Varieties of the Coconut

S. R. GANGOLLY, K. SATYABALAN and
K. M. PANDALAI
Central Coconut Research Station, Kasaragod.

VARIETY is generally a term designated to denote a single strain or a group of strains which distinctly differed in structural or functional characters from one another or a group of the same species which can be depended upon to reproduce itself true to type. In the coconut, Hunter and Leake (1933) pointed out that the number of varieties could not be determined because of the difficulties inherent in such determinations due to wide distribution and partly because of the lack of genetical purity due to cross fertilisation. The cross-pollination prevailing in the coconut has given rise to a highly variable progeny of palms (Mendiola 1926). Jack (1923) estimated that in coconut plantations hardly ten per cent of the trees proved true to type.

The promiscuous crossing occurring in the coconut, is responsible for giving rise to a large scale multiplication of single genetically heterozygous varieties, widely varying from each other or groups of closely related incompatible varieties (Darlington and Janaki Ammal 1945). The occurrence of the latter groups has also been indicated by Copeland (1931). According to him, in certain regions, particularly in some of the islands isolated from each other, certain types suited to the locality with well defined, relatively constant phenotypic characters were found evolved possibly through generations of natural selection. In the Philippines, the absence of the San Ramon type of coconut in the region of the Laguna variety is an instance in point (Mendiola 1926). Cook (1901) was of the opinion that varieties were doubtless local at first and their differentiation was probably favoured by isolation in

accordance with general tendency among the palms to form series of similar species of limited distribution. These groups occurring in nature and referred to differently by research workers on the coconut, *viz.,* Biotypes, Ecotypes, Strains, Types, Races, Forms or Agricultural varieties may, therefore, be considered as synonymous under the existing knowledge of the palm or at least till all these forms are studied in detail and an authentic systematic position of each is determined.

Many such varieties have been reported from the different coconut-growing countries. Wester (1918) has recorded about thirty-five distinct varieties of the coconut, which number according to him is remarkably small, considering the antiquity of its cultivation and its wide distribution. Cook (1901) pointed out that in the Malayan region more than fifty sorts were reported with distinct names and characteristics. Haji Omar (1919) recognised fourteen forms or races in Singapore. According to Burkill (1919), there were twenty races recognisable at Kuala Kangsar in Malaya. Simmonds (cited by Copeland 1931) listed thirty varieties. In Java, Jumelle (cited by Copeland 1931) stated that at least twenty-five varieties were known. According to Jumelle and Hubert (cited by Copeland 1931), there were more than forty varieties of coconuts in the Philippines. Shortt (1885) named thirty varieties from Travancore. Hooker (1894) mentions *Cocos nucifera,* Lin., as the most commonly cultivated species and *Cocos nana,* Griffith. as a small low variety grown in Maldivi Islands. Stockdale (1924) cites Rajapakshe in Ceylon identifying nineteen distinct types differing from one another in respect of external features, *viz.,* shape and size of nut. The best known varieties of Ceylon, Indo-China and the Islands of the Indian Ocean have been studied by Prudhomme (cited by Copeland 1931). Types of coconuts in Java, Ceylon and Malabar have been described by Boldingh (1920), Kluyver and Reksohadiprodjo (1923). John and Satyabalan (1955) have described three varieties common in the Laccadive Islands.

Although many of these forms were recorded in coconut literature, Copeland (1931) pointed out that the more conspicuously different varieties for the most part were, undoubtedly, duplicated in the different coconut-growing countries. While considerable attention had been bestowed by research workers in the past on projects relating to various aspects of coconut culture, attempts to study the large number

of forms or races or varieties of the coconut occurring in the different coconut-growing countries in the tropics have been comparatively few. This is significant from the fact that very few publications relating to such studies are available. Wester (1918) also pointed out that no studies on coconut heredity were undertaken. The study of forms and varieties with a view to systematic classification, is of vital importance in coconut improvement work. Coconut, being a seed-propagated crop, requiring an unusually long period of prebearing life, the evolution of promising varieties through breeding became a difficult and time-consuming project. The research workers on the coconut were, therefore, obliged to rely on the introduction and study of named varieties for achievement of quicker results in their work on coconut improvement. Although necessity for such studies was keenly felt, the execution of such a work presented many difficulties. The chaos prevailing in the nomenclature of varieties was a serious handicap in the matter of securing varieties of coconuts from different countries.

Among the other contributing factors may be mentioned the highly variable character of the palm, the diversity of forms met with, the lack of comprehensive standardised terminology to describe the different characters of the coconut varieites and, above all, the absence of a Central or International Organisation to undertake such a project. The work of varietal differentiation, as pointed out by Cook (1901), in a plant like the coconut is difficult, as it may be expected to require much more time than with annual species, probably at least ten times as much, which rendered the problem most unattractive to research workers. Further, the coconut being a monocot, incapable of branching and devoid of cambium, the perpetuation of varieties through vegetative methods of propagation is ruled out.

The importance of the coconut industry and the existence of chaos in nomenclature in the coconut warranted, therefore, a detailed study of the varieties. It is interesting to note that this is engaging the attention of the Agricultural Organisation of the United Nations as a result of the recommendation of the Eighth Pacific Science Congress held in the Philippines in November 1953.

CHARACTERISTICS OF THE VARIETIES

So far most of the growers of and research workers on the coconut have distinguished, almost

intuitively, the different varieties under cultivation by phenotypic characters alone. In this process they have relied largely, if not wholly, on the fruiting, rather than vegetative characters. Cook (1901) and Patel (1938) indicated that the coconut varieties differed greatly in size, shape, colour and quality of the nut. Many of these varieties met with in cultivation have been pictured and briefly described or listed in the different publications on the coconut. A perusal of these publications has revealed that the varieties differed from each other in their morphological characters of the trees to some extent, and to a large extent in respect of fruit characters.

Cook (1901) indicated that the trees of the coconut had some varietal peculiarities. Patel (1938), on the other hand, did not observe any major morphological differences between varieties in the studies carried out by him on the West Coast of India. Copeland (1931) observed that the differences in form were unimportant as it is easy in any place with coconuts propagated through the seed to find considerable differences in form. Patel (1938) stated that from the shape of the crown, three types of palms could be distinguished, *viz.*, palms having leaves which appeared like the ribs of a fully opened umbrella and so arranged that they received maximum amount of light, palms having leaves with green colour petioles and oriented at right angles to the stem and the third type having leaves which made an obtuse angle with the stem and generally yielding very poorly.

Some differences have been noted in respect of characters of the leaves. Cook (1901), Copeland (1931) and Patel (1938) recorded instances of trees, leaflets of which were joined and not split as is the case in the leaves of ordinary trees. Patel (1938) also observed that the number of leaves in the palm was positively and significantly correlated to annual yield of nuts and negatively correlated to the age at first flowering. He pointed out that palms having more number of leaves could, therefore, come to flower early and yield more.

