertaken with 14 coconut genotypes which include eleven tall and three dwarf genotypes. Among the 14 coconut genotypes, eight exotic and six indigenous were from diverse geographical origins. All the coconut genotypes showed variation for yield, yield contributing characters and quality traits. East Coast Tall recorded maximum plant height while Laccadive Ordinary recorded maximum stem girth. With respect to leaf characters, Philippines Ordinary recorded maximum number of leaves while Jamaica Tall recorded maximum petiole length followed by Fiji Tall. With respect to the flowering traits, Philippines Ordinary recorded the maximum number of inflorescence per palm. The tall genotype, Laccadive micro recorded maximum number of female flowers. Length of stalk was highest in tall genotype Strait Settlement Green. Exotic tall genotype, Jamaica Tall recorded maximum spadix length. For the yield characters, Laccadive Ordinary recorded the highest number of bunch per palm per year by followed by Jamaica tall while Laccadive Micro recorded maximum number of nuts per bunch, number of nut per palm followed by Andaman Ordinary. For the nut characters studied, the exotic tall coconut genotype Jamaica Tall recorded maximum whole nut weight, dehusked nut weight, husk weight, husk thickness, kernel weight, shell weight, shell thickness followed by Laccadive Ordinary and Philippines Ordinary. On the other hand, Laccadive Ordinary recorded maximum kernel thickness and nut length. Andaman Ordinary recorded maximum nut breadth followed by Philippines Ordinary. With respect to quality traits, the indigenous tall genotypes Andaman Ordinary recorded maximum copra content and in case of oil content Laccadive Ordinary recorded maximum followed by Andaman Ordinary.

Key words
Coconut genotypes, Evaluation, Morphological characters, floral traits, Yield

Introduction

The coconut palm botanically known as (*Cocos nucifera* L) is an important tree in the humid tropical regions of the world, where it is grown both as a cash and subsistence crop. It is one of the important plantation crops of tropical world grown in more than 93 countries and supports the livelihoods of millions of people. Epigraphically, literal and sculptural evidences provide proof that coconut has served humanity for more than three millennia. Indonesia and Philippines are the first and the second largest coconut producing countries in the world. India is the third largest coconut producing country. Four southern States of India put together account for 90.99% of the total coconut production in the country (NHB 2016-17).

This palm, a monotypic species of the family arecaceae is a cross-pollinated crop with wide variability for most of the morphological traits (Selvaraju and Jayalakshmy 2011). Several works have been reported on the diversity of coconut populations around the world. Earlier attempts to pool this diversity resulted in collection of different genotypes from all over the world. Knowledge of genetic divergence existing in the population will help to generate a selected population, which can be utilized in breeding programmes. The contribution of morphological traits to the yield was reported by Nampoothiri *et al*., (1975). Since yield is the most important criterion for selection, an estimate of inter-relationship of yield with other characters is of immense help in crop improvement programme. Coconut palm breeders and agronomist are aware of the difference in coconut palm (*Cocos nucifera L.*) performances among varieties from location to location and from year to year (Natarajan *et al*., 2010). Hence, the present study was undertaken to evaluate the performance of indigenous and exotic coconut genotypes under coimbatore conditions for yield and yield contributing characters.

Materials and Methods

The study was conducted at Coconut nursery, Department of Spices and Plantation crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore to evaluate the performance of indigenous and exotic coconut genotypes. The genotypes used and their origin are furnished below. (Table1)

All the indigenous and exotic genotypes were planted at a distance of 7.5 x 7.5 m. These genotypes were of 19 years old at the time of experiment. The experiment was laid out in a randomized block design with 2 replications with each genotype representing six palms per replication. Observations were recorded from all the six palms representing each genotype in each replication on vegetative, floral, nut and yield characters and the mean values were arrived at.

Vegetative characters**-** Six traits namely height of the palm, girth of the stem, number of leaves, petiole length, numbers of leaflets and leaf length were recorded. The height of the palm was measured from the collar region to the base of crown region and expressed in meters. The girth of the stem at one meter above collar region was measured and expressed in centimeters. The number of leaves per palm during each harvest were counted and recorded. Petiole length was measured for three leaves per palm and mean length of the petiole was arrived and expressed in metre. The numbers of leaflets on both sides of same three leaves were counted and the mean values are calculated. Length of the leaf was measured for three leaves per palm and mean length of the leaf was arrived and expressed in metre.

Floral characters**-** Four floral traits namely number of inflorescences, length of spadix, length of the stalk, number of female flowers were recorded. The number of inflorescence produced per month was counted and the sum of inflorescences produced per year was arrived at. The length of spadix was measured from the base of the stalk to the inflorescence tip and the mean values were expressed in centimetre. The length of the stalk was measured from the base of the stalk to its tip and the mean values were expressed in centimetre. The number of female flowers present per inflorescence was counted and the mean values were recorded.

Nut and yield characters**-** Thirteen traits namely whole nut weight, husk weight, husk thickness, kernel weight, kernel thickness, shell weight, shell thickness, number of nuts per bunch, number of nuts per palm, length of the nut, breadth of the nut, copra content and oil content were recorded. For whole nut weight, harvested nuts of 5 per genotype were weighed and recorded and their mean values were expressed in grams whereas for dried nuts they were dehusked and mean weight was expressed in grams. Husk weight was recorded for five nuts and their mean values were expressed in grams. Husk thickness at the widest portion for the same five nuts was measured and the mean values were arrived at centimeter. The kernel weight was recorded for 5 nuts and the mean values were expressed in grams. The shell of five nuts was weighed and the mean values were expressed in grams for shell weight. Dehusked nuts were deshelled and the kernel (endosperm) was split into two halves to measure endosperm/kernel thickness and the mean values were expressed in centimeter. The shell thickness was measured at the middle region of the nut and the mean values were expressed in centimeter. The number of nuts per bunch per harvest was counted and total number of nuts/bunch was arrived at. Number of nuts per palm in each harvest recorded and total number of nuts per palm per year arrived at. The length of the nut from one pole to other was measured by setsquare blocking of the nut and measuring the distance using a meter scale gave the polar diameter of the fruit in centimeter. The breadth of the nut at the middle portion measured by setsquare blocking of the nut and measuring the distance using a meter scale gave the equatorial diameter of the nut in centimeter. The copra content was recorded by, dehusked nuts were deshelled and dried under the sun to remove the moisture for a week and the mean values were expresses in grams. Oil content in percentage was measured by extraction procedure carried out in soxhlet extractor as per AOAC (1970).

