A MANUAL OF CULTIVATED PALMS IN INDIA

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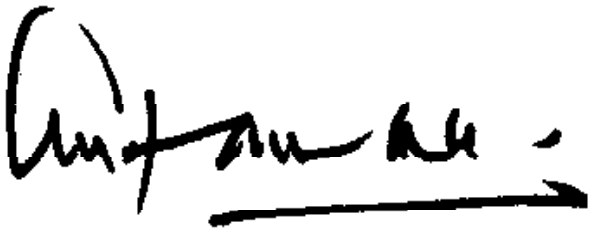
FOREWORD

The family Palmae is one of the most useful groups of flowering plants confined to the tropics. Its versatile use ranging from building materials, to paper, food, oil and medicine, leaving aside its unique horticultural value is responsible for its wide cultivation including even the arid and semi-arid zones of the tropical region. Despite its wide diversity in this sub-continent, which even provide with a remarkable landscapic effect, no comprehensive document on Palmae is available. Its general biology, anatomy, reproductive mechanism, physiological set up stress resistance, biorhythmic patterns, leaving aside the method of culturing and cultivation are all ideal ingredients of thought of researchers interested in this specialized group of plants.

The antiquity of palms too can hardly be overrated. Its existence since the dawn of civilization, reference in vedic scriptures as well as fossil records bear enough testimony of its primitiveness. Its cultivation through diverse systems, culturing *in vitro*, transplantation techniques, ecosystem preference and susceptibility to diseases are all matters of great importance to both academics, professionals and industrialists.

Undoubtedly, this treatise as the authors state is the work of five years of intensive study in this group but more important is the fact that each aspect of the book proclaims the masterly experience of Dr. Shyamal Kumar Basu and Dr. Rothin Kumar Chakraverty. It reflects their decades of experience at the Botanical Survey of India, Indian Botanic Garden and deep personal involvement of the authors in the study of this unique group of plants. I heartily congratulate them for this wonderful treatise written with meticulous care and remarkable precision. I am confident that this book would be an essential guide for any scientist engaged in the study of plants and particularly of this unique group.



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(A.K. Sharma)

CENTRE OF ADVANCED STUDY
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UNIVERSITY OF CALCUTTA
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Late Prof. T. Antony Davis, the former Head of the Natural Science Unit, Indian Statistical Institute, Calcutta who was also the Ph.D. guide of one of the authors (SKB) for his thesis on "the studies on Indian Palms" first conceived that a book containing uptodate revision of cultivated palms of India was of urgent need for the benefit of research workers, palm growers and palm lovers. Due to his untimely demise, his desire was not fulfilled.

In 1987 when Botanical Survey of India, entrusted Indian Botanic Garden to collect information for National Plant Data Base and to publish manuals of cultivated plants under the functional re-organisation programme, we thought it prudent to publish a manual of cultivated palms in India without further delay. We believe this complete manual is a befitting homage to late Prof. T. A. Davis.

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INTRODUCTION

Palms are the most fascinating group of plants that attract attention of both botanists and horticulturists all over the world. A predominantly tropical group, palms occupy a position of primacy among all other groups of plants because of their usefulness to the mankind and by their very characteristic appearance. Oil, wax, fibre, cane, dye, sago, sugar etc., are some of the main commercial products that palms yield. Palms are also a part and parcel of daily life of the rural communities in the tropics because they provide food, shelter, drinking water and other commodities for sustenance. The 'Tree of Life' in the Bible is a Date Palm *(Phoenix dactylifera)*. In Tamil poem Talavisalam written by Arunachalam, 801 uses of Palmyra Palm *(Borassus flabellifer)* have been documented. The Coconut Tree *(Cocos nucifera)* in India is regarded as a sacred tree, its green and ripe nuts are used as offerings to God. Several scriptures of Hindu and Buddhist religions were written on Tal or Talipot *(Borassus flabellifer)* palm leaves and preserved as sacred religious documents.

The beauty and elegance of palms are no less important than their traditional and commercial values. There is no substitute for the gracefulness that palms offer, palms and tropics are thus synonymous. Palms are, therefore, cultivated not only for their economic reasons but introduced in the landscape for their aesthetic value also. They are grown for beautifying interiors of houses, house gardens, parks, large estates, road sides and institutional gardens. Some species of palms are treated as potent decorative materials for creating the general atmosphere of home much pleasing and congenial. The dried fruits, bracts, prophyll and leaves of some palms are also very decorative, therefore, used for vase decoration. The hard endosperm of some palms are used as substitute of ivory and carved into beads for making attractive jewelleries.

Introduction and cultivation of exotic palms in India perhaps began at the time of first Mohammadan invasion to Sind (in undivided India) in the early eighth century when Arabian Date Palm *(Phoenix dactylifera)* was brought for cultivation in some parts of Western India (Blatter, 1926). Arab ship traders believed to have brought African Doum Palm *(Hyphaene thebaica)* to the west coast of India long before the arrival of the Europeans.

Cultivation of indigenous and exotic palms on a scientific basis was started after the establishment of East India Company's Garden in Bengal in the year 1787. Colonel Robert Kyd, the founder Superintendent of the then Company's Garden introduced some Malayan Sago Palms *(Metroxylon sagu)* which he thought would be suitable for cultivation in Bengal as substitute food plant during famine. This species did not thrive well, but several useful palms were found acceptable

to the soil of lower Bengal. While appreciating multifarious uses of Indonesian Sugar Palm *(Arenga pinnata)*, Sir William Roxburgh (1819), the 'Father of Indian Botany' wrote 'I cannot avoid recommending (it) to every one who possess land, particularly as low, near the coast of India to extend cultivation, thereof as possible.The palm wine itself and the sugar it yields, the black fibre for cable and cordage and the pith for sago, independently of many other uses are objects of very great importance' During the early period of the then East India Company's Garden, major attention was paid to cultivate commercially exploitable palms.Therefore, apart from Malayan Sago Palm and Indonesian Sugar Palm, African Oil Palm *(Elaeis guineensis)*, South American oil yielding Babasunut Palm *(Attalea speciosa)* were also introduced. Almost all of the above mentioned exotic palms survived in the new environment but none of them proved to be commercially successful, therefore, continued to remain in cultivation only for scientific and ornamental interests.

Several indigenous alongwith exotic palm species of both Old and New World tropics have since been cultivated either for botanical studies or as ornamental plants. A majority of them through the efforts of the Indian Botanic Garden, Howrah had been introduced in the country making their place in the public and private gardens. Benthall (1946) wrote 'in the former days indigenous palms were much grown in the Indian parks and gardens, but they have almost replaced by more graceful exotic kinds of which large number are planted in and around Calcutta' In the recent times there is a growing popularity for palm cultivation both for indoor and outdoor decoration and exotic palm species are being introduced at a steady stream. The credit of their introduction, however, does not always go to the Indian Botanic Garden, Howrah or other Government agencies but to the enthusiasm of numerous palm lovers in India and the endeavour of the International Palm Society who provide the palm lovers with viable seeds of exotic palm species. The newly formed Palm Society of India is also committed to popularise palm cultivation in India and to encourage young botanists in India to take up studies on the natural history of palms.

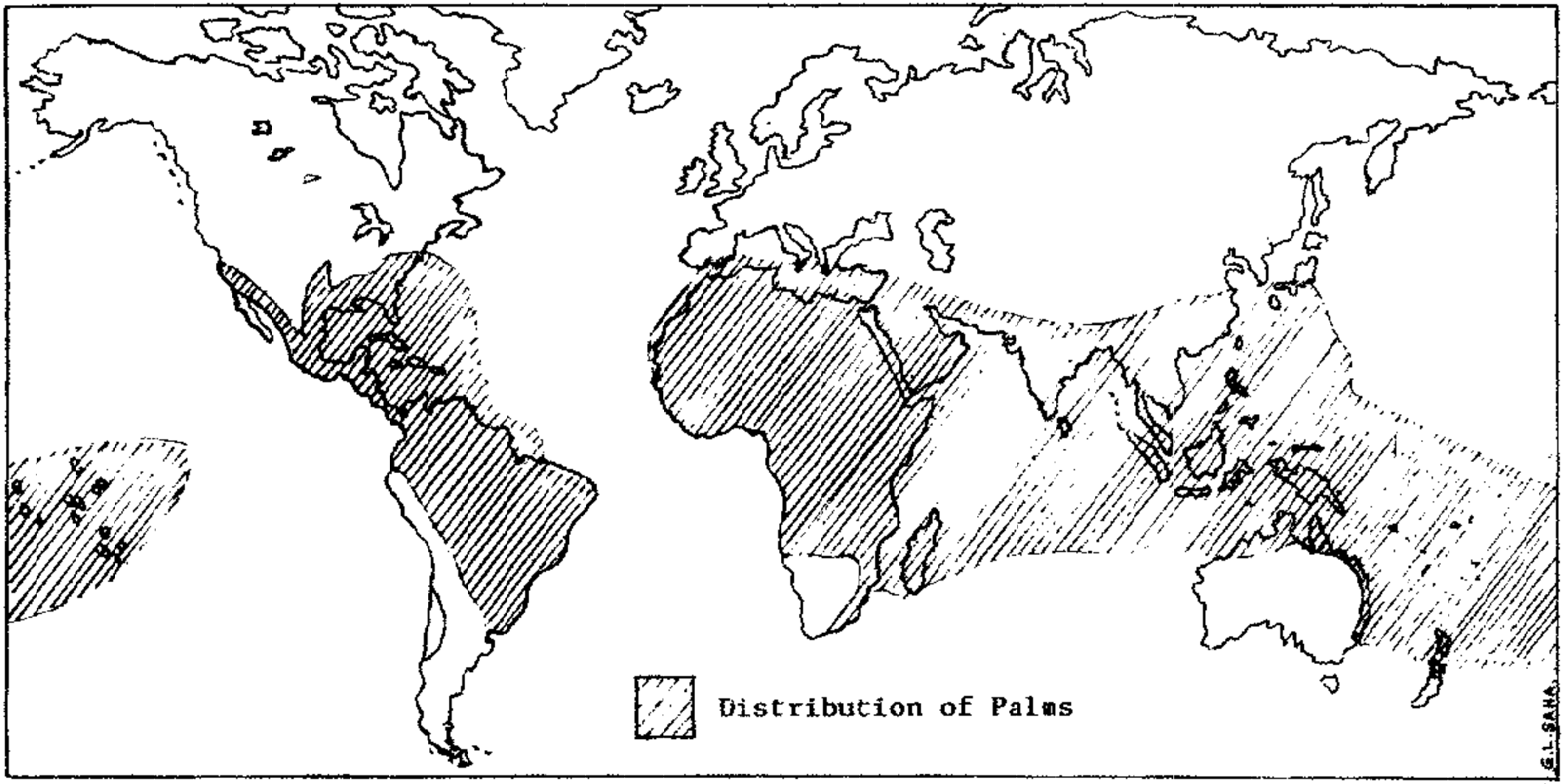
It is not exactly known how many species of palms are at present cultivated in India because quite a large number of them are the collections of the private growers, therefore, inaccessible to others or in the possession of the nurserymen who mostly do not care to enlist their palm collections with proper identity. In many important public and Government gardens in India palms are seldom labelled and listed with their correct nomenclature and thus cause inconvenience to the palm lovers.

For preparing this manual of cultivated palms in India, it was, therefore, necessary to visit all the major gardens in India and at the same time had to visit all important plant shows held during the last 5 years for recording the species of palms under cultivation in India. The main skeleton of this inventory is however deserved to be based on palm collections of the Indian Botanic Garden, Howrah,

which has built up over 200 years of its existance one of the richest collection of living palms in South East Asia.

The purpose of this manual is not just to enlist by name the palms that are cultivated in India but to give an overall impression on palms to those who wish to know their biology, propagation and culture and try to identify palms in the field or in their own garden. We hope that this will be possible by the simple key and description aided with photographs and map. All examples of palms given in this book are cultivated in India. In some exceptional cases examples of some palms not yet cultivated in India have also been cited because those are typical.

A glossary of the scientific terms used in this book is given at the end with appropriate English alternatives.


Distribution of Palms
G.L.SAHA

CHAPTER I

MORPHOLOGY OF PALMS

The vegetative structure of palms in general consists of a shoot that ends in a crown of leaves. The major reproductive process in palms is sexual through setting of seeds.

Palm Stem (Solitary)

The stem of palms is generally applied to the shoot. The most common feature of a palm is a solitary columnar stem, sometimes also termed as trunk, and crown of fan like (e.g. *Borassus flabellifer)* or feather like (e.g. *Cocos nucifera)* leaves. The single stemmed palm may be tall, dwarf, robust, slender or rarely a slender climber. The solitary stem of Doum Palm of Africa *(Hyphaene thebaica)* divides repeatedly above the soil and appears as a multiheaded tree. On rare occasion a solitary stemmed palm may manifest in their offspring a cluster forming habit by the simultaneous development of all the three active embryos in the seed. This false suckering habit has been seen in *Cocos nucifera, Borassus flabellifer* and *Rhopaloblaste augusta*. Unusual aerial branching may also occur in a single stemmed palm when injury is inflicted upon the growing terminal bud. Under abnormal condition a normally single stemmed palm may also produce several axillary shoots (bulbil shoots) in place of inflorescences. These aerial shoots may die in the course of time or grow into axillary branches as seen mostly in *Cocos nucifera, Borassus flabellifer, Phoenix sylvestris, Arenga pinnata* and *Elaeis guineensis*, which are strictly single stemmed palms. The surface of the palm stem may be smooth, rough and cracked, ringed, spiny or covered with fibrous outgrowths.

Palm Stem (Cluster Forming)

In some palms, the underground part of the stem throws out aerial shoots from the dormant axillary buds and by the repeated development of axillary shoots from below the ground the palm appears tufted with multiple stems. In some palms the underground portion of the stem throws axillary shoots which do not come out close to the main stem but grow away horizontally below the ground and appear as erect aerial shoots. By the repeated development of aerial shoots in this manner a single palm forms a huge colony of several stems. This type of colonisation is characteristic of *Acoelorraphe wrighii, Bactris major, Calamus arborescens, Rhapis excelsa, R. humilis* etc. *Chrysalidocarpus lutescens*, a normally close cluster forming palm, produces aerial shoots not from the axils of the leaves but also from the bud initiated on the abaxial side of the leaf base, in the same palm the aerial shoots may fork from the node showing distinct adnation of axillary bud with the leaf sheath.

Underground Stem

There are some palms whose stem grows underground, only their leafy crown comes above the soil thus the palms become acaulescent in appearance. The common example is *Phoenix acaulis* and *Sabal minor*. In Silver Saw Palm (*Serenoa repens)* of the coastal Florida, vegetative shoot and inflorescence both are produced from the underground prostrate stem. In the case of estuarine Nypa Palm *(Nypa fruticans)*, the underground stem grows horizontally in the mud and fork repeatedly pushing its leaves above the water level. In Salak Palm of Indonesia *(Salacca edulis)*, the underground stem also grows horizontally producing rosetted shoots above the soil.

Climbing Stem

The climbing habit in palms is a special adaptation for surviving in the tropical rain forests and seen in some groups of palms of the eastern and western tropics. All climbing palms have long slender aerial stem with long rounded internodes.They may grow upto 100 m and climb upon tallest trees of the tropical rain forests. For climbing, these palms have to depend on their special climbing organs such as flagellum, which is morphologically an axillary sterile inflorescence, and cirrus, the spiny whip-like extension of the leaf midrib. There are other climbing organs such as hooks, claws and spines below the midrib. With the exception of a few species of *Calamus* all climbing palms are cluster forming. The climbing genera of the eastern tropics are *Calamus, Daemonorops, Plectocomia, Korthalsia, Myrialepis, Ceratolobus, Cornera, Retispatha* and *Plectocomiopsis*. The last five genera are not seen in India. In the western tropics the climbing palms are *Desmoncus* and a species of *Chamaedorea*. The African climbing genera are *Ancistrophyllum, Eramospatha* and *Oncocalamus*, these are also unknown in India.

Growth of Palm Stem

The secondary meristem activity that causes thickening of the stem in dicot plants is absent in palms. In palms, all tissues are formed by the activity of the terminal bud (meristem) and this is the reason why a palm stem does not grow in length until it attains its maximum girth. Inspite of the absence of secondary growth activity in the stem, a number of palm species increase their girth by the expansion of the ground tissue together with the expansion of fibrous tissues which constitute the sheath of the conducting tissues. As this expansion of tissues are not restricted to any particular zone of the stem it is therefore termed as diffused secondary growth (Tomlinson 1961). The typical example of diffused secondary growth is seen in the Royal Palm of Cuba *(Roystonea regia)*.

Palm Leaf

Palm leaves have two basic forms : the pinnate form and the palmate form, and under these two basic forms a great diversity in shape and size of palm

leaves is encountered. The longest leaf of the plant kingdom is of African Palm, *Raphia* whose one pinnate leaf is about 28 m long. The giant palmate leafblade of a Talipot Palm *(Corypha umbraculifera)* is about 4 m wide. A single leafblade of *Coco de mer (Lodoicea maldivica)* of Seychelles Islands is large enough to cover the roof of a standard size mud hut. Several species of South American *Chamaedorea* palm on the other hand have leaf as small as 60 cm in length.

The adult palm's leaves whether pinnate or palmate, consist of an axis and a blade. The axis normally has three distinct parts; the lowermost part that connects the leaf with the stem is the leaf sheath; the axial part above the leafsheath upto the point of origin of basal leaflets in pinnate leaf, and to the base of the leaf blade in palmate leaf is the petiole; the portion of the same axis beyond the petiole that holds the leaflets in pinnate leaf is the rachis (midrib). In true palmate leaf, rachis is absent or unrecognizable. In some palmate leaves petiolar axis extends into the blade, thus the flat blade curves outside; this type of curved palmate leaves are termed as costapalmate.

Leafsheath

The leafsheaths in palms have different shape, size and texture. Their structure depends on the type of mature leaf that the palm holds. Leaves that are shed immediately on drying have thin, less fibrous leafsheaths; on the other hand; leaves that remain attached to the stem even after drying for a considerable period, have thick, leathery, semiwoody leafsheaths. In some group of palms, thin, tubular leafsheaths aggregate and appear like a tube or a cylinder in continuation to the stem. This tubular or cylindrical structure appearing just below the crown is termed as crownshaft. In palms having crownshaft, the outer most leaf clears off as soon as it dries leaving behind a circular scar mark on the stem. In some groups of palms leafsheaths are slightly thicker and they do not form a perfect crownshaft but their leaves are self clearing after drying. The typical form of crownshaft is seen in the genera *Roystonea, Archontophoenix, Ptychosperma, Veitchia* etc. The palms that form no crownshaft generally have semiwoody to woody and extremely fibrous leafsheaths, as in *Cocos nucifera, Borassus flabellifer, Phoenix sylvestris, Corypha umbraculifera* etc. The hardy leafsheaths sometimes split longitudinally upto the base as a result of expansion of the stem and the splitted leafsheaths form a very regular cris-cross pattern on the stem, as seen in the genera *Sabal, Livistona, Borassus, Washingtonia, Attalea.* In the genus *Washingtonia,* not only the leafsheaths are persistent on the stem but the entire dry leaves remain on the stem for several years and form a typical "petticoat" like structure just below the crown. In some genera of palms, leafsheaths may have characteristic fibrous outgrowths from the margins and these dense fibres act as a protective covering on the stem (e.g. *Arenga pinnata, Trachycarpus fortunei,* etc.). In *Cocos nucifera,* the leafsheath fibres ramify and form large nets on both sides of the leaf base. In most genera of rattans leafsheaths are sheathing, persistent and overlapping. In the genus *Korthalsia* each leafsheath produces an upper bulbous appendage known as ocrea which sometimes acts to

inhabit ants. The outer surface of the leafsheaths may have scaly cover, small hairs, felt or coated with powdery substance; may be smooth or armed with short to long spines, hooks, bristles, etc. The colour of the leafsheath in most palms is green, it may be bright red as in *Cyrtostachys* and *Latania* or yellow to yellowish green in *Areca vastiara, Chrysalidocarpus lutescens,* etc. or black in some species of *Calamus.*

Petiole

In most palmate leaved palms petiole is long. It is almost absent in some pinnate leaved palms because in these palms leaflets are formed just on the upper axial part of the leafsheath. Petiole may be halfround, round or biconvex in cross section or sometimes flattened, sunken above and rounded below. Surface and margins of the petiole may be smooth or spiny or toothed, with or without fibrous outgrowths. The outer surface of the petiole is usually smooth or covered with scales, indumentum etc., or sometimes thickly covered with spines and spicules.

Rachis

In pinnate leaves, rachis is rounded below with distinct grooves on both sides of the central ridge and the leaflets are attached in the grooves. In a true palmate leaf there is no rachis, the inner end of the leaf segments are compressed together at the uppermost point of the petiole and the entire outer folded portion spreads like a fan. In costapalmate leaves, leaf segments are also attached on the extended portion of the petiole thus the entire leafblade curves outside *(Livistona, Licuala, Sabal, Corypha,* etc).

Leafblade

Leaflets in pinnate leaves are either arranged on the rachis evenly on both sides (Paripinnate) as in coconut palm or in addition to the former pattern there occurring a terminal leaflet (imparipinnate) as in Date Palms. Some basically pinnate leaves may have entire leafblade *(Phoenicophorium).* In some sago palms *(Caryota),* leaves are twice pinnate and the ultimate foliar units are wedge shaped (like a fish tail).

In pinnate leaves, leaflets are either free or jointed, regular or in clusters, deflected from the rachis in one plane or in different planes. In some palms not only the lateral leaflets are jointed at irregular intervals but the terminal leaflets are also jointed thus forming two broad multinerved segments *(Areca triandra).* The multinerved wedge shaped segments of *Normanbya normanbyi* split longitudinally and form several one nerved groups of leaflets.

The palmate leafblades may be divided into one nerved, one folded or several nerved, several folded segments. These segments divide for some distance from the margin and the undivided inner portion of the leaf blade is known as palmen.

In *Rhapis*, the multinerved segments are divided upto the base. In most fanleaved palms, the outer part of the blade is free and usually longer than the undivided middle part; the outer free parts further divide forming narrow, one nerved, entire or bilobed, drooping or stiff tips.

Folding of Palm Leaves

Leaflets in pinnate leaves or leaf segments in palmate leaves are folded at their point of attachment with the rachis or at the tips of the petioles. This folding may be as V with the main nerve below (induplicate) or folded like a reverse V (reduplicate) with the main nerve above. Induplicate folding is common in Date Palms and seen in almost all palmate leaves and partially in the leaves of *Arenga pinnata, Caryota urens,* etc.

Seedling Leaves (Eophylls)

The first foliage leaf of a palm seedling is termed as "eophyll" Its shape is varied and consistent which in turns offers a good diagnostic character. The simple form of eophyll is elongated, tapering and entire, occurs mostly in the palms of subfamily Coryphoideae and in some genera of subfamilies, Calamoideae, and Ceroxyloideae and some members of tribes Caryoteae, Iriarteae, Areceae and Cocoeae of subfamily Arecoideae. Undivided eophyll is also seen in Date Palm, Royal Palm, etc. Eophyll is bifid in most palms with reduplicately folded adult leaves. The eophyll is pinnate in most genera of rattans and in genera *Latania, Rhopaloblaste,* etc., in *Nypa fruticans,* the eophyll is imparipinnate.

Palm Inflorescence

Palm flowers are displayed on inflorescences that are considerably different from other plants. Unopened inflorescences in general are enclosed under one, two, or many fleshy bracts. The outermost of these bracts is termed as "prophyll". The fleshy prophyll and fleshy bract or bracts on the peduncle are sometimes collectively called as spathes and the inflorescence is termed as spadix. The first bract at the point of origin of flower branches in a compound inflorescence is also termed as 'prophyll'

The position of palm inflorescences may be axillary or terminal. When a palm tree after attaining maturity starts producing axillary inflorescences in ascending order as the growth advances and the position of the inflorescences remain within the crown (interfoliar) or below the crown (infrafoliar), the reproductive phenomenon is termed as 'pleonanthic' This phenomenon is common to most palms excepting a few genera and species under three subfamilies.

In two genera of Subfamily Coryphoideae and eleven genera under Subfamily Calamoideae, the shoot after a long period of vegetative growth produces a terminal compound inflorescence that composed of many axillary reproductive branch system

that terminates the shoot. The entire inflorescence dies after maturation of fruits along with the death of the palm tree. This once and terminal flowering phenomenon is termed as 'monocarpism' In some cluster forming palms having this terminal flowering phenomenon, only the flowering shoots wither after maturation of the fruits but the life process of the plant continues with the development of new shoots from the underground stem, this phenomenon is termed as 'hapaxanthic' In almost all genera of the tribe Caryoteae of the Subfamily Arecoideae, the shoot after a certain period of vegetative growth produces a terminal inflorescence, followed by the development of axillary inflorescence in the descending order (basipetal) and the tree (in the single stemmed palm) or the shoot in the cluster forming palm dies after the lowermost axillary inflorescence had flowered (e.g. *Arenga pinnata, Caryota urens, C. mitis,* etc.).

Under abnormal condition a pleonanthic palm may also produce terminal inflorescence. This phenomenon has been reported in *Cocos nucifera, Chrysalidocarpus lutescens* and in a species of *Daemonorops.*

Extra Axillary Inflorescences

Normally each leaf axil of a palm bears only one inflorescence, but there are exceptions where more than one inflorescence develop from one leaf axil. The common example is *Arenga englerii.* Emergence of more than one inflorescences has also been reported in *Arenga pinnata* which normally produces one inflorescence in a leaf axil.

Structure of Palm Inflorescence

Palm inflorescences are basically axillary monopodial branch system with a strong or delicate peduncle and simple to simply branched or multiple branched flower branches.The ultimate flower bearing branches are called rachilla or rachillae. Structurally the most simple inflorescence is only an unbranched axis, as in *Calyptrocalyx spicatus.* In *Howeia belmoreana* several simple flower branches arise from a short common stalk. The highly multibranched compact inflorescences are of general occurrence in the Subfamilies Coryphoideae, Arecoideae, Nypoideae, Calamoideae and in some genera of Subfamily Ceroxyloideae. In some species of *Calamus,* inflorescences are long and flagelliform with ramified axillary fertile branches known as partial inflorescences.