Some peculiarities in respect of the flower are met with. Jacob (1941) described a variety which he called spicata with unbranched inflorescence and without the usual flower-bearing spikes. He observed in this variety masculinity least expressed, with low number of male flowers (50) as against a mean number of 600 met with in ordinary varieties.

Patel (1938) reported that planters recognised varieties mainly

based on colour, shape and size of nuts. According to him, the colour of the nut varied from dark green to deep orange or brick red. Copeland (1931), on the other hand, indicated that the colour varied from green to yellow and brown. The colour of nuts has been reported to be a somewhat indefinite character (Stockdale 1924). Shape of the nut is another one which was considered to be an identifiable character. Stockdale (1924), Copeland (1931) and Patel (1938) pointed out that some may be globular while others may be spindle shaped or even distinctly triangular being nearly twice as long as they are thick. Copeland (1931) observed that differences in shape were usually the characteristics of the tree, the nuts on a single tree being alike, and was of the opinion that they could easily be maintained by selection and developed into race characters. According to Cook (1901), some varieties appear to have been differentiated for special qualities, *viz.*, flavour of the flesh, oil or milk or the abundance and the ease of extraction of fibre. The husk is also sometimes of diagnostic value. In some varieties the husk disclosed a pink colour from which a pink dye could be extracted (Tropical Agriculturist, Ann. 1884-85). Patel (1938) reported a variety (Kaithathali) which had a soft edible husk. Alzina (1931) recorded a variety *Caumanis* in which the tender fruit had sweet husk and is eaten like an artichoke which it resembled much in flavour. Adriano and Manahan (1932) reported a variety Makapuno which contained a white, viscous, translucent and jelly-like meat approaching the consistency of hard boiled rice with detectable flavour. Omar (1919) cited a variety Klapa Wangi which had fragrant endosperm.

Patel (1938) recorded a variety known as Thairuthengai where the nuts had no milk and were filled with a jelly-like substance of the consistency of thick curd from which the vernacular name is derived. Henry (1920) reported a variety which produced nuts with husk that is easily detachable and very white. Watt (1889) mentioned a small form met with in East Africa which did not possess the fibrous pericarp. Alzina (1931) recorded a variety Lopisan which had very scanty husk and the meat was abundant and very thick and, therefore, yielded more oil than others and another known as Bontanun where the husk was very thick and spongy and meat very thin. He observed certain differences in shells. Shells of certain varieties, according to him, were always white, those of others were spotted with white and black while those of still others were very black

throughout.

On the basis of the growth of the stem and the age of fruiting, coconut palms can be classified into two groups, *viz.*, Dwarf and Tall. The characteristic features of these groups are described below.

DWARF COCONUTS

As the name indicates, the dwarf coconuts are small in stature. They commence bearing earlier than the Tall variety. Dwarf coconut palms flower as early as the third year after planting and come to regular bearing in the ninth year. The origin of dwarf nuts has not been determined so far with any degree of accuracy. Handover (1919) and some others (Anon 1921) suggested that these were mutants of tall ones, appearing first probably in Java. Jack and Sands (1922) believed ivory dwarf coconuts to be mutation from tall or common form due to some change in heredity or genetic factors taking place at rare intervals, leading to production of palms with pronounced size differences. These were reported to occur where large areas of coconuts exist and in widely distributed places. It is generally supposed that the dwarf palms were introduced into Malaya between 1890-1900 by planters from Krion. Other apparently distinct dwarf races are also known in the Philippines, Fiji, Madagascar, Ceylon, Maldives and Nicobar Islands. The dwarf palms are rather limited in their cultivation and the biggest plantation of these in the world is reported to be the one at Singur Nipali estate on the coast between Fort Dickson and Sepany in Malaya, extending over 500 acres raised from nuts obtained from 12 year old trees in Krion District.

These palms have been reported to thrive well on any situation where water is abundant but not stagnant, though it is evident that in well drained alluvial soil it is at its best. According to Sharples (1930), the dwarf variety is more frequently subject to injury by an attack of fungus. These have also been reported not to yield commercial crops on light to medium soils without irrigation. These have been reported to be very hardy, growing well in white clays, red loam or deep peat (Anon 1921). Some believed that these were not hardy, although under favourable conditions they were capable of exceedingly high yields. Some, on the other hand, opined that they were unsuited to peat soils. Yellow form of this variety proved least resistant to unfavourable soil conditions.

Handover (1919) invited the attention of coconut growers to the commercial possibilities of

cultivating the dwarf type known as Nyior Gading in Malaya, which is said to have been imported by the Dutch. Jack and Sands (1922) noted three distinct types of the local Nyior Gading Dwarf palms based on colour of the fruit, *viz.*, apricot, green and ivory yellow with the last type predominating and mixed in plantations of ordinary tall and semi-tall palms. Jack (1925) pointed out that natural crossing taking place between the tall and dwarf races gave rise to semi-talls or intermediates occurring as first generation hybrids between the tall and the dwarf. The green varieties of dwarf palms were reported to throw a proportion of semi-tall palms. It was generally assumed in Malaya that dwarfs are self-pollinated and are, therefore, genetically pure. It was reported that the percentage of seeds of dwarf palms breeding true to colour of the fruit is very high, being as high as 96% in the case of ivory yellow variety. It has also been pointed out that the green type should, undoubtedly, have preference to its less uniform progeny on account of its hardiness and size of nuts. The appearance of families from single mother palms of the dwarf varieties at Port Swettenham in Malaya supported this view, as the yield records of these families presented a very different picture as the co-efficient of variability varied from 36·0 to 41·5, from 14·7 to 74 and 12·1 in that of yellow, green and red types respectively. (Anon 1938).

Certain floral characters are associated with these palms. Duration of male phase varied in these palms between 15-24 days with an average of 21 days while the female phase was eight days. This was shorter than that observed in tall palms in respect of the male phase and longer in respect of the female phase. Inflorescences in the same line in the dwarf variety followed each other after an average interval of four days. In most cases in these palms, the female phase ended at the time or earlier than the male phase. In a few others, female phase began before the end of the male phase and the end of the female phase was never more than three days behind the end of the male phase, making self-pollination not only possible but very probable, particularly high in dry weather since the coconut pollen grains appeared to maintain their viability for several days under fairly dry conditions.

Although the dwarf palms came into bearing early and yielded well, the copra was inclined to be softer and more pliable and leathery and not quite of such good quality as that from the tall palms. Cooke

and Jagoe (1933) have shown by experiment that the copra from dwarf palm nuts is of inferior quality to copra prepared from ordinary tall palm nuts in a good kiln. They also reported that it is difficult to prepare hard copra from dwarf coconuts as usually a large proportion of wrinkled, distorted, rubbery copra is produced, as shown below.

SUMMARY OF RESULTS

Copra ex	Appearance (in order)	Percentage of rubbery pieces	Nuts per picul of copra
Tall nuts	Good	0-10	200-284
Green dwarfs	Fair	10-36	350-370
Yellow dwarfs	Poor	18-80	477-667
Red dwarfs	Very poor	50-92	370-513

They were of the opinion that in raising coconut estates, it was advisable to plant only tall palms. In Malaya the profitable bearing life of the dwarf coconut has been reported to be not so long as that of tall coconut. Dwyer (1938) reported that larger nuts from the ordinary tall palms are decidedly more valuable than small nuts from dwarf palms. He also observed that from a given number of small and large nuts copra can be manufactured more cheaply from the large nuts than from the small.