The mean values of morphological, floral, nut and yield characters over 12 months on the 14 genotypes were subjected to statistical analysis using TNAUSTAT (https://sites.google.com/site/tnaustat)

Results and Discussion

In the present study, the tall genotypes recorded higher plant height and stem girth than dwarf genotypes. The mean height of the palm ranged from 4.14 to 15.06 m. Among the tall genotypes East Coast Tall recorded the maximum plant height of 15.06 m. The minimum height of 4.14 m was recorded by Chowghat Orange Dwarf. Abeywardena and Mathew (1980), Rajamony *et al*. (1983), Ramanathan *et al.* (1992), Ratnambal *et al.* (1995), Renuga (1999) and Jayalakshmy and Sree Rangasamy (2002) reported that higher plant height has been noticed with tall varieties (Table 2).

Stem girth is normally considered as a trait which is positively correlated with vigour and higher productivity. Differences in stem girth are readily noticeable between palms belonging to different genotypes (Table 2). Abeywardena and Mathew (1980) and Rajamony *et al*., (1983). Patil *et al*. (1993b) reported that the high nut yields were associated with high stem circumference, closely spaced short petioles and broad leaflets. Iyer (1980) reported that the increase in trunk height with simultaneous increase in number of leaves contributed to the overall yield of the palm.

Annually a palm produces twelve leaves and the number of available functional leaves at a time decides the health of the palms which will reflect on the nut production. Regarding the leaf characters the fourteen genotypes showed noticeable variation among themselves. In this study, Philippines Ordinary produced maximum number of leaves (33.89). Generally, numbers of leaves were higher in tall genotypes than dwarf genotypes. Ratnambal *et al*. (1995) Renuga (1999) and Princy (2013) also reported similar results (Table 2). Length of leaf is an important character, since it decides the ability of the leaf to support the bunches in its axils also the photosynthetic efficiency. Larger the leaf, weaker it seems to be and unable to provide ample support to its bunches. On the other hand shorter leaf always provide adequate support to its bunches (Pieries, 1934). In the present study also the tall exotic genotypes Jamaica Tall, Fiji Tall and Phippines Ordinary recorded higher leaf length and petiole length with decreased number of nuts per bunch per palm (Table 2).Generally petiole length was higher in tall genotypes than in dwarf genotypes.

The mean performance for number of leaflets was higher for tall genotypes. Increase in length of leaf size will result in maximum number of leaflets. Similar trend of result have been documented by Sugimura et al. (1997). Higher the number of leaflets higher is the yield as reported by Ratnambal *et al*. (1995). The number of leaflets on one side was high in Andaman Ordinary (121) followed by Laccadive Ordinary (120.06), Philippines Ordinary (117.28), Strait Settlement Green (117.12), East Coast Tall (115.44), and West Coast Tall(114.22) in the present study (Table 2). Number of leaflets was less in dwarf genotypes as reported by Ratnambal *et al.* (1995) and Renuga (1999). In the present study also lowest number of leaflets was recorded in Chowghat Orange Dwarf (106.64). Hence the trait could be utilized for the identification of palms during collection programmes.

The breadth of leaflet which is one among the trait included in the list of characters to be observed for the documentation of diversity in coconut (Anon., 1995). This character showed notably wide variation among the studied coconut genotypes. The breadth of leaflet was highest in East Coast Tall (5.39) followed by West coast Tall (5.32), Jamaica Tall (5.30), Laccadive Ordinary (5.23) (Table 2). Generally the breadth of leaflet was low in dwarf genotypes as reported by Ratnambal *et al*. (1995) and Augustine Jerard (2002).

Floral characters are considered to be the key factors for nut yield in coconut. In a coconut palm which has reached a normal bearing stage, every leaf axil produces a spadix or inflorescence. The inflorescence characters showed wide range of variation among the genotypes studied. In present study, tall genotypes namely Philippines Ordinary (13.37), Laccadive Ordinary (13.26) and Andaman Ordinary (12.40) were found to be superior as they produced maximum number of inflorescence per palm per annum. Results are in accordance with the findings of Renuga (1999) (Table 3). The inflorescence length and stalk length were found to be important for characterization of coconut genotypes (Pillai *et al*., 1991). They reported that generally dwarf genotypes produced short stalk length. Short stalk always help bunches to rest on the leaf which will avoid the buckling of bunches. The length of inflorescence was highest in tall genotype Jamaica tall (1.31) followed by Zanzibar (1.24). Generally dwarf genotypes were observed with shorter inflorescences. Strait Settlement Green (51.13) recorded highest stalk length among tall genotypes (Table 3).

Significant variation was observed for number of female flowers per inflorescence among all the fourteen genotypes studied (Table 3). Kannan and Narayanan Nambiar (1974) indicated that high yielding hybrids produced higher number of female flowers. According to Patel (1938), the number of nuts harvested out of the number of female flowers produced was the most important yardstick for consideration.

