

COMPARATIVE STUDY OF FIBRE FROM SOME CULTIVARS OF COCONUT IN RELATION TO CERTAIN CHARACTERS OF THE NUT

R. GOPINATHAN NAIR* and K. SATYABALAN

Central Coconut Research Station, Kasaragod, Kerala

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Introduction of desirable and economic varieties from different countries is an accepted method in the improvement of crops. A few exotic cultivars of coconut from Andamans, Laccadives, Java, Federation of Malay States, the Philippines, New Guinea, Cochin-China, Thailand, Fiji and Straits Settlements were obtained and planted at the Agricultural Research Station at Pilicode, Kerala. Later, their progenies were planted at the Agricultural Research Station (the present Central Coconut Research Station) at Kasaragod. The varieties and their progenies were studied for the yield of nuts and the nut and copra characters (Narayana and John, 1949; Vasudevan Pillai and Satyabalan, 1960; Ninan *et al.*, 1961; Ratnam and Satyabalan, 1964). The fibre of coconut, which has considerable economic importance, received very little attention in these studies. The quality of fibre depends to a considerable extent on the maturity of the nut from which it is extracted. The fibre from immature or over-mature nuts is not suitable for extraction and cannot be commercially used. Studies have indicated that the quality and quantity of fibre of 10- and 11-month-old nuts of 'West Coast Tall' palms are good (John *et al.*, 1948; Sayeed and Narayana, 1953; Marar, 1958). The present investigation was undertaken to make a comparative study of the fibre from some of the cultivars growing at the Central Coconut Research Station, Kasaragod, in relation to their nut characters and assess their performance for copra and fibre outturn.

MATERIAL AND METHODS

Ten exotic cultivars, viz. 'Philippines Ordinary', 'Straits Settlements Apricot', 'Straits Settlements Green', 'Laccadive Small', 'Andaman Dwarf', 'Laccadive Ordinary', 'Cochin-China', 'Andaman Giant', 'Federated Malay States' ('F.M.S.') and 'New Guinea', and four indigenous types, viz. the two tall types of 'West Coast Tall' and 'Kappadam', the semi-tall 'Gangabondam' and the 'Tall × Dwarf' hybrid maintained at the Central Coconut Research Station, Kasaragod, were studied for their nut and fibre characters. Most of the palms of the exotic types studied are progenies of the direct introduction at the Agricultural Research Station, Pilicode. As the nut and fibre characters may vary with different periods of maturity, nuts that are 9, 10, 11 and 12 months old were selected from each cultivar for study. For this, the date of opening of the spathes were noted and the maturity period of the nuts was observed for 12 months. The nuts were collected on the particular date,

*Present address: Central Tuber Crops Research Institute, Trivandrum.

counting the period from the date of opening of the spathes. Three bunches were selected for each variety and three nuts, one from each bunch, were collected representing each stage of maturity every month. The nuts obtained were studied for length, girth, weight and volume of the fruit (unhusked nut) and husked nut, thickness of husk, weight of shell, volume of water and the thickness of kernel. The weight of husk for each cultivar was worked out from the data. The fibre from the husk was extracted by the method adopted by Menon (1942). The non-fibrous matter and the fibre dust were removed and the fibre strands obtained were utilized for the study of fibre-characters like length, diameter, specific gravity, and moisture percentage of fibre, and the length and diameter of the ultimate fibre cells. The weight of the fibre was taken and the percentage of fibre in the husk was obtained. The length : diameter ratio of the fibre and of the ultimate fibre cells was worked out. The specific gravity of the different samples of fibre was determined by the method suggested by Menon (1942). Fifty fibre strands from each nut, the completeness of which was ensured by the two-tapering ends, were utilized for the measurement of length and diameter, and five samples each having a small collection of strands selected at random were used for the determination of specific gravity and moisture percentage. The study of component fibre cells was made by macerating mature strands by prolonged boiling in concentrated potassium hydroxide and staining in saffranin. Fifty fibre cells were used for the measurement of length and diameter.