Prophyll and Bracts

The term 'prophyll' was used by the well known palm taxonomist, Late H. E. Moore Jr. to denote the primary bract on the peduncle or on the lateral branches of the inflorescence with the other bracts. In general, both prophyll and bract or bracts are homologous with leaves. The shape and structure of prophyll and bract/bracts depend on the structure of inflorescences and the nature of protection the inflorescence needs before opening. The mode of emergence

of flower branches from the cover of the prophyll and bract/bracts is not identical in all types of palms. In *Phoenix* the solitary prophyll is thick and persistent and envelopes the peduncle and flower branches till the flowers are matured and the prophyll opens like two valves by a longitudinal split at the middle. In *Areca*, the solitary prophyll covers the entire inflorescence until it detaches from the peduncle for releasing the flower branches. In *Dictyosperma, Ptychosperma, Rhopaloblaste, Veitchia, Archoptophoenix, Carpentaria, Roystonea* and many other genera of palms of the tribe Areceae, the prophyll is large and 2-keeled (bi-carinate) and completely encloses the peduncular bract which is also large and envelopes the flower branches. At the opening, the prophyll splits from below and falls, the inner large peduncular bract expands and gets detached from the peduncle by the push of the elongating flower branches. In *Heterospathe, Chrysalidocarpus* etc., of the tribe Areceae, the prophyll is much shorter than the inner peduncular bract but fully envelopes the inflorescence at the very early stage of development. During emergence, the peduncular bract enclosing the flower branches comes out through a slit made at the tip of the prophyll. The prophyll whose base is fused with the peduncle remains attached. In *Calyptrocalyx spicatus*, both prophyll and peduncular bracts are persistent. In *Hydriastele microspadix*, the prophyll encloses the peduncular bract and both open simultaneously by a longitudinal split on the inner side for releasing the flower branches. In most genera of the tribe Cocoeae, the prophyll is small in comparison to the peduncular bract and remains hidden under the leafsheath. During emergence, the peduncular bract pierces through the prophyll and grows to a great length enclosing the flower branches and opens by a longitudinal split on the inner side. The multi-bracteate inflorescence is characteristic of Subfamilies Coryphoideae (excluding the tribe Phoeniceae), Calamoideae, Chamaederoideae, Nypoideae and all genera of the tribe Caryoteae. In a multi-bracteate inflorescence the peduncular bract/bracts are sterile and the bracts on the rachis (main axis) and on flower branches (excepting the prophyll) are fertile because each bract holds a flower branch of the next order. In *Prichardia*, there are only sterile peduncular bracts. The genera *Arenga, Caryota* and *Wallichia* of the tribe Caryoteae have only two to many sterile peduncular bracts.

Texture of Prophyll and Bracts

The prophyll and the peduncular bract/bracts are usually thin and papery in inflorescences that emerge by the shedding of the corresponding leaves, in these inflorescences emergence is automatic therefore the prophyll and bracts do not require to be strong enough, moreover, until emergence, the unopened inflorescence during its development, gets additional protection from the leafsheath of the corresponding leaf. In interfoliar emergence, the growing inflorescence has to push out of the pressure of the leafsheaths therefore for protecting the delicate flower branches and flower buds the prophyll and covering bracts need to be thicker and stronger and more fibrous in texture.

Flower Clusters

Palm flowers are either solitary or in the form of clusters. The clusters may be of several kinds. Solitary flowers may be spirally arranged or closely crowded or irregularly disposed on the rachilla.

Cincinnus

In cincinnus flowers are sympodial in development; when a second flower develops in the axil of the floral bracteole, the bracteole below the second flower then subtending a third flower and so on. In this type of growth flower clusters of several forms are produced depending on the relative position of the bracteole and its subtending flower (Uhl and Dransfield 1987). The cincinnus type of flower cluster is characteristic in the Subfamilies Coryphoideae, Calamoideae, Ceroxyloideae and Arecoideae.

The *Dyad*

Dyads are characteristic of the Subfamily Calamoideae, may consists of either of two hermaphrodite flowers or two male flowers or one female and one neuter flower (sterile male flower). In the genus *Korthalsia*, the solitary bisexual flowers are reduced from dyads.

The Triad

The triad consists of two lateral male flowers and a middle female flower. It is the most common floral unit seen in palms of the Subfamily Arecoideae. By the supression of the middle female flower a triad may appear as a cluster of paired male flowers and by supression of the male flowers the cluster may represent only solitary female flower. This supression of one sex from the triad is characteristic of the genera *Areca, Caryota* and *Wallichia*.

Acervulus

Palm flowers are unisexual in the genus *Hyophorbe* and the flower clusters are formed in two lines, the proximal flower in the line is a pistillate and the distals are staminate. The bracteoles of the clusters are reduced or inconspicuous at anthesis.

Palm Flower

Palm flowers are unisexual or bisexual, sessile or pedicellate and basically trimerous with 3 sepals and 3 petals ; stamens 3-6 or many, and ovary distinctly 3 carpellate with one ovule in each carpel.

Perianth in Palm Flowers

The perianth in palm flowers is composed of similar or dissimilar sepals and petals, sometimes uniseriate with variable number of lobes. Sepals are mostly 3 in number, distinct, imbricate or connate or tubular. Petals are mostly 3 in number, imbricate or valvate or connate; mostly valvate in male flowers and bisexual flowers or rarely united with free lobes and no distinct aestivation is recognized. Petals are absent or inconspicuous in the genera *Thrinax* and *Cocoothrinax* of the tribe Corypheae.

Androecium

The androecium consists of 3 to 6 or many stamens, with distinct short or long filaments, variously connate or adnate or both with the petals. Anthers are basifixed or dorsifixed and pistillode may be present or absent in male flowers.

Gynoecium

The gynoecium is apocarpus with 1-3 carpels or syncarpus with 3 or more, rarely 10 locules or pseudomonomaerous with 2 aborted and 1-fertile locule and ovule. Carpels are smooth or hairy or with imbricated scales on the outer surfaces. Style is distinct, connate or indistinguishable. Stigmas 3, erect or recurved ; or with slit in the carpel *(Nypa)*. Ovules anatropous, hemianatropous, campylotropous or orthotropous, basally, laterally, apically attached ; 1 ovule in each locule. Staminodes may be present or absent in female flowers.

Palm Seed Germination

When palm seeds germinate and the minute embryo in the seed grows, the single cotyledon (seedling leaf) never expands and functions like a green assimilating blade, but remains partially or wholly enclosed within the seed itself and function as a hustorium to absorb nutrients of the endosperm. This special function of the cotyledon continues till the seedling is capable of uptaking nutrients from the soil by its own root system.

Dormancy in Palm Seeds

Unlike dicotyledonous seeds where dormancy is a natural process, in palms there is no true period of dormancy. The embryo which is embedded in the endosperm close to the seedcoat dries up quickly and becomes incapable of germination if favourable condition does not prevail. Hence the period of dormancy of palm seeds is the length of time required to complete drying of the embryo after maturation of the seed. The exact period of 'dormancy' is difficult to record because several internal and external factors are responsible for it. Among the internal factors, the thick endocarp cover delays drying process of the embryo. It has been found that the palms of the subtropical areas where there is marked seasonal changes,

the embryo remains viable for a longer period, whereas in the humid tropics due to absence of seasonal change, the embryo looses viability quickly.

Types of Palm Seed Germination

According to the amount of extension of the cotyledonary structures following types of germination can be broadly recognized.

Remote Tubular

After sufficient growth of the cotyledon within the endosperm, the cotyledonary petiole, much more particularly the sheath, elongates carrying the embryo out of the seed into the soil. Eventually the initial leaves grow out through the long narrow oblique cleft representing the mouth of the sheath. The radicle is short lived and replaced soon by the adventitious roots. Here the ligule is absent. This typical tubular type of germination is seen in the genus *Phoenix*.

Remote Ligular

In this type of germination the cotyledonary petiole and the sheath with the ligule extend carrying the embryo out of the seed. The young seedling develops through the ligule. The remote ligular germination is common in most Coryphoid genera of palms. In *Borassus, Hyphaene* and *Lodoicea* the cotyledonary sheath may grow upto several meters into the ground before the development of shoot and roots. In *Borassus flaballifer* a succulent primary leaf is formed below the ground and is eaten as vegetable.

Adjacent Ligular

In most palm genera of the Subfamilies, Arecoideae and Calamoideae, the cotyledonary sheath does not grow longer but remaining close to the seed and the young seedling leaves develop through the adjacent ligule.

CHAPTER II

PROPAGATION OF PALMS

Palms are generally propagated by seeds, but they are also propagated by vegetative means such as by rhizomes, suckers, offsets etc. Seeds are the only means of propagation in all palms that have single stem with one terminal bud. Like many other monocot plants, palms cannot be grafted or budded or propagated by using some portion of the stem as cutting.

Propagation by Seed

Propagation by seed is the most easy, cheap and conventional method for all palms excepting those where seeds are not obtainable. The Date Palm *(Phoenix dactylifera)* although produces enormous quantity of seeds it is propagated by suckers for retaining parental characters of superior genotypes which otherwise deteriorate if propagated by seeds.

Seeds can be sown in seed beds, flats, seed pans or in pots in a soil mixture approximately 6-18 cm deep. Only the fully ripe and freshly harvested seeds should be taken for germination. In the Indian Botanic Garden, Howrah, palm seeds are germinated in the specially constructed seed beds which are about 60 cm above the ground level containing equal parts of white sand, leaf mould and garden loam. Palm seeds can also be germinated in vermiculite, a micaceous material which has the capacity to hold water and dissolved nutrients for the growing seedlings.Vermiculite also keeps the seedlings free from pests and diseases therefore it is the best medium for transporting seeds and seedlings in a disease free condition.

Palm seeds that germinate in adjacent ligular type can be sown without difficulty in any type of seed bed or seed pan depending on the number and size of the seeds to be sown. Seeds should not be sown too deep into the soil, the best result is obtained if seeds are sown about 1 cm below the surface. If the seeds are fresh no soaking with water is necessary, seeds should be cleaned, removing the fibre and the pulp. Seeds that throw longer sheaths should not be sown in beds or in deep pots because once germinated seedlings cannot be taken out for transplantation. Excepting *Latania*, all other Borassoid palms should be sown in a shallow pot keeping the seeds half buried. The giant *Lodoicea maldivica* (Giant Double Coconut) seeds cannot be sown in a standard sized seed pan. Moreover as the seed throws out several metre long sheath before producing first leaf and root, it is impossible to dig out the seedling from the nursery bed, without causing fatal injury to the young plant. Hence *Lodoicea* seed should always be sown directly at the spot where this giant palm is to be grown. For achieving success ground preparation is necessary so that the sheath can grow easily into the soil then turns up with its shoot.

The giant *Lodoicea maldivica* palm at the centre of the Large Palm House of the Indian Botanic Garden, Howrah was grown in this manner when the seed sown in 1894. For raising *Nypa fruticans* seedlings in the nursery, the best result can be obtained if the mature fruitlets are sown in mud with their stigmatic side half buried. For steady growth of the seedlings there should be water above the mud bed. It is not necessary that the water should be saline. There are some gardens in India (Theosophical Society's Garden in Adyar, Madras and Raj Bhavan Garden in Calcutta) where Nypa palms were raised and grown successfully in sweet water surroundings.

Vegetative Propagation

Some genera and species of palms have suckering or clumping habit.These palms over a period of time develop several stems (shoot) which are jointed at the base below the ground or at the ground level or the stems grow horizontally underground then come up the ground as independent shoots. In some species of *Calamus, Bactris, Rhapis,* the underground stems produce several shoots away from the main stem and form a huge colony. Therefore all palms that develop suckers and offsets and have roots below can be separated from the mother plant and each one separated can be established as a new plant.

Palm clump to be separated or splitted for taking out suckers needs careful examination for ascertaining whether the parent plant has sufficient number of suckers and healthy enough to sustain the stress of injury of splitting or severing of suckers. The suckers that have developed roots should normally be selected for separating from the parent plant. In stoloniferous palms, a portion of the underground stem along with the shoot may be separated. If the shoot has no root of its own, the practice is to cut the sucker along with the portion of the stem that joins the parent plant. This serves to cut off part of the food supply to the sucker (offset) and thus encourages it to begin new roots of its own. In some clustering palms adventitious roots develop from the nodes above the soil. By putting moist leaf mould around these roots and covering the ball of leaf mould with polythene film enhance development of more roots. The shoot alongwith the roots can be taken out and planted as a new plant. By this method it is possible to separate stems of *Hydriastele microspadix, Ptychosperma macarthurii, Rhopaloblaste singaporensis, Rhapis excelsa, R. humilis, Areca triandra, Licuala spinosa, Chrysalidocarpus lutescens,* and several cluster forming slender palms.

Bulbil Shoots

In exceptional cases, in some palms, the entire inflorescence or individual rachilla or the male and female flowers transform into vegetative shoots, popularly called as bulbil shoots. Instances of such bulbil shoot production were recorded in following palms : *Arenga pinnata, A. englerii, Areca catechu, Borassus flabellifer, Chrysalidocarpus lutescens, Cocos nucifera, Coccothrinax argentea, Elaeis*

guineensis, Phoenix sylvestris, P. rupicola etc. These bulbil shoots may develop further as distinct shoots or wither away in the course of time. Little attention has been paid so far to utilize bulbil shoots as propagule particularly for those economically important single stemmed palms. Some attempts were made to induce bulbil formation in *Cocos nucifera*. Davis *et al.* (1981) were successful in rooting bulbil shoots in Coconut palm and to grow these rooted bulbil shoots as separate plants.

By splitting the growing point of a seedling it is also possible to induce suckers. Using this technique Davis (1968) induced sucker formation in Coconut seedling and thus effected vegetative propagation of a single stemmed palm on a small scale.

Tissue Culture in Palms

Tissue culture is invitro culture of tissue or cell taken out from the actively growing parts of plants under controlled condition in aseptic medium with the application of required nutrients. Raising of plantlets of palms by tissue culture technique is in the experimental stage. Some progress has been made towards producing callus by putting ovule sections in the nutrients medium. Reynolds *et al.* (1979) were able to produce callus from ovule sections of the palms : *Phoenix dactylifera, Howeia fosteriana* and *Chamaedorea costericana* on high auxin medium. The callus mixture when placed on auxin free medium produced numerous embroys. According to Guzmen *et al.* (1971, 1978), it was possible to grow mature embryo of Coconut palm in auxin containing medium. It was also found that high sugar concentration in the medium was effective in producing callus from the cotyledonary sheath but no true embryos have been obtained from this callus although rootlets and protocorm like bodies were produced. Scientists were able to produce callus and plantlets of some species of rattan palms and they were able to standardize the nutrients for callus formation. In Philippines, attempts were made to propagate eleven species of *Calamus* and two species of *Daemonorops* by tissue culture technique. In four species of *Calamus*, scientists in Philippines were able to produce shoots from the callus tissue in the media supported with 2-4% sucrose in the presence of 1.8 mgL benzyl adenine and 1.8 mg/L2, 4-D. Roots formed when shoots were transferred to a medium of 4% sucrose and trace of auxin in Cytokinin (Umaligarcia 1985). Tissue culture experiment in palms is still in the very early stage in India and no encouraging results have so far been reported. Tissue culture is undoubtedly the most effective method of propagation which can compete with the seed germination and has the best advantage of retaining the genetical qualities of elite palms of economic importance.

CHAPTER III

PALM CULTURE & PESTS AND DISEASES

Transplantation of Palm Seedlings

After the seeds germinate it is best to keep the seedlings in partial shade preferably under the shade of big trees or in the green houses. Seeds germinated in the seed beds should not be allowed to starve for water, therefore liberal watering is necessary. All growing seedlings need moisture in the soil but if the soil becomes soggy due to lack of drainage, there is chance of fungal attack and death of the seedlings. Too much exposure to sun is also harmful for the seedlings, it is therefore better to place on the seed bed frame with a layer of coconut leaf so that filtered sunrays should fall on the seedlings. The heavy rains also cause damage to the seedlings by washing out the top soil from the seed bed or seed pan thus expose the delicate root system. To overcome this problem it is advisable to cover the seed beds during rains with transparent polythene sheets. Warm humid atmospheric condition and good nourishment available in the soil always help in the steady growth of the seedlings.

When large number of seedlings are raised, it is most important to transplant all the seedlings before they are fairly grown and all their roots formed an interwoven mass. Too old seedlings are difficult to separate without causing damage to their delicate absorbing roots. It is frequently observed in many palms especially those which are remotive in germination that their seeds germinate one by one or in small number with time gaps and their germination continues for a longer period. The most convenient period of transplantation is when the seedlings are in the 2-leave stage. The seedlings at this stage are to be lifted out carefully without causing damage to their roots and at the same time causing no injury to the adjacent seedlings that had just sprouted. Although it is very easy to advise but in practice it is seen that just sprouted seedlings cease to develop further when their surrounding soil is disturbed. A palm grower therefore has to use his own discretion and to develop methodology for transplantation that suits him.

When the seedlings have produced the first and second foliage leaves, their root system just beginning to develop and the young seedling still receives some nourishment from the endosperm. The seedling if transplanted at this stage will not starve till the time its roots are capable of drawing nourishment from the soil. The seedling of 2-leaved stage should always be planted in small pot (10 cm). When the seedling is more than two years old it needs further transplantation to bigger size pot. Casualty of the seedlings can be minimised if seedlings are grown at least for two years in pots prior to their plantation in the ground. The rainy season is the best time for transplantation because both soil and atmosphere remain humid and it saves lot of man power required for frequent watering. Older

palms can be transplanted at any time of the year provided there is sufficient moisture available to the soil. A palm root does not produce rootlets if cut, therefore for transplanting older palms care should be taken to keep the ball of earth containing the roots intact and sufficiently moist; for doing this the ball of earth should be covered with polythene sheet. Prunning of some leaves is recommended if older palms are transplanted in dry season, this reduces the loss of water by transpiration. The loss of water in fanleaved palm is more than the feather leaved palm.

Palms Grown for Landscape Beautification

The beauty and elegance of palms can be fully realised if selected types of palms are planted at a selected locality. The selection of locality depends on the exposure needed by the particular palm to be planted, whether it needs full sun, partial sun or shade. The planting site should also have good soil. Apart from exposure requirement, an initial assessment is necessary how best the shape and size of the palm will fit with the environment. A careful selection of palm species prior to their planting is always advisable for getting the maximum effect and for avoiding disappointment. Palms can be planted in the landscape in symmetrical, asymmetrical or informally with assorted species.

Palms Planted in Groves

Palm groves are excellent unifying element in the large landscape planning. A striking effect can be created if several palms of the same species are planted well apart or in the close group arrangement. The best result is obtained with the single stemmed palms. The graceful *Cocos nucifera, Phoenix sylvestris, P. dactylifera* when planted in groves make a fine sense of shelter and shade. Large groves can be made with any type of palms. All robust palms with large crown such as, *Corypha umbraculifera, Caryota urens, Borassus flabellifer, Sabal blackburniana, Roystonea regia, R. borinquena, Attalea speciosa, Arenga pinnata, Elaeis guineensis, Washingtonia robusta, W. filifera, Phoenix canariensis* etc., need sufficient space around them so that their heads do not touch each other. The slender palms of tall and intermediate heights such as *Livistona chinensis, L. decipiens, L. rotundifolia, Sabal palmetto, Areca catechu, Actinorhytis calapparia, Bentinckia nicobarica, B. condapanna, Archontophoenix alexandrae, A. cunninghamiana, Ptychosperma elegans, Heterospathe elata, Carpentaria acuminata, Dictyosperma album, Veitchia merrillii, Arecastrum romanzoffianum, Syagrus schizophylla* give a very good cumulative effect when planted as a single species of six to twelve plants or as assorted group of pinnate and palmate leaved palms. If a grove is made of several species of the same genus or of different genera, the rate of growth and the nature of leaves must be known for maintaining the harmony in the grove. As for example, among the Livinstonas, *Livistona rotundifolia* and *L. decipiens* are fast growing palms and *Livistona saribus, L. jenkinsiana, L. australis, L. chinensis* are slow to moderately fast growing. All species of the genera *Thrinax, Coccothrinax,*

Sabal are very slow growing in the local climate. Among the feather leaved palms, *Actinorhytis, Ptychosperma, Carpentaria, Chrysalidocarpus, Roystonea,* are faster in growth, while *Heterospathe, Dictyosperma, Rhopaloblaste, Howeia, Hyophorbe, Aiphanes, Syagruss, Arecastrum, Attalea, Orbygnia* are slow growing palms. Therefore in a grove slow and fast growing palms are to be planted alternately or the slow growing palm in the inner circle and the fast growing in the outer circle or according to the suitability. If the place for the proposed grove is exposed to sun for the whole day, the shade loving palms should be selected for planting in the inner circle and planting of such species should be deferred until the hardy palms are of such size to provide shade.

The slender palms, *Licuala peltata, L. paludosa, L. grandis, Howeia belmoreana, H. fosteriana, Phoenicophorium, Calyptrocalyx, Rhopaloblaste, Rhopalostylis, Pinanga, Aiphanes, Veitchia, Wallichia, Cyrtostachys* need moist soil and cannot tolerate full day's exposure to sun during dry hot months from March to June. The strong sun during this period quickly desiccates the luxuriant foliages. The cluster forming palms such as *Ptychosperma macarthurii, P. sanderanum, Araca triandra, Rhopaloblaste singaporensis, Chrysalidocarpus lutescens, Licuala spinosa, Hydriastele microspadix, Rhapis humilis, R. excelsa, Arenga englerii, Wallichia densiflora* can make smaller groves in partial shade. The cluster forming *Acoelorraphe wrightii, Bactris major* and *Calamus arborescens* should not be planted in the grove along with other palms, because the spreading habit of these palms will upset the coherence among all other species.

Palms Planted in Rows

Palms when planted in one or many rows along the pathways or leading to a long building become very attractive and eye pleasing. The single stemmed palms always make excellent avenue when planted with same species. A most striking example is Palmyra Avenue of the Indian Botanic Garden, Howrah. It is a pleasant experience to walk below the rows of lofty palmyras waving their fan-like leaves in the gentle breeze. The tall elegant palms especially *Roystonea regia* is most suitable for planting in a row along the boundary of a large estate or as a space divider. In the industrial township where the houses are almost similar in shape, occasional planting of tall palms breaks the monotony. The clusterforming palms of low height are suitable for planting close to the building or on both sides of the portico and along the periphery of the lawn or in the shrubbery. The curious-looking palms such as multiheaded *Hyphaene* can be used as focal point of a large garden.

Palms for Pot Culture and Decoration

Palms are also very good decorative plants for growing in pots out of door or indoor. As palms have no prop roots they can be grown easily in a smaller size pots in comparison to other dicot foliage plants. The fibrous roots of palms quickly spread into the soil and the palm adjust itself without much drawback.

Most potted palms need sufficient light otherwise they will appear sickly and unattractive. For maintaining healthy looking palms periodic exposure to partial sun is necessary. The most difficult problem for pot culture is to determine the water requirement of potted palms. Dry warm condition and insufficient ventilation are negative factors for growing palms indoor. All potted palms absorb moisture by their feeding roots located at the bottom of the pot, therefore, while watering it should be ascertained whether water is percolating to the bottom of the pot. A good result can be obtained if the pot is placed on a dish so that any excess water falling on the dish or percolated from the bottom of the pot is further absorbed.

Pot Mixture

The soil for pot culture should be porous and contain sufficient humus to hold the moisture. In the Indian Botanic Garden, Howrah, the general pot mixture used for growing palms contains equal part of sand, leafmould and garden loam and cup full of lime for each pot. For growing *Cyrtostachys* and *Howeia* the pot mixture should contain lateritic soil and sufficient quantity of sphagnum pieces. Preparation of pot mixture greatly depends on the type soil preferred by a particular species of palms and for this knowledge on the habitats of palms is essential.

Manures and Fertilizers

For pot grown palms organic source of nitrogen is most satisfactory than inorganic fertilizers. Use of quick action inorganic fertilizers only hasten the growth of the pot plants and make them unsuitable as indoor plants. Oil cake dust, bone meal, fish meal are useful organic manures, when applied as top dressing, decompose slowly in the soil releasing the essential nutrients to the growing potted plants for a longer period. Well rotten cow dung is also useful as a manure, but too much use of cow dung is harmful to the plant because it invites insects and other pests. The pot mixture should be applied before the growing season. Normal growing seasons in this region are at the end of colder months or just before and during monsoon rains. The nutritional requirement of palms planted in the garden or along road sides can be met by using a combination of organic and inorganic fertilizers. The inorganic fertilizers should contain 4-8% N, 6-8% P_2O_5 and 4-8% K. Commercial fertilizers containing balanced N.P.K. and sold in different brand names are also useful. It is not desirable to follow a standard doze for all types of palms, the doze to be determined according to the need of the plant.

Nutritional requirement of commercially grown palms such as *Cocos nucifera*, *Areca catechu*, *Elaeis guineensis*, *Phoenix dactylifera* greatly depends on the variety and edaphic condition of the region where these palms are cultivated. There are many research institutions in India and abroad where research on nutritional requirements of commercially grown palms is going on and data are available in some standard books and journals referred at the end.

Live Storage of Palm Pollen

Palm pollens are essential genetical material for deriving and maintaining new varieties of palms, therefore it is necessary to keep the palms pollen alive for as many days as possible so that these can be suitably transported from one place to another for research in cross breeding or for genetical studies. For facilitating research on palm breeding some information has been documented on the storage of live palm pollens.

The first rule in collection of live viable pollen for storage or for transporting is to keep it dry. Flowers should not be collected in rains or with heavy dew because of possible contamination. Flowers should be spread out on dry smooth paper or in a warm oven (not hot) for a few hours in order to dry out the floral parts as much as possible. Pollen is collected by allowing the stamens to shed on a paper. The loose pollen grains then should be stored in geletin capsule as used for medicine and placed in an air tight container with dry silica gel as moisture absorber. It is desirable not to store more pollen in one capsule, it is better to use more capsules containing less pollens for eliminating the risk of inadequate dehydration. The capsuled pollen can be kept viable for 4 months at a temperature of 26°C. Refrigeration increases the lifespan of the pollen as long as the pollen is sufficiently dry. After taking out from the refrigerator, the vial containing the capsules should be kept outside until the capsules returns to the room temperature. This removes the moisture condensed on the vial. A small camel hair brush can be used to pick up the pollens for transferring to female flowers in receptive condition.