Nut characters in coconut is more important and is evaluated based on the nut as well as the husk materials. Within the nut material, the kernel weight, kernel thicknesses, copra content are more important. The husk characters have also assumed importance in recent days because of not only its use in coir industries but also for coco peat which has got lot of export and local demand as a media for high value horticultural crops. Ramanathan *et al*., (1992) during their evaluation study with various cultivar and hybrids of coconut noticed that the cultivars West Coast Tall and Strait Settlement Green recorded the highest weight for whole nut. In the present study the tall genotypes, Jamaica Tall (868.71), Philippines Ordinary (829.94), East Coast Tall (823.58), Laccadive Ordinary (802.08), Strait Settlement Green (797.81), West Coast Tall (740.83), and Andaman Ordinary (698.89) recorded maximum value for this character. These genotypes also exhibited maximum value for husk weight and husk thickness (Table 4). Also tall coconut genotypes recorded maximum value for dehusked nut weight with high kernel weight. Increase in kernel weight and shell weight depend upon the weight of dehusked nut. The obtained result is in accordance with the findings of Santos et al. (1981), Ramanathan *et al.*, (1992), Patil *et al.*, (1993b), Renuga (1999) and Manna *et al.*, (2002).

In the present study those genotypes having maximum value for dehusked nut weight also showed maximum value for kernel weight and shell weight. Similar trend was reported by Ramanathan *et al*., (1992) and Patil *et al*., (1993b) respectively. The tall genotypes Laccadive Ordinary (16.64cm), Strait Settlement Green (16.52 cm), West Coast Tall (16.32 cm) and Andaman Ordinary (16.35cm) showed increased nut length. Nut breadth was higher in Andaman Ordinary (30.92cm), Philippines Ordinary (30.13 cm), East Coast Tall (29.22 cm), West Coast Tall (29.14 cm) and Laccadive Ordinary (28.95cm) (Table 4). Similar result was obtained by Renuga (1999). Balakrishnan and Vijayakumar (1988) during their evaluation studies of coconut involving indigenous and exotic cultivars they also found that the cultivar Laccadive Ordinary was superior for the character nut breadth. They reported that this character was desirable and directly related to the copra content of nut (Table 4).

The present investigation showed that the tall genotype Laccadive Ordinary (11.78) and Jamaica Tall (11.19) produced maximum number of bunches per palm per annum. Similar results in West Coast Tall were reported by Potty *et al.*, (1980) on comparison of coconut varieties for number of bunches per palm. The tall genotypes namely, Laccadive micro (10.65), Andaman Ordinary (9.34), Laccadive Ordinary (8.81) and Philippines Ordinary (8.03) recorded maximum number of nuts per bunch (Table 5). These genotypes also showed maximum values for nut yield. Ninan *et al*., (1961) and Patil *et al.*, (1993b) also recorded maximum number of nuts per bunch with high yield in Laccadive Ordinary. In the selection programme due emphasis should be given for this character as it leads to production of number of nuts per palm (Abeywardena and Mathew, 1980).

The study on classification of coconut varieties based on nut character by Long (1993) showed that the dwarf varieties registered thin meat than tall varieties. In the present study also the dwarf type Chowghat Orange dwarf (1.01cm) recorded low value for kernel thickness. Dwarf genotypes also recorded low copra content than tall genotypes (Table 4). Similar result was obtained by Siju (2003). Oil content is another important trait as coconut oil is used in the preparation of many products. Oil content was found to be superior in the Laccadive Ordinary (70.58%) and Andaman Ordinary (69.39%). Long (1993) reported that oil content did not show much variation among tall and dwarf types (Table 5). In the present study also the difference in oil content between tall and dwarf genotypes was insignificant. A wide range of variation is reported for oil and copra content in different countries as it depends upon the stage of maturity and place of origin etc.

Growth is a complex entity associated with many characters, which are themselves interrelated. Such inter relationship of various growth components is highly essential to understand the relative importance of each character involved. If genetic correlation is high, attempts to obtain response in one character by selecting for the associated trait may be worth-while. This is especially true for the dependant character like nut yield. Knowledge of the association between yield and other biometrical traits themselves will greatly help in effecting selection for high yield. Genotypic and phenotypic correlations of different biometrical traits with nut yield per palm were estimated and presented in Table 6&7.

In general, genotypic correlation coefficients between characters were greater in magnitude than the phenotypic and environmental correlation coefficients. Higher genotypic correlation coefficient than the phenotypic correlation coefficient indicates low environmental effects on the expression of association between characters. Renuga (1999), Sindhumole and Ibrahim (2001) and Augustine Jerard (2002) also observed such trends in coconut. The traits *viz.,* number of female flowers per palm, number of inflorescence per palm, number of nuts per bunch, shell thickness, oil content, number of bunch, nut breadth, dehusked nut weight exhibited positive and significant correlation at both genotypic and phenotypic levels with number of nuts per palm(Table.6).

At genotypic level alone, the characters, number of leaves, petiole length and shell weight registered significant and positive correlation with yield. Hence, these characters could be considered as major yield contributing characters in coconut. The results are in consonance with the findings of Renuga (1999). Positive and significant correlation for number of nuts per bunch with number of female flowers was reported by Pieries (1934), Thampan (1970), Ballingasa and Caprio (1976) and Louis (1983), number of inflorescence by Abeywardena (1976), number of nuts per bunch and oil content by Patil *et al.*, (1993b), number of leaves by Patel (1937), Satyabalan *et al.*, (1972), Abeywardena (1976) and Balakrishnan *et al.*, (1991).Sindhumole and Ibrahim (2001) and Selvaraju and Jayalekshmi (2011) reported yield had significant positive correlation with both vegetative and reproductive characters. Due emphasis should be given for these character in selection programme.

Plant height, length of leaf, number of leaflets (left), whole nut weight, kernel weight and kernel thickness also showed positive and non significant association with nut yield per palm. Similar results have also been reported for plant height by Satyabalan (1972), length of leaf and number of leaflets by Abeywardena (1976) and Sukumaran *et al.*, (1981) and kernel thickness by Louis (1983) and Patil *et al.*, (1993b). Negative and significant correlation was observed for stem girth with nut yield per palm indicating selection for stem girth is of minor importance. The results are in line with the findings of Ramanathan (1984), Renuga (1999) and Augustine Jerard (2002).