RESULTS AND DISCUSSION

The weight of fruit, thickness of husk, weight of husk, volume of water, thickness of kernel, weight of fibre and percentage of fibre in the husk were found to vary significantly between cultivars and between different stages of maturity (Table I). 'Kappadam' was found to yield nuts of maximum size with an average weight of 3,320 g, and 'Laccadive Small' gave nuts of minimum size with a mean weight of 1,073 g. A progressive decrease in the average weight of nuts was noticed after ninth months, which may be owing to the corresponding decrease in the weight of husk and water content of the nut. The outturn of husk was found to be high from the cultivars which produced large-sized nuts. 'Straits Settlements Apricot' possessed the least amount of husk. Thickness of husk, though varied with the cultivar, registered constant increase with the maturity period of the fruit. 'Andaman Giant', 'Kappadam' and 'Cochin-China' were found to have thick husks, while 'Straits Settlements Apricot' had the thinnest husk. Husk and water content of the nut varied significantly between cultivars, and registered a downward trend with the advancement of maturity. The thickness of kernel was also found to vary significantly between cultivars, and registered an increase with the maturity period. The weight of fibre varied significantly with the cultivar, and was found to decrease with the advancement of maturity. The outturn of fibre was high in the case of cultivars which produce large-sized nuts. The percentage of fibre in the husk also varied significantly in the different cultivars studied and also with the different periods of maturity. 'Straits Settlements Apricot', which has the lowest value for the weight of husk, had the maximum fibre content. The non-fibrous contents of the husk were mainly responsible for the variation in the thickness of husk and fibre content in the husk.

TABLE I. CHARACTERS OF THE NUT FOR WHICH BOTH CULTIVAR AND MATURITY DIFFERENCES ARE SIGNIFICANT

Cultivar	Weight of fruit (g)	Thickness of husk (mm)	Weight of husk (g)	Volume of water (ml)	Thickness of kernel (mm)	Weight of fibre (g)	Percentage of fibre in the husk
'Philippines Ordinary'	2,333.88	43.13	1,297.80	266.48	13.08	85.48	7.30
'Straits Settlements Apricot'	1,921.75	23.75	462.50	334.58	11.33	54.25	13.70
'Straits Settlements Green'	2,505.33	35.05	1,602.25	304.88	10.70	94.83	6.68
'Laccadive Small'	1,073.40	36.40	718.05	71.23	11.90	41.18	6.08
'Andaman Dwarf'	1,378.88	29.50	1,083.63	142.38	10.63	58.00	5.70
'Kappadam'	3,320.48	49.55	1,825.73	476.28	14.05	127.55	7.63
'Laccadive Ordinary'	1,485.05	37.13	943.70	128.70	12.15	49.48	5.28
'Cochin-China'	2,338.00	45.80	1,185.35	378.80	11.38	81.43	6.50
'Tall x Dwarf' hybrid	1,607.15	44.88	955.80	153.55	12.95	62.55	6.80
'Andaman Giant'	1,981.65	51.58	1,140.98	217.90	11.95	65.55	7.08
'West Coast Tall'	2,018.15	43.98	1,324.43	104.60	12.38	115.33	9.63
'Gangabordam'	1,833.48	34.63	1,061.48	179.05	12.05	66.73	6.88
'Federated Malay States'	1,885.63	36.38	977.63	255.75	13.63	78.25	7.63
'New Guinea'	2,975.50	40.75	1,168.75	677.00	13.08	93.50	8.03
S.E.	131.775	2.262	79.380	28.518	0.471	4.399	0.784
C.D.	376.447	6.605	266.765	81.467	1.344	12.566	0.238
Maturity period							
12 months	1,571.21	38.81	721.99	223.17	12.69	72.42	10.67
11 months	1,958.73	42.71	1,036.03	245.09	13.16	72.20	7.17
10 months	2,153.36	40.28	1,237.49	264.21	12.14	85.47	6.81
9 months	2,436.21	36.06	1,503.07	322.14	10.93	76.79	5.31
S.E.	70.437	1.209	42.430	15.243	0.252	2.351	0.419
C.D.	201.218	3.530	121.212	46.470	0.719	6.717	1.196