Many varieties of dwarf palms have been reported and described. Hamilton and Grange (1937) recorded seven varieties of dwarf palms in Samoa which were subsequently planted at Buitenzorg, Java. Three varieties of these are reported from the Philippines, two from Fiji and two from Malaya. Bhavani Shankar Rao and Koyamu (1955) have described two dwarf coconut types common in Chowghat area in India. The description of some of these available from literature is given below:—

MALAYA

(1) **Klapa Gading (Nyior Gading)** It is a distinct variety of medium dwarf or semi-tall type common in Malaya States supposed to have been originally introduced from the Dutch Indies. This variety is reported to have first occurred as a mutant in Java. It is a small hardy palm which begins to bear in about three to four years after planting. Bearing is profuse and the yield is said to be about 120 nuts per tree. The fruit is ovoid in shape and the apex of the fruit is slightly sunken and the 'eye' is small. The kernel is thick and the quality of copra satisfactory. About 8400 nuts yield

Fig. 1. Coconino

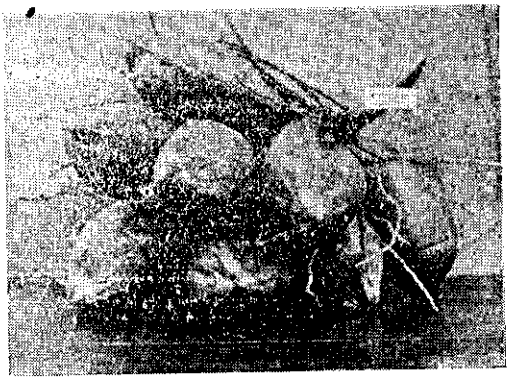

Fig. 2. Andaman dwarf

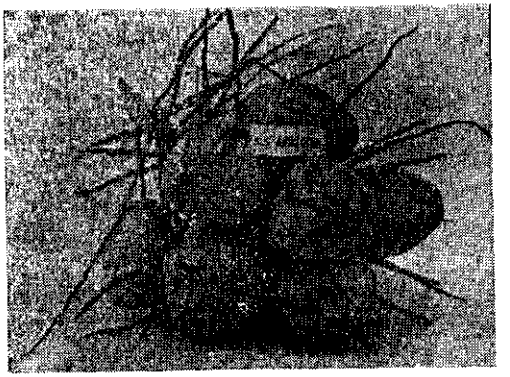

Fig. 3. Gangabondam

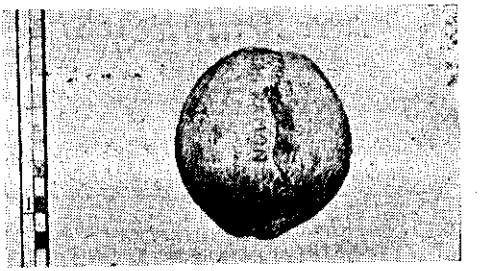

Fig. 4. San Ramon

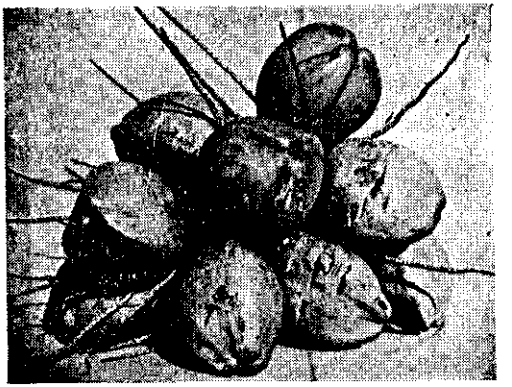

Fig. 5. Indian Tall

Fig. 6. Kappadam

Plate I

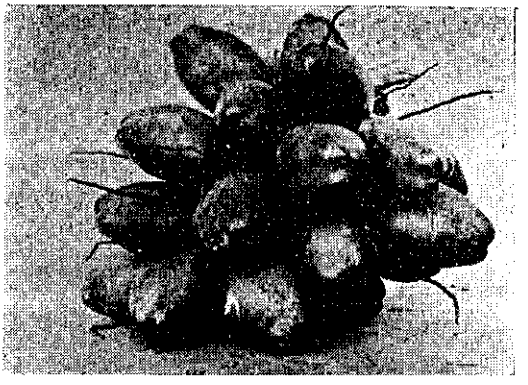

Fig. 7. Laccadive ordinary

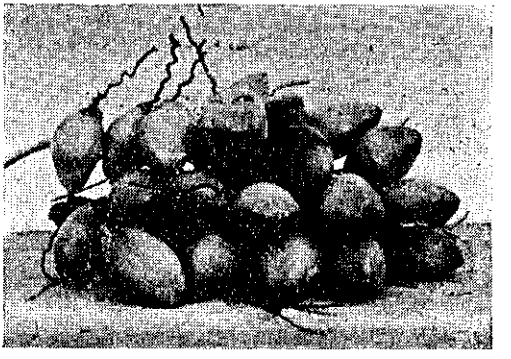

Fig. 8. Laccadive micro

Fig. 9. New Guinea

Fig. 10. Kaithathali

Fig. 11. Spikeless

Plate II

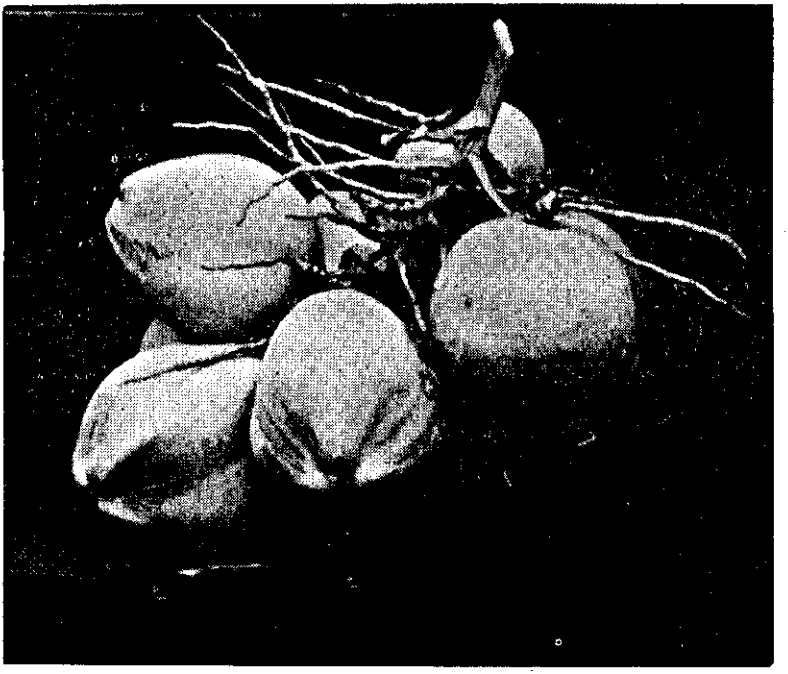

Fig. 12. Cochin China

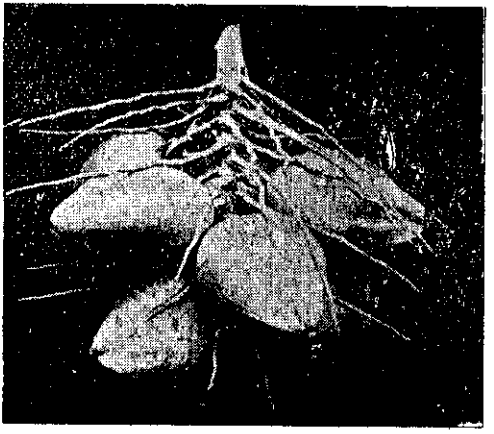

Fig 13. Java

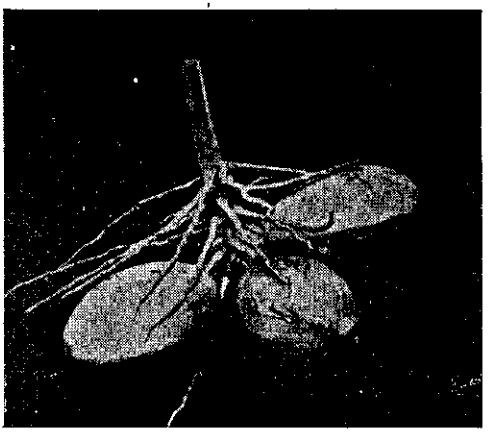

Fig. 14. Siam

Plate II!

Fig. 15. Coco Seychellois

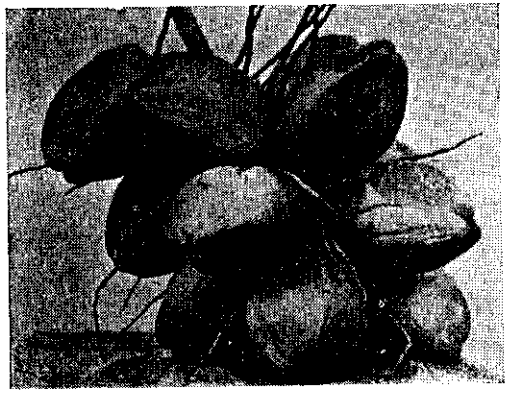

Fig. 16. Fiji

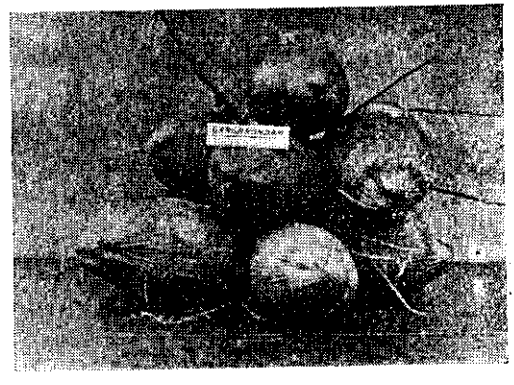

Fig. 17. Straits Settlements—Apricot

Plate IV

a ton of copra, which is quite rich in oil. Trees thirty years old occurring in various parts of Malaya are said to be bearing profusely. Colour variants with yellow, golden, ivory yellow, green, brick red, bronze and intermediate colours occur in the variety. The chances for self-pollination are greater in this variety than in the ordinary tall variety; 70-80% or more of the progenies breed true to type. This is the only dwarf grown on a plantation scale in Malaya (Handover 1919 and Jack and Sands 1922).

(2) **Klapa Puyoh (Quails coconut)**: Klapa puyoh is the name given to the green dwarf in Malaya. This has now become much more common than it was before, due to the very early yielding character (Omar 1919).

PHILIPPINES

(1) **Coconino or baby coconut**: This is a distinct dwarf form with a short trunk flowering in about 4 years after planting. The nut produces thick and hard copra. It is a prolific bearer producing about 100 nuts per tree annually. About 7000 nuts are required to make a ton of copra. This type is specially valued for tapping purposes (Copeland 1931). (*Vide* Fig. 1, Plate 1).