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Table 1. Genotypes studied and their origin

Sl. NO.	GENOTYPE	ORIGIN
1.	Laccadive Ordinary	India
2.	Andaman Ordinary	India
3.	Laccadive Micro	India
4.	Jamaica Tall	Jamaica
5.	Zanzibar	Zanzibar
6.	British Solomon Island	Solomon Islands
7.	Fiji tall	Fiji islands
8.	Philippines Ordinary	Philippines
9.	Straight Settlement Green	Malaysia
10.	Malayan Yellow Dwarf	Malaysia
11.	Malayan Green Dwarf	Malaysia
12.	Chowghat Orange Dwarf	India
13.	East coast Tall	India
14.	West coast Tall	India

Table 2. Mean performance of coconut genotypes for vegetative characters

Genotypes	Plant height (m)	Stem girth (cm)	Number of leaves	Length of petiole (m)	No of leaflets on one side	Leaf length (m)	Leaf breadth (m)	Leaf let breadth (cm)
Laccadive Ordinary (LO)	11.19	118.11	33.86	1.12	120.06	4.44	2.21	5.23
Andaman Ordinary (AO)	12.16	95.04	33.56	1.15	121.00	4.85	2.21	4.84
Laccadive Micro (LM)	11.18	109.02	30.11	1.28	111.94	4.36	2.04	4.71
Jamaica Tall (JT)	10.94	99.06	33.78	1.44	116.94	4.94	2.24	5.30
Zanzibar (ZB)	10.79	92.29	33.64	1.16	114.83	4.53	2.08	4.71
British Solomon Island (BSI)	11.57	104.16	27.75	1.17	115.06	4.62	2.12	4.16
Fiji tall (FT)	9.10	96.94	32.50	1.38	113.78	4.99	2.18	4.91
Philippines Ordinary (PO)	11.23	106.05	33.89	1.08	117.28	4.43	2.15	5.10
Straight Settlement Green (SSG)	10.65	99.27	32.36	1.09	117.12	4.49	2.30	5.11
Malayan Yellow Dwarf (MYD)	6.35	78.95	29.78	1..05	110.72	4.35	2.03	4.59
Malayan Green Dwarf (MGD)	6.27	69.22	28.61	1.04	107.04	4.08	1.84	3.56
Chowghat Orange Dwarf (COD)	4.14	87.84	27.44	1.16	106.64	3.58	1.78	3.89
East Coast Tall (ECT)	15.06	81.07	33.56	1.10	115.44	4.54	2.17	5.39
West Coast Tall (WCT)	12.06	101.39	31.86	1.14	114.22	4.48	2.27	5.32
Mean	10.08	95.59	31.62	1.13	113.48	4.47	2.12	4.77
S.Ed	1.29	7.35	1.02	1.64	0.82	9.71	5.15	0.28
CD (0.05)	2.79	15.89	3.12	5.01	2.49	29.66	15.73	0.84

Table 3. Mean performance of coconut genotypes for floral characters

Sl.no.	Genotypes	Number of inflorescence/ palm per year	Length of the spadix(m)	Length of stalk (cm)	Number of female flowers/ inflorescence
1	Laccadive Ordinary (LO)	13.26	1.18	45.09	127.50
2	Andaman Ordinary (AO)	12.40	1.15	45.49	104.33
3	Laccadive Micro (LM)	12.15	1.12	46.85	162.50
4	Jamaica Tall (JT)	11.25	1.31	51.03	118.17
5	Zanzibar (ZB)	11.15	1.24	48.93	90.17
6	British Solomon Island (BSI)	11.15	1.23	45.75	65.50
7	Fiji tall (FT)	11.55	1.18	43.21	102.00
8	Philippines Ordinary(PO)	13.37	1.13	47.32	105.00
9	Straight Settlement Green(SSG)	12.10	1.14	51.13	106.50
10	Malayan Yellow Dwarf (MYD)	11.02	1.11	43.16	111.00
11	Malayan Green Dwarf (MGD)	11.05	1.10	41.04	91.67
12	Chowghat Orange Dwarf (COD)	11.00	1.02	39.65	101.00
13	East Coast Tall (ECT)	12.25	1.16	45.50	124.67
14	West Coast Tall (WCT)	12.30	1.13	42.68	107.33

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Table 4. Mean performance of coconut genotypes for nut and husk characters

Genotypes	Whole nut weight (g)	Dehusked nut weight (g)	Kernel weight (g)	Shell weight (g)	Kernel thickness (cm)	Shell thickness (cm)	Husk thicknes s (cm)	Husk weight (g)	Nut length (cm)	Nut breadth (cm)
Laccadive Ordinary (LO)	802.08	419.16	213.77	89.22	1.34	0.37	2.31	379.35	16.64	28.95
Andaman Ordinary (AO)	698.89	422.36	208.56	85.31	1.21	0.37	2.16	292.23	16.35	30.92
Laccadive Micro (LM)	472.18	228.72	123.05	51.23	1.15	0.29	1.85	226.42	13.97	24.89
Jamaica Tall (JT)	868.71	466.50	216.53	91.17	1.29	0.40	2.38	446.93	16.26	29.63
Zanzibar (ZB)	634.47	369.67	170.50	73.55	1.21	0.38	2.08	294.18	15.56	28.30
British Solomon Island (BSI)	546.12	302.06	155.54	65.75	1.16	0.35	1.98	268.33	14.74	27.48
Fiji tall (FT)	591.31	325.35	159.81	69.07	1.21	0.33	1.96	277.91	14.54	27.78
Philippines Ordinary (PO)	829.94	443.16	210.34	91.37	1.25	0.39	2.25	415.33	15.26	30.13
Straight Settlement Green (SSG)	797.81	395.31	198.61	83.00	1.24	0.38	2.29	399.92	16.52	27.86
Malayan Yellow Dwarf (MYD)	610.21	345.03	171.99	71.40	1.06	0.28	1.74	234.87	14.53	28.41
Malayan Green Dwarf (MGD)	512.62	274.18	141.62	60.21	1.04	0.27	1.82	224.74	14.85	25.81
Chowghat Orange Dwarf (COD)	652.84	301.87	187.23	64.95	1.01	0.24	1.67	205.05	16.44	28.66
East Coast Tall (ECT)	823.58	420.77	204.97	86.82	1.26	0.37	2.30	411.83	15.93	29.22
West Coast Tall (WCT)	740.83	395.03	202.13	84.68	1.27	0.36	2.20	354.73	16.32	29.14
Mean	675.51	375.05	186.05	78.41	1.19	0.35	2.07	316.56	15.57	28.59
S.Ed	52.83	43.95	17.42	7.52	0.02	0.02	0.09	28.12	0.36	0.72
CD (0.05)	114.15	94.96	37.64	16.24	0.05	0.04	0.19	60.75	1.10	2.17