PEST AND DISEASES

Like most plants palms are also susceptible to diseases caused by fungi, bacteria, insects, mites and various other unknown causal organisms. Excepting information on diseases of commercially grown palms such as *Cocos nucifera*, *Areca catechu* and *Elaeis guineensis*, no comprehensive data is available on diseases occuring on palms cultivated in India particularly those palms that are grown for ornamental purposes. The following paragraphs therefore record some common diseases that are encountered in cultivated palms along with their causal organisms just to enlightened the growers and palm lovers about the diseases.

Fungal Diseases

Buttrot : This is caused by the fungus *Ganoderma*. Once the fungus invade the roots and trunk, it becomes difficult to check and eradicate the disease. The affected palms loose vigour, lower leaves turn yellow and wither. The newly formed leaves will be smaller until the tip ceases to produce new leaves and the plant ultimately die. The fungus spreads through the soil from affected to healthy plants and also by means of air borne spores. The large white fruit

bodies of the fungus may also be conspicuous at the bottom of the trunk. The application of fine sulphur to the soil around the affected tree was reported to be helpful (Venkatakrishnaia 1956).

Root rot : Root rot disease is caused by the fungus *Fusarium*. This is also a deadly disease and cause untimely wilting of the entire palm.

Bud rot : The symptom of bud rot disease include wilting, yellowing of the leaves caused by the fungus *Phytopthora palmivera*.

Leaf spots : Leaf spots occur mostly in the seedlings of *Roystonea, Syagrus, Cocos, Phoenix, Sabal, Thrinax, Coccothrinax* etc., and caused by the fungus *Helminthoporium*. The primary symptom of infection on the leaves are oval to irregular sunken spots with brown centre and yellowish green margins. The fungus under favourable condition sporulate on the spots and spores are transmitted by the wind and water. These leaf pots grow and join with others to form a continuous lesion. Spraying of copper oxychloride solution on the affected parts check the spread of the disease.

Bacterial bud rot : This bacterial disease is reported from *Roystonea regia, Areca catechu* and *Dictyosperma album*. The causal organism is *Xanthomonus vasculorum*. Control of bacterial disease is difficult once the disease is fully set. Removal of all affected seedlings of young plants check the spread of disease.

Mites :

Mites are the common pests of the ornamental plants. It is very difficult to control the mites once these infect the palms because mites cannot be killed unless the plants are treated at regular intervals with effective miticides. Palm seedlings are most susceptible to mite attack; they suck the sap of the leaves and soft part of the stem and weakens the seedlings and ultimately kill the plant. Presence of mites can be detected by the presence of web below the leaflets. Application of Ethion 25% EC or Malathion 50-70% EC in emulsified form at regular intervals check the spread of infection. Application of Dimethoate with the dilution of 100 ml in 100 litres of water at fortnight intervals on the affected palms controls the infection of mite (*Tetranychus telerius*).

Nematodes :

It was reported that among palms, *Chamaedorea* species are susceptible to the attack of nematodes (Esser 1967). Infected palms become stunted and their leaves turn yellowish, roots decay, stem becomes reddish brown. The leaves finally wilt and the plant dies. For controlling nematodes Zinophos or Desonit are recommended for treating the soil, but these chemicals are highly toxic to man therefore should not be used in the home garden. It is best to practice plant sanitation procedures like using treated seeds and sterilised soil etc.

Insects

Scale Insects : Scale insects are the most common insect pests of ornamental plants including palms. These insects cause more injuries than any other group of insects. Scale insects attack mostly the leaves, young stems and cause dicoloration and weakening of the plants. These insects appear as isolated white woolly patches or as thick mass. Application of Dimethoate with the dilution of 125 ml in 100 litres of water at fortnight intervals is effective againt Scale insects (*Coccus* sp. and *Saissetia* sp.). With the application of parathion emulsion in water on the effected plants check the spread of scales. Parathion is highly toxic to man therefore a careful handling is necessary.

Aphids : Aphids are also harmful to younger palms and responsible for damage to leaves and younger part of the stem. The presence of aphids can be detected by the presence of ants on the plant. A regular application of Dimethoate with the dilution of 75 ml in 100 litre of water help in eradication of aphid *(Aphis gossypii, Macrosiphum* spp., *Myzus persicae).*

Palm leaf Skelitonizer : Leaves of several species of palms are attacked by the pest *Homaledra sabalella.* The larvae feed on the leaves and devour the leaflets within a short time if remain undetected. Malathion may be used with the recommended doze mentioned on the cartoon.

Ambrosia Beetles : This small beetles burrow into the trunk of palms and carry with their body the fungal spores into the burrow. Larvae which hatch from the eggs deposited by the beetle grow and develop by feeding on mycelia of the fungus. The fungi also attack the healthy tissue outside the hole. It is sometimes difficult to determine, whether the beetle or the fungi are responsible for the cause of the death of the palm. Spraying with B. H. C. has some effect in controlling the beetles.

Termite : Termite infection occurs if the palm is of low vitality. Termites cause decay to the outer layer of the trunk and make the decaying portion vulnerable to secondary infection. Washing the affected portion with a solution of Chlordene or Aldrin removes the termites. The soil around the palm should also be treated with the same chemical.

Thrips : Green House thrips feed on fronds and they destroy the green colour of the leaves and suck the sap. Infestation occurs when the leaves just start to unfurl. Spraying with malathion at regular intervals control the attack.

Lethal Yellowing Disease

This dangerous disease had caused havoc in recent times to the Coconut palms and other palms in many parts of the world. The causal organism is yet to be determined although the presence of Mycoplasma was detected in the affected parts of the palm. Application of antibiotic in some cases was reported (Romney 1976).

Corypha umbraculifera L.

Corypha macropoda Kurz.

Licuala spinosa Thunberg

Livistona chinensis (Jaeq.) R. Br.

Licuala grandis Wendl.

Licuala paludosa Griff.

Livistona decipiens Becc.

Prichardia pacifica Seem et Wendl.

CHAPTER IV

DISTRIBUTION OF PALMAE (ARECACEAE)

Palms include 212 genera and about 2779 species (Moore 1973) and are predominantly equitorial in distribution, a majority of them have distribution in the tropical Asia and tropical America. The number of palm species in Africa and Arabia is relatively small. Palms are also distributed in the subtropics and temperate regions where climatic condition is tolerable for the growth of the palms.

In the western tropics, the distribution of palms is extended northward to California and Carolina of North America and Chile and Argentina of South America. Palms have their footing in the Southern Europe and across North India and China to Korea and Japan in the extreme north. In the south, they grow in New Zealand and South Africa.The southern and northern extremes in the temperate zone where palms grow are to 44° N latitude in Europe and Japan and 44°S latitude in Chatham Island off New Zealand. The more usual limit of palm distribution is the region where *Cocos nucifera* is successfully cultivated. The intensive palm vegetation is, however found in the equitorial rain forests between 5°N latitude and 5°S latitude. The two genera of the tribe Corypheae such as *Sabal* and *Washingtonia* dominate the colder regions of Carolina and California, the genus *Trachycarpus* of the same tribe is the most cold resistant palm, distributed northward from Himalaya to Upper China. *Rhapis* is another cold resistant genus naturally occuring in Japan upto its northern limit. *Phoenix dactylifera* of the tribe Phoeniceae and *Nannorrhops ritchiana* of the tribe Corypheae grow wild in the desert. The genus *Chamaerops* is the only Coryphoid plam dominates in the Southern Europe. In the Southern hemisphere, the common extratropical palms are *Butia* and *Jubea* of the tribe Cocoeae and *Rhopalostylis* of the tribe Areceae, the former two genera are distributed in the southern part of South America while the latter in the New Zealand. With some exception most of the palm taxa have originated either from the old world or from the New World. The *Cocos nucifera* although thought to be of Malesian origin is pan tropic in distribution. The genus *Elaeis* of the tribe Cococae has two species, one is restricted in tropical America and the other in Africa. Among the tribe Calameae, the genus *Raphia* has wide diversity in Africa but with only one species occurring in America. The genera common to Asia and Africa are *Phoenix* of the tribe Phoeniceae, and *Hyphaene* and *Borassus* of the tribe Borasseae and *Calamus* of the tribe Calameae. The genera *Latania* and *Lodoiceae* are the two Borassoid genera restricted to Mascarene and Seychelles Islands. The maximum diversity in the Subfamily Calamoideae is noted in Southeast Asia. It is believed that this group of palms have originated from this geographical area. The typical Calamoid genera of this area are *Eugeissona* and *Salacca*. In Africa the typical Calamoid genus is *Ancistrophyllum*, while *Metroxylon*, one among the most economically important genera has natural distribution in the Pacific Islands. Among the tribe Areceae, a large number of genera and species are found both in the

eastern and western tropics. The chief western tropical genera of the tribe Areceae are *Roystonea, Geonoma, Euterpe, Prestoa* and *Howeia* in the Pacific Islands. The common eastern tropical genera of the tribe Areceae are *Areca, Bentinckia, Pinanga, Actinorhytis, Ptychosperma, Rhopaloblaste, Chrysalidocarpus, Veitchia, Archontophoenix, Hydriastele, Carpentaria, Normanbya, Heterospathe, Orania* etc. The tribe Caryoteae of Subfamily Arecoideae comprises the genera *Arenga, Caryota* and *Wallichia*, all have their centre in Southeast Asia, Indo China, Burma, extending to the Indian Subcontinent.

The genera *Podococcus* and *Sclerosperma* of tribe Areceae are endemic to tropical Africa. The Carribean Islands and the central part of America have large distribution of the tribe Corypheae. The major genera of this region are *Coccothrinax, Thrinax, Copernicia,Colpothrinax, Sabal, Acoelorraphe* etc. The genus *Corypha* is Indo-Malesian and the genera *Livistona* and *Licuala* from the bulk of the Indo-Malayan species of the tribe Corypheae. The genus *Prichardia* is abundant in the Pacific Islands. Among the tribe Cocoeae a wide diversity is encountered in South America, the important genera are *Bactria, Butia, Arecastrum, Syagrus, Aiphanes, Attalea, Orbygnia* etc. The tribe Caryoteae is restricted in the eastern tropics only. The subfamily Nypoideae has only one genus *Nypa* is of eastern tropics only. The subamily Phytelephantoideae with its monotypic genus *Phytelephas* is restricted to the western topics only. Our present knowledge on the distribution of the family Palmae took shape from the works of Corner (1966), Moore (1973), Beccari (1908, 1911, 1918, 1933), and Uhl and Dransfield (1987).

Distribution of Palmae (Arecaceae) in India

About 92 species and 4 varieties of wild and semiwild palms in 21 genera have distribution in India. They are chiefly occuring in the three major geographical regions, *viz.* Peninsular India, Eastern & Northeastern India and Andaman & Nicobar Islands. A small number of palm taxa also occur in the rest of India, particularly in the sub-Himalayan valleys and plains of northern India, semi-arid parts of western India, Gangetic plains, estuerine mangrove forests of Ganga and Mahanadi delta, moist hilly tracts of Orissa, south and north Bihar. Apart from semiwild and wild palms, *Cocos nucifera* and *Areca catechu* are largely cultivated as commercial crops. Among the wild palms, the genera *Calamus, Daemonorops, Plectocomia, Korthalsia, Arenga, Wallichia, Nypa, Trachycarpus, Pinanga, Corypha* are poorly represented in cultivation.

1. *Peninsular India*

The Peninsular India comprises the central highland with Satpure, Maikala, Vindya and Bundelkhand ranges (600-900 m), on the North and Western Ghats on the west. On the east, the Eastern Ghats, not continuous like Western Ghats with highest peak at Mahendra Giri (1680 m). The Eastern and Western Ghats

meet at Nilgiri south of Karnataka. The regions west of Western Ghats and east of Eastern Ghats slope towards the coastal plains. The rest of the regions are either river valleys or coastal plains. On the western slopes of the Western Ghats comprises mostly tropical evergreen forests occuring in the states of Karnataka and Kerala. The eastern slopes of Western Ghats consists mostly of moist deciduous forests. Palms are most frequent as evergreen forest component, frequent in the semi-evergreen and occasional in the moist deciduous forests. The conspicuous palm genera within the area are *Areca, Pinanga, Calamus, Bentinckia, Caryota* and *Corypha*. The dominant palm genus is *Calamus*. The genus *Hyphaene* with one indigenous endemic species is abundant in the coastal plains of Goa, Daman, Diu and Saurasthra coast of Gujarat. The genus *Phoenix* is extensive in the deciduous forest belts and along the coastal plains of Coromondal. *Borassus flabellifer* is the most conspicuous semi-wild palm all along the coastal plains of Andhra Pradesh and Tamil Nadu. More than half of the *Borassus* population of India is located in this region.

2. *Eastern and Northeastern India*

This broad geographical region comprises Assam Valley, submontane regions of Assam, Arunachal Pradesh, Nagaland, Mizoram, Manipur, Tripura and Meghalaya; lower mountain valleys of eastern Assam, Sikkim, West Bengal and Bihar; Tista and Brahamaputra valleys of Sikkim, West Bengal and Assam. The natural vegetation of this composite region is mostly tropical moist deciduous forests in the plains and tropical semi-evergreen to evergreen forests in the mountain valleys. Palms are conspicuous in all the three types of forests. The most widespread palm genera are *Calamus, Daemonorops,* and *Plectocomia*. The other palm genera are *Arenga, Areca, Wallichia, Caryota, Phoenix, Livistona, Licuala, Pinanga, Trachycarpus* and *Salacca*. *Cocos nucifera* and *Areca catechu* are cultivated in the plains. The semiwild palms, *Borassus flabellifer* and *Phoenix sylvestris* are also frequent in the plains.

3. *Andaman and Nicobar Islands*

Andaman and Nicobar Islands are the summits of the submerged mountain range from an arcuate chain connecting western Burma and Sumatra, separated from each other by creeks, straits, passage having a coast line of 1962 km. The approximate land area of Andamans and Nicobars is 1953 sq. km. The forest vegetation is still very rich though in many islands it is greatly depleted due to biotic pressure. The main forest types are tropical evergreen, semi-evergreen and moist deciduous and extensive coastal mangroves. Palms are frequent in all types of forests representing the genera *Areca, Bentinckia, Calamus, Daemonorops, Korthalsia, Licuala, Corypha, Phoenix, Pinanga, Rhopaloblaste* and *Nypa*. The genus *Korthalsia* is absent in the mainland of India. In addition to indigenous species several exotic species of palms have been introduced as ornamental plants.

4. *Other Regions*

A few palm species are also found in the moist tropical forests of sub-Himalayan valleys and plains of northern India. The semi-arid western parts of India have only one palm species, *Phoenix sylvestris*, its distribution extends through the Gangetic plains with occasional presence of *Borassus flabellifer*. In the estuarine mangrove forests of Sundarbans, *Nypa fruticans* and *Phoenix paludosa* occur as pure stands. The entire lower Bengal and coastal Orissa have extensive population of *Phoenix sylvestris* and *Borassus flabellifer* and isolated pure stands of *Phoenix paludosa* in the Mahanadi mangrove system. The two locally useful canes, *Calamus viminalis* and *C. tenuis* are common in this region. The beautiful fan-leaved *Licuala peltata* has a restricted distribution in some moist pockets of south Bihar plateau.

CHAPTER V

FAMILY : PALMAE (ARECACEAE)

Small to large, solitary or clusterforming, armed or unarmed, hapaxanthic or pleonanthic, hermaphrodite, polygamaous, monoecious or dioecious plants. Stems arborescent to slender, delicate, short or very tall, creeping, subterrenian, climbing or erect, mostly unbranched, rarely dichotomously branched. Leaves alternate, spirally arranged, sometimes distichous or tristichous; leafsheath thin, semi-woody or woody, loose or closely sheathing, tubular, armed or unarmed outside; petiole present or inconspicuous, usually terete or half terete, flat or channelled above with or without armature outside; hastula present or absent; leafblade palmate, costapalmate, pinnate, bipinnate or bifid or entire or pinnately veined, induplicate or reduplicate; tip of the leafsegments or leaflets acute, acuminate, truncate, oblique, bifid, praemorse or irregularly toothed or lobed; rachis sometimes prolonged into a whip-like spiny appendage. Inflorescence axillary, solitary or multiple, infrafoliar, interfoliar or suprafoliar, spicate or branched upto 6 order, sometimes inflorescence whip-like spiny appendage; prophyll usually 2-keeled, in different shape and size; peduncular bract present one to many or absent; rachillae short to long, slender filiform to massive. Flowers hermaphrodite or unisexual or dimorphic, sessile or stalked, borne single or in groups; perianth rarely of similar parts, usually clearly differenciated into sepals and petals; stamens 3, 6 or many; filaments erect, free or variously connate and adnate; anthers basifixed or dorsifixed rarely didymous; staminodes from tooth-like to well developed, distinct, connate, sometimes adnate to petals or gynoecium; gynoecium apocarpus, 3-carpelled or variously syncarpous with usually 3 or rarely more locules or pseudomonomerous with 1 fertile locule, smooth, hairy or covered with scales; styles distinct or not clearly differentiated; stigmas erect or recurved; ovule solitary in each locule, anatropous, hemianatropous, campylotropous or orthrotropous pistillode present or absent. Fruit usually 1-seeded, sometimes 2-3 to 10 seeded, small to very large, epicarp smooth, hairy, prickly, corky warted or covered with imbricate scales; mesocarp fleshy, fibrous or dry; endocarp thin or hard or not differentiated; seed with or without fleshy testa; endosperm homogeneous, ruminate; embryo apical, lateral, basal. Germination adjacent ligular, remote ligular or remote tubular.

The Family Palmae (Arecaceae) is divided into 6 subfamilies (Uhl and Dransfield 1987) *viz.* Coryphoideae, Calamoideae, Nypoideae, Ceroxyloideae, Arecoideae and Phytelephantoideae. The Subfamily Coryphoideae is further divided into the following tribes: Corypheae, Phoeniceae and Borasseae. The Subfamily Calamoideae is divided into the tribes : Calameae and Lepidocaryeae. The Subfamily Ceroxyloideae is divided into the tribes : Cyclospatheae, Ceroxyleae and Hyophorbeae. The Subfamily Arecoideae is divided into the following tribes : Caryoteae, Iriarteae, Areceae, Cocoeae, Geonomeae. The Subfamilies Nypoideae and Phytelephantoideae are monotypic.

Key to the Subfamilies

1a. Leaves palmate or costapalmate, rarely entire, induplicate, rarely reduplicate (apocarpae) or mixed, induplicate, reduplicate (*Licuala*) or pinnate but induplicate and the leaflets with entire tips (*Phoenix*), flowers solitary or clustered, never in triads of a central female and two lateral male flowers *Coryphoideae*

1b. Leaves pinnate, bipinnate or entire and pinnately ribbed or rarely palmate, but then reduplicate and flowers syncarpus, reduplicate or rarely induplicate but then leaflets with praemorse tips ; flowers solitary or clustered frequently in triads 2

2a. Ovary and fruit covered in imbricate scales; flowers hermaphrodite or unisexual but only rarely dimorphic, arranged singly or in dyad or rarely in cincinni *Calamoideae*

2b. Ovary and fruit glabrous or with pelted or with basifixed scales, hairs, corky warts or spines but not with imbricated scales; flowers hermaphrodite or unisexual often dimorphic, borne singly or in triads or in pairs derived from triads 3

3a. Pistillate flowers borne in a terminal head, each flower with 3(4) free, large, asymmetrical carpels and six minute perianth segments : staminate flowers crowded on spike at the tip of inflorescence branches below the pistillate head, each flower with 6 linear distinct perianth segments and 3 anthers borne on a solid stalk *Nypoideae*

3b. Pistillate flowers not borne on terminal head or if so then plant dioecious and flowers multiparted; staminate flowers with stamens filaments free or variously connate, very rarely forming a solid stalk 4

4a. Pistillate flowers borne in a head on a short peduncle, very large, each with numerous, spirally arranged sepals and petals and an elongate cylindrical style, gynoecium 5-10 locular; fruit corky, warted with 5-10 seeds; staminate flowers large, sessile or stalked, receptacle flat or club like, with reduced uniseriate perianth or perianth scarcely discernible, stamens very numerous *Phytelephantoideae*

4b. Pistillate flowers not borne in a head, both staminate and pistillate flowers with sepals and petals in 2 whorls, style usually short, not long and cylindrical, locules 1-3, rarely more 5

5a. Flowers usually unisexual, rarely hermaphroditic, borne singly or in lines (acervuli) very rarely in groups of 3 but then staminate flowers above the pistillate and peduncular bracts numerous *Ceroxyloideae*

5b. Flowers always unisexual, borne in triads or in pairs derived from triads, very rarely staminate flowers above the pistillate but the peduncular bract one *Arecoideae*

Subfamily : Coryphoideae

Key to the Tribes

1a. Leaves palmate, costapalmate or entire, acanthophyll absent 2

1b. Leaves pinnate, basal leaflets modified into spines *Phoeniceae*

2a. Hermaphroditic or polygamodioecious, rarely dioecious ; if dioecious flowers not or only slightly dimorphic; rachillae lacking deep pits; endocarp usually thin, crustaceous or cartilaginous . *Corypheae*

2b. Dioecious; flowers usually strongly dimorphic; staminate and sometimes pistillate flowers borne in deep pits form by connation and adantion of rachilla bracts; endocarp very thick and hard *Borasseae*

Tribe : Corypheae

Usually hermaphroditic or polygamodioecious; if dioecious flowers not or only slightly dimorphic. Leaves palmate, costapalmate or undivided and induplicately folded. Inflorescence usually with many peduncular and rachis bracts; rachillae lacking deep pits; fruits usually 1-seeded; endocarp usually thin, crustaceous or cartilagenous.

Key to the Genera

1a. Monocarpic palm. Stem always solitary, massive; leafblade very large, always costapalmate, massive, petiole heavily armed with teeth *Corypha*

1b. Pleonanthic palms. Stem acaulescent to slender reed-like, to moderately robust; solitary or clusterforming. Leaves palmate or costapalmate; petiole armed or unarmed 2

2a. Stem clusterforming, reed-like; leafblade deeply segmented *Rhapis*

2b. Stem not reed-like 3

3a. Leaves palmate 4

3b. Leaves costapalmate 7

4a. Stem prostrate, underground, rarely erect and overground. *Serenoa*

4b. Stem erect, above around 5

5a. Base of the leafsheath split in petiolar region; inflorescence emerging through the split. Fruit globose; seed not furrowed; endosperm in seed homogeneous *Thrinax*

5b. Base of the leafsheath not split in petiolar region. Fruit globose or reniform or oblong; endosperm of seed not homogeneous; seed coat deeply intruded 6

6a. Leafsheath disintegrating into a mass of fine and coarse fibres, seed reniform or oblong (Sub-Himalayan palm) *Trachycarpus*

6b. Leafsheath disintegrating into a regular fibrous network or masses of long slender fibrous mat. Seed globose, deeply furrowed. *Coccothrinax*

7a. Leafblade divided along abaxial folds to the petiole into single fold or several folds, usually wedge shaped truncate segments, or undivided *Licuala*

7b. Leafblade divided along adaxial folds into single fold or several folds, but not truncate segments 8

8a. Inflorescence with long peduncle, branch only at its tip, corolla lobes caducous *Prichardia*

8b. Inflorescence branching not to confined to the tip; corolla lobes not caducous at anthesis 9

9a. Stem solitary 10

9b. Stem numerous *Acoelorraphe*

10a. Leaves persistent on the stem even after drying and form like a petticoat below the crown; leaf segments filamentous at tips, interfold filaments conspicuous *Washingtonia*

10b. Leaves on drying not persistent on the stem; if persistent, for a short time only; interfold filaments present or absent, segments may or may not be filamentous at tips 11

11a. Petiole with strongly armed margins or armed at the base only; gynoecium widest above the locules, abruptly narrowed to the style. *Livistona*

11b. Petiole with unarmed margins; gynoecium shallowly 3-lobed, style elongate, broad, only slightly narrower than the ovarian part *Sabal*

Acoelorraphe H. A. Wendland

Distribution : South Florida, the West Indies and part of the Carribbean coast of Central America. 1 species.

Pollen grains : Monosulcate, exine smooth or scabrous (tectate). Foveolate or finally raticulate (semi-tectate).

Acoelorraphe wrightii (Griseb. & Wendl.) Wendl. ex Becc. *Silver Saw Palm.*

Soboliferous palm. Stem erect, 3-5 m long, 6-8 cm in diameter, covered with leafsheath fibres and petiole bases. Leaves costapalmate; leafsheath disintegrate into interwoven mass of brown fibres; petiole slender, to 1m long, strongly armed at margins with orange coloured teeth; abaxial hastula conspicuous; leafblade nearly orbicular, deeply and regularly divided into narrow 1-folded, stiff segments, bifurcated at tips. Inflorescence inter-foliar, decompound with long slender peduncle and rachis, both covered with series of tubular leathery bracts. Flower branches bracteate; bracts obliquely lipped at appex; flowers in cincinni, paired or solitary towards the apex of the rachillae, bright yellow at anthesis, highly deciduous; each 3.5 mm long; calyx deeply lobed, minutely ciliate outside; petals deltoid, ciliate outside; stamens 6, filaments united in a basal ring; free portion short, abruptly narrowed. Fruit globose; epicarp smooth; 5 mm in diameter. Seed globose endosperm homogeneous.

Flowering & Fruiting : April-September.

Distribution : South Florida, West Indies, Central America. A brakish water swamp palm. Unlike most palms, this species thrives well in soil in which considerable amount of salt exists.

Cultivated in the Indian Botanic Garden, Howrah for more than 50 years where there are three big colonies exist. A moderately fast growing species and withstand waterlogging. This species spreads by its underground creeping rhizome.

Seed germination : Remote ligular.

Chromosome number : 2nd = 36 (Read 1964) Sharma and Sarkar (1956) as *Thrinax argentea.*

Coccothrinax Sarg.