(2) **Pugai**: This is a very dwarf form and commences to bear in about 3 years after planting. The nut is about 7 cm. in diameter with a 2 cm. thick husk. These very small nuts are used as curiosities or they may be stuffed with candy or sweet meats (Copeland 1931).

(3) **Lincoranay**: This is characterised by its low growth. It includes a number of minor types having fruits red or green and large or small. It includes Dahili and Inano which possess nuts of smaller size (Copeland 1931).

(4) **Pagara**:
(5) **Pilipog**:

These are characterised by thin trunks and short fronds and are delicate in nature (Alzina 1931).

(6) **Mangipod**: Among the forms intermediate between the Coconino and the Pugai there is a dwarf nut known in Laguna region of the Philippines as 'Mangipod'. This is also a very early bearer. This variety is said to produce fruit when the tree is so small that the cluster rests directly on the ground (Copeland 1931).

FIJI ISLANDS

(1) **N'uleka**: The local dwarf coconut of Fiji is called the N'uleka. Under ordinary conditions it begins to bear in 5 years and is a prolific yielder, producing more than 400 medium size nuts per tree (Anon 1920).

(2) **N'udam:** This type is a very quick and good bearer of round nuts with an exceptionally thin husk and is considered a very hardy type (Anon 1920).

INDIA

(1) **Chowghat Dwarf:** The dwarf types of Chowghat Green and Orange are delicate and short-lived. They are easily susceptible to diseases and pests. The out-turn of copra is low and the quality is also poor. Chowghat dwarf green maintains almost cent per cent purity on account of self-pollination, while in dwarf orange both self and cross-pollination occur (Rao and Koyamu 1955).

(2) **Laccadive or Maldive Dwarf:** These are dwarf types from Laccadive and Maldive Islands. They yield on an average not more than 50 nuts per tree per annum. They give good copra both in quality and quantity. The copra content per nut is about 115-145 gms. and the percentage of oil in the copra is about 71.

(3) **Andaman Dwarf:** This is a dwarf type from the Andaman Islands. It is a poor yielder. The copra content per nut is about 145 gms. and the oil content in the copra is about 63. (*Vide* Fig. 2, Plate 1).

(4) **Chennangi:** This is a dwarf type from Andhra.

(5) **Gangabondam:** This belongs to the medium dwarf or semi-tall type. The time of first bearing occurs in about 4 years after planting. The nut matures in 11 months. It is a prolific yielder. The nuts are elongated in shape, medium sized and have fairly thick kernel. They give good quality copra. The copra content per nut is about 230 gms. and oil percentage in the copra is about 72. (*Vide* Fig. 3, Plate 1).