Table 5. Mean performance of coconut genotypes for yield and quality characteristics

Genotypes	Number of nuts /bunch	Number bunches/palm	Number of nuts /palm/year	Copra content (g)	Oil content (%)
Laccadive Ordinary (LO)	8.81	11.78	88.33	122.10	70.58
Andaman Ordinary (AO)	9.34	10.61	108.17	128.07	69.39
Laccadive Micro (LM)	10.65	10.44	113.83	95.17	68.24
Jamaica Tall (JT)	6.48	11.19	66.50	122.85	69.40
Zanzibar (ZB)	7.07	10.58	80.50	120.05	65.64
British Solomon Island (BSI)	5.69	8.69	57.83	90.91	62.59
Fiji tall (FT)	6.09	10.44	60.00	97.10	66.54
Philippines Ordinary (PO)	8.03	10.03	76.50	117.56	68.70
Straight Settlement Green (SSG)	7.37	11.14	89.00	123.69	67.60
Malayan Yellow Dwarf (MYD)	6.92	9.81	82.00	84.79	66.36
Malayan Green Dwarf (MGD)	8.21	9.82	90.83	88.81	66.32
Chowghat Orange Dwarf (COD)	7.79	9.19	85.00	88.98	66.25
East Coast Tall (ECT)	7.70	10.86	96.50	135.77	68.00
West Coast Tall (WCT)	7.35	11.14	93.00	120.56	68.50
Mean	7.68	10.41	84.86	112.38	69.07
S.Ed	0.58	0.57	4.95	10.28	1.56
CD (0.05)	1.24	1.23	15.13	31.42	4.76

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Table 6. Genotypic correlation coefficient for vegetative, floral and nut character of coconut genotypes

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	Y
X1	1.000	0.433	0.413	0.144	0.669**	0.261	0.778**	-0.087	0.863**	0.546 *	0.636**	0.536*	0.590*	0.176
X2		1.000	-0.584*	0.266	-0.584*	0.470*	0.679**	-0.269	0.734**	0.358	0.720**	0.689**	0.686**	-0.909**
X3			1.000	0.469*	0.887**	-0.311	0.809**	0.824**	0.982**	0.493*	0.457	0.373	0.665**	0.766**
X4				1.000	0.033	-0.302	0.180	-0.460*	-0.024	-0.262	0.176	-0.012	0.573*	0.896**
X5					1.000	0.562*	0.832**	0.671**	1.070**	0.807**	0.714**	0.502*	0.700**	0.461*
X6						1.000	0.611*	0.741**	0.510**	0.559*	0.721**	0.470*	0.064	-0.342
X7							1.000	0.218	1.071**	0.715**	0.831**	0.694**	0.539*	-0.097
X8								1.000	0.174	0.184	0.768**	0.283	0.399	0.535*
X9									1.000	0.612*	0.851**	0.745**	0.696**	0.090
X10										1.000	0.558*	0.415	0.453	-0.246
X11											1.000	0.789**	0.317	-0.220
X12												1.000	0.325	-0.100
X13													1.000	0.465*
Y														1.000