Dwarf to moderately tall monoecious, pleonanthic palm. Stem slender, upper part of the stem mostly covered with leafsheaths. Leaves orbicular, pale green to silvery white below; leafsegments induplicate; free portion of segments narrow, acuminate, bifid at apex; petiole slender, biconvex in cross section, unarmed at margins; hastula prominent adaxially, pointed; leafsheath fibres coarse, network forming. Inflorescence interfoliar, pleonanthic, mostly shorter than leaves; prophyll semiwoody, bicarinate, tubular at base; peduncle and inflorescence axis covered with alternate tubular obliquely opened bracts; flower branches lateral, axillary to fertile bracts; lower flower branches much ramified, bracteate; rachillae slender,

bearing very small spirally arranged thin, pointed bracts each subtending a flower. Flowers solitary, bisexual, usually pedicellate; perianth broadly or shallowly cupshaped with several short points. Stamens 9 (6-13); filaments slender, flat, shortly connate at base; anthers oblong or sagittate, dorsifixed. Fruit globose, purplish black to deep brown at maturity; stigmatic remains apical; epicarp smooth or rough; mesocarp thin; anastomosing fibres next to the membranous endocarp. Seed globose, grooved; endocarp homogeneous, except for grooves.

Distribution : In the Islands of the West Indies (Uhl & Dransfield 1987). Grows on lime stones or serpentine rocks mostly on open highlands. 49 species, 3 species cultivated in India.

Uses : Its leaves are used as thatch and for making brooms, baskets etc.

Pollen grains : Monosulcate; exine smooth or scabrous (tectate), foveolate or finely reticulate (Semitectate).

Key to the Species

1a. Stem more or less clean; leafsheath persistent only on upper part of the stem. Leafblade divided halfway from the margin 2

1b. Stem entirely covered with leafsheath having dense fibrous outgrowths. Leafblade deeply divided *crinita*

2a. Stamens 7-9; fruits sessile *argentea*

2b. Stamens 10-12; fruits pedicellate *dussiana*

Coccothrinax argentea (Lodd. ex Schult.) Sarg. ex Becc. *Silver Thatch Palm.*

Stem solitary, slender, smooth outside, 5-6 m long, 12 cm in diameter near base. Leaves palmate; leafblade orbicular, cordate at base, 70-80 cm from hastula to tip of the middle segment; leaf segments about 38 in number, not deeply divided, 2.5-3 cm wide at base, pale green in colour conspicuously pubescent on lower side. Inflorescence interfoliar, erect from the leaf axil, to 60 cm long; flowers bisexual, sessile; floral envelope very narrow, shorter than pistil; stamens mostly 9, larger than perianth; filaments subulate; anthers bright yellow in fresh flower. Ripe fruits globose, deep violet, 8 mm in diameter, 1-seeded; seed globose, deeply furrowed. Eophyll linear lanceolate, 15-18 cm long, 7-8 mm wide.

Flowering : February-March. *Fruiting* : July-September.

Distribution : West Indies.

Cultivated in the Indian Botanic Garden, Howrah. A very slow growing palm, locally known as *Thrinax argentea*. Crown not very crowded with leaves.

Chromosome number : 2n = 36.

Coccothrinax crinita Becc.

Stem solitary, completely covered with light brown leafsheath fibres. Leaves palmate; petiole slender about 60 cm long; leafblade deeply divided, glossy green above and greyish green below; leaf segments split at apex. Inflorescence interfoliar, shorter than leaves. Ripe fruits light purple, very fleshy, about 1.5 cm in diameter; seed 1 cm in diameter; endosperm ruminate.

Distribution : CUBA. In the natural habitat this palm attains about 10 m height.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. In 1971 seeds were brought from Cuba. A very slow growing palm, it prefers well drained soil. From the base of the petiole are produced long strands of fibre that completely cover the stem and make the palm very curious looking.

Seed germination : Remote ligular. Seeds germinate readily. After the first few leaves have produced a full sun situation is preferred. Although this palm tolerates shade but too much shade is not good for healthy growth.

Coccothrinax dussiana L.H. Bailey

Stem solitary, to 4 m long, to 18 cm in diameter, clean and smooth on outer surface; leafsheath extremely fibrous, fibres anastomosing; petiole, to 80 cm long, slender, biconvex in cross section; leafblade orbicular, about 1 m from hastula to the tip of the middle segment; lower side of blade pale green to whitish, thinly pubescent; hastula erect, pointed, bright orange in colour. Inflorescence interfoliar, to 1 m long, much shorter than leaves; primary flower branches much ramified. Flowers bisexual, 3.5 mm long; floral envelope with short triangular points; stamens 10-12 in number; filaments shorter than pistil, subulate, connate at base. Ripe fruits globose, deep brown, 1-seeded; seed not deeply furrowed.

Flowering : March. *Fruiting* : August-September.

Distribution : GUADELOUPE.

Cultivation : Introduced in the Indian Botanic Garden, Howrah in 1968. Cultivated in the Green House. Leaves are very attractive and glossy.

Corypha L.

Monocarpic palm. Stem solitary, robust, columner, with or without distinct spiral marking, with distinct leaf scars. Leaves massive, costapalmate; petiole heavy, long, deeply channelled above, armed at margins with strong teeth; leafblade distinctly folded, dissected to various depths into segments. Inflorescence terminal, pyramidal, compound. Flowers bisexual, sessile or falsely stalked; calyx more or less 3-lobed, corolla with 3-distinct petals; stamens 6; carpels jointed, ovary with 3-furrowed chambers; each chamber with 1 ovule. Fruit 1-seeded, globose, semi-globose, fleshy inside; stigmatic remains conspicuous near base; seed globose or semiglobose; endosperm white, homogeneous; endocarp thin. Eophyll lanceolate. Flowering and fruiting depend on the maturity of the tree.

Distribution : Species 5, in INDIA (Malabar coast, Bengal and Andaman Islands), BURMA, (Myanmar) MALAYA, INDONESIA, PAPUA NEWGUINEA, PHILIPPINES, NORTHEAST AUSTRALIA, SRI LANKA.

Uses : Leaves are used as thatch and some times made into umbrella. The sap is collected and fermented for making toddy, arrak and viniger. The strong petiole is splitted and used for making rough baskets, brooms etc.

Pollen grains : Monosulcate; exine smooth or scabrous tectate, fobeolate or finely reticulate (semi-tectate).

Key to the Species

1a. Stem with distinct spiral marking; petiolar teeth 1-1.5 cm long, blackish 2

1b. Stem without spiral markings; petiolar teeth less than 1 cm long, deep brown 3

2a. Petiole long, slender, longer than leafblade, breaks from the middle when dry. Ripe fruits yellowish, to 2 cm in diameter *utan*

2b. Petiole robust as long as leafblade; leaves self clearing from base. Ripe fruits reddish brown, 1.5-2 cm in diameter *macropoda*

3a. Leafblade large, flabellate; leaf segments overlapping at the petiolar region. Primary branches of inflorescence emerge from the mouth of the peduncular bracts. Ripe fruits deep green, 3-3.5 cm in diameter *taliera*

3b. Leafblade very large, non overlapping at the petiolar region but form an acute angle with the petiole. Primary branches of inflorescence pierce through the respective basal bracts. Ripe fruits pale green, 2.5-3 cm in diameter *umbraculifera*

Corypha umbraculifera L. *Condapani* (Mal.), *Talipot. Tala, Talagas, Coddapanna* (Tamil), *Sidalum* (Tel.), *Bene Tali, Shri Tali* (Kan.).

Stem solitary, robust, dark grey in colour, with distinct half rounded leaf scar marks, 10-15 m long, to 90 cm diameter near base; leaf base persistent from middle to upper part of the stem. Leaves costapalmate, massive; leafbase split into two halves; petiole about 3 m long, 15 cm broad at base; leafblade suborbicular, segments not deeply divided, to 1.9 m from hastula to the tip of the middle segment; free portion of segments, to 1 m long, to 10 cm broad at base; tip of the free segments obtusely lobed. Inflorescence terminal, about 6 m long, decompound; primary flower branches alternate, horizontal from main axis; ultimate flower branches (rachillae) 12-40 cm long, satin white, smooth. Flowers bisexual, inclusters of 3-6 flowers, each 4 mm long, pedicellate. Calyx obscurely 3-lobed, fleshy. Petals 3.5 mm long, oblong, obtuse, connate at base. Stamens 6, slightly longer than petals; opposite filaments stouter. Ovary contracted into a small pointed style; stigma minute. Fruits pedicellate; two aborative carpels conspicuous at the base. Seed globose, to 2.5 cm in diameter.

Distribution : India (Kerala, Karnataka), Sri Lanka.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. Roxburgh (1814) noted that this species was introduced in the then Calcutta Botanic Garden (now Indian Botanic Garden, Howrah) from Sri Lanka in the year 1798 through General H.M.M. Dowall. Full grown trees were seen in some public gardens in India.

Natural population of this species exists in the moist forests of Kumpta and Manvar Taluk of North Kanara covering an extensive area near Garsappa and Yena river, also on Yallapur Ghat (Blatter 1926). Its present population in the wild is unknown. Semi-wild population also exists near Kottayam in Kerala in association with Coconut trees. This species is rarely cultivated as ornamental palm. It is difficult to take out the seedlings from the ground once it is germinated. Casualty of the seedlings can be reduced if freshly collected seeds are sown in large polythene bags containing germinating medium consisting of garden loam, sand and leafmould. A two year old seedling grown in polythene bag can be easily transplanted without disturbing its delicate roots.

Uses : About 100 kg of edible starch can be extracted from the core of Talipot palm. A mature tree also yields about 100 litres of sweet sap per day for several days from the cut end of the inflorescence. Leaves are used for covering the roof of grain storages, mud huts etc. The tender leaves are used for making mats, hats, and umbrellas. Stem fibres are strong, can be used for making ropes. Basal section of the stem is made into hollow cylinder for making "Drum" a musical instrument used by the tribal people in some parts of Sri Lanka. The hard solid endosperm of the seed is Ivory-like and used for making buttons and beads. Some ancient Hindu and Buddhist scriptures were written on Talipot leaves. The Talipot palm is also the national floral emblem of Sri Lanka.

Corypha macropoda Kurz

Stem massive, erect, columnar, 10-12 m long, about 90 cm in diameter near base, swollen at middle with faint spiral marking on outer surface. Leaves very large, to 6 m long; leafbase broad, semiwoody, splitted into two halves at the base; petiole deeply channelled, to 3 m long, yellowish green in colour, strongly dentate at margins, marginal teeth more or less uniform in size; leafblade semicircular, to 3 m long from hastula to the tip of middle segment; lateral segments deeply bilobed at apices; middle segments obtusely and shortly bilobed apices. Inflorescence terminal about 6 m long; pyramidal with long horizontal primary flower branches. Flowers bisexual, pedicellate, in clusters of 3-6 flowers, yellowish green at anthesis. Calyx 3 mm long, 3 lobed; one lobe slightly longer, hyaline. Petals incurved, fleshy at base, 3 mm × 1 mm. Stamens 4 mm long at anthesis; filaments subulate; anthers orange yellow. Ovary 1.5 mm long; style shorter than stamens. Fruits falsely pedicellate. One or two conjointed abortive carpels conspicuous at pedicellar part; mesocarp pulpy, greenish yellow. Seed 1.5 cm in diameter.

Distribution : INDIA (Andaman Islands). Endemic. Infrequent in Andaman Islands. Mostly in the coastal plains to higher elevations of Middle and South Andamans associated with *Dipterocarp* species.

Cultivation : A few trees are seen in the Indian Botanic Garden, Howrah. These are obviously offsprings of the earlier introduced plants. *Corypha macropoda* is now identified as one of the threatened plants of India therefore needs protection from extinction.

Corypha taliera Roxb.

Stem solitary, erect about 10 m long, 60-70 cm in diameter near base. Leaves costapalmate, to 6 m long; leafbase does not split at the base; petiole about 3 m long, 18 cm broad at base; leafblade almost rounded, not deeply divided, about

2.5 m long from hastula to the tip of the middle segment; segments mostly 80 in number; free segments, to 120 cm long, to 12 cm broad at middle; middle segments unequally bilobed at apices; lateral segments acuminate. Inflorescence terminal, pyramidal about 6 m long; ultimate flower branches pale yellow, 40-80 cm long, slightly angular at sterile basal part. Flowers in clusters of 3-6; each 5 mm long, pale yellow. Calyx 2 mm long, lobes unequal, obtuse, hyaline. Petals slightly incurved, fleshy, 3 mm × 1 mm. Stamens upto the height of petals; filaments 2 mm long; anthers dorsifixed, ovate-oblong to elliptic-oblong, 1.5 mm long. Fruits shortly pedicellate by thickening of receptacle; mesocarp non-fibrous; greenish yellow. Seed 2.5 cm in diameter.

Distribution : INDIA (Bengal). Endemic. According to Beccari (1933) this species is close to *Corypha lacomtei* Becc. of INDOCHAINA. According to Roxburgh, (1832) this species is a native palm of undivided Bengal, but no documentary evidence was available regarding its presence in the wild. Herbarium specimens available in the Central National Herbarium, Calcutta were collected from the palms cultivated in the then Company's Botanic Garden in Calcutta (now Indian Botanic Garden, Howrah). Now only one tree is seen in the Garden which will perhaps flower in another five years time. All others are very young plants. A solitary tree was recently discovered in a village near Santiniketan, in the Birbhum District of West Bengal. Tree was in the early fruiting stage. Unfortunately, the tree was cut down by the villagers, fearing it as a ghost palmyra tree (Basu 1986).

Corypha utan Lamk. *C. elata* Roxb.

Stem solitary, erect, dark grey in colour, with distinct spiral marking, about 20 m long, to 40 cm in diameter at base. Leaves costapalmate, typically ascending from the stem; petiole slenderer than other species, 3-4 m long; uppermost part of the petiole triangular in cross-section; leafblade half orbicular, deeply divided into 2 m to 2.5 m long segments; segments about 90 in number; outer segments acuminate, splitted into two slender points; middle segments broad with two obtuse lobes at apices. Inflorescence terminal, pyramidal, about 4.5 m long; ultimate flower branches (rachillae) 10-15 cm long, pale yellow when fresh. Flowers bisexual, in clusters of 5-7; each 4.5 mm long, pale yellow at anthesis. Calyx 2 mm long; lobes rounded, fleshy; solid basal part elongates after anthesis. Petals boat shaped, 3 mm × 1.5 mm. Stamens, to 4 mm long; opposite filaments incurved, subulate; anthers cordate-ovate. Ovary 2.5 mm long; style 1.5 mm long; stigma 3 dentate. Fruits falsely pedicellate; 'pedicel' 3mm long; abortive tuberculiform carpels conspicuous. Seed globose, 1.5 cm in diameter.

Distribution : INDIA (W. Bengal, Andaman Islands), BURMA, MALAYSIA, INDONESIA, PAPUA, NEW GUINEA, PHILIPPINES, NORTHEAST AUSTRALIA. Often found in the lowlands

along the river banks and moist swampy areas. It is one of the palm species that can sustain extreme water logged condition.

Cultivation : It is the most common *Corypha* species in cultivation. A large swampy area by the side of the river Hooghly in the Indian Botanic Garden, Howrah has become a "forest" of this species. This elegant palm is frequent in the villages adjacent to the Indian Botanic Garden, Howrah due to dispersal of seeds by birds, bats and squirrels that eat the ripe fruits. A neotenic form of this species has been reported from the Indian Botanic Garden, Howrah (Basu 1987).

Uses : Dried leaves are used as thatch. The coarse fibre from the petiole is used for making ropes. The strong petiole itself serves the purpose of roof support. Young and tender leaves are used for making baskets, brooms, bags, hats, floor mats etc. The inner core of the stem yields edible starch.

Licuala Thunberg

Solitary or cluster forming monoecious palm, dwarf to intermediate in height. Stem slender, erect or inclined; aerial part of the stem annulate. Leaves palmate, persistent after drying; leafsheath with fibrous or netlike outgrowths; petiole slender, mostly strongly dentate along margins; hastula conspicuous on adaxial side; leafblade orbicular, entire or deeply divided along the abaxial rib to form single to multifolded segments; apical part of the leaflets bifid at apex. Inflorescence interfoliar, pleonanthic, monoecious, shorter or longer than leaves; prophyll bicarinate; peduncle and axis of inflorescence covered with tubular bracts; fertile part of inflorescence with a spicate rachilla on each node or with much ramified flower branches ending in rachillae. Flowers solitary or in groups, sessile or pedicellate, bracteate. Calyx cupular, 3 fid; corolla longer than calyx, 3 lobed, hairy outside; stamens 6 epipetalous; filaments flattened, connate at base to form a cup with 6 projections, each bearing an anther. Ovary 3 carpellate, nearly free; 1 ovule in each carpel. Fruit globose, ovoid; endocarp crustaceous; seed basally attached; endosperm homogeneous.

Distribution : About 108 species; in INDIA (W. Bengal, Bihar, Sikkim, North East India, Andaman and Nicobar Islands), SOUTH CHINA, SOUTHEAST ASIA, MALESIA, NORTHEAST AUSTRALIA, SOLOMON ISLANDS, NEW HEBRIDES etc. 4 species cultivated in India.

Uses : Leaves provide thatch and cordage. 4 species are grown in India as ornamental plants.

Pollen grains : Elliptic monosulcate; exine smooth or scabrous (tectate); foveolate or finely reticulate (semi-tectate); exine coarsely reticulate in *Licuala peltata* and *L. spinosa*.

This genus is easily distinguished anatomically from the other palms by the presence of transverse fibre sclereid in the mesophyll tissue of the leaf (Tomlinson 1961).

Key to the Species

1a. Stem solitary 2

1b. Stem clusterforming 3

2a. Leafblade orbicular, very large, deeply segmented. Inflorescence erect from the leafaxils much longer than the leaves. Flower branches (rachillae) solitary from node, pendulous *peltata*

2b. Leafblade rotundate, undivided. Inflorescence as long as leaves, paniculately branched *grandis*

3a. Leafblade orbicular, deeply segmented, segments 8-10 in number; petiole armed with small conical spines *paludosa*

3b. Leafblade orbicular, segments 12-19 in number; petiole with distinct angular spines *spinosa*

Licuala grandis Wendl.

Stem solitary, prominently annulate, clean, to 4 m long, to 12 cm in diameter near base with persistent leaf bases just below the crown. Leaves palmate, dark green, ascending to spreading in all direction; petiole slender armed with curved spines; leafblade rotundate, stiff, plaited, more or less entire, margins shallowly lobed; lobes obtuse; hastula concave, acute. Inflorescence interfoliar, arching outward from the axils, 100-120 cm long, with 3-4 primary branches closely sheathed under deep green glossy, leathery bracts. Flowers bisexual, irregularly disposed on rachillae; each 3 mm long, slightly pedicellate; sepals forming a tube with 3 ciliated lobes. Corolla tubular with 3 distinct ciliated concave petals with their lip slightly incurved. Stamens 6; filaments connate at base, attached to the throat of the corolla tube; carpels 3, free, joined at style; stigma simple. Ripe fruits cherry red, globose, 1.5 cm in diameter, smooth with fleshy mesocarp, endocarp brittle; endosperm homogeneous within growth from the seed wall.

Flowering & Fruiting : August-September; May-July.

Distribution : New Hebrides.

Cultivation : This species is widely cultivated as indoor decorative plants. In the Calcutta climate it is difficult to grow this palm in full sun therefore mostly cultivated under the shade of large trees or in the Green Houses.

Licuala paludosa Griff.

A clusterforming fanleaved palm. Stem 2.5-4 m long, 3-4 cm in diameter at middle, unarmed, more or less smooth. Leaves orbicular, 7-9 partite, spreading to all direction; petiole slender, to 50 cm long, subtrigonous, armed along margins, except towards upper part, with small, black, shortly conical curved teeth; segments cuneate, lateral ones oblique, acutely 2-3 lobes at apices, others more or less truncate with 4 broad, bifid lobes; hastula linear, 2 cm long, gradually attenuate at apex. Inflorescence interfoliar, stout, with about 8 spreading branches; peduncular and rachis bracts broad, lacerate at mouth. Flowers bisexual, sessile, glabrous, minute; calyx cupshaped 2 mm broad; petals very short, ovate. Fruit globose 5-6 mm in diameter.

Distribution : Malaya Peninsula, Thailand. India (Andaman Islands).

Note : This species is close to *Licuala spinosa* in shape but differs from *L. spinosa* by its smooth less prominently ringed stem. Flowers are also small and turbinate.

Cultivation : In cultivation, this species is mostly confused with *L. spinosa*. It prefers to grow in moist shady areas.

Licuala peltata Roxb. *Selai pathi, Mota pathi* (Hindi), *Chata pat* (Beng.).

Stem solitary, slender, 2-3 m long, to 15 cm in diameter near base; leafbases persistent on upper part of the stem; leafblade orbicular, 12-30 partite, to 1.5 m in diameter; segments variously connate, many toothed at margins; petiole, to 1.2 m long or more, planoconvex in cross-section, strongly armed throughout margins with strong curved spines. Inflorescence with long stout peduncle, flattened at base; primary axis cane-like, covered with series of 15-30 cm long, leathery bracts, scurfy outside. Flower branches solitary, pendulous, axillary to fertile bracts, to 40 cm long; sterile base of flower branches adnate at its base to main axis, thickly tomentose outside. Flowers solitary, in loose spirals, pedicellate, 2 mm long, thickly tomentose. Calyx campanulate with 3 short marginal projections, densely ciliate. Corolla deeply 3-lobed; lobes 1 cm long, lanceolate, reflexed, densely ciliate. Stamens with filaments connate at base, adnate to corolla. Ovary turbinate, carpel coherent by their apices; ovule solitary, erect; style filiform; stigmas 3, at the same level with anthers. Ripe fruit ellipsoid, 1-seeded, deep orange in colour; perianth persistent.

Flowering : September-November. *Fruiting* : April-May.

Distribution : India (Assam, Himalayan Range below Darjeeling; Bihar, Manipur, Tripura and Andaman and Nicobar Islands), Bangladesh, Burma.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. It grows luxuriantly in the moist shady places. Plants grown in the Green Houses have much larger deep green leaves and longer inflorescences. Flower branches always hang high above the canopy of leaves. Each flower branch (rachilla) bears about 350 solitary flowers. Fruit setting is irregular in the Calcutta climate.

Uses : In Andaman Islands, leaves are extensively used for thatching. In Chittagong hill tracts of Bangladesh the local people use the large leaves as rain hats. Split lamina is used for making baskets, mats etc. It is also reported that elephants feed on the lower part of the stem.

Licuala spinosa Thunb. *Jungli selai* (Hindi).

A clusterforming fanleaved palm. Stem slender, 2-3 m long, 6-9 cm in diameter; leafscars prominent on the stem. Leaves orbicular to reniform, about 18 partite; with petiole about 1.5 m long; leafsheath triangular, strongly fibrous at margins, petiole slender, obtusely trigonous in cross-section; armed throughout at margins with angular spines; leafblade orbicular, about 60 cm from tip of the hastula to the tip of the middle segment; lateral segments obliquely praemorsed; 3-4 lobed; median segments 10-11 lobed. Inflorescence interfoliar; erect, then arching out, longer than leaves, to 3.5 m long; primary flower branches 6-10 in number, alternate, adnate to primary axis at base; lower branches divide into 3-5 ultimate flower branches (rachillae). Flowers sessile, irregular or in cluster of 2-3 flowers. Calyx cupular, 2 mm long, 3 toothed, ciliate outside. Corolla little longer than calyx, 3-lobed; lobes lanceolate, acuminate. Stamens with filaments short, setaceous; anthers oblong-ovate; ovary turbinate bearing filiform style. Ripe fruits obovoid, 5-7 mm long, pedicellate, deep red in colour.

Flowering : September-December. *Fruiting* : May-June.

Distribution : India (Andaman Islands), Southeast Asia. In Andaman Islands it usually grows in damp swampy mangrove areas and often growing in small patches.

Cultivation : One of the most widely cultivated palms. It grows luxuriantly in moist shady places even along the edges of fresh water ponds. Plants grown in shade are taller and have longer petiole, large, deep green blades. Emergence of inflorescence does not take place at a time in all the stems in a cluster. This species is also grown as potted ornamental palm.

Uses : Leaves are sometimes used as thatch.

Livistona R. Br.

Solitary fan leaved palm. Stem usually clean of leafsheaths, stout. Leaves costapalmate; leaf sheaths large, tough, brown, consisting of several layers of anastomosing fibres; petiole long, mostly slender, spiny at margins, leaf segments induplicately folded; each segment 1-nerved; free segments forked at apices, sometimes with long fine pendulous thread emerging between the free lobes. Inflorescence interfoliar, axillary, much branched, flowers bisexual, solitary or clustered; petals as a short tube with long lobes; stamens 6, jointed at base to form a shallow cup; carpels 3, free joined by their style. Ripe fruits brightly coloured, globose, semiglobose, ovoid, develop from one carpel; 2-abortive carpels sometimes conspicuous near base; epicarp fleshy, slightly fibrous; endocarp mostly thin, brittle, smooth; endosperm homogeneous with convolute intrusions of seed wall.

Distribution : INDIA (Sikkim, Arunachal Pradesh, Assam, Meghalaya). SOUTH CHINA to SOLOMON ISLANDS to AUSTRALASIA. 24 species. 6 species cultivated in India.

Pollen grains : Monosulcate; exine smooth or scabrous (tectate). Foveolate or finely reticulate (semi-tectate).

Uses : Almost all species are decorative. Leaves of several species of Livistona are used for thatching or made into hats. Segments of the lamina are used for making umbrella. Rope is made from the fibre of the sheath. Endosperm of the seed contains fatty oil.

Key to the Species

1a. Leafblade irregularly divided into 2-6 costulate divisions, which further divided into unicostate, bifid or bidentate segments *saribus*

1b. Leafblade regularly divided into many equal unicostate segments. 2

2a. Petiole armed although or not prominently armed in adult plant. 3

2b. Petiole strongly armed although 5

3a. Tip of the leaf segments drooping, leafblade not rotundate, postichous segments not overlapping 4

3b. Tip of the leafsegments rigid; leafblade rotundate; postichous segments overlapping or close to each other *rotundifolia*

4a. Fruit ovoid, 1.5 cm × 1 cm, bluish green when ripe; petiole armed only nearly at the base *chinensis*

4b. Fruit globose, 8-9 mm in diameter, deep black; petiole strongly armed although *decipiens*

5a. Stem with distinct protruding leaf scar marks. Leafblade divided and subdivided into elongated drooping lacinae. Fruit small, globose, black *australis*

5b. Stem more or less smooth, annulate. Leafblade reniform, tip of the segments rigid. Fruits large, globose, copper blue in colour *jenkinsiana*

Livistona australis R.Br.