CEYLON

The Dwarf varieties of the coconut met with in Ceylon have been described (Report of the Coconut Commission 1949 and MacMillan 1954) as follows:

(1) **King Coconut:** This is otherwise called as Rath Thembili. It is a distinct variety resembling the Malayan dwarf type "Puyoh", said to have originated in Ceylon. It bears a yellow ovoid fruit distinguished by its sweet juice and esteemed for culinary purposes. But it is of little commercial value for copra.

(2) **Gon Thembili:** It is a dwarf type bearing ivory yellow nuts.

(3) **Navasi Thembili:** This is another type of dwarf nut having a husk which when tender is fleshy and of a sweetish acid taste.

VIETNAM

(1) Cây dua xiêm: The coconut is named the Dwarf coconut of Siam. It bears numerous small fruits, poor in copra. Its water is very pleasant to drink. It flowers early at the age of 4 or 5 years. The leaves are short (3 metres) and the trunk narrow. The Annamites designate it under the name Xiêm lai (Xiêm metis). (Private Communication, 1956).

TALL PALM

This is the ordinary or the common Tall variety of palms most extensively grown on a plantation scale in all coconut tracts of the world. It is a long-lived palm living generally to an age of about 80-90 years, although, sometimes older trees are also met with. The palm thrives well under different soil conditions varying from littoral sands to red loams and laterites and also under varying climatic and rainfall conditions. It is observed to grow well up to an altitude of 3000 ft. above the sea level. It is fairly resistant to disease and pests. The trees attain a height of about 15-80 metres or more. It begins to bear in about 8 to 10 years after planting. The palms of this variety are generally cross-pollinated in nature, although, in summer months there exist chances of self-pollination due to the overlapping of spadices. After pollination, the nuts mature in a period of 12 months. The nut is medium to big in size, varying in shape, from spheroid to linear and with colours varying from green, yellow and orange to shades of brown. The quality and quantity of copra from nuts of this variety are satisfactory. About 6000 nuts yield a ton of copra. These are generally the palms recommended for large scale planting as they are superior to those of the dwarf palms from which it differs widely in many respects. The following table gives some of the differences between nuts of the Dwarf and Tall palms.

PRODUCTION OF DWARFS AND TALLS COMPARED

The figures for dwarfs are average from six estates after Jack and Sands (1929)

	Dwarfs	Talls
Number of palms planted per acre	90	48-55
Copra in pikuls per acre, 4th year	2·29	..
Copra in pikuls per acre, 5th year	6·19	0·5
Copra in pikuls per acre, 6th year	7 52	2·00
Copra in pikuls per acre, 7th year	9·24	4·00
Copra in pikuls per acre, 8th year	11·68	6·00
From 10th year estimated	13·00	8·73

Number of nuts per pikul of copra (mainly yellow)	560 (approx. 9430 per ton)	251 (approx. 4230 per ton)
Number of nuts per pikul of copra average of two estates (mixed dwarf palms)	482 (approx. 8118 per ton)	251
Number of nuts per pikul of copra— Green race only (estimated)	430	251
Weight in grammes of copra per nut to nearest 10 grammes	130 (0·29 lb) (4·68 oz)	268 (9·36 oz)
Number of nuts per palm per annum (conditions favourable)	90	56
Production of copra in pounds per palm per annum (conditions favourable)	25	32
Production of copra per acre per annum in pounds (favourable conditions)	2,250	1,600

Average oil content of copra—64·78 per cent and 7·74 per cent (moisture)
1 pikul = 133 1/3 lb.

Many forms of these varieties are recorded in the different coconut-growing regions. Some of them are briefly described below.

PHILIPPINES

(1) **San Ramon:** This is a very high yielding type with large nuts, nearly twice as large as the ordinary. It requires 3270 nuts to produce a ton of copra. This is found in various coconut countries ranging from Ceylon across Malaya, Polynesia and probably in West Indies. This is, perhaps, the largest nut ever known on a plantation scale. It starts bearing in about 5 to 6 years after planting (Copeland 1931). (*Vide* Fig. 4, Plate 1).

(2) **Laguna:** This is the ordinary tall variety and represents the typical coconut of the world. 5600 nuts are required to produce a metric ton of copra (Copeland 1931).

(3) **Lono or Luno:** The nuts have a soft endosperm and hence are not suited for making copra (Copeland 1931).

(4) **Taban:** This type is known as Taban in Pangasinan, 'Cayamis' in Northern Mindanao and 'Kalapa Tebu' in Java. The husk of this variety when tender is sweet so that it may be chewed like sugarcane. Its water is tasteless. When the husk becomes harder it is just like the other varieties (Copeland 1931).

(5) **Tataguden:** The nuts of this type have a thick husk (Copeland 1931).

(6) **Tutupaen:** The nuts are small with very thick shell (Copeland 1931).

(7) **Lupisan:** Produces large nuts with thin husk (Copeland 1931).

(8) **Agta:** This is grown in the Nisayan Islands of Leyte. The nuts

are so dark green that they appear to be almost black.

(9) **Busag:** The fruits are very pale green in colour (Copeland 1931).

(10) **Bulavo:** This type has pale brown fruits (Copeland 1931).

(11) **Makapuno:** In Makapuno nuts instead of a cavity inside the hard endosperm, there is a light yet firm tissue filling the entire interior of the nut. Makapuno nuts themselves will not germinate, but are likely to be produced on trees along with normal nuts. The Makapuno nut is valued as a delicacy. It resembles the "Thairu Thengai" type met with in India.

(12) **Bontanum:** The nuts have very thick husk. The husk is spongy and the meat very thin (Alzina 1931).

(13) **Carahun or Saloquihan:** Shells of this type are thin (Alzina 1931).

(14) **Dailig:** This is stated to commence flowering from the 3rd year of planting. It is not a dwarf type (Alzina 1931).

(15) **Palavan:** The palms of this variety grow almost side by side like fingers on a hand, although, they are more widely dispersed over-head. The nuts either sprout on the palms themselves or fall to the ground (Alzina 1931).

INDIA

(1) **Indian Tall Variety:** The ordinary or common tall variety of coconut is extensively cultivated in all the important coconut tracts of India and is of commercial importance. This varity is tall-growing, long-lived, hardy multipurpose palm yielding nuts, copra, oil and fibre of good quality. Under favourable conditions it begins to bear in about six to eight years after planting. The average yield of this variety is about 50—60 nuts per tree per year, under rain-fed condition. The mean copra content is about 5 oz. and the oil content in the copra is about 72 per cent. (*Vide* Fig. 5, Plate 1).

(2) **Kappadam:** This is allied to the ordinary tall type but is more robust in all characters, particularly in the size of the nut which is one of the largest on record. The shape of the nut is broadly ellipsoid. The yield is rather low, being about 60 nuts per palm per year. The quantity of copra is high and copra is thick and hard. This type is met with in parts of South Malabar (India). (*Vide* Fig. 6, Plate 1).