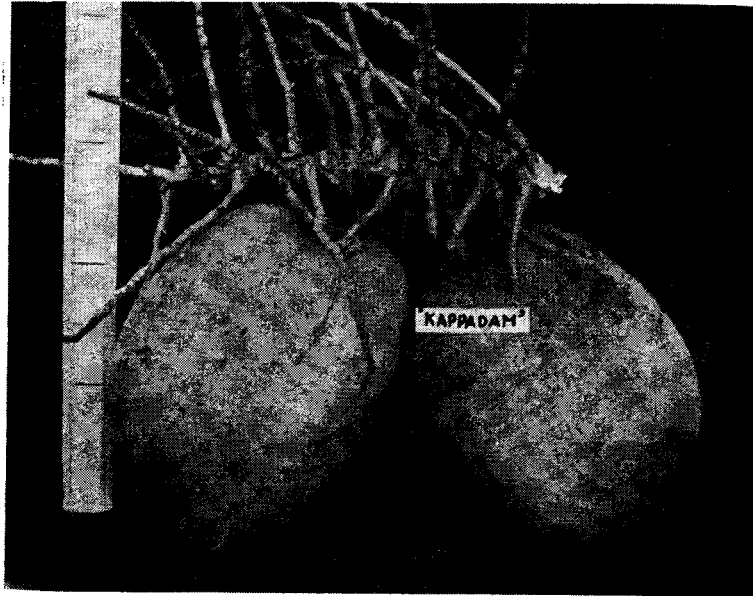


FIG. 1. A BUNCH OF 'KAPPADAM'.

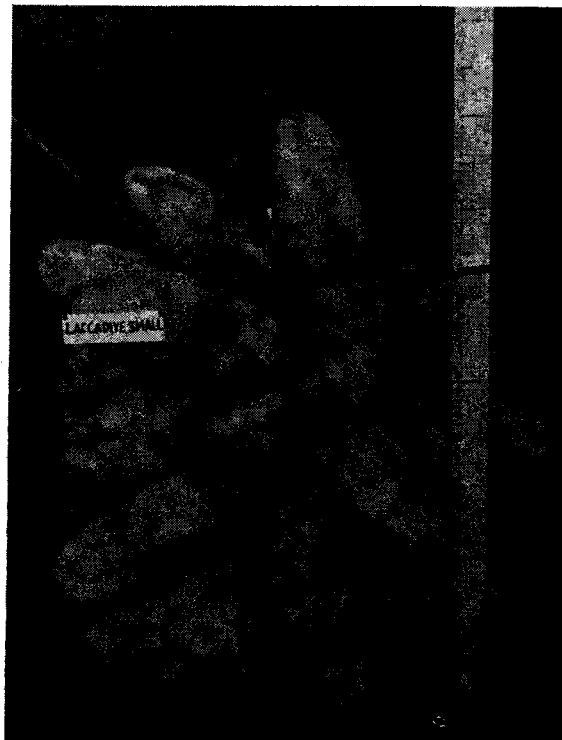


FIG. 2. A BUNCH OF 'LACCADIVE SMALL'.

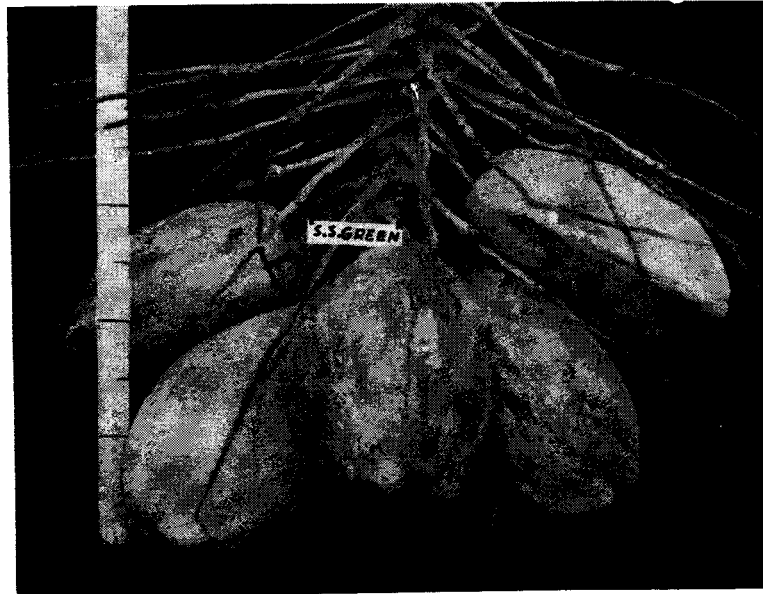


FIG. 3. A BUNCH OF 'STRAITS SETTLEMENTS GREEN'.