*Significant at 5 per cent level **Significant at 1 per cent level

CHARACTER	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	X26	Y
X1	-0.568*	0.523*	0.262	0.705**	0.833**	0.816**	0.185	0.188	0.782**	0.890**	0.549*	0.293	0.027	0.176
X2	0.330	0.196	0.138	0.462*	0.544*	-0.192	0.711**	-0.197	0.569*	0.218	-0.028	0.177	0.056	-0.909**
X3	0.637**	0.429	0.400	0.727**	0.842**	0.348	0.376	0.623**	0.758**	0.934**	0.558*	0.323	0.020	0.766**
X4	0.889**	0.221	0.548*	0.191	-0.098	0.169	0.555*	0.589*	0.886**	0.070	0.558*	0.049	0.524*	0.896**
X5	0.283	0.787**	0.618**	0.842**	0.902**	0.461*	0.909**	0.524*	1.013**	1.093**	0.603*	0.468*	0.311	0.461*
X6	0.008	0.463*	0.521*	0.388	0.502*	-0.453	0.543*	0.475*	0.614**	0.377	0.209	0.398	0.514*	-0.362
X7	0.016	0.698**	0.430	0.843**	0.922**	0.344	0.964**	0.328	1.013**	0.787**	0.483*	0.411	0.148	-0.097
X8	-0.093	0.223	0.342	0.163	0.216	0.251	0.301	0.271	0.409	0.144	-0.097	0.261	0.317	0.553*
X9	0.424	0.817**	0.553*	0.883**	0.970**	0.510*	1.036**	0.523*	0.943**	0.711**	0.779**	0.380	0.269	0.090
X10	0.454	0.659**	0.416	0.654**	0.456	-0.435	0.710**	0.535*	0.429	0.761**	0.344	0.450	0.475*	-0.246
X11	0.328	0.560*	0.509	0.627**	0.708**	0.423	0.765**	0.529*	0.826**	0.571*	0.414	0.424	0.362	0.220
X12	-0.440	0.647**	-0.456	0.744**	-0.326	-0.373	0.330	0.402	0.400	0.582*	-0.497	0.437	0.163	-0.100
X13	0.612*	0.498*	0.389	0.570*	0.626**	0.466*	0.691**	0.439	0.532*	0.594*	0.419	0.379	0.235	0.465*
X14	1.000	0.083	0.647**	0.193	0.174	0.477*	0.248	0.683*	0.773**	0.248	0.883**	-0.039	0.666**	0.823**
X15		1.000	0.912**	0.927**	0.859**	0.563*	0.688**	0.896**	0.763**	0.788**	0.841**	0.750**	0.646**	0.272
X16			1.000	0.685**	0.605*	0.988**	0.550*	0.613*	0.597*	0.475*	0.606*	0.813**	0.913**	0.599*
X17				1.000	0.968**	0.607**	0.870**	0.647**	0.873**	0.881**	0.820**	0.563*	0.318	-0.167
X18					1.000	-0.425	0.956**	0.555*	-0.256	1.057**	0.677**	0.614**	0.468*	-0.067
X19						1.000	0.574*	0.422	0.436	0.417	0.561*	0.438	0.407	0.477*
X20							1.000	0.657**	0.946**	0.865**	0.544*	0.468*	0.137	0.085
X21								1.000	0.543*	0.430	0.582*	0.862**	0.913**	0.467*
X22									1.000	0.914**	0.577*	0.407	0.550*	0.903**
X23										1.000	0.665**	0.605*	0.144	0.219
X24											1.000	0.445	0.775*	0.827**
X25												1.000	0.685**	-0.110
X26													1.000	0.708**
Y														1.000

Table 7. Phenotypic correlation coefficient for vegetative, floral and nut character of coconut genotypes

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	Y
X1	1.000	0.322	0.402	0.150	0.585*	0.188	0.690**	-0.078	0.600*	0.506*	0.433	0.484*	0.516*	0.110
X2		1.000	- 0.532*	0.124	-0.555*	0.459*	0.436	0.188	0.347	0.270	0.527*	0.438	0.490*	-0.459*
X3			1.000	0.554*	0.739**	-0.299	0.577*	0.759**	0.667**	0.363	0.473*	0.377	0.454	0.289
X4				1.000	0.129	-0.314	-0.163	-0.495*	0.031	-0.231	-0.060	-0.033	0.461*	0.878**
X5					1.000	0.404	0.662**	0.538*	0.693**	0.640**	0.610*	0.410	0.515*	0.126
X6						1.000	0.495*	0.704**	0.421	0.468*	0.565*	0.466*	0.528*	-0.358
X7							1.000	0.244	0.737**	0.674**	0.433	0.516*	0.467*	-0.077
X8								1.000	0.204	0.178	0.581*	0.258	0.325	-0.504*
X9									1.000	0.495*	0.592*	0.420	0.547*	0.059
X10										1.000	0.483*	0.312	0.421	-0.212
X11											1.000	0.596*	0.158	0.125
X12												1.000	0.252	-0.036
X13													1.000	0.463*

CHARACTER	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	X26	Y
X1	0.148	0.400	0.147	0.622**	0.739**	0.124	0.745**	0.129	0.646**	0.568*	0.485*	0.182	0.001	0.110
X2	-0.526*	0.173	0.119	0.290	0.377	0.127	0.579*	0.126	0.418	0.049	-0.037	0.155	0.020	-0.459*
X3	0.548*	0.412	0.338	0.611*	0.655**	0.336	0.418	0.524*	0.568*	0.422	0.515*	0.436	0.107	0.477*
X4	0.664**	0.154	0.606*	-0.133	-0.099	0.338	0.609*	0.586*	-0.163	0.152	0.510*	0.045	0.495*	0.878**
X5	0.211	0.627**	0.472*	0.719**	0.784**	0.397	0.815**	0.437	0.776**	0.658**	0.518*	0.360	0.271	0.126
X6	0.091	0.473*	0.580*	0.383	0.404	-0.346	0.458	0.453	0.528*	0.201	0.109	0.250	0.471*	-0.358
X7	0.032	0.541*	0.268	0.692**	0.769**	0.248	0.820**	0.261	0.740**	0.455	0.406	0.284	0.086	-0.077
X8	-0.102	0.203	0.282	0.170	0.185	0.204	0.267	0.212	0.344	0.123	-0.108	0.211	0.243	-0.504*
X9	0.291	0.669**	0.456	0.774**	0.718**	0.399	0.795**	0.407	0.735**	0.576*	0.592*	0.386	0.241	0.059
X10	0.297	0.316	0.358	0.624**	0.727**	-0.455	0.677**	0.407	0.431	0.573*	0.360	0.452	0.431	-0.212
X11	0.178	0.563*	0.448	0.565*	0.593*	0.453	0.697**	0.441	0.736**	0.473*	0.342	0.453	0.412	0.125
X12	-0.160	0.505*	0.319	0.622**	0.603*	-0.289	0.324	0.272	0.394	0.321	-0.330	0.252	0.093	-0.036
X13	0.302	0.361	0.228	0.520*	0.561*	0.264	0.593*	0.266	0.437	0.357	0.360	0.208	0.107	0.463*
X14	1.000	0.052	0.614**	0.099	0.106	0.484*	0.198	0.388	0.668*	0.123	0.742	-0.079	0.630*	0.528*
X15		1.000	0.879**	0.887**	0.799**	0.478*	0.671**	0.837**	0.763**	0.686**	0.781**	0.740**	0.637**	0.183
X16			1.000	0.638**	0.566*	0.971**	0.490*	0.666**	0.582*	0.593*	0.585*	0.806**	0.896**	0.475*
X17				1.000	0.934**	-0.374	0.837**	0.596*	0.854**	0.697**	0.777**	0.532*	0.324	-0.110
X18					1.000	-0.414	0.210	0.422	-0.402	0.743**	0.656**	0.551*	0.473*	-0.007
X19						1.000	0.498*	0.975**	0.487*	0.507*	0.550*	0.518	0.913**	-0.003
X20							1.000	0.401	0.407	0.653**	0.409	0.469*	0.495*	0.038
X21								1.000	0.504*	0.519*	0.589*	0.420	0.492*	-0.052
X22									1.000	0.721**	0.531*	0.409	0.459*	0.545*
X23										1.000	0.584*	0.652**	0.356	0.252
X24											1.000	0.454	0.709**	0.641**
X25												1.000	0.354	-0.056
X26													1.000	0.471*
Y														1.000