(3) **Andaman Giant:** This is a form from the Andaman Islands. The palms are of tall stature, massive proportion and majestic appearance. The nuts are green and large, perhaps the largest on

record. The yield is poor. Though the copra content is high, the copra is thin and of poor quality. It comes to bearing in about eight years after planting. The palms are resistant to diseases (Narayana and John, 1949).

(4) **Andaman:** This is a medium type from the Andamans. This resembles the Andaman Giant in all respects except in stature. It is a good yielder of toddy.

(5) **Laccadive ordinary:** This type resembles the ordinary tall variety. The average yield under ordinary conditions is about 127 nuts per palm per year. The copra content is 155 gms. and the oil content in the copra is 72% (John and Satyabalan, 1955). (*Vide* Fig. 7 Plate 2).

(6) **Laccadive medium:** In this type the nut is comparatively smaller in size than Laccadive ordinary. The average yield is about 192 nuts per palm per year and the average copra content is about 85-115 gms. with an oil content of 75% (John and Satyabalan, 1955).

(7) **Laccadive micro:** In this type the nuts are very small compared to those of the above mentioned types. The yield is about 164 nuts per tree per year. The average copra content is about 80 to 95 gms. per nut with an oil content of 75% (John and Satyabalan, 1955). (*Vide* Fig. 8, Plate 2).

(8) **Thairu thengai:** There are certain palms among the Tall type of the West Coast, which are locally known as "Thairu thengai" (curd coconut). In the nuts there is no milk and they are completely filled with a jelly of the consistency of thick curd from which the name is derived. The kernel is not hard enough to make copra but it is good for eating. These nuts do not germinate but a few in every bunch produced by such trees are quite normal and when planted may give rise to trees of this type. (Patel, 1938).

(9) **Kaithathali:** Among the tall palms of the west coast there is a variety called 'Kaithathali' which is rare. It has a soft fleshy husk. In the tender nut the fibres are so poorly developed that the husk is sometimes eaten raw and is said to be a very good antidote against sea-sickness. (Patel, 1938) (*Vide* Fig. 10, Plate 2).

(10) **Spikeless:** This variety is quite distinct from the ordinary coconut palm in having no branches or spikes in the inflorescence. In this variety femaleness is most expressed and maleness least expressed because the number of male flowers is as low as 50. The setting percentage is very low. The mature nut is smaller than in

the ordinary variety. It is found that 50% of the progenies of this variety breed true to type. It is also found to cross freely with other coconut varieties. This variety is found to be useless for tapping. It has been described by Jacob as a distinct botanical variety, i. e., var. Spicata (Jacob 1941; Narayana and John, 1949) (*Vide* Fig. 11, Plate 2).

(11) **Gangabhavani:** This is a distinct type from Andhra. The nuts are big and oblong in shape. This type is found to be good as tender nuts for drinking. The copra content per nut is about 168 gms.

(12) **Verri Kobbari:** This type from Andhra is found to be almost similar to Laccadive small type. The nuts are small, oblong and tapering at both ends. The copra content per nut is about 85-115 gms.

(13) **Rangoon kobbari:** This type from Andhra appears similar to the Andaman Giant type. The nuts are big and oblong. The copra content per nut is very high varying from 255-280 gms.

CEYLON

In Ceylon the ordinary tall variety is grown on a plantation scale. It resembles the West Coast tall variety of India. It is further classified according to the colour and nature of the husk. (Report of the Coconut Commission Ceylon, 1949).

(1) **Ran Thembili:** This is a green nut having pink coloured husk within.

(2) **Navasi:** The husk in this case is sweet.

(3) **Peni-pol:** The peculiarity of this is that it has very sweet kernel.

(4) **Dikiri-pol:** This resembles the Philippines macapuno.

(5) **Bodiri:** Here the bunches bear large numbers of small sized nuts.

(6) **Pora-pol:** Nuts of this have characteristically thick shells.

NEW GUINEA

(1) **New Guinea:** The nuts of this type are large, spherical or ellipsoid in shape, the colour varying from green to brown. The nuts contain plenty of sweet water in the tender stage. The quality of copra is not as good as that of the West Coast Tall type. Under ordinary conditions the palm yields on an average about 65 nuts per tree per year. It has a copra content of 228 gms. and an oil content of 66 per cent (John, 1952). (*Vide* Fig. 9, Plate 2).

(2) **Markham:** Nuts from Markham Valley in New Guinea are noted for their large size, perfect shape and good yield. Trunk of

the trees are shorter. It requires about 4,000 nuts to produce a ton of copra as against 6,000–7,000 nuts of the ordinary variety. The nuts have a fairly thick husk. The husked nuts are ovate in shape. The kernel is very thick. There is a tendency for the nut to ridge. The nuts of this variety are compared to those of the San Ramon variety of the Philippines. (Dwyer, 1938)

COCHIN CHINA

(1) Cochin China: The nuts of this type are large sized, spheriod in shape and coloured from green to shades of brown. The water in the tender nut stage is sweet and plentiful. The trees bear about 90 nuts per tree per year. The copra is of fair quality and weighs about 228 gms. per nut and has an oil content of 66 per cent (John, 1952). (*Vide* Fig. 12, Plate 3).

JAVA

(1) Java: This is a tall variety with fairly stout trunk. The nuts are medium to large in size and round or somewhat elongated in shape. It yields about 95 nuts per tree per year. The copra is of good quality. It has a copra content of 200 gms. and an oil content of 66 per cent (John, 1952). (*Vide* Fig. 13, Plate 3).

SIAM

(1) Siam: The nuts of this type are green in colour and medium to large in size and ellipsoid in shape. The palm yields about 50 nuts per tree per year. The copra is of good quality and weighs about 228 gms. per nut and has an oil content of 74% (John, 1952). (*Vide* Fig. 14, Plate 3).

SEYCHELLES

(1) Coco Seychellois: This is most extensively cultivated in Seychelles. There are two types: green and yellow. Early nutfall is the rule with this type. This type is classified as tall with very curved trunk, dark green leaves with wide pinnules. The fruit is oblong, the diameter length ratio being 0·59. The nut is of small size and situated right at the bottom of the fruit near the pointed end (Durocher Yvon 1953). (*Vide* Fig. 15, Plate 4).

(2) Coco raisin: Bunch of small spherical nuts resembling grapes in shape (Durocher Yvon 1953).

AMERICA

(1) San Blas: It is a variety from Central America. It is a prolific yielder. The palm is of a medium type with an open crown. The variety is conspicuous due to a large number of leaves hanging down more or less vertically. The

fruits are much more elongated than those of the Tall. The nut inside is also elongated. In this variety layers of cells are present between the shell and the endosperm on coconut of which the meat is easily removed from the shell. The nuts of this variety have a very high husk percentage amounting to 43·7% of the whole fruit, compared with 26·1% of the tall variety. The variety is reported to be not suited to the heavy alluvial clays of West Coast of Malaya (Dwyer 1938 and Smith 1932).

INDONESIA

(1) **Takame coconut:** This is a variety from the island of Ternate. The tree bears a large number of comparatively small nuts which results from the fact that there is no shedding of nuts in this variety. Many trees of the progeny are said to inherit this character (Tammes 1955).