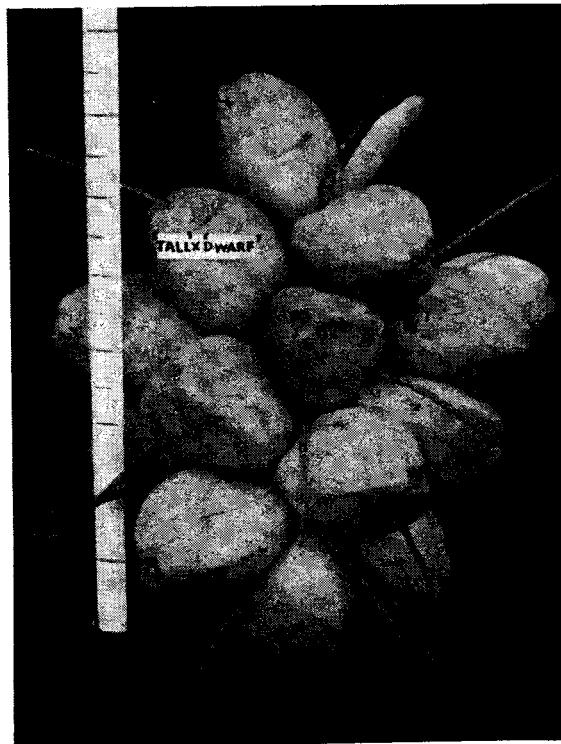


FIG. 4. A BUNCH OF 'TALL X DWARF' HYBRID.

Among the fibre characters of the cultivars studied, specific gravity of fibre and diameter of ultimate fibre cells were found to vary significantly between cultivars and between different periods of maturity (Table II). The length : diameter ratio of the ultimate fibre cells also varied significantly between the cultivars. The specific gravity of the fibre gets reduced with the advancement of maturity of the nut, which is in conformity with the observations of Menon (1942). The diameter of ultimate fibre cells also varied significantly among the cultivars studied and registered an upward trend with the advancement of maturity of the nut. The length : diameter ratio of the ultimate fibre cells also differed significantly with each cultivar and decreased with the advancement of maturity.

TABLE II. CHARACTERS OF THE FIBRE FOR WHICH BOTH CULTIVAR AND MATURITY DIFFERENCES ARE SIGNIFICANT

	Specific gravity of fibre	Diameter of ultimate fibre cells (μ)	L:D ratio of ultimate fibre cells
Cultivar			
'Philippines Ordinary'	1.225	18.60	52.05
'Straits Settlements Apricot'	1.115	19.58	57.23
'Straits Settlements Green'	1.263	19.63	49.08
'Laccadive Small'	1.290	19.15	61.20
'Andaman Dwarf'	1.200	20.00	48.93
'Kappadam'	1.270	20.85	53.43
'Laccadive Ordinary'	1.228	20.00	64.03
'Cochin-China'	1.160	18.00	61.30
'Tall \times Dwarf' hybrid	1.278	17.50	64.80
'Andaman Giant'	1.130	19.18	56.33
'West Coast Tall'	1.203	20.00	52.08
'Gangabondam'	1.145	17.50	61.78
'Federated Malay States'	1.230	20.78	52.28
'New Guinea'	1.200	19.15	56.00
S.E.	0.033	0.612	3.441
C.D.	0.095	1.747	9.829
Maturity period			
12 months	1.141	20.36	52.82
11 months	1.200	19.89	54.35
10 months	1.252	19.20	58.13
9 months	1.245	17.66	60.55
S.E.	0.018	0.327	1.839
C.D.	0.051	0.934	5.254

To determine the relationship between yield of copra and fibre content, and the weight of the nut and weight of the husk with fibre content, correlations were worked out between these characters, as shown below.

Characters	Correlation coefficient	Level of significance (%)
Yield of copra and fibre content per nut	0.5146	
Nut weight and fibre content per nut	0.8622	0.001
Husk weight and fibre content per nut	0.8420	0.001

The data indicate that there is no relationship between the yield of copra and fibre content. On the other hand, nut weight and husk weight were found to be highly correlated with fibre content.

From the data in Table III it is evident that 'Straits Settlements Green', because of its high yield, large-sized nut, high copra content per nut and high fibre content, gave the maximum outturn of copra as well as of fibre. 'Laccadive Ordinary', 'Gangabondam', 'Tall x Dwarf' hybrid, 'Laccadive small' and 'Kappadam' gave higher outturn of copra only because of their high yield of nuts or high copra content per nut, whereas 'Kappadam', 'West Coast Tall', 'Philippines Ordinary', 'Laccadive