Stem solitary about 15 m long, to 50 cm diameter near base, with distinct protruding leaf scar marks on the stem; bole slightly enlarged; leafbase persistent on upper part of the stem. Leaves costapalmate, to 3.5 m long; petiole strongly armed along margins; marginal teeth sometimes jointed by their base; leafblade almost rotundate, deeply segmented; segments about 50 in number, glossy green with distinct yellowish nerves on lower side. Inflorescence interfoliar, about 1.5 m long, decurved; peduncular bracts many, alternate, leathery, to 20 cm long, acuminate, light brown in colour; rachillae filiform, light yellow in colour; flowers bisexual bracteolate, 4-5 mm wide at middle, borne on a small column. Calyx 3-lobed; lobes broadly obconical, obtuse. Corolla deeply 3-partite; petals almost triangular, obtuse. Stamens with oblong anthers; stigma punctiform. Ripe fruits globose, 12 mm in diameter, black, epicarp smooth, mesocarp nonfibrous, slightly reddish. Seed globose, 9 mm in diameter; endocarp not hard; endosperm homogeneous with middle spongy tissue.

Flowering : September. *Fruiting* : April.

Distribution : AUSTRALIA.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah where a few trees exist. The large rounded leafblade is deep green in colour and has metallic lustre. Spines on the petiole margins are deep black, straight and as hard as iron nails.

Livistona chinensis (Jacq.) R. Br. *Chinese Fan Palm.*

Stem solitary, to 15 m long, 20-25 cm in diameter near base, usually with clean surface, sometimes leafbases adhering on upper part. Leaves costapalmate; to 3 m long, about 20 in number per crown; petiole slender, 1.5 m long, 3-3.5 cm wide at middle; basal part of the petiole dentate; upper part of the petiole more or less smooth at margins; leafblade deeply segmented; segments 1-nerved; tip of the segments deeply forked, with two pendulous tips. Inflorescence interfoliar, decompound, 2-3 times divided; prophyll bicarinate, hard, densely tomentose outside; peduncular and rachis bracts externally fibrous, brownish in colour; primary flower

branches much ramified; rachillae slender, yellowish. Flowers bisexual, bracteolate, 2 mm long, yellowish green at anthesis; bracteoles scale-like. Calyx deeply 3-lobed. Corolla 2 mm long, deeply 3-lobed, lobes ovate-acute. Stamens with filaments 2 mm long; filaments connate, adnate to corolla at base; anthers broadly ovate. Carpels angular, obovoid; inner faces straight, grooved above, free at base, united by the fused narrow portion of the style; stigma punctiform. Ripe fruits ovoid, 1.5 cm long, epicarp bluish green, glossy, mesocarp thin, fleshy, not fibrous; endocarp brittle, seed ovoid, to 1 cm long, slightly compressed.

Flowering : December-January. *Fruiting* : August-September.

Distribution : CHINA.

Cultivation : It is one of the finest exotic palms widely cultivated in the parks and gardens; introduced in India during the earlier part of nineteenth century (Voight 1845). Thrives best in wall drained soil with plenty of sunshine. It grows well in northern India and quite a number of trees are seen in the gardens of Delhi, Dehradun, Lucknow and other important cities of northern India.

Uses : Mostly grown as ornamental plant. The kernel of *Livistona chinensis* seeds yield upto 70% fatty oil (Komarov 1964). Leaves are widely used in China and Japan for the production of palm fans which are exported in large quantities to all parts of the world.

Livistona decipiens Becc.

Stem solitary, erect, without persistent leafsheaths. Crown not dense with leaves. Leaves costapalmate, to 3.5 m long; petiole slender, to 2 m long, 1.8 cm broad at middle, channelled on dorsal side near base; armed at margins with series of curved, black teeth; hastula almost triangular, acuminate; leafsegments about 80 in number; free portion of the segments deeply divided with narrow pendulous lacinae. Inflorescence, to 1.5 m long, decompound, slightly arching; prophyll and peduncular bracts semi-woody to leathery; prophyll 5 cm wide, at middle bicarinate, acuminate; rachis bracts tubular, green with fibrous outgrowths from the margins. Flower branches smooth, bright yellow when fresh, not spreading from the main axis. Flowers bisexual, pedicellate, in clusters, each 4 mm long. Calyx 3-lobed, hyaline. Corolla deeply divided into 3 ovate, membranous segments. Ripe fruits pedicellate, globose, deep black, 8-9 mm in diameter.

Flowering : August-September. *Fruiting* : March-April.

Distribution : AUSTRALIA.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. A moderately fast growing palm, suitable for cultivation in moist sunny places.

Livistona jenkinsiana Griff. *Toko pat, Takau-araung* (Mikir).

Stem solitary, erect, without persistent leafsheaths, 8-10 m long, 30-40 cm in diameter near base, surface rough, dull grey in colour; crown large with evenly spreading leaves. Leaves 2.5 m long; leafblade costapalmate, shining green upper, dull bluish below; leafsegments 70-80 in number, to 1.5 m long; upper free part of segments bilobed; lateral segments deeply bifid at apices; petiole channelled above, strongly dentate at margins; hastula cordate. Inflorescence interfoliar, to 1.2 m long; peduncle strong, flattened, 4-6 cm long; prophyll reddish brown, hard, bicarinate, peduncular and rachis bracts leathery; basal flower branches twice or thrice branched to form alternate, bright yellow coloured rachillae. Flowers bisexual, sessile, about 3 mm long, borne on short tubercle, solitary or paired on distal part of rachilla. Calyx cupular, 2 mm long, 3-lobed. Corolla twice longer than calyx, 3-lobed, lobes triangular. Stamens with short filaments; anthers oblong; ovary obconical, yellow with a depressed red spot; carpels coherent; style filiform. Ripe fruits globose copper blue in colour, slightly attenuate at base, 2.5 cm in diameter. Seed globose with a broad raphae like line; endosperm horny.

Flowering : February-March. *Fruiting :* September-December.

Distribution : India (Sikkim, Arunachal Pradesh, Assam, Meghalaya). A component of the moist forests of Northeast India.

Cultivation : Not common in cultivation. This species is susceptible to dry warm climate therefore difficult to grow in the plains.

Uses : Fresh nuts of this palm is used by the Mikir tribals as masticatory. Leaves are in universal use throughout Assam for covering the top of huts and roof of boats and also for making rain hats (Jhapi). In Arunachal Pradesh Toko leaves and stems are largely used by the tribals for making huts.

Livistona rotundifolia Lamk.

Stem solitary, slender, erect, annulate, dull grey in colour, about 20 m long, 30-35 cm in diameter near base; crown with evenly spreading leaves. Leaves costapalmate, to 2.5 m long; leafsheath chestnut brown; persistent only just below the crown; petiole slender, to 2.5 m long, armed at margins with evenly spaced strong recurved spines; leafblade 1.5 m from hastula to the tip of the middle

segment, leafsegment jointed from hastula, to 2/3rd length of the blade; free portion of the segments shallowly forked. Inflorescence interfoliar, to 2.5 m long; primary axis of the inflorescence slender covered with reddish brown leathery bracts; prophyll and peduncular bracts bright green with orange red shade on upper part. Flowers bisexual, 2.5 mm long bright yellow; calyx 3-lobed, lobes triangular; corolla larger than calyx. Stamens with subulate filaments; ovary turbinate, trisulcate. Ripe fruits 2.5 cm in diameter; seed globose.

Flowering : January-February. *Fruiting* : July-October.

Distribution : JAVA, PHILLIPPINES, CELEBES, MOLUCCUS.

Cultivation : A fast growing palm among Livistonas. This is the only species seen in almost every gardens in Calcutta. It grows luxuriantly in the open therefore largely used for landscape beautification. A high percentage of abortive fruits are seen in the infructescences in each fruiting season, otherwise the ripe fruits are very colourfully globose and decorative. This species is also suitable for cultivation as pot plants.

Livistona saribus (Lour.) Merr. ex Chev. *L. cochinchinensis* Lour.

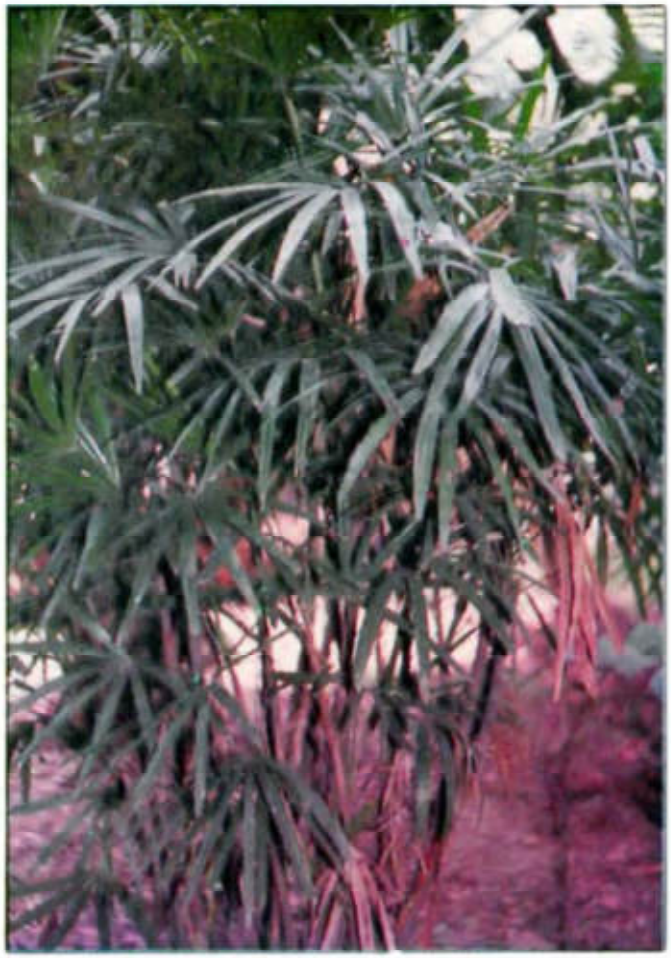
Stem solitary, erect, to 15 m long, to 30 cm in diameter near base. Crown variable in leaf number. Leaves costapalmate, rigid ; petiole strong, to 1 m long, strongly dentate at margins; leafblade orbicular, 1.5 m from hastula to the tip of the middle segment; some leafsegments divided upto the hastula, others mostly divided upto the middle of the blade; free upper part of the segments deeply divided, tip of which sometimes pendulous. Inflorescence interfoliar, not longer than leaves; primary flower branches thrice or four times branched to form the rachillae; peduncular and rachis bracts semiwoody to leathery, thickly tomentose outside. Flowers bisexual, spirally disposed on small tubercle. Calyx cupular, obscurely 3-lobed, corolla divided upto the middle into 3 broad triangular segments. Anthers small, ovate; ovary sub-globose; style short. Ripe fruits globose, about 1.2 cm in diameter; mesocarp thin fleshy; epicarp smooth, bluish green.

Flowering & Fruiting : January-March; August-September.

Distribution : EAST INDIES, SOUTHEAST ASIA.

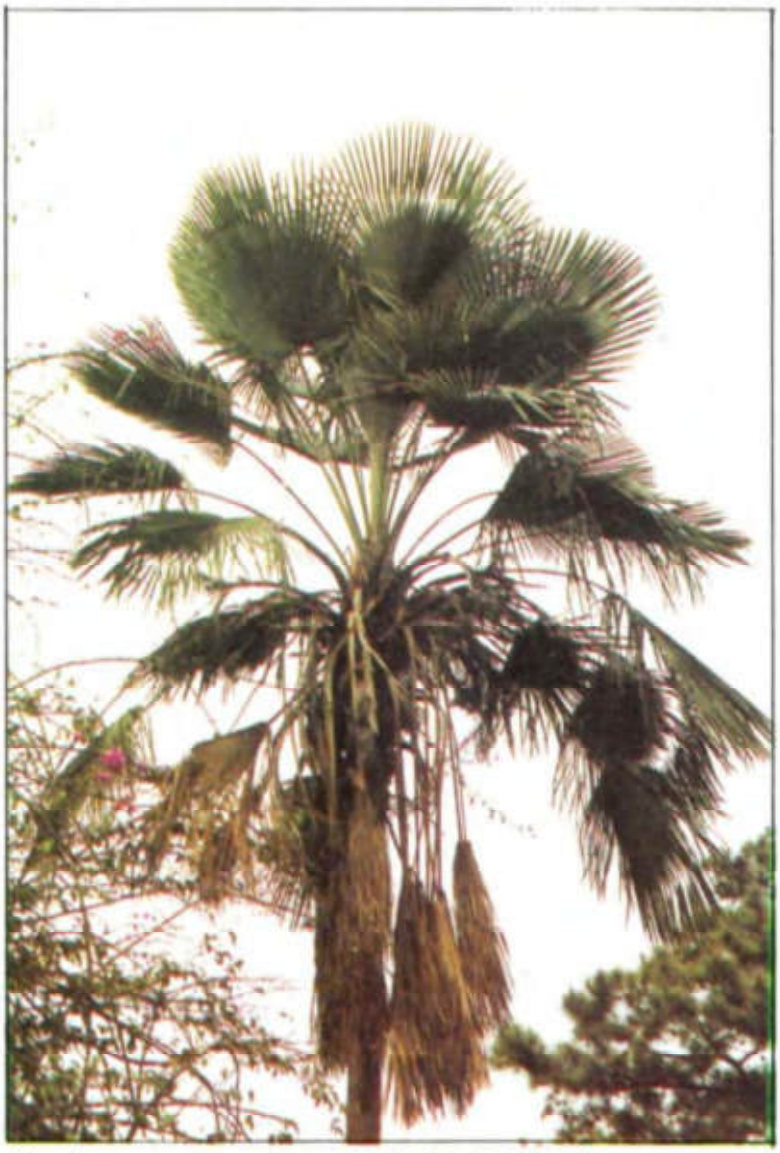
Cultivation : Cultivated in the Indian Botanic Garden, Howrah. Not common in cultivation. Mostly grown as pot plants. The young plants can be identified in the field by the presence of triangular leafbases on the stem embedded in coarsely knitted dark brown sheath fibres.

Rhapis humilis Bl.



Sabal blackburniana
Glaseb ex Schult.

Serenoa repens Small.

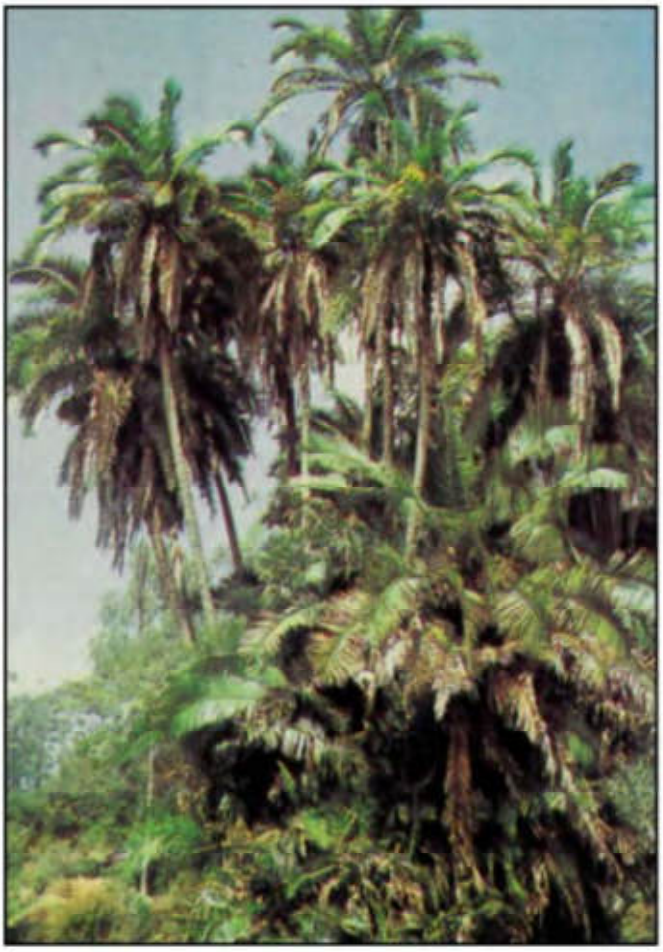


Trachycarpus martiana (Wallich) H. Wendl.

Washingtonia filifera (Linden) Wendl.

F *hoenix loureirii* Kunth

Phoenix paludosa Roxb.



Phoenix reclinata Jacq.

Prichardia Seem. et Wendl. ex Wendl.

Moderately tall fanleaved palm; stem erect, more or less smooth or shallowly or closely annulate. Leaves costapalmate, induplicate; leafsheath hairy, tomentose outside; petiole channelled above, rounded below, scurfy outside; hastula adaxial; abaxial hastula absent; leafblade shallowly divided along adaxial folds; outer free segments not deeply folded; each further divided into two shallow stiff lobes; lower side of the blade tomentose on ribs. Inflorescence pleonanthic, interfoliar, longer or shorter than leaves; peduncle long, covered with successive leathery peduncular bracts, terminates into a small fertile part holding many, crowded simple rachillae. Flowers sessile or borne on small tubercle, bisexual. Calyx tubular, shallowly 3-lobed; corolla longer than calyx, tubular at base with 3-oblong valvate lobes; lobes highly caducous. Stamens 6, filaments connate to form a cup, longer than calyx; ovary with 3 connate carpels, style with 3 lobed stigma; one ovule in each carpel. Fruit spherical or ovoid, developed from one carpel; epicarp smooth; mesocarp thin; endocarp brittle; seed globose; endosperm homogeneous; embryo basal.

Distribution : Fiji, Hawaii and other Pacific Islands. Grows on the moist wind-ward slopes in moist forests from sea level to over 1400 m. Also reported from dry forests on the leeward side. About 37 species. 2 species cultivated in India.

Cultivation : Some species are popular in cultivation.

Pollen grains : Elliptic monosulcate.

Key to the Species

1a. Inflorescence stiff, erect from the leaf-axil, much shorter than leaves; leafblade roundish *pacifica*

1b. Inflorescence longer than leaves; leafblade ovoid *thurstonii*

Prichardia pacifica Seem. et Wendl.

Stem solitary, more or less smooth, about 10 m long, 30-40 cm in diameter near base. Leaves costapalmate, about 20 per crown; petiole about 1 m long, unarmed, thickly tomentose outside; leafsheath thickly fibrous at margins; leafblade more or less roundish about 1.5 m from the tip of the petiole to the uppermost margin, deeply plaited, undivided most part; costae on the lower side with white woolly coating. Inflorescence interfoliar, much shorter than leaves about 1 m long, stiff, more or less erect from the leafaxils; flower branches (rachillae)

alternate. Flowers bisexual, brownish yellow. Ripe fruits globose, black, 1 cm in diameter.

Flowering : September-January. *Fruiting* : March-August.

Distribution : Fiji.

Cultivation : A common cultivated palm in the gardens of South India. A good palm for pot culture.

Prichardia thurstonii F. Muell. et Drude

Stem solitary, smooth, to 6 m long, to 25 cm in diameter near base. Leaves costapalmate, petiole, to 1 m long, unarmed, thickly tomentose outside; leafsheath thickly fibrous at margins; leafblade 3/4th united from base, deeply plaited; free segments tapering, tip of which divided into 2 narrow strips; costae on lower side thickly coated with tomentum. Inflorescence interfoliar about 1.4 m long, horizontal from the leaf axil, about same size of the leaf; peduncle slender about 1 m long; covered with successive light green leathery bracts; each slightly pubescent outside. Flower branches (rachillae) simple, closely alternate on the uppermost part of the main axis, 10-30 cm long. Flowers bisexual 3.5 mm long, orange yellow in colour. Calyx cupular; petal lobes highly caducous. Ripe fruits pedicellate, conical, 1 cm long with persistent stigmatic remains.

Flowering : September-January. *Fruiting* : March-August.

Distribution : Fiji.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. This species is not common in cultivation. It prefers to grow on moist soil under the shade. A slow growing palm.

Rhapis Linn. f.

Dioecious palm. Stem clusterforming, slender, canelike, covered with fibrous leafsheaths. Leaves induplicate, palmate, deeply segmented, cuneate, denticulate; leafsheath composed of interwoven black or grey fibres; petiole unarmed, slender; adaxial hastula triangular. Inflorescence interfoliar, slender, pleonanthic; staminate inflorescence much remified than pistillate; prophyll bicarinate, splits adaxially at the middle; peduncular and rachis bracts sheathing; primary flower branches adnate to the rachis at base; rachillae smooth, each with a fertile bract. Flowers solitary, spirally disposed on the rachillae. In male flowers calyx cupular, shallowly 3-lobed, hairy outside; corolla tubular, thick, 3-lobed, little above the calyx with

3-triangular lobes; stamens 6; filaments elongate most part, adnate to the base of corolla lobes; anthers rounded. In female flowers staminodes conspicuous; slightly shorter than stamens; carpels 3, fleshy, wedge shaped, each with a short apical style; stigma tubular, fimbriate. Fruit 1- seeded, globose.

Distribution : SOUTH CHINA, JAPAN. 12 species. 2 species cultivated in India.

Pollen grains : Exine smooth or scabrous (tectate). Foveolate or finely reticulate (semi-tectate).

Uses : All species are ornamental, a large number of them are cultivated as indoor plants.

Key to the Species

1a. Leafblade bright green, palmate, divided into 10-12 segments; hastula short with woody outgrowth; tip of the leafsegments obliquely cut in two unequal 2-fid lobes *humilis*

1b. Leafblade dull green, digitate, broadly segmented, segments many nerved, unequal; hastula has no woody outgrowth; tip of the segments unequally bifid, but shorter than *humilis* *excelsa*

Rhapis excelsa (Thunb.) Henry ex Rehd. *R. flabelliformis, Large Lady Palm.*

A bush forming palmate leaved palm. Stem slender, cane-like; naked stem deep green, annulate; petiole 30-40 cm long, unarmed, slender, emerge out from the interwoven leafsheath fibres; leafblade digitate, 5-10 segmented; segments broadly lanceolate, mostly 5-nerved, to 30 cm long, deep green and glossy upper side; margins finely dentate; lateral segments narrower than the middle. Inflorescence interfoliar, to 30 cm long, much shorter than leaves, sparsely branched. Male flowers fleshy 4-5 mm long, spirally disposed; calyx thickened at base, lobes acute; corolla 3-lobed, double the length of calyx; stamens with filiform filaments, adnate to corolla tube at base.

Distribution : CHINA.

Cultivation : Mostly grown as pot plants. Due to its bush forming habit it is sometimes grown as hedges. Prefers to grow on moist soil under semishade condition.

Rhapis humilis Bl. *Slender Lady Palm.*

A bush forming palmate leaved palm. Stem slender, covered with fine black leafsheath fibres and persistent petiole bases, petiole 30-40 cm long, 5-6 mm wide at middle, biconvex in cross section; leafblade palmate, deeply segmented; segments broadly lanceolate, to 35 cm long, to 3 cm broad at middle. Male inflorescence interfoliar, divided from base to form five divaricate flower branches; rachillae filiform. Male flowers not closely set, alternate, to 7 mm long.

Distribution : China, Japan.

Cultivation : Not widely cultivated in India. Indian Botanic Garden, Howrah has some bushes. Fruiting is rare in the Garden.

Sabal Adanson

Stem solitary, tall, intermediate or dwarf, acaulescent or erect, with persistent leafbases or with smooth to rough surface. Leaves costapalmate, induplicate; leafsheath generally with distinct cleft and fibrous margins; petiole slender, unarmed at margins, concavo-convex in cross-section with felt like coating; adaxial hastula short, triangular, acute or acuminate; leafblade mostly arched; outer free segments one folded mostly deeply bifid with interfold filaments. Inflorescence interfoliar, pleonanthic, lower and middle flower branches ramified upto fourth order to form rachillae; each order of branch with conspicuous bracts; rachillae slender with spirally arranged bracts, each subtending a solitary flower. Flowers bisexual, symmetrical, mostly odorous at anthesis; calyx tubular, shallowly 3-lobed, corolla tubular below, with 3 distinct elliptic incurved petal lobes; stamens 6; filaments fleshy, adnate upto the mouth of the corolla, each with a narrow elliptic terminal anther. Ovary 3-lobed, papillose, ovule basal, anatropous. Fruit small, globose, with conspicuous stigmatic scars and abortive carpel; epicarp smooth; mesocarp fleshy, nonfibrous; endocarp thin; seed depressed globose; endosperm homogeneous with slight intrusion of the seed coat, embryo lateral, dorsal.

Distribution : Tropical America, West Indies. Grows from swampy to dry open land to sandy coastal region. About 14 species. 4 species cultivated in India as ornamental plants.

Pollen grains : Monosulcate; exine smooth or scabrous (tectate). Foveolate or finely reticulate (semi-tectate).

Key to the Species

1a. Stem acaulescent. Leaf blade slightly costapalmate; older leaves break and form like inverted umbrella. Inflorescence delicate, erect from the leaf axil *minor*

1b. Stem erect, cylindrical, leaf blade deeply costapalmate. Inflorescence stout, much ramified 2

2a. Stem bare of leaf sheath. Inflorescence shorter or longer than leaves 3

2b. Stem with persistent leaf sheath, at least on upper part of the stem. Inflorescence not longer than leaves 4

3a. Stem smooth, robust, not distinctly annulate; leafblade not deeply dissected. Inflorescence shorter than leaves; fruits globose to depressed globose *blackburniana*

3b. Stem columnar, distinctly annulate; leaf blade deeply dissected. Inflorescence much longer than leaves. Fruits dipressed globose. *mauritiiformis*

4a. Stem cylindrical, robust, erect; lower part of the stem more or less smooth without persistent leaf bases *mexicana*

4b. Stem not robust, with persistent leaf bases at least on upper portion, surface broken by shallow, interrupted fissures *palmetto*

Sabal blackburniana Glaseb. ex Schultes

Stem solitary, robust, columnar, swollen at base, to 20 m long, to 60 cm in diameter near base; outer surface of stem smooth, whitish, free of leaf base; crown not dense with leaves. Leaves costapalmate, petiole, to 2 m long, unarmed at margins, shallowly channelled above, broadly convex below; leafblade sub-orbicular, greyish-green, curved outside, divided about halfway from margin; leafsegments 2-2.5 m long, stiff, acuminate, deeply bifid at apices; midnerve prominent on lower side with thread like outgrowth from the tip. Inflorescence interfoliar; shorter than leaves, about 2 m long; peduncular bracts, alternate tubular at base with acuminate tips. Flower branches glabrous, alternate, axillary to fertile bracts; lower flower branches much ramified, greenish yellow at anthesis. Calyx cupular about 2 mm long, narrow at throat. Corolla 3 times longer than calyx. Stamens not longer than corolla; filuments subulate; anthers cordate. Ripe fruits depressed globose, about 10 mm in diameter, deep green to black.