FIJI

(1) **Fiji:** This type from Fiji resembles the ordinary Tall type of the West Coast of India. It is a high yielder and produces more than 120 nuts per tree per year. The copra content per nut also is very high, about 8 oz. and the oil percentage in the copra is about 70. (*Vide* Fig. 16, Plate 4).

MALAYA

Omar (1919) has reported the following varieties (1 to 12)

(1) **Klapa jantong:** Heart coconut

(2) **Klapa bulat:** Round coconut

(3) **Klapa besar:** Big nut

(4) **Klapa sepang:** Heart coconut

These constitute the commonest types in Singapore. Most of the Singapore copra is made from these races. The nuts of these differ from eachother.

(5) **Klapa laga:** This is too small for copra making and is sold at cheap rates.

(6) **Klapa bijau:** } These are
(7) **Klapa nipah:** } rare types giving high yields. The nuts are excellent for making copra.

(8) **Klapa dadeh:** This produces little detached granules of endosperm in the milk in about 4 to 5 per cent of the nuts. It is eaten with sugar as a delicacy.

(9) **Klapa kuning:** Yellow coconut, has more sugar in the milk than most other coconuts and hence reserved for eating.

(10) **Klapa logi:** The nuts of these are eaten in the tender nut stage.

(11) **Klapa Wangi:** Fragrant coconut. This is preferred for making medicines. The meat has a pleasant scent.

(12) **Klapa sekol:** The shell of this type is fancied for making cups.

(13) **Straits settlements apricot:** This is semi tall type from Straits Settlements. It is a poor yielder. The copra content per nut is about 240 gms. It has got a peculiar character of early maturity and germination. (*Vide* Fig. 17, Plate 4).

VIETNAM

A few varieties are met with in Vietnam as under. (Private communication 1956).

(1) **Cây dua ta** The palm has large green nuts.

(2) **Cây dua num:** The fruits resemble those of the preceding variety. A small conical protruberance is seen at the junction of the three ridges. Mr. Prudhomme cites a variety equivalent to this at Madagascar.

(3) **Cây dua li:** The palm has large fruits but more elongated than in the variety Cây dua ta. But the sides are less marked.

(4) **Cây dua dai:** It is called bindinh in Cochin China while this name is unknown in Annam. The fruits are very elongated and this variety is best for the production of coir because the fibres are extremely long.

(5) **Cây dua tron:** The nuts are round. The palm is called the coconut palm of Vihn long.

(6) **Cây dua bong:** The palm has green fruits very similar to those of the variety cây dua ta. When the fruits are young the kernel has a pleasant and an agreeable taste of salad. It appears to resemble the variety 'Navasi' of Ceylon.

(7) **Cây dua sap:** The fruits have a very sweet pulp, it has been pointed by Mr. Robin (in the Bulletin of the Scientific Institute of Indo-China No. 7. The Culture of the coconut palm in the Island of Phutuc).

(8) **Cây dua lua:** The coconut palm has red nuts. Perhaps it would be necessary to distinguish two types, one with bright red fruits and the other with deep red ones. The petioles of the leaves are similarly coloured but more lightly.

(9) **Cây dua lua lai:** The gradations of colour from yellowish green to bronze are seen in the nuts and this type is considered by the Annamites to be a hybrid of red and green coconuts.

(10) **Cây dua tanguang:** These coconut palms are less tall than the

preceding types. The leaves are yellow, fruits become yellowish white when mature, elongated, large, but not prolific.

NEW CALEDONIA

There are many varieties of the coconut indigenous to the islands. Some of them are simple curiosities. They are: (Private communcation 1956):

(1) Nu mi or Nu main: Coconut bearing red nuts.

(2) Nu Kono Cocotier: Coconut bearing green fruits.

(3) Nu Kaume cocotier: Coconut bearing white fruits.

(4) Nu Je Meka Cocotier: Fruits with stripes of green and white.

(5) Nu Wa or Cocos sucre: This is a sweet coconut whose fibre is edible like sugarcane.

(6) Nu Kafa: The fruits of this type are not very productive. The husk in this case has long fibres used for the manufacture of coir ropes.

(7) Nu Melo: The water of the nut is very sweet.

(8) Nu Kita: Produces small fruits from which the kernel is easily or entirely detached. Each inflorescence consists of a large number of small nuts.

(9) King coconut: This is an ornamental variety with yellow leaves.

(10) Cocotier des wallis: The fruits in this type are twice the size and give three times more copra than the ordinary variety. This is being grown in a large scale in Ouvea.

BRITISH GUIANA

(1) Santa Rosa: This is a promising variety of coconut cultivated in Moraca District of British Guiana (Agri. Jourl. of B. G. Vol. 4, No. 4, p. 212).

CLASSIFICATION OF VARIETIES

As already indicated, very few publications relating to the classifications of varieties are available in the world literature on coconut. Based on the study of the varieties made at the Agricultural Research Station, Pilicode, Kerala, a systematic classification has been made by Narayana and John (1949). According to them the cosmopolitan species of *Cocos nucifera*, Lin. can be divided into five varieties.

KEY FOR THE IDENTIFICATION OF COCONUT VARIETIES AND FORMS

A. Inflorescence unbranched or rarely with one or two small

spikes—variety spicata.

A. A. Inflorescence normal and always branched.

B. Tall late bearing palms.

C. With both male and female flowers—variety typica.

C. C. With only male flowers—variety androgena.

B. B. Dwarf and early bearing palms.

D. Vigorous palms bearing in 4 years—variety javanica.

D. D. Delicate palms bearing in 3 years—variety nana.

FORMS OF VARIETY TYPICA

A. Nuts very small (about 1000 c. c. in volume) and very many in a bunch—even 100 or more pusilla (laccadive small).

A. A. Nuts not small.

B. Nuts very large (7000 c. c.) majestic palms. Copra content low and quality inferior—gigantea (Andaman Giant).

B. B. Nuts medium large (almost 6000 c. c. or less).

C. Nuts about 6000 c. c. copra superior and quantity high about 10-12 oz. per nut.

D. Yield of nuts per tree per year, about 100 even—ramona.

D. D. Yield of nuts low about 35 per tree per year–Kappadam.

C. C. Nuts 4000 c. c. in volume or less.

E. Trunk robust—90-100 cms. in girth.

F. Percentage of oil in copra high (74) siamea.

F. F. Percentage of oil in copra low (66-69).

G. Female flower production (annual)—very high (744) nova-guineana.

G. G. Female flower production (annual) low (220) malayensis.

E. E. Trunk of medium girth (73-83 cms).

H. Copra thin (0.82 cms) and percentage of oil in copra low 66—Cochin chinensis.

H. H. Copra thicker (1.2—1.3 cms) and percentage of oil high (72) Laccadive.

ACKNOWLEDGMENT

We are indebted to Dr. K. P. V. Menon, Director Central Coconut Research Station, Kayangulam and to Shri M. M. Krishna Marar, Agronomist of this Research Station for their keen interest and help in the preparation of this paper.