X1 – Plant heigh
X2 - Stem girth
X3 – No of bunches
X4 - No of nuts per bunch per palm
X5 - No of leaves per palm
X6 – Leaf length
X7- Leaf breadth
X8- Leaf petiole length
X9 – Leaflet breadth
X10- Leaflet on one side
X11- Spadix length
X12- Stalk length
X13 – No of inflorescence per palm per year
X14 – No of female flowers per palm per year
X15 – Whole nut weight
X16 – Dehusked nut weight
X17 – Husk weight
X18 – Husk thickness
X19 – Kernel weight
X20- Kernel thickness
X21 – Shell weight
X22 – Shell thickness
X23 – Copra content
X24 – Oil content
X25 – Nut length
X26 – Nut breadth
Y – No of nuts per palm per year (yield)

Plate. 1. Field view of the experimental plot

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West Coast Tall

East Coast Tall

Chowghat Orange Dwarf

Andaman Ordinary

Laccadive micro

Laccadive Ordinary

Plate. 2 Indigenous coconut genotypes evaluated

 DOI: 10.5958/0975-928X.2019.00117.0

Malayan green Dwarf

Strait Settlement Green

Philippines Ordinary

Zanzibar

Jamaica tall

Fiji Tall

British Solomon Island

Malayan Yellow Dwarf

Plate. 3 Exotic coconut genotypes evaluated

DOI: 10.5958/0975-928X.2019.00117.0

Plate. 4. Variation in nut characters of the coconut genotypes

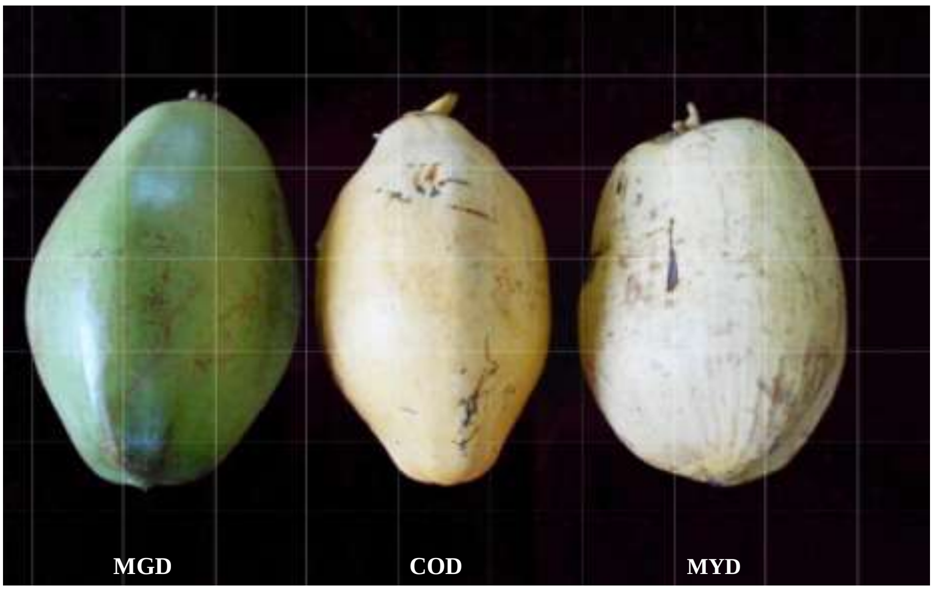