Flowering : February-March. *Fruiting* : August-September.

Distribution : Tropical America.

Cultivation : Introduced in the Indian Botanic Garden, Howrah in the later part of the last century. Not common in cultivation. A few trees exist in some Calcutta gardens which are old and perhaps offsprings of the earlier plants introduced in the Howrah Garden.

Sabal mauritiiformis (H. Karsten) Griseb. et Wendl.

Stem solitary, columner with distinct well apart rings, 10-20 m long, to 30 cm in diameter near base; crown large with about 15 fully emerged leaves. Leaves, to 6 m long; petiole smooth, sharp edged, to 2 m long; leafblade cut almost to base with about 30 deeply cut segments, each, to 10 cm wide, bluish green in colour. Along each side of the costa pairs of segments are separated nearly to the costa but within each pair, the segments are united by their inner margin for some distance and thus appeared to be 3-nerved. Inflorescence interfoliar, extends beyond the leaves; primary flower branches divided 3 times into slender short rachillae which represent branches of the 5th order and branches of the first to fourth order bear a two edged prophyll at the base. Flower bisexual, whitish, fragrant. Ripe fruits glabrous, black, 8-11 mm, globose; seed semi globose with strongly protruded base.

Flowering : March-April. *Fruiting* : August-November.

Distribution : Brazil to Northern South America.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. It is a fast growing palm among *Sabal*. The columner stem with distinct well apart rings and deeply dissected leaves and much longer inflorescences are very characteristic of this species. It requires moist soil for steady growth. Not very popular in cultivation.

Sabal mexicana Mart.

Stem solitary, erect. Leaves costapalmate; leafblade regularly divided with one nerved segments. Inflorescence interfoliar, shorter than leaves; flowers bisexual; calyx lobes with a thin membranous margin lacking the brownish tip. Petals separated at the base by stamen-filament and free lobes which when dry tend to be ascending, subcucullate with inrolled margins and very prominent nerves.

Distribution : Mexico.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. Very close to *Sabal palmetto*. Ripe fruits and seeds not seen.

Sabal minor Pers.

Stem acaulescent or rarely grow above the ground level. Leaves palmate, bluish-green, ascending from the ground level; petiole about 70 cm long, 2 cm wide, unarmed at margins, not fully extended into the blade; leafblade deeply segmented; segments, to 90 cm long, to 3 cm wide at middle, with conspicuous threads at the sinuses; free part of the segment stiff, tapering, split at apices; midnerve proment on lower side. Inflorescence, to 10 cm long, erect; peduncular and rachis bracts tubular, acuminate with fibrous outgrowths from the margins; flower branches alternate, 6 10 in number, axillary to fertile bracts. Flowers bisexual, white, loosely dispersed on rachillae, about 3 mm long. Calyx 1.2 mm long, 3-lobed; lobes deltoid; petals 3, nearly double the size of the calyx; connate at base. Stamens 6, exceeding the corolla at anthesis; filaments subulate, anthers cordate. Ovary narrowly trigonous; style stout, shorter than petals; stigma papillose. Ripe fruits globose, narrowly sub-sessile, about 9 mm in diameter 1-seeded; seed blackish to brown, flattened; endosperm hard, homogeneous.

Flowering : March-April. *Fruiting* : June-November.

Distribution : FLORIDA.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. This species is not popular in cultivation. The plants that are in the Garden are more than 50 years old and none of them has visible stem. The older leaves break at the tip of the petiole and the blade hangs like an inverted umbrella.

Sabal palmetto (Walt.) Lodd. ex Schults.

Stem solitary, erect, 5-10 m long, to 30 cm in diameter near base with persistent leafsheaths on the upper part of the stem; leafsheaths splitted in a typical criss-cross fashion. Leaves deeply costapalmate about 3 m long, petiole slender, flat above, convex below; hastula pointed; leafblade suborbicular, 2.5 m long, deeply segmented; free part of the segments splitted upto 1/3rd length forming linear, pointed strips. Inflorescence interfoliar, about 2 m long; peduncular and rachis bracts tubular, alternate, acuminate, deep green, smooth on outer surface. Flower branches much ramified, each subtended by a papery obliquely opened bracts; flowers bracteolate, bisexual, fragrant, about 5 mm long, arranged in irregular spirals. Calyx with 3 deltoid lobes; each lobe 1 mm long. Corolla twice longer than calyx, petals oblong. Stamens 6, filaments subulate; style elongate, columner, stigma capitillate. Ripe fruits globose, dark grey, about 9 mm in diameter.

Flowering : February March. *Fruiting* : August September.

Distribution : CAROLINA TO FLORIDA.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. A very slow growing palm. It prefers to grow on sandy soil near the sea coast.

Uses : Large succulent leafbuds are cooked and eaten as vegetable. The wood of *Sabal palmetto* is light, soft and pale brown in colour. Polished cross section of the stem sometimes serves to make the top of small table.

Serenoa Benth. & Hook. f.

Distribution : Species 1, in South East United States. One species cultivated in India.

Pollen grains : Monosulcate ; exine smooth or scabrous (tectate), foveolate or finely reticulate (semi-tectate).

Serenoa repens Small. *Saw Palmetto.*

Stem subaculescent. Leaves palmate; petiole slender, margins finely dentate; hastula membranous, short scale-like structure; leafblade orbicular; flat about 1m long at middle; leafsegments 9-12 cm long; pointed at apices. Flowers and fruits not seen.

Distribution : South East United States.

Cultivation : Introduced in the Indian Botanic Garden, Howrah in 1972. A very slow growing palm.

Thrinax Swartz

Small to moderate, solitary, unarmed, pleonanthic, hermaphrodite palm. Stem smooth or fibrous, column faintly ringed. Leaves palmate; leafsheath disintegrate into fibrous mats; petiole long, slender, unarmed at margins, hastula adaxially prominent, long pointed; leafblade fan shaped; segments jointed basally about half the length of the blade, free part of the segment lanceolate, pointed, sometimes bifid. Inflorescence interfoliar, slender, branched to 2 order; prophyll tubular, bicarinate; peduncular bracts many, closely sheathing. Flowers on very short or conspicuous stalk; perianth cup-like with 6 lobes. Stamens mostly 6-12 ; filaments slender; anthers elongate, dorsifixed. Fruit white, smooth outside; mesocarp thin; endocarp very thin; endosperm homogeneous.

Distribution : West Indies. 12 species. Only one species cultivated in India.

Pollen grains : Elliptic to broadly elliptic in outline; monosulcate.

In the natural habitat *Thrinax* species are strict calciphiles occuring on coralline sand and weatherd lime stone out crops from sea level to over 914 m. They are distributed from areas of strong seasonal draught with an average rainfall of 100-112 cm (Read 1975).

Thrinax parviflora Sw.

Solitary unarmed fanleaved palm. Stem slender 4-7 m long, 10-12 cm in diameter near base, more or less smooth on outer surface, dull grey in colour. Leaves palmate; leafsheath liguliform, lower portion of which fibrous in older leaves; petiole, to 1.5 m long, 2.5 cm wide at middle, unarmed at margins; hastula triangular; leafblade orbicular, distinctly plaited, glossy green upper; lower side covered with indumentum; leafsegments about 50 in number; each, to 80 cm long, to 4.5 cm broad at middle. Inflorescence interfoliar, about 1 m long; prophyll flat, yellowish green in colour, covered with light brown scurfs, mostly concealed under the leafsheath. Flower branches alternate on primary axis, axillary to tubular axial bracts. Flowers bracteolate, bisexual, yellowish white at anthesis, closely placed on rachillae, consist of a cup with 6 short lobes in series, petals absent; stamens 6, attached on the bottom of the perianth lobe, connate at base; anthers linear, 2-3 mm long ; ovary 1-celled; sŭgma obliquely funnel shaped. Flowers pedicellate after anthesis. Ripe fruits globose, epicarp glossy, milky white in colour, to 10 mm in diameter; seed globose, endosperm white, homogeneous.

Distribution : JAMAICA. According to Read (1974), it is a very variable species and occurs over an equally variable and complex system of environment from near sea level to 914 m altitude.

Cultivation : This species was introduced in India during the earlier part of this century (Gage 1912). Not common in cultivation and difficult to grow in the open sun at the warm and dry climatic regions. In Calcutta it grows best on moist soil under the shade of big trees. Fruiting season in Calcutta is July and August. This species can also be grown in pots.

Trachycarpus Wendl.

Stem solitary or rarely sucker forming, more or less clean or covered with thick layer of leafsheath fibres. Leaves palmate; leafblade orbicular or reniform; leaf segments narrow. Inflorescence interfoliar, shorter than leaves; prophyll semi-woody, hidden under leafsheath; peduncular bracts many, alternate, sheathing, leathery, highly tomentose outside. Flowers bisexual, unisexual, small; sepals 3, lobed, lobes ovate; petals 3, broadly ovate, valvate; stamens 6; filaments free,

anthers short, dorsifixed; carpels 3; stigmas recurved. Fruit drupe, globose, oblong; seed with or without longitudinally grooved.

Distribution : INDOMALAYSIA, ASIA, PHILIPPINES, about 4 species. 2 species wild in India. 3 species in cultivation. (Kimnach 1977).

Key to the Species

1a. Depth of division of leafsegments regular; leafbases non persistent when dry. Fruit ovoid, oblong; seeds longitudinally grooved on one side *martiana*

1b. Depth of division of leafsegments irregular; leafbases persistent even when dry. Fruits globose, reniform; seed without longitudinal groove. 2

2a. Leafblade divided more than halfway. Fibres on the stem loose, ruffled; leafbase appendage ribbon-like, recurving *fortunei*

2b. Leafblade divided to about the middle; leafsheath fibres on the stem closely appressed; leafbase appendage triangular *takil*

Trachycarpus martiana (Wallich) H. Wendl.

Stem solitary, slender, irregularly annulate, to 10 m long; retaining the leafbases only on the upper part, otherwise naked; leafbase appendage broadly triangular; petiole unarmed, slightly twisted. Leafblade palmate, reniform, 80-90 cm long from tip of the petiole to the margin; leafsegments divided halfway from the margin, bluish green below; free segments obliquely bilobed at apices; lateral segments acuminate narrowly bilobed at tips. Inflorescence interfoliar, shorter than leaves, to 1.5 m long; peduncle about 30 cm long; prophyll bicarinate, 30-40 cm long, semi-tufted at apex; rachillae 3-5 cm long. Flowers solitary, in pairs, minutely bracteate. Calyx 3-lobed, ovate, subobtuse. Petals 3 ovate-orbicular; stamens 6, as long as corolla; anthers linear-oblong; ovary 3 folded, woolly outside, stigma capitate; endosperm horny; horseshoe shaped in transverse section; embryo at the centre on dorsal face. Ripe fruits oblong, glossy, blue, about 1 cm long.

Flowering & Fruiting : March-April; August-September.

Distribution : EASTERN HIMALAYA, BURMA.

Cultivation : A very slow growing palm, difficult to grow in the plains in hot dry climate. Griffith (1845) noted this palm from the then Company's Botanic Garden (Now Indian Botanic Garden) and reported to be thriving tolerably well in a shady raised spot. It was however lost from the Garden and reintroduced in 1961. This species is also cultivated in the Lloyed Botanic Garden, Darjeeling and some public and private gardens in Kalimpong, Shillong and Mussouri.

Trachycarpus fortunei (Hook.) H. Wendl. *Windmil Palm.*

Stem solitary, erect, thickly covered with loosely arranged black leafsheath fibres with exposing ribbon-like leafbase appendage. Leaves spreading to all direction; petiole 30-40 cm long, flat above, convex below; leafblade bluish-green, to 60 cm long from the tip of the petiole to the margin; free segments stiff, bilobed at apices. Flowers mostly in clusters of four or less. Ripe fruits 3 lobed, kidney shaped (reniform), 1 cm long, dark blue in colour.

Flowering : March-April. *Fruiting* : September-November.

Distribution : China.

Cultivation : This species is difficult to grow in the plains in the hot dry climate. A few young plants are in the Indian Botanic Garden, Howrah grown in the Green House. Older plants are seen in the Lloyed Botanic Garden, Darjeeling and some private and public gardens in the lower Himalayan towns and cities.

Uses : The utility of this species has been documented in details by Essig and Deng (1987). Fresh flowers are eaten in China and the seeds are used as animal feed. Trunks are used as house piller. The leafsheath fibres are strong and similar to coconut fibre and used for making ropes, mats, mattresses and brushes. Rough raincoats are made from the leaf-segments; segments are also used for making fans, hats and to thatch the roof of huts. The outer portion of the fruits has thick layer of wax which is extracted by separating the pericarp from the large single seed and by treating it in ethanol. By evaporating the alcohol dark yellow wax is obtained. One Kg of ripe fruit yields about 4 gm of wax. In China, wax from the Windmill Palm is used for making shoe polishes, wax paper, stencil, floor polish and carbon paper. Haemostatic drugs are made from the seeds, clinical trial shows that it is effective in about 90% cases. Seed extract stimulates urine contraction, controls hypertension and diarrhoea. Root is used for birth control probably its effect on uterine contraction. The leafstalk or petiole is said to contain an agent effective against hypertension. Its flowers have the same effect of controlling blood pressure and uterine contraction therefore forbidden to pregnent women. In China about 2000 tons of *Trachycarpus fortunei* fruits are produced each year. Each tree produces 25-50 kg of fruits per year.

Trachycarpus takil Becc. *Thakal, Thakil.*

Stem solitary, erect, not tall, somewhat robust, covered with closely appressed stem fibres; leafbases persistant with conspicuous triangular appendage; leafblade half orbicular to reniform; leafblade divided rather unevenly to about middle. Fruits reniform similar to *T. fortunei.*

Flowering & Fruiting : Unknown.

Distribution : KUMAON, INDIA. Grows on shady moist slopes upto 1500 mt.

Cultivation : One of the cold tolerant palms. It can sustain in snow fall and prolonged cold spell. Reported to be cultivated in Chaubattia Garden in Northern India. A rare palm of scientific importance. Listed as threatened palm (Basu 1988).

Uses : Leafsheath fibres are largely used by the local people for making ropes for which they cut the mature trees thus cause depletion of its population.

Washingtonia Wendl.

Solitary fanleaved, tall, pleonanthic palm. Stem cylindrical, more or less robust. Crown large, with distinct petticoat-like accumulation of dry leaves below. Leaves costapalmate, leafblade orbicular, filiferous; hastula generally pointed, sometimes strongly winged; leafsheath light brown in colour with conspicuous fibrous outgrowths from the margins; petiole green with hook-like teeth along the margins; leafsegments deeply 2 lobed, rigid. Inflorescence interfoliar, paniculately branched; prophyll flattened, enclosed within the sheath; peduncular and rachis bracts narrow, elongate, leathery, alternate on the axis. Flowers minute, white; calyx 3-lobed, scarious, erosed, imbricate; corolla funnel-shaped; stamens 6; filaments inserted near base of the corolla; anthers linear to lanceolate, versatile, pale yellow when fresh; ovary superior, on a basal disc, 3 chambered. Fruit ovoid, black when ripe; seed ovoid to ellipsoid.

Distribution : Species 2, distributed in NORTH AMERICA, WEST INDIES. 2 species cultivated in India.

Pollen grains : Elliptic monosulcate, exine smooth or scabrous (tectate), foveolate or finely reticulate (semi-tectate).

Key to the Species

1a. Petiole green; leafblade thickly filiferous in young plant; petiole heavily dentate only on lower margin. Crown larger than *robusta*. . *filifera*

1b. Petiole brownish; heavily dentate at margins; leafblade not thickly filiferous even in young plants *robusta*

Washingtonia filifera (Linden) Wendl.

Stem solitary, robust light grey in colour, with faint vertical cracks on outer surface of the exposed part, to 15 m long, about 98 cm in diameter

near base; upperpart of the stem or sometimes the whole trunk covered with enormous accumulation of dry leaves. Leaves costapalmate about 2 m long; leafblade 1.5 m from hastula to tip of the middle segment, divided more or less half way to base with conspicuous white threads attached with the segments and sinuses of segments. Inflorescence interfoliar, to 4 m long, erect at emergence, drooping in fruits; peduncular and rachis bracts pinkish; rachillae yellowish white. Flowers bisexual, 5 mm long, 3 mm wide at base; base obscurely 3-angled. Calyx campanulate, deeply 3-lobed, truncate at base; margins denticulate. Corolla twice longer than calyx, tubular at base; 3 lobed, lobes broadly lanceolate. Stamens alternate or opposite to corolla lobes; filaments terete in alternate stamens; anthers lanceolate, acute, bifid at apex. Ovary turbinate; style filiform stigma punctiform. Ripe fruits ovoid, about 1 cm long; seed chocolate brown in colour, slightly compressed, 5 mm. × 4 mm.

Flowering : August-September. *Fruiting* : April-June.

Distribution : Arizona to Southeastern California into Baja California.

In its natural habitat this species thrives near the occasional stream or spring, sometimes growing to about 25 m in height and 1 m in width near base. This species is the only endemic palm in the Western United States. It can withstand 110 F and thrives in average rain fall of about 60 mm.

Cultivation : A very popular ornamental palm but because of its attractive filiferous leaves, bright red coloured petiole and sheath it is mostly grown in pots. Indian Botanic Garden, Howrah has a few mature trees growing in the open.

Uses : A healthy mature tree produces upto half a million ripe fruits each year. The small pea-like fruits possesses sweet tasting pulp similar to that of common dates (Cornett 1985).

Washingtonia robusta Wendl. *Desert Fan Palm.*

Stem solitary, slender, erect about 25 m long. Crown crowded with deep green leaves. Leaves costapalmate about 1.5 m long or more, evenly spreading; petiole and blade almost equal in length; hastula triangularly pointed, thinly edged, 2-7 cm long; leafblade half orbicular, bright green, under surface of the leaf segment highly tomentose near hastula. Inflorescence interfoliar about the same length of the leaves. Ripe fruits about 1 cm long, black mesocarp pulpy; seed ovoid; endosperm homogeneous.

Flowering : May-June. *Fruiting* : September.

Distribution : MEXICO.

Cultivation : Introduced in the Indian Botanic Garden, Howrah in 1961. A moderately fast growing palm, grows faster than *Washingtonia filifera*. At present Garden has four tall trees growing along the river side and one of them had started flowering and fruiting in 1989.

Uses : Fruit of this species is edible, the fruit pulp is sweet. The crushed endosperm is also edible and taste like coconut.

Tribe : Phoeniceae

Dioecious palm. Leaves pinnate, induplicate; leaflets with acute tips; proximate leaflets developed as spines. Inflorescence bearing a prophyll only and branching to one order; flowers solitary, dimorphic, endocarp inconspicuous, membrane-like; seed with a deep longitudinal furrow.

Phoenix Linn.

Distribution : Species 17, in SOUTHERN EUROPE, AFRICA, ARABIA, MADAGASCAR, SEYCHELLES, INDOMALAYSIA, HONGKONG, TAIWAN & PHILIPPINES. About 7 species and 2 varieties in India.

Grows in various ecological conditions, from the coastal mangrove swamps, to the alluvial riverine plains, to the rockey surface of lower hill valleys and slopes and to the deserts near water source.

Pollen grains : Monosulcate, homogeneous.

Key to the Species

1a. Stem solitary 2

1b. Stem clusterforming 8

2a. Leaflets 4 fariously fascicled 3

2b. Leaflets not fascicled 5

3a. Stem robust with persistent tesselated leafsheath markings. *robusta*

3b. Stem not always robust, with spirally arranged persistent leafsheath on the stem 4

4a. Stem dwarf, leaf short, stiff. Ripe fruits oblong, cherry red in colour, 1.5 cm long *loureirii*

4b. Stem tall, slender to robust, leaves arching. Ripe fruits oblong, orange yellow to light brown in colour, 3 cm long *sylvestris*

5a. Stem very robust, columnar, with persistent leafsheaths. Leaves comperatively shorter with narrow non stiff leaflets *canariensis*

5b. Stem slender to moderately robust 6

6a. Stem slender, dwarf; leaves short, leaflets narrow, soft. *roebelinii*

6b. Stem moderately robust 7

7a. Leaflets bifarious, soft, glossy green in colour. Fruit oblong, 2-2.5 cm long, cherry red to brown when ripe *rupicola*

7b. Leaflets deep green, stiff; tip of the leaflets sharply pointed *zeylanica*

8a. Stem robust with persistent leaf sheaths; leaflets deflected more or less in one plane. Fruits 3-5 cm long, with sweet edible pulp, deep brown in colour *dactylifera*

8b. Stem acaulescent, or slender, with or without persistent leaf bases, mostly in close cluster 9

9a. Stem acaulescent or extremely dwarf 11

9b. Stem slender, with or without persistent leafsheath, mostly in close clusters 10

10a. Leafsheath persistent, leaves arching; leaflets more or less stiff. Flower branches irregularly arranged. Fruits with sweet pulp, orange-yellow in colour, ovoid, or ellipsoid *reclinata*

10b. Leafsheath non persistent, stem annulate, clean. Fruit about 2 cm long (mangrove swamp component) *paludosa*

11a. Stem underground or very short above. Fruits orange red to black *acaulis*

11b. Stem dwarf to bulbiform 12

12a. In inflorescence prophyll green, about 20 cm long, leaflets stiff, margins lined with hairs. Ripe fruits oblong. (grows on coastal sandy soil) *farinifera*

12b. In inflorescence, prophyll leathery, yellowish, leaflets bluish green, soft, (mostly on inland hill slopes) *pedunculata*

Phoenix acaulis Buch.-Ham. ex Roxb.

Acaulescent to subacaulescent palm. Leaves pinnate, almost erect from the ground, about 90 cm long; leaflets stiff, fascicled, induplicately folded; petiolar

spines, to 30 cm long, stiff, sharp. Inflorescence interfoliar, erect, to 60 cm long; prophyll semiwoody; flower branches alternate, stiff, simple. Male flowers 6 mm long; pale yellow at anthesis. Calyx cupular; petals 3, each obliquely lanceolate, acute, 6 mm × 3 mm. Stamens 6, each 3 mm long; filaments almost absent. Infructescens erect from the leafaxil with much longer peduncle. Fruits, to 3 cm long, ellipsoid, shortly mucronate, brownish.

Flowering : January. *Fruiting* : May-June.

Distribution : INDIA, BURMA (Myanmar).

Grows as bushy date palm in the lower hill valleys and sub-himalayan plains, also common in Chotonagpur especially on poor clay soil and on open grassy field.

Cultivation : Normally this species is not preferred for plantation in the gardens, a few colonies exist in the Indian Botanic Garden, Howrah.

Uses : Fleshy sweet pulp of the fruit is eaten by the tribals of Northeastern India. Rope is made in certain localities from the beaten leaves. Leaves are also used as thatch. In Chotonagpur a sort of sago is made from the pith, but unlike common date palms its stem or peduncle is not used for tapping sugery sap.

Phoenix canariensis Hort. ex Chabaud. *Canary Island Date Palm.*

A single stemmed robust palm. Stem cylindrical, usually covered with persistent leafbases in a very distinct spiral fashion. Lowermost part or the base of the stem swollen. Leaves pinnate about 200 in number per crown, each, to 6 m long; leaflets unduplicately folded, 150-200 pairs; each linear, stiff, sharply pointed, light green in colour; petiole short; petiolar spines progressively longer from base upwards. Inflorescence interfoliar, pleonanthic. Ripe fruits globose, about 2 cm in diameter, orange coloured. Seed wrinkled outside.

Distribution : CANARY ISLAND (Endemic).

Cultivation : Although this species is a very popular ornamental palm in the western world gardens, it is unknown in most part of India. A solitary old plant was seen in a private garden in New Delhi.

Phoenix dactylifera Linn. *Arabian Date Palm.*

A cluster forming robust palm. Stem usually, to 15 m long, covered with persistent leafbases or marked with distinct leafscars. Leaves pinnate, upper leaves

ascending; lower leaves curving, about 40 in number per crown; each, to 6 m long; petiole slender, almost flattened, greyish in colour; leaflets induplicately folded, greyish green to bluish in colour, rigid, sharp pointed, arranged in several ranks at least in the basal part of the leaf. Inflorescence interfoliar about 1.5 cm long. Infructescence accrescent, drooping by the weight of the fruits. Male flowers white fragrant. Ripe fruits ovoid, oblong, deep brown or orange coloured with thick layer or sweet pulp.

Distribution : ARABIA and NORTH AFRICA. (Mostly cultivated).

Cultivation : Commercial cultivation does not exist in India. This species was unsuccessfully tried in the Indian Botanic Garden in the early 19th Century. Living collection exist in some gardens of Northern India and Western India. This species prefers warm dry zones between 15° and 30° North latitudes. Propagation is done by the selection of sucker from the good varieties of female plants. It is said that one male tree is sufficient under natural condition to pollinate about 100 female fruit bearing trees. Excessive humidity is harmful to the plants and quality of fruits becomes poor due to fermetation of sweet pulp.

Uses : It is one of the most commercially grown palms. Fruits are staple food for common people of Arabia, Iran, Egypt and adjacent countries.

Phoenix farinifera Roxb.

Stem acaulescent or very shortly stemmed; stoloniferous; aerial portion of the stem thickly covered with leafbases. Leaves, 1 m or more long, erect to slightly inclined; petiole short, with a few solitary or paired spines; leaflets mostly opposite, ensiform, much pointed, smooth, green in colour. Inflorescence, to 30 cm long at anthesis; rachillae slender, simple, irregularly disposed on the axis. Male flowers 1 cm long, white, calyx slightly 3—toothed; petals oblong, rigid; stamens 6, filaments inserted into the fleshy globular receptacle; anthers oblong. Ripe fruits 1-1.5 cm long, ovoid; pericarp pulpy, sweet; seed ovoid, smooth, brown in colour, greenish within, longitudinally grooved.