TABLE III. AVERAGE ANNUAL YIELD OF NUTS, MEAN COPRA CONTENT AND ANNUAL OUTTURN OF COPRA AND FIBRE

Cultivar	Average yield of nuts (1951-60)	Mean copra content per nut (g)	Total outturn of copra per year (kg)	Total outturn of fibre per year (kg)
'Philippines Ordinary'	84.0	234.3	19.68	7.2
'Straits Settlements Apricot'	69.2	171.6	11.88	3.8
'Straits Settlements Green'	138.4	227.5	31.49	13.1
'Laccadive Small'	172.9	116.3	20.11	7.1
'Andaman Dwarf'	91.5	173.4	15.87	5.3
'Kappadam'	77.1	260.7	20.11	9.4
'Laccadive Ordinary'	132.4	191.3	25.33	6.6
'Cochin-China'	64.8	245.9	15.93	5.3
'Tall x Dwarf' hybrid	113.0	178.2	20.14	7.1
'Andaman Giant'	70.2	174.4	12.24	4.6
'West Coast Tall'	76.8	142.6	10.95	8.9
'Gangabondam'	102.8	240.2	24.69	6.9
'Federation of Malay States'	78.1	194.7	15.21	6.1
'New Guinea'	52.8	262.3	13.85	4.9

'Small' and 'Tall × Dwarf' hybrid gave higher outturn of fibre because of their high yield of nuts or high fibre content per nut. Among the different cultivars studied, 'Straits Settlements Green', 'Kappadam', 'Tall × Dwarf' hybrid and 'Laccadive Small' can be considered as high-yielders in both copra and fibre.

The husk content gets considerably reduced in the 12-month-old nut, whereas in the 9-month-old nut it is high. But it is not desirable to select 9-month-old nuts as the percentage of fibre in the husk is low. Moreover, the coir produced from such nuts is reported to be much inferior in quality. Husks from fully mature 12-month-old nuts are also not quite good, as the quality of their fibre is considered unsuitable for coir making. Unnithan (1956) has reported that to obtain high-quality fibre, the husk should neither be too tender nor too ripe and that dry husk yields brown fibre which is hard and brittle and unsuitable for being spun into ropes. Hence, 10- or 11-month-old nuts should be preferred for fibre.

SUMMARY

A comparative study was made of certain characters of the fibre extracted from ten exotic and four indigenous cultivars of coconut in relation to some characters of the nut harvested at four different stages of maturity. The weight of the fruit (un-husked nut), weight and thickness of the husk, weight and percentage of the fibre in the husk, and fibre characters like specific gravity, diameter and the length : diameter ratio of the ultimate fibre cells were found to vary significantly between varieties and according to the period of maturity. Nut weight and husk weight are highly correlated with fibre content. 'Straits Settlements Green', 'Kappadam', 'Tall × Dwarf' and 'Laccadive Small' gave higher outturn of both copra and fibre. For outturn and quality of fibre, 10- or 11-month-old nuts were found to be better.

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REFERENCES

- JOHN, C. M., VENKATANARAYANA, G., ITTYACHAN, C. T. and SAYEED, P. M. 1948. Copra, oil and fibre in relation to the maturity of coconuts. *Indian Coconut J.* 1(3): 5-16.
- MARAR, M. M. K. 1958. When to harvest coconuts. *Coconut Bull.* 12: 69-71.
- MENON, S. R. K. 1942. Some observations on the growth of the coconut fruit with special reference to some of the changes undergone by the fibrous constituent of its mesocarp. *Indian J. agric. Sci.* 12: 423-32.
- NARAYANA, G. V. and JOHN, C. M. 1949. Varieties and forms of the coconut (*Cocos nucifera* Linn.). *Madras agric. J.* 36: 349-68.
- NINAN, C. A., PANKAJAKSHAN, A. S., SATYABALAN, K. and GOPINATH, P. 1961. A comparison of the performance of some cultivars of coconuts at the Central Coconut Research Station, Kasaragod, and Agricultural Research Station, Nileshwar (Pilicode). *Indian Coconut J.* 15: 12-9.
- RATNAM, T. C. and SATYABALAN, K. 1964. A note on the study of a few cultivars of coconut. *ibid.* 17: 69-76.
- SAYEED, P. M. and NARAYANA, G. V. 1953. Scheme of research on coconuts in Madras State. Final report on the work done during the period of the scheme from 15th September 1943 to 31st March 1952. *ibid.* 6: 102-25.
- VASUDEVAN PILLAI, R. and SATYABALAN, K. 1960. A note on the seasonal variation in yield, nut characters and copra content in a few cultivars of coconuts. *ibid.* 13 (2): 45-52.
- UNNITHAN, K. P. 1956. The raw material for coir industry. *Coir* 1 (2): 5-6.