Plate. 5. Variation in nut character of the dwarf coconut genotypes

Andaman Ordinary

West Coast Tall

Laccadive Micro

East Coast Tall

Laccadive Ordinary

Chowghat Orange Dwarf

Plate.6 Variation among the whole nuts of the indigenous coconut genotypes

 DOI: 10.5958/0975-928X.2019.00117.0

Philippines Ordinary

Strait Settlement Green

Jamaica Tall

Zanzibar

Fiji Tall

British Solomon Island

Malayan Yellow Dwarf

Malayan Green Dwarf

Plate.7 Variation among the whole nuts of the exotic coconut genotypes

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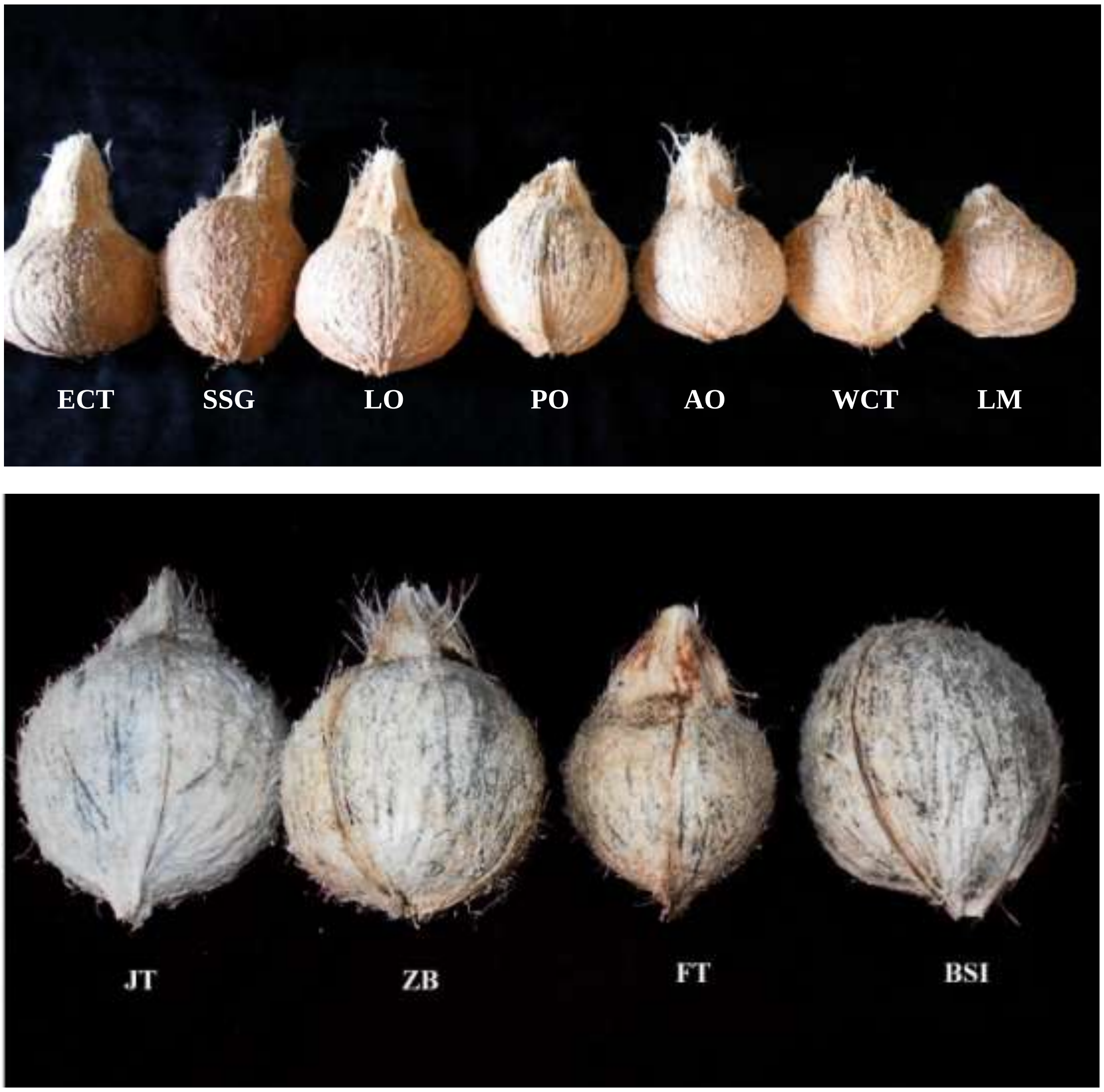

Plate. 8 Variation in dehusked nut among coconut genotypes

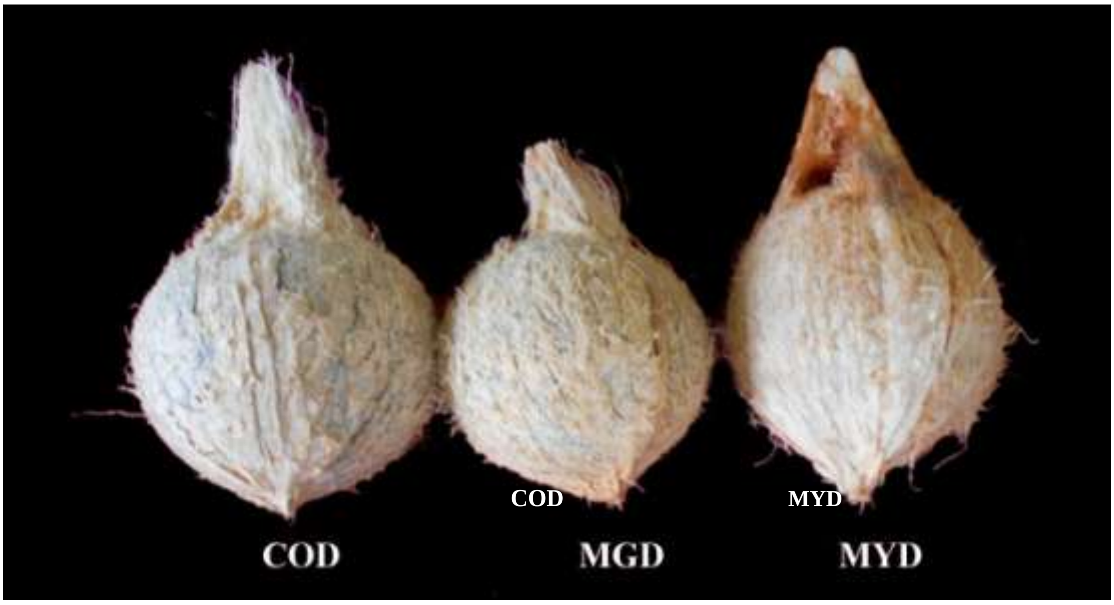

Plate. 9 Variation in dehusked nut among dwarf coconut genotypes

DOI: 10.5958/0975-928X.2019.00117.0

Andaman Ordinary

East Coast Tall

Laccadive micro

Laccadive Ordinary

West Coast Tall

Chowghat Orange Dwarf

Plate. 10 Cross section of the nuts of indigenous coconut genotypes

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British Solomon Island

Fiji Tall

Jamaica Tall

Zanzibar

Philippines Ordinary

Strait Settlement Green

Malayan Yellow Dwarf **Malayan Green Dwarf**

Plate 11. Cross section of the nuts of exotic coconut genotypes