Flowering : January. *Fruiting* : April-May.

Distribution : INDIA (Coromondol coast).

A bush forming Date Palm, common on sandy soil on open or in coastal forests.

Cultivation : Not cultivated for ornamental purpose. Indian Botanic Garden, Howrah has a few clumps growing in the Palmetum.

Uses : The ripe fruits contain sweet pulp which is eaten by the local village people. Leaflets after separating from the rachis are used for making sleeping mats *(Chattai)*. The petiole after splitting are also used to make baskets etc. The stem contains starchy material and for extracting the starch, trunk is cut into small pieces, dried and beaten with wooden hammer for crushing the fibrous pith. The broken parts are sifted to get the crude starch powder.

Phoenix loureirii Kunth

Stem solitary, dwarf, cylindrical, closely packed with persistent leaf bases, in distinct, close spiral fashion. Leaves many, mostly ascending, about 1.5 m long, with rigid rachis; petiole short, armed with 2-4 cm long straight spines; leaflets irregularly placed on the rachis, pale green upper; bluish-green below, stiff, sharply pointed at tips. Inflorescence interfoliar, to 30 cm long; prophyll yellowish-orange in colour, carinate, with fringed margins. Male flowers 5 mm long; yellowish at anthesis; stamens 6, with inconspicuous filaments, adnate to the base of petals. Ripe fruits ovoid-oblong, 12 mm × 6 mm, deep scarlet; fruiting perianth deep green, persistent.

Flowering : February. *Fruiting* : May.

Distribution : India, Indochina, Hongkong.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah.

Uses : Unknown.

Phoenix paludosa Roxb. *Hetal, Thinbaung.*

A clusterforming palm; stem slender, annulate, to 6 m long, 15-16 cm in circumference near base. Leaves arching, pinnate, to 120 cm long or more; leafsheath fibrous, reddish in colour; petiole reddish brown, scurfy outside; petiolar spines not very stiff, 5-9 cm long, channelled at middle; leaflets linear, induplicate, about 60 in number per leaf. Inflorescence interfoliar, erect from the leaf axil; prophyll compressed, reddish brown, spatuliform. Male flowers bright yellow at anthesis. Female flowers accrescent. Ripe fruits yellowish to purple and turning black, about 2 cm long.

Flowering : January-February. *Fruiting* : June.

Distribution : India to Malaya. A component of the estuarine mangrove swamps. In India it is naturally found in Sunderbans, Mahanadi Delta of Orissa

and Andaman and Nicobar Islands. This species is characterised by its narrow sword shaped glossy bluish green leaflets, bright orange coloured prophyll and flower branches.

Cultivation : This is a very handsome looking date palm and can be grown inland away from the saline areas. This species can also be tried as pot grown plant because it appears from its cultivation in the Indian Botanic Garden, Howrah that this species has no special choice for soil and water.

Uses : Its leaves are used in Sunderbans for making ropes for tying boat and logs and also for thatching. Crushed leaves are used for making brooms. The stem of the smaller trees are used as walking sticks and longer ones serve for rafters. The local people believe that snake gets out of the way of any person having such a stick.

Phoenix pedunculata Griff.

A clusterforming palm, stem short, bulbiform, sometimes grow upto the height of 3-5 m. Leaves pinnate about 1.2 m long; petiolar spines not many, solitary or in pairs, not very stiff; leaflets not stiff, linear, induplicate, pale green to slightly bluish-green in colour, more or less fascicled. Inflorescence interfoliar; prophyll about 20 cm long, semi-woody, with deep brown hairy outgrowth from the margins. Ripe fruits oblong-ovoid, orange red to black, 1-1.5 cm × 5 mm. Seed 8 mm long with a narrow median groove.

Flowering : January. *Fruiting* : July-August.

Distribution : INDIA (Western Ghats from Konkan south ward ascending upto 200 m on the Nilgiri Hills. Grows on the cool hill valleys and slopes).

Cultivation : A few clumps exist in the Indian Botanic Garden, Howrah. A very slow growing palm. Takes 50-60 years to attain a height of 3 m.

Note : This is a distinct species and deserves to be identified separately from *P. loureirii* Kunth.

Uses : Its leaflets are used for making mats and brooms. Due to large scale gathering of the leaves of this species it has become threatened in its natural habitats. (Padmanabhan and Sudhersan 1988).

Phoenix reclinata Jacq. *Senegal Date Palm.*

A clusterforming palm; stem more or less erect about 7 m long, about 10 cm in diameter near base, covered with peristent leaf bases at least at the upper

part. Leaves arching; leafsheath about 30 cm long, moderately fibrous at margins; petiole almost absent; leaflets linear acuminate, induplicate, about 90 in number per leaf; each irregularly attached on the rachis. Inflorescence interfoliar, pleonanthic, erect from the leafaxils, to 45 cm long; peduncle flattened, smooth, bright orange in colour; prophyll narrowly bicarinate, semiwoody, greenish yellow; flower branches borne on a short axis; each swollen at base, slightly ascending; male flowers 6 mm long, trigonous in bud; calyx in triangular cup; petals acuminate; stamens 6, shorter than corolla. Female flowers globose, yellow; corolla opens to expose stigmas only. Ripe fruits ovoid, orange yellow in colour about 2 cm long.

Flowring : January-February. *Fruiting* : May-June.

Distribution : TROPICAL AFRICA. MADAGASCAR. Grows in the humid hot regions of Africa.

Cultivation : Not widely cultivated as ornamental palm. A few clumps are in the Indian Botanic Garden, Howrah. It prefers to grow on moist soil. Very attractive when planted in a large garden with sufficient space around the clump.

Uses : This species is important for its variability and adaptibility and considered an important date species for crossing with Arabian Date Palm. It produces soft, sweet pulpy fruits of considerable size.

Phoenix robusta Hook. f.

Stem solitary, robust about 5 m long, closely covered with persistent leaf bases; exposed part of the stem marked with distinct tessellated leafscars. Leaves many, about 2.5 m long; leaflets fascicled, stiff, induplicately folded, sharply pointed at apices. Flowers and fruits unknown.

Distribution : INDIA (Pareshnath Hill in Bihar and Bhorkas in Pune).

Note : This species is imperfectly known and perhaps a robust form of *Phoenix sylvestris L.* Mahabale and Parthasarathy (1963) however consider this as a distinct species of *Phoenix*.

Cultivation : A few robust stemmed Date Palms matching with the original description were seen in the arboretum of the Forest Research Institute, Dehra Dun.

Uses : Unknown.

Phoenix roebelinii O'Brien *Pigmy Date Palm.*

Stem solitary, dwarf, rarely attains a height of more than 2 m, with persistent leafbases only on upper part; leaf scars on the stem slightly swollen and conspicuous. Leaves delicate looking in young plant, non rigid, about 80 cm long; leafsheath light brown in colour; leaflets linear, narrow, light green in colour, soft, bifarious on rachis, each about 30 cm long; petiolar spines soft, dark green, powdery coated. Inflorescence interfoliar, to 30 cm long. Ripe fruits ovoid, about 1 cm long, reddish in colour.

Distribution : TAIWAN.

Cultivation : A very popular ornamental date palm. Mostly grown in pots as indoor decorative plant. Also cultivated in the Indian Botanic Garden, Howrah.

Phoenix rupicola T. Anders.

Stem solitary, about 7 m long, 30 cm diameter near base, without persistent leafbases, more or less smooth on outer surface, deep grey in colour. Leaves gracefully arching, to 3 m long; petiolar spines deep green, not stiff and sharply pointed; leaflets linear, deep green, glossy, bifarious on rachis, about 50 cm long. Inflorescence interfoliar, about 70 cm long; prophyll fusiform, scurfy outside, greenish yellow in colour, opens by longitudinal split. Male flowers pale yellow. Female flowers 4 mm long, globose, calyx cupular; petals oblong, imbricate or twisted. Fruits oblong, deep crimson to chocolate brown in colour, 2-2.5 cm long.

Flowering : April (sometimes in March). *Fruiting* : September.

Distribution : INDIA (Sikkim, Assam). Grows on rockey slopes of lower Himalaya.

Cultivation : A showy ornamental palm. Its glossy green leaves are attractive and ornamental therefore cultivated as garden plants. A few mature trees are in the Indian Botanic Garden, Howrah.

Uses : The core of the stem contains starchy materials and during food shortage the trees are felled by the Lepchas for extracting the core.

Phoenix sylvestris Roxb. *Wild Date Palm, Sugar Date Palm.*

Stem solitary, erect, usually robust, to 18 m long, covered with compact leafbases. Leaves about 5 m long; lower leaves arching; petiole short, flattened, strongly spinous at margins; petiolar spines, to 8 cm long, stiff, sharply pointed, triangular

in cross section; leaflets stiff, induplicate, sharply pointed at tips; each, to 80 cm long, each projecting in different planes from the rachis. Inflorescence interfoliar about 40 cm long; prophyll semiwoody, spatuliform, scurfy outside, opens by longitudinal split from the middle; peduncle flat, stout; flower branches simple fasciculate, bright orange in colour, to 30 cm long at anthesis. Male flowers white about 6 mm long; unopened male flowers angular, oblique; calyx with 3 prominent points; petals 3, much longer than calyx, with 3 prominent points; petals 3, much longer than calyx, deeply furrowed inside. Stamens 6, adnate to petals at base; anthers linear. Female flowers alternately disposed; calyx cupular with three prominent points; petals 3, imbricate. Fruits about 3 cm long, 1.5 cm broad at middle; olive shaped, deep brown when ripe.

Flowering : December-January. *Fruiting* : April-June.

Distribution : Common all over India. Adapted to various ecological conditions, abundant in the coastal district of West Bengal. Those growing on marshy land have more or less clean stems.

Cultivation : This species is rarely cultivated in the gardens as ornamental plant. Mostly grow in the countrysides as semiwild plants.

Uses : One of the most useful palms in India. Freshly obtained sap of the wild date palm is clear as water having 12-15% sugar and is a delicious drink rich in vitamin. Application of lime in the receiving pot delay the fermentation of the juice. When the sweet juice is boiled a thick syrup is obtained which is consumed in various ways. After sufficient boiling sweet juice condenses into palm jaggery (Gur) which is moulded in suitable blocks. It is often more expensive than the crystal sugar made from sugar cane. On an average a date palm in one season yields about 40 kg of jaggery. Leaves are crushed and the beaten leaflets are made into brooms, baskets or woven into mats locally known as chattai. Old unproductive palms are cut and pieces of stems are used as fuel for burning tiles etc.

Phoenix zeylanica Trim. *Ceylon Date Palm.*

Stem solitary, erect about 7 m long, densely covered with leafbases. Leaves comperatively shorter than *P. sylvestris;* leaflets induplicate, deepgreen, 4 fariously arranged; each, to 30 cm long, linear, sharply pointed at tips. Inflorescence interfoliar about 30 cm long; prophyll hard, woody, light green in colour; opens by longitudinal split from the middle into two halves. Ripe fruits ovoid, oblong, deep scarlet, 10 mm × 8 mm. Pulp is sweet and edible.

Flowering : December-January. *Fruiting* : April-June.

Distribution : Sri Lanka.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. A full grown tree is easily recognised by its shorter olive green stiff leaflets and dark brown stem, narrower near the bottom.

Tribe : Borasseae

Dioecious palm; leaves palmate or costapalmate; induplicate; staminate and sometimes pistillate flowers borne in deep pits formed by the connation and adnation of the rachillae bracts; staminate flowers rarely solitary, usually in a cincinnus of two to many flowers; stamens exserted from the pits by elongation of the floral receptacle between the calyx and corolla; pistillate flowers solitary, bibracteolate; fruit 1-3 seeded with thick hard endocarp.

Key to the Genera

1a. Staminate and pistillate inflorescences dissimilar. Male flower clusters concealed in pits. Pistillate flowers sessile, in the axil of large leathery bract. Fruit sessile, 1-3 seeded, endocarp forming pyrenes 2

1b. Staminate and pistillate inflorescences similar. Flowers of both sexes sunken in pits. Fruit stalked, usually 1-seeded, pyrenes not formed *Hyphaene*

2a. Ripe fruits very large, pyrenes bilobed 3

2b. Ripe fruits not very large; pyrenes not deeply bilobed, ridged or sculptured outside *Latania*

3a. Fruits with sweet, light orange coloured pulpy mesocarp; staminal rachillae several, stamens 6; pyrenes not deeply bilobed, usually 3 in number, shallowly to deeply lobed *Borassus*

3b. Fruits very large, each about 20 kg; staminal rachillae 1-3, stamens 15-18 in number; pyrene deeply bilobed, thick *Lodoicea*

Borassus Linn.

Distribution : Species 7, distributes in AFRICA, INDIA, BANGLADESH, BURMA, SRI LANKA, JAVA, SUMATRA, CELEBES, NEW GUINEA, NORTH AUSTRALIA. One species in India.

Pollen grains : Monosulcate, exine verrucate (semi-tectate).

Borassus flabellifer Linn. *Palmyra Palm. Tal.*

Robust, fanleaved dioecious palm. Stem columnar, 15 m or more long, about 60 cm in diameter near base, deep grey to black in colour with distinct annulate leafscar marks on the stem. Base of the stem swollen, sometimes with exposed superficial roots. Leaves costapalmate, rigid; crown more or less roundish with evenly projecting leaves; leafbase splits at base; petiole rigid, strongly dentate

at margins; hastula distinct on both sides; leafsegments induplicate, divided halfway from the margin; segments stiff at the apices; with long threads between the segments. Inflorescence interfoliar, stout; peduncular bracts leathery, alternate, tubular at base, acuminate; staminate inflorescence simply branched, rachillae mostly paired, covered with series of reniform bracts; male flowers in vertical rows, pitted. Pistillate inflorescence simply branched, sheathed under large leathery bracts; female flowers globose, 2 cm in diameter. Fruits semiglobose to globose, deep brown when ripe, to 20 cm in diameter; mesocarp fibrous, with thick pulp; pyrenes usually 3; young endosperm juicy and edible.

Flowering : March-April. *Fruiting* : July-September.

Distribution : INDIA, BANGLADESH.

Cultivation : It is one of the widespread semiwild palms of India, abundant in the coastal districts of India; its concentration is more in the state of Andhra Pradesh and Tamil Nadu. Rarely grown as ornamental palm. Indian Botanic Garden, Howrah has a beautiful avenue, lined on both sides with lofty Palmyra Palms.

Flowering in general commences from March and fruits mature from July. Emergence of inflorescences in April or May is also not uncommon. Some young trees in the Indian Botanic Garden, Howrah also flower in December. Early flowering was noted recently in a huge population of more than 2000 trees spreading over a large areas between Lakshmikantapur and Kulfi in South 24 Parganas of West Bengal. Most of these trees had mature fruits in March. It was most interesting that a majority of these Palmyra trees had newly emerged inflorescences in addition to mature fruits in March.

Uses : One of the most economic palms of India. It yields sweet sap from the peduncle which is converted into jaggery (Gur) or fermented into toddy. Numerous village level artisans are thriving on this jaggery industry. The other parts of the tree are also useful. Mature stem is hard and termite resistant, therefore used in the village for making roof beams of thatched and semi-permanent masonary houses, stem pieces are also used as fuel in brick kiln. Unopened Palmyra leaves are soft, therefore used for making baskets and various other fancy handicrafts. In South India in religious ceremonies and marriages ripe fruits are used as sacred objects just as green coconuts are used in the Eastern India (Basu 1991).

Hyphaene Gaertn.

Dichotomously branched or caespitose dioecious palm. Stem cylindrical, with or without persistent leafbases. Leaves costapalmate; petiole planoconvex in crosssection with upwardly pointed teeth on margins, petiole and rachis coated with felt-like substance and indumentum; hastula well developed on

Phoenix rupicola T. Anders.

Phoenix zeylanica Trim.

Latania loddigesii Mart.

Lodoicea maldivica (Gmelin.) Pers.

Lodoicea maldivica
(Gmelin.) Pers.

Daemonorops kurziana Becc.

adaxial side; abaxial hastula absent, leafblade divided 2/3rd its length along the adaxial rib to form single folded segments; intersegmental filaments long. Inflorescence interfoliar, multibracteate; in staminate inflorescence rachillae catkin like; male flowers in cincinnus, bracteolate, embedded in hairs; stamens 6, adnate to base of corolla. Pistillate inflorescence less branched; female flowers stalked; sepals 3, rounded, imbricate; petals 3, similar like sepals; staminodal ring epipetalous. Fruits 1-seeded or 2-3 seeded. Endosperm homogeneous, hollow at middle.

Distribution : About 30 species in AFRICA, MADAGASCAR, INDIA, ARABIA. 1 species wild in India. 2 species cultivated.

Pollen grains : Monosulcate, exine verrucate (semi-tectate).

Key to the Species

1a. Tree dichotomously branched both aerially and at ground level. . . 2

1b. Tree trunk branched below the ground, aerial shoots unbranched . . . . *schatan*

2a. Stem black to dark grey, without persistent leafsheaths. Ripe fruits sessile, oblong, ovoid, 5 cm × 3 cm, epicarp distinctly punctate (African) . . . *thebaica*

2b. Stem with persistent leafbases, at least when young. Ripe fruits with short stalk, obovate, attenuate at base, 6-10 cm × 2-6 cm (endemic in India) . . . *dichotoma*

Hyphaene dichotoma (White) Furtado *Ravana Tal. Indian Doum Palm.*

Stem solitary at base, cylindrical, robust; upper part of the stem dichotomously branched. Leaves costapalmate; leafblade orbicular; petiole armed at margins; segments, to 120 cm long, bilobed at apices, lobes acuminate more or less stiff at apices. Inflorescence interfoliar, unisexual peduncular bracts leathery,, sheathing at base; upper part triangular, acuminate, densely tomentose outside; male rachillae digitate, terete. Pistillate inflorescence less branched; female flowers about 7 mm long. Ripe fruits stalked, stalk covered with dense brown hairs; epicarp smooth, mesocarp thick, fibrous; seed with endocarp (stone) ovoid to obovoid; endosperm homogeneous.

Flowering : March. *Fruiting* : July.

Distribution : West Coast of INDIA (between 18-23°L such as coastal area opposite Nagaon, Shergaon, Daman and Diu).

Cultivation : Cultivated in the Indian Botanic Garden, Howrah and some large public gardens in the Western India.

Uses : The fleshy fibrous mesocarp of fruits is sweet and are eaten by the local people. The pulp is considered astringent and anthelmentic. Unripe kernel is edible. Leaves are used as thatch and trunk wood is useful as posts and roof beams, wood is also used as fuel. Due to large scale felling of this wild palm this species has become scarce in its natural habitats (Rao 1964).

Hyphaene schatan Bojer

A clusterforming palm; stem erect or obliquely ascending from the ground, 3-5 m long, cylindrical, 20-25 cm in diameter, more or less clean of leafsheaths, deep grey in colour. Leaves costapalmate; petiole margins armed with 1 mm long black recurved spines; rachis, to 30 cm long, curved, thickly tomentose outside; leaf segments rigid, about 60 cm long, 2-3 cm wide at middle, light green in colour with distinct brown minute spots (punctation); inter segmentary nerves ending in long filaments. Male inflorescence interfoliar, once branched; flower branches solitary, each ending into a solitary rachilla. Female inflorescence once branched; peduncle about 12 cm long, slender; peduncular and rachis bracts tubular, leathery, thickly tomentose outside. Female flowers pedicellate; perianth lobes alike; ovary trigonous. Fruit pedicellate, pedicel about 1 cm long, thickly tomentose outside with 1-2 abortive fruits at the base of the mature fruit.

Flowering : March. *Fruiting* : September.

Distribution : MADAGASCAR.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. It is growing as a big colony of several stems along the edge of a pond. The tree produces numerous ripe fruits in each fruiting season. Its leaves are not self clearing but dry leaves break from the uppermost part of the petiole and the blades hang for sometimes until get detached by the wind and the lower portion of the petiole and sheath remain on the stem for sometime. (Basu 1978).

Hyphaene thebaica Mart. *African Doum Palm.*

Stem solitary at base, upper part dichotomously branched, terete, black to dark grey in colour with distinct leafscar marks. Leaves costapalmate; petiole stout, strongly dentate at margins; leafbase triangular, rusty tomentose outside; leafblade orbicular, deeply segmented; free part of segments, to 50 cm long, acuminate. Staminate inflorescence about 110 cm long; peduncle about 2 cm wide at base, erect during emergence; peduncular and rachis bracts leathery, tubular at base,

upper part triangular, thickly tomentose outside, about 14 in number; prophyll semiwoody, flat, base fused with the peduncle. In male flowers calyx deeply divided into 3 yellowish lobes; petals broadly ovate; stamens 6; anthers linear, slightly sagittate; pistillode absent. Pistillate inflorescence slightly shorter in length; female flowers globose: calyx lobes orbicular; petals ovate, concave, valvate, shorter; than calyx; staminodes 6; ovary globose; stigmas sessile.

Flowering : March-May (Staminate). April-June (Pistillata).

Fruiting : December-January.

Distribution : North Africa.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah.

Imperfectly known species in cultivation

Hyphaene bussei Dammer ex Busse

Stem dichotomously branched below the ground and appear as if 3-4 stems coming out from the ground in close proximity. Each of these stem branch aerially in dichotomous fashion. Fruits are obovate to oblong, light brown in colour; epicarp smooth, wavy; mesocarp extremely fibrous.

Distribution : Kenya.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah.

Latania Comm. ex Juss. *Latan Palms.*

Solitary, unarmed, dioecious palm. Stem erect, rough, marked with prominent leafscars. Leaves costapalmate; sheath narrow, split horizontally at base, smooth or densely tomentose, some times with dark brown indumentum; petiole robust, adaxially deeply channelled; margins smooth or with a few shallow teeth; adaxial hastula short. Inflorescence interfoliar; prophyll short, wide, 2-keeled with sharp pointed limb; peduncular bract 1-2, or several, loosely sheathing; rachillae short or long, terete. Male flowers many, deciduous, partially sunken; pits conspicuous after shedding of flowers. Female flowers placed in between the thick bracts bordering the pits. Pistil conical, slightly projected beyond the bracts. Stamens many, staminodes in the form of a cup. Fruits oblong, obovoid to globose, smooth, blackish, 3 seeded. Endosperm homogeneous. Eophyll digitately lobed.

Distribution : Species 3, in the Tropical East Africa and Mascarene Islands. 2 species cultivated in India.

Pollen grains : Monosulcate, exine foveolate, fossulate or regulate (semi-tectate).

Key to the Species

1a. Leaves bluish green when fresh; ribs and veins light green to bluish, not red; hastula large, conic; seeds as long as broad, reticulate at top . . . *loddigesii*

1b. Leaves bright green; ribs and veins bright red in colour; hastula broad, not conic; seeds pyriform, non reticulate at top . . . *lontaroides*

Latania loddigesii Mart. *Blue Latan Palm.*

Stem solitary, distinctly annulate with slightly bulging leafscar marks, 6-10 m long, to 30 cm in diameter near the base; without persistent leaf bases. Leaves costapalmate; petiole pale green, flat above, rounded below, thickly covered with light brown felts, about 1 m long; leafblade about 1.2 m from hastula to the tip of the middle segment; metallic in texture, bluish green in colour; leaf segments 5 cm broad at middle, acuminate, non dropping; midnerve on lower side prominent, thickly tomentose. Inflorescence interfoliar, unisexual. In staminate inflorescence male flower branches alternate, axillary to fertile bracts; rachillae 6-10 in number, terete, digitate; each 15-25 cm long; number of rachillae less in number in the distal flower branches; male flowers 8 mm long; petals caducous; stamens 16-20 in number; pistillode 3-5, as long as stamens. Female rachillae not digitate; female flowers sessile, spirally disposed on rachillae, prominently 2 bracteolate, about 1 cm wide at base, conical at apex; sepals 3, fleshy, 1 cm × 1.1 cm, deep green, minutely ciliate at margins; petals 3, imbricate or twisted; each 8-9 mm wide. Fruits 4-5 cm long. Seeds 2-3 cm long, oblanceolate. Eophyll digitate.

Flowering : June-July. *Fruiting* : December-January.

Distribution : Mauritius to Mascarene Islands.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. Not common in cultivation. In juvenile leaves, petiole, ribs and veins are bright red in colour, the depth of colour gradually fades as the tree grows old and ultimately loose its red colour. The blue latan palms are grown in pots or in the ground without any difficulty in respect of soil. Ripe fruits are edible, the tree squirrels are fond of eating the green fruits.

Latania lontaroides (Gaertn.) Moore *Latania borbonica* Lamk., *L. commersonii* Gmel., *L. rubra* of Horticulture. *Red Latan Palm.*

Stem solitary, without persistent leafbases, with distinct swollen leaf scar marks, 6-12 m long, 18-20 cm in diameter near base. Leaves costapalmate, evenly spreading in the crown; petiole heavy, channelled above, rounded below, deep pink in colour,

thickly tomentose outside, to 1.6 m long; leafsegments, to 70 cm long, to 5 cm broad at base, deeply divided, tip of the free segments narrowly acuminate; midnerve prominent on lower side; deep pink, densely scurfy near the junction of the petiole. Staminate inflorescence, to 2 m long; primary branches 9-16 in number, alternate, each holding, to 40 cm long digitate rachillae. Male flowers about 8.5 mm long; stamens about 30 in number; pistillode pyramidal, trigonous. Pistillate inflorescence about 2 m long; primary branches about 8 in number, alternate, each ending into a rachilla. Fruit globose, about 4 cm in diameter; epicarp smooth, glossy, deep brown in colour; seed pyriform; endosperm homogeneous.

Flowering : May-June. *Fruiting* : December.

Distribution : MASCARENE ISLANDS.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. A popular ornamental palm, mostly grown in pots for its attractive glossy green leaves with red petiole and ribs. This species is slow growing therefore easy to keep in pots for a longer period. Mature fruits are eaten by the tree squirrels.

Lodoicea Comm. ex Labill.

Distribution : SEYCHELLES ISLANDS. (Endemic).

Pollen grains : Monosulcate; exine smooth or acabrous (tectate), foveolate or finely reticulate (semi-tectate).

Lodoicea maldivica (Gmelin.) Pers. *L. seychellarum* Labill. *Coco de mer,* Sea Coconut, Double Coconut, *Sedrac*.

Stem solitary, about 140 cm in circumference at base; leaves costapalmate, very large, ascending, about 10 in number per crown; petiole about 4 m long, 20 cm wide near middle, light green in colour, upper side concave to channelled, lower side semiterete; leafbase semiwoody, triangular, about 60 cm broad, splits at the base; leafblade about 4.5 m long from the tips of the hastula to the tip of the middle segment; leafsegments about 9 cm wide, 80-85 segments in a blade; free portion of segments about 115 cm long, acuminate. Pistillate inflorescence interfoliar, unbranched. Fruits very large; seed bilobed, very large.

Flowering : The pistillate tree in the Indian Botanic Garden, Howrah, flowered for the first time in 1988 when a solitary female inflorescence emerged out of the leafsheath in late October. In two years it emerged to about 90 cm and the large female flowers were visible. No fruiting occurred.

Cultivation : Rarely cultivated in the Gardens. The only tree in the Indian Botanic Garden, Howrah was raised from seed planted in 1894. The tree in the Garden produces one leaf a year, its crown always bears 8 fully expanded green leaves, one half expanded leaf and one spear-like emerging leaf. An emerging leaf takes about 16 months to expand fully. The everage rate of elongation of the petiole in the initial stage is 62-70 cm per month. The rate of elongation decreases at a rate of 45-1 cm from 5th to 15th months and the petiole ceases to elongate when the leafblade is fully expanded.

Subfamily : Calamoideae

Tribe : Calameae

Leaves pinnate or entire or bifid, pinnately ribbed. Hapaxanthic (rarely) or pleonanthic, dioecious, acaulescent or climbing palm. Leaf ending in a cirrus or without cirrus. Staminate inflorescence with paired or solitary flowers. Pistillate inflorescence bearing dyads or sterile male flower (neuter flower) and pistillate flower.

Key to the Genera

1a. Mostly spiny climber, sometimes with erect stem . . . 2

1b. A rosette forming spiny undergrowth palm . . . *Salacca*

2a. Leaflets linear lanceolate, linear ensiform; upper margin of leaflets entire. Inflorescence with unisexual flowers . . . 3

2b. Leaflets mostly rhomboid; upper margin of leaflets erose. Inflorescence with bisexual flowers . . . *Korthalsia*

3a. Stem hapaxanthic. Inflorescence in the axils of upper reduced leaves . . . *Plectocomia*

3b. Stem mostly pleonanthic. Inflorescence mostly in the axils of normal leaves . . . 4

4a. Inflorescences with tight, sheathing, persistent bracts . . . *Calamus*

4b. Inflorescence with loose, boat shaped or spatulate nonsheathing bracts . . . *Daemonorops*

Salacca Reinwardt

Almost stemless caespitose, spinous, dioecious palm. Leaves pinnate, ecirrate; leaflets lanceolate, linear lanceolate, sigmoid, falcately acuminate, usually 3 nerved; back of the rachis with long spines. Inflorescence interfoliar; staminate

and pistillate inflorescences dissimilar; bracts membrane like, mostly lacerated. Male inflorescence bearing several catkin like male rachillae composed of very approximate bracteoles more or less connate by their margins. Male flowers ovate or oblong with hairy or woolly bracteoles; calyx thin, deeply 3 partite corolla longer than calyx: stamens 6, inserted at the throat of the corolla; filaments short, subulate; pistillode minute. Pistillate inflorescence less branched; female rachillae with a pistillate and a neuter flower in each dyad; female flowers ovoid; calyx membrane like, 3 partite; corolla leathery, slightly longer than calyx, with cup like base and 3 valvate segments; staminodes 6, inserted at the throat of the corolla; ovary distinctly 3 celled, ovoid. Fruits mostly globose, 1-3 seeded, covered with reversed scales with stiff point.

Distribution : INDIA, BURMA, THAILAND, MALAYA PENINSULA, INSULAR MALAYSIA, PHILIPPINES, INDONESIA. About 7 species. 3 species cultivated in India.

Uses : Fruits of some species are edible. Salak is the popular fruit in Indonesia (Mogea 1981). Seed is embedded in a juicy pulp which is consumed raw.

Key to the Species

1a. Leaflets whitish below, narrowly lanceolate . . . *edulis*

1b. Leaflets green on both sides, oblanceolate, lanceolate . . . 2

2a. Leaflets oblanceolate, narrower to a straight base, nerves or the midnerve spinulose near the apex . . . *wallichiana*

2b. Leaflets straight, lanceolate, with 3 spinulose upper nerves. . . *secunda*

Salacca edulis Reinw.

Caespitose, almost stemless palm. Leaves interruptedly pinnate; rachis armed on lower middle with a line of large flattened spines, and spinous also at the sides in its basal part. Leaflets bifarious, all in one plane, often several, one after the other, equidistant with vacant space in between; narrowly lanceolate, slightly sigmoid or falcate, acuminate, terminating in a filamentous tip. Male inflorescence, to 50 cm long; subsecund panicle composed of 5-6 slender, alternate, superposed branches; prophyll and bracts lanceolate - acuminate, thinly rusty tomentose, degenerates into longitudinal fibres. Male flowers just before opening 6-7 mm long, about 2.5 mm broad; calyx 3 partite; corolla 3 partite to form 3 triangular acute segments. (Fruit top shaped, flattened above with 3 seeds enclosed within thick layer of sweet pulp).

Distribution : MALAYSIA, INDONESIA.

Cultivation : It is one of the most widely cultivated palms in South East Asia for its edible fruits. Indian Botanic Garden, Howrah has a large clump of male plants. As the local climate has a long dry period, flowering does not occur in each season.

Salacca secunda Griff.

Leaves pinnate, about 10 m long; petiole covered with rusty indumentum, terete in its upper part; leaflets in groups, of 2-3 on each side of the rachis on its lower part; upper part of the rachis trigonous, unarmed. Leaflets regularly alternate from middle to upper, straight, lanceolate (not sigmoid or falcate), acuminate, filamentous at tip; green and shining on upper surface, distinctly 3-nerved, bristly spinulous on upper nerves from middle to upper, nerves smooth below; margins spinulous from middle upwards; middle leaflets, to 95 cm long, to 7 cm broad; lowermost leaflets shorter and narrower; upper leaflets gradually smaller and less acuminate; uppermost leaflets sometimes united at their base. Male inflorescence with a robust axis; prophyll and bracts covered with rusty indumentum, lanceolate acuminate; primary branches long each bearing rachillae; each coming from the mouth of a fertile bract; rachillae 6-7 cm long, 14-15 mm broad, supported by a slender elongate pedicellar part. Male flowers 8 mm long, clavate, exserted from the bracts. Calyx encloses the corolla before opening; after opening, calyx deeply 3-lobed; corolla little longer than calyx, divided into 3 oblong segments; stamens 6, anthers linear oblong. Fruit globose turminate, very veriable in size and shape, usually 4 cm in diameter; pericarp crustaceous, brittle, covered with sublate-lanceolate dark brown scales, 8-10 mm long, 2-3 broad at base.

Distribution : India (Upper Assam, Mishmee Mountain).

Cultivation : A sterile specimen exists in the Indian Botanic Garden, Howrah which has great similarity with the description by Beccari (1918). According to Beccari (1918) this species is distinct among other *Salacca*.

Salacca wallichiana Mart.

A tufted spreading, dioecious palm. Stem tufted, to 0.5 m long, about 10 cm in diameter, or creeping on the ground. Leaves pinnate, to 7 m long, leaflets deflected upright from the rachis, upper part of leaflets obtriangular with sigmoid acute lobes; leafsheath and petiole extremely spinous, covered with thin, flattened, linear, triangular spines in series like combs. Inflorescence unisexual. Staminate inflorescence, to 1 m long with many rachillae arising from the axial of fertile bracts. Pistillate inflorescence like the staminates. Flowers pale pink to red. Fruits orange brown.

Distribution : Burma, Thailand, Malaya Peninsula.

Uses : Fruit is edible, it is reported that the fruits are consumed as substitute for tamarind as a cooking ingredient (Mogea 1981).

Note : The staminate portion of this species was described from a plant cultivated in the Indian Botanic Garden, Howrah.

Korthalsia Bl.

Dwarf to high climbing rattan. Stem clusterforming, branches aerially, leaves cirrate; leafsheath without knee, without flagellum, armed outside with spines, coated with scales and indumentum; ocrea distinct, thick or membrane like, inflated, sometimes harbouring ants, sometimes armed like leafsheaths; leaflets mostly rhomboid, sometimes elongate, cuneate at base, connected with the rachis with a short stalk (ansa) and with radiating nerves from the base. Inflorescence emerge through the axil of the reduced leaf; rachillae catkin like, tightly covered by membranous bracts; flowers hermaphrodite surrounded by woolly outgrowths; calyx more or less 3 lobed; corolla longer than calyx, tubular at unexposed part; upper part with 3 distinct leathery petals; stamens 6, filaments adnate to the lower part of the corolla tube; style conical with 3 stigmatic grooves; fruit 1 seeded; pericarp covered with rows of scales; seed with fleshy sarcotesta; endosperm ruminate or homogeneous.

Distribution : BURMA and INDOCHINA through MALAYA ARCHIPELAGO to NEW GUINEA. About 31 species. 3 species wild in Andaman and Nicobar Islands (INDIA). None in Indian mainland (Basu 1985).

Plectocomia Mart. ex Bl.

High climbing rattan, hapaxanthic, dioecious. Leaves cirrate; leafsheath without knee and flagellum; leaflets numerous, in groups on both side of the rachis. Inflorescence axillary to the uppermost leaf axils of the reduced leaves; main axis of the inflorescence subtends many pendulous flower branches; each flower branch covered by series of non-tubular, boat-shaped over-lapping bracts; each bract encloses a small branch system that bears flowers. In male flower calyx cupular, 3 dentate, corolla much longer than calyx, divided into 3 valvate petals; female flowers much longer than males; calyx cupular, deeply 3 lobed, not thickened at base; corolla much longer than calyx, divided into 3 acuminate petals; staminodal ring with 6 radiating teeth; ovary 3 ovulate; fruit globose, 1-3 seeded, beaked; fruit scales usually with frilled margins, sometimes densely villous outside; endosperm homogeneous.

Distribution : INDIA, MALAYSIA, INDONESIA and PHILIPPINES. About 14 species Madulid (1981). 4 species in India. None cultivated now.

Daemonorops Bl.

Mostly high climbing rattans, dioecious, pleonanthic, rarely hapaxanthic. Stem cluster forming, with long terete internodes. Leaves cirrate, leafsheaths densely armed with very organised and scattered spines, leafsheath knee conspicuous; flagellum absent; cirrus long whip-like, armed with clusters of strong digitate claws; radical leaves ecirrate; leaflets linear, linear-lanceolate, acuminate; prominently nerved on upper side; margins and nerves of the leaflets mostly bristly. Male and female inflorescences superficially similar, shorter than leaves, emerge opposite to the leaves; the inner bracts enclosed within the outer most bract or prophyll, split along their length to expose flowers or bract borne on some what elongate inflorescence, tubular in bud that at flowering split along their entire length to leave no tubular portion; flower branches usually compact, ramify upto the fourth order to form rachillae. Male flowers solitary in each bract, calyx cupular, 3 dentate; corolla longer than calyx deeply divided into 3 petal lobes; stamens 6, pistillode minute. Female flowers larger than males, each with a sterile male flower; calyx truncate, 3 dentate; corolla twice longer than calyx with 3 distinct thicker petals; staminodes 6, connate, cupular with 3 rudimentary anthers. Fruit ovoid or ellipsoid, distinctly beaked, covered with raflexed scales, 1 seeded; seed with deeply ruminate endosperm.

Distribution : INDIA, CHINA, MALAYSIA, INDONESIA, BURMA, LAOS, VIETNAM, CAMBODIA, BRUNEI, PHILIPPINES. About 114 species. 3 species wild in India. 4 species cultivated in the Indian Botanic Garden, Howrah (Basu 1991).

Key to the Species

1a. Leaflets lanceolate, alternate to subopposite, in pairs. Inflorescence elongate with deeply and broadly spoon shaped prophyll and bracts . . . *didymophylla*

1b. Leaflets linear, alternate to subopposite, not in pairs. Inflorescence with boat shaped prophyll and bracts . . . 2

2a. Leaflets upto 3 cm broad at middle. Outer bract of inflorescence with slender criniform spines; beak of the unexposed inflorescence much longer than fusiform basal part . . . 3

2b. Leaflets more than 3 cm broad at middle. Outer bract of inflorescence with flat, pectinate spines; beak of the unopened inflorescence shorter than fusiform basal part . . . *kurziana*

3a. Peduncle of inflorescence almost smooth. Fruit scales channelled near about the base only, light brown in colour . . . *manii*

3b. Peduncle of inflorescence armed with thick black spines, fruit scales deeply channelled at middle, light yellow in colour . . . *jenkinsiana*

Daemonorops didymophylla Becc.

A clusterforming cane; stem with leafsheath, to 3 cm in diameter; leaf-sheath obliquely truncate, sulcate, tomentose outside, armed with, to 3 cm long solitary, broad based spines. Leaves, to 5 m long, cirrate; petiole biconvex in cross-section, gradually flattened above, armed with short, erect spines on both upper and lower side; rachis angular on upper side, convex lower, armed with solitary or in cluster of strong incurved claws; leaflets lanceolate, alternate to subopposite pairs, about 30-35 in number on each side, attenuate at base, to 35 cm long, 3.5 cm broad, filamentous at apices; midnerve prominent on upper side, lateral nerves inconspicuous. Male inflorescence with peduncle slightly armed. Male flowers 4 mm long, almost linear. Calyx shortly cupular, 3 toothed. Corolla 3 times longer than calyx. Female flowers conical 7 mm long, flat at base, acute. Calyx cupular, obconical, broadly 3 lobed, lobes apiculate, rusty tomentum outside, finely striated. Corolla deeply 3 lobed, twice longer than calyx, petals triangular, acuminate. Fruits broadly ovoid, 2 cm × 1.8 cm; fruit scales brownish, swollen.

Flowering : August. *Fruiting* : Irregular in the Indian Botanic Garden, Howrah.

Distribution : Peninsular Malaysia.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. Grows luxuriantly in the damp atmosphere of the Large Palm House.

Daemonorops jenkinsiana (Griff.) Mart.

A cluster forming dioecious palm. Stem with leafsheath, to 3 cm or more in diameter; internodes, to 20 cm long, striated; leafsheath with distinct knee, scurfy outside, armed with densely packed, to 3 cm long sharp, black needle like spines. Leaves cirrate, to 5 m long; petiole scurfy, to smooth with age, channelled above, convex below; rachis flat to bifaced; armed below with clusters of half whorled black tipped claws; leaflets ensiform, 20-30 on each side, tips ended in small bristles; midnerve and lateral nerves spinous above; occasionally spinous below. Inflorescence subaxillary, not very broadly fusiform; bracts reddish to reddish brown in colour; flower branches densely scurfy at base. Male flowers oblong in bud, 5 mm × 2.5 mm; calyx cupular, hairy at tips; corolla with 3 oblanceolate petals; stamens 6, filaments subulate, connate and thickened at base. Rachillae in female inflorescence, to 8 cm long, sinuous. Female flowers ovoid to globose, 5-5.5 mm long. Fruits globose, 1.8 cm in diameter; fruits scale yellowish in colour with distinct darker marginal lines; seed globose about 8 mm in diameter.

Distribution : India, Bangladesh, Bhutan.

Cultivation : Cultivated in the Large Palm House of the Indian Botanic Garden, Howrah. Experimental cultivation exists in North Bengal under Silviculturist,

Forest Department, Government of West Bengal. It is one of the most useful cane species utilised as raw material for the furniture industries.

Daemonorops manii Becc.

A high climbing cane species; stem slender, with leafsheath, to 3 cm in diameter. Leaves cirrate, cirrus about 2 m long; petiole slightly convex to flat above, smooth, armed with straight unequal, black spines; rachis and cirrus armed with series of half whorled to 3/4th whorled black tipped digitate claws; leaflets deep green, papery, closely set, alternate to subopposite, narrowly ensiform, acuminate and stiffly pointed, 3 nerved, nerves bristly above; largest leaflets, to 30 cm long, to 15 mm broad at middle. Female inflorescence thinly branched, to 28 cm long, peduncle rigid about 3 cm long; outermost bract narrowly boat shaped, distinctly beaked; rachillae 5-8 in number, 2-4 cm long; 4 female flowers in each rachilla. Fruit globose, 1.5 cm in diameter, shortly mamillate; fruit scales in 18 longitudinal series, pale yellow in colour.

Distribution : INDIA (Andaman and Nicobar Islands

Cultivation : Cultivat . in the Indian Botanic Garden, Howrah. The plant in the Large Palm House is a female and fruits profusely from May to August. Fruits are slightly smaller in size.

Daemonorops kurziana Becc.

A high climbing cane species; stem robust, without leafsheath, to 3 cm in diameter. Leaves cirrate; leafblade without cirrus about 4 m long; leafsheath armed with 2-3 cm long blackish, flattened, subulate spines in groups; petiole very stout; basal part of the petiole armed with recurved hooks and several blackish flattened spines; leaflets ensiform, numerous, equidistant, opposite to subopposite, ensiform, to 60 cm long, 3 cm or more broad at widest part; upper part gradually acuminate; upper midnerve more or less smooth from base to middle, only bristly on the apical part. Inflorescence rigid; outer most bract of the inflorescence armed with numerous pectinate spines. Fruits globose, about 2 cm in diameter, very strongly beaked; fruit scales straw yellow in colour with darker finely erosed margins; seed suborbicular.

Distribution : INDIA (South Andamans).

Cultivation : Introduced in 1988 through seeds received from Economic Botany Section, BSI. 4 plants were raised in the Indian Botanic Garden, Howrah.

Calamus Linn.

Dioecious palm; stem mostly cluster forming, climbing or erect, tightly covered with leafsheaths which are armed with delicate to strong, scattered or organised spines, rarely without spines. Leaves pinnate; leafsheath with or without whip-like spinous climbing organ (flagellum), with prominent knee or knee absent; petiole short to long, sometimes armed with spines; in some species rachis extended into a whip-like appendage known as cirrus leaflets mostly linear-ensiform, linear-lanceolate, lanceolate; regular or irregular on rachis; male and female inflorescences axillary, compact or with long slender axis that ends into spiniferous flagellum. Prophyll and bracts tubular at base; involucre prominent in female inflorescence. In male flowers stamens 6; pistillode minute. In female inflorescence with each female flower accompanied with a small sterile male flower. Fruit ovoid, ellipsoid or globose, with or without a beak, covered with medially channelled or flat scales. Seed mostly covered with sarcotesta; exposed seed pitted or grooved; endosperm homogeneous or ruminate; embryo basal or lateral.

Distribution: AFRICA, INDIA, SOUTH CHINA, Southward through MALAYA ARCHIPELAGO to NORTHERN AUSTRALIA and FIJI. About 370 species. 36 species and 2 varieties wild in India. About 9 species cultivated in the Indian Botanic Garden, Howrah (Basu 1991).

Uses : One of the most exploited forest product. Canes are used for making furniture frames and various other items of local uses.

Key to the Species

1a. Leaf with rachis not ending in a cirrus . . . 2

1b. Leaf rachis ending in a cirrus . . . 9

2a. Stem non climbing . . . 3

2b. Stem climbing . . . 4

3a. Large colony forming palm; leaflets long, deep green above, whitish below; inflorescence slender, pendulous . . . *arborescens*

3b. Stems tufted; leaflets green on both sides; inflorescence compact, more or less erect from the leaf axil . . . *erectus*

4a. Leaflets regularly disposed on the rachis . . . 6

4b. Leaflets irregularly disposed on the rachis, sometimes in groups. . . 5

5a. A strong robust climber; leaflets ensiform; fruit scales fimbriate at margins, tiger stripped, not channelled . . . *longisetus*

5b. A slender climber; leaflets lanceolate, in groups, fruit scales not fimbriate at margins, yellowish in colour . . . *viminalis*

6a. Primary bracts of the inflorescence after opening form a long free appendage . . . *guruba*

6b. Primary bracts of inflorescence after opening do not form free appendage . . . 7

7a. Leaflets pectinate, papery; thickly spinulose on upper nerves; petiole and rachis covered with deep brown tomentum . . . *ciliaris*

7b. Leaflets alternate to subopposite, not papery, not thickly spinulose on nerves, not covered with deep brown tomentum . . . 8

8a. Leafsheath armed with small, broad based spines in rows, jointed at base . . . *tenuis*

8b. Leafsheath armed with scattered, needlelike bulbous based spines . . . *rotang*

9a. Leafsheath covered with closely packed bulbous based spines; leaflets broadly lanceolate, irregularly alternate, not in groups . . . *unifarius var. pentong*

9b. Leafsheath unarmed; leaflets linear ensiform . . . *inermis*

Calamus arborescens Griff.

A non climbing colony forming rattan; stem erect, strong, 3-5 m long, 4-6 cm in diameter near base, annulate. Leaves arching, about 2 m long; leafsheath, petiole and rachis covered with thick, black, subulate, seriate to pectinate, 1-4 cm long black spines; leaflets equidistant, to 80 cm long, acuminate, to thinly bristly at apices, prominently bristly on upper and lower nerves. Inflorescence interfoliar, to 2 m long, pendulous; peduncle smooth, compressed, green; bracts 20-30 cm long, lacerate at upper part, thickly spiny below; male rachillae scorpiod; male flowers distichous; anthers linear, exserted; pistillode angular with 3 abortive carpels united upto the middle.

Distribution : Burma, Indochina, Malaya Peninsula. This species has no natural distribution in India. Introduced in the Indian Botanic Garden, Howrah in 1810 from Pegu, Burma (Myanmar). Now Garden has several large colonies of this species.

Cultivation : This species can be grown in large earthern pots as ornamental palm. Its beautiful dark green foliages are very attractive. Needs regular watering and soaking of the pot. It prefers to grow along the pond or lake if planted in the open.

Uses : Dried stem though very thick in diameter is not durable and cannot be bent easily therefore unsuitable for making furniture frames, but the mature stem can be used as poles or as roof support of thatched huts or can be used as handle of hatchets etc.

Calamus ciliaris Bl.

Clusterforming slender rattan; stem with leafsheath, to 1.5 cm in diameter. Leaves pinnate, 40-60 cm long; leafsheath striated, densely spiny outside; spines straight, swollen at base; leafsheath flagellum slender about 1.5 m long, almost unarmed at base, aerial part of the flagellum spinulose, filiform at tip; petiole prominently channelled above, rounded below, armed with solitary, scattered, small hooks and sharp straight spines; rachis bifaced above, convex below, densely tomentose outside; tomentum deep brown in colour; leaflets linear papery, about 60 in number on each side of the rachis, 9-12 cm long, prominently 3 nerved. Flowers and fruits not seen.

Distribution : MALAYA PENINSULA.

This slender rattan species is in cultivation in the Indian Botanic Garden, Howrah since long time, its exact date of introduction is untraceable. Due to its delicate nature it is mostly grown in pots as ornamental palm. In 1986 an overgrown potted plant was planted in the Palmatum under the shade of bigger palms. Not yet flowering.

Cultivation : Not common in cultivation. The sucker shoots remain erect upto 1 m from ground. Vegetative propagation is possible by sucker shoots which should be cut at the base along with some growing roots.

Uses : Other uses unknown.

Calamus erectus Roxb.

Clusterforming non climbing rattan; stem with leafsheath about 4 cm in diameter; leafsheath without flagellum, armed on outer side with black, flattened spines; ocrea conspicuously auriculate; petiole more or less rounded, covered with irregular and whorled flattened spines; leaflets linear-ensiform, equidistant on rachis; rachis armed below with irregular to whorled straight spines. Inflorescence interfoliar, non flagelliform, compact; primary bracts elongate, tubular at base, lacerate at upper portion; peduncle strongly armed with black, flattened comb-like spines. Fruits ellipsoid, 3 cm × 2 cm, with distinct beak, seed oblong to ovoid; endosperm ruminate; embryo basal.

Distribution : INDIA (Sikkim, West Bengal, Assam, Meghalaya, Manipur). BANGLADESH, BURMA (Myanmar), THAILAND. Grows on lower hill slopes especially on the drier slopes. Frequent in the Tista and Rangit valley or Sikkim and West Bengal.

Cultivation : Experimental cultivation exists in Jalpaiguri of West Bengal under North Silviculture Division. Experimental cultivation also exists in the Forest Research Institute of Bangladesh in Chittagong. This species is also cultivated in the Indian Botanic Garden, Howrah, mostly propagated through suckers.

Uses : Due to shorter nodes cane is not useful for furniture making. Thick sticks are mostly used as posts, alpenstocks etc.

Calamus inermis T. Anders.

Clusterforming robust climber. Stem with leafsheath 5-6 cm in diameter. Leaves ending in cirrus; leafblade excluding cirrus about 2 m long; leafsheath smooth outside with distinct knee, deep green in colour, thinly covered with light brown indumentum; leaflets numerous, linear-lanceolate, in pairs on each side of the rachis; middle to upper leaflets alternate, to 60 cm long, to 5 cm broad at middle; midnerve and lateral nerves more or less smooth; margins spinulose. Female inflorescence about 1 m long; rachillae 8-10 cm long, each inserted within the mouth of the respective basal bract; fertile portion of the rachilla wavy, with 8-10 flowers on each side. Fruits ellipsoid, about 3 cm long, 1.5 cm wide at middle; fruit scale light brown in colour, in 18 series, deeply channelled at middle.

Distribution : INDIA (Sikkim, West Bengal). This robust cane is localised in the mixed plain forest and lower hill forests of Sikkim Himalaya upto 800 m. Now infrequent in its natural habitat. (Basu & Chakraverty 1990).

Cultivation : Reported to be cultivated in Jalpaiguri under North Silviculture Division. Cultivated in the Indian Botanic Garden, Howrah. So long it was remain unnamed in the Garden.

Uses : The strong hard cane is used as police sticks and for making chair frames.

Calamus longisetus Grift.

Clusterforming robust climber. Stem with leafsheath, to 4 cm in diameter, internodes about 40 cm long, deep green in colour. Leaves without cirrus, pinnate, arching, about 5 m long; leafsheath covered with deep brown to blackish

felt like coating and armed with 