REFERENCES

1. Adriana, F. T. and Mamerta, Manahan (1931-32) The nutritive value of green, ripe and sport coconut. Philippine Agriculturist. Vol. 20 pp. 195-8.

2. Alzina, F. I. ... (1931) On the palms which are called Cocos and their great usefulness. Philippine agriculturist No. 7. Dec. 1931 p. 435.

3 Anon ... (1884-85) The pink Coconut. Tropical agriculturist Vol. 4 p. 104.

4.	Anon ...	(1920)	Dwarf from Fiji. Jour. of Jamaican Agricultural Society, Vol. 24 p. 37.
5.	Anon ...	(1921)	Further information about dwarf coconuts. Jour. of Jamaican Agri. Society, Vol. 25. p. 285.
6.	Anon ...		Coconuts. Agrl. Jourl. of British Guiana, IV. 4. p. 212.
7.	Anon ...	(1928)	Dwarf Coconut in Malaya. Mal. Agrl. Jour. Vol. XXVI 1938.
8.	Boldingh, I. ...	(1920)	Cited by Mendiola (1926).
9.	Burkill, I. H. ...	(1919)	Some notes of the pollination of flowers in the Botanic Gradens, Singapore and other parts of Malaya, Peninsula. The Gardens Bulletin S. S. Vol. 2, No. 5.
10.	Cook, O. F. ...	(1901)	The origin and distribution of Cocoa palm. U. S. Agri, Dept. Dn. of Botany National Herbarium Vol. VII No. 2.
11.	Cooke, F. C. and Jagoe, R. B. ...	(1933)	"Further observations on the Dwarf Coconut in Malaya". Mal. Agrl. Jour. XXI No. 4. p. 164.
12.	Copeland, E. B. ...	(1931)	The coconut (3rd edit) MacMillan and Co, London.
13.	Darlington, C. D. and Janaki Ammal, E. K.	(1945)	Chromosome atlas of cultivated plants (George Allen and Unwin Ltd., London).
14.	Durocher Yvon, F. ...	(1953)	"The coconut industry of Seychelles". World Crops. Vol. V. No. 11 p. 437.
15.	Dwyer, R. E. P. ...	(1938)	"The Coconut improvement by seed selection and plant breeding. The New Guinea Agrl. Gazette, Vol. 4, No. 3, July 1938. pp. 24-102.
16.	Hamilton, W. M. and Grange, L. I.	(1937)	Report on the Soils and Agriculture of Western Samoa. Dept. Sci. and Industrial Res. Report made for Samoan Administration on New Zealand Reparation Estates, Sept. 1937.
17.	Handover, W. P. ...	(1919)	"The Dwarf Coconut" Mal. Agrl. Jourl. Vol. VIII, pp. 295-297.
18.	Henry, G. M. ...	(1920)	As cited by Mendiola (1926).
19.	Hooker, J. D. ...	(1894)	Flora of British India, Vol. VI p. 482-83 L. Reeve and Company, London.
20.	Hunter, H and Leake, H. M. ...	(1933)	Recent Advances in Agrl. Plant Breeding, Pub. J & A Churchill, London, 1933).
21.	Jack, H. W. ...	(1923)	Selection of coconuts. Tropical Agriculturist. Vol. IX, March.
22.	Jack, H. W. ...	(1925)	"Dwarf Coconut" Tropical Agriculturist, Vol. LXIV p. 75.
23.	Jack, H. W. and Sands, W. N. ...	(1922)	The Dwarf Coconut in Malaya. Mal. Agril. Jourl. X, pp. 4-12 Jan-Dec, 1922.
24.	Jack, H. W. and Sands, W. N. ...	(1929)	Observation on the Dwarf Coconut Palm in Malaya. Mal. Agri. Jour. Vol XVII No. 6 pp. 110-165. 1929.
25.	Jacob, K. C. ...	(1941)	A new variety of Coconut palm (Cocos nucifera, Lin. var. spicata, K. C. Jacob.) Jour. Bombay. Natur. Hist. Soc. Vol. 41 pp. 906-7. 1941.
26.	John, C. M. ...	(1952)	Coconut cultivation. Pub. Indian Central Coconut Committee, Ernakulam 1952.
27.	John, C. M. and Satyabalan, K. ...	(1955)	A note on the important coconut varieties of the Laccadive Islands. The Indian Coconut Jour. Vol. VIII No. 2. Jan-Mar, 1955
28.	Jumelle ...		As cited by Copeland (1931)
29.	Jumelle and Hubert ...		As cited by Copeland (1931)

30. Kluyver & Reksohadiprodjo (1923) As cited by Mendiola (1926)

31. Macmillan, H. F. ... (1954) Tropical planting and gardening, Macmillan & Co. Ltd., London. p 376.

32. Mendiola, N. B. ... (1926) A manual of plant breeding for the tropics. Chap. IX pp. 169-188. Manila Bureau of printing.

33. Narayana, G. V. and John, C. M. (1949) Varieties and Forms of the Coconut. Madras Agrl. Jour. Vol. XXXVI. Aug. 1949.

34. Omar, Ahmed, Bin. Haji (1919) "Races of the coconut palm". The Gardens' Bulletin, Vol. 2, No. 5 p. 143.

35. Patel, J. S. ... (1938) The Coconut-A monograph, Government Press, Madras.

36. Prudhomme, E. ... As cited by Copeland, E. B. (1931)

37. Rao, Bhawani Shankar, M. and Koyamu, K. ... (1955) "The dwarf coconut". Indian Coconut Jour. Vol. VIII No. 3 Apl.—June. 1955. pp. 106-112.

38. Report of the Coconut Commission, Ceylon 1949.

39. Sharples, A. ... (1930) "Coconut Research in Malaya" Mal. Agri. Jour. Vol. XVIII No. 2, p. 71. Feb. 1930

40. Shortt, J. ... (1885) A monograph on the Coconut palm or Cocos nucifera. Madras Agri. College, Mis. Pub. 1885.

41. Simmonds ... As cited by Copeland, E. B. 1931.

42. Smith, A. C. ... (1932) "San Blas Coconuts in Malaya". Mal. Agri. Jour. Vol, XX, 11, p. 583.

43. Stockdale, F. A. ... (1924) "Coconut: Varieties of Coconut". Tropical Agriculturist, Vol. LXII 1924. p, 204.

44. Tammes, P. L. M, ... (1955) Review of coconut selection in Indonesia. Euphytica Vol. 4 No. 1 Feb. 1955 pp. 17-24.

45. Watt, G, ... (1889) Dictionary of Economic Products of India, Vol. II, part II. pp. 415-49 Govt. Printing, India, Calcutta.

46. Wester, P. J. ... (1918) "The Coconut palm-its culture and uses" (2nd revised edition) Bull. Philippines Bur. Agri. No. 35, 1920 also Phili. Agri. review Vol, XI p. 13, 1918.

47. ... Varieties of Coconuts in Vietnam, Private communication, 1956.

48. ... Varieties of Coconuts in New Caledonia. Private communication, 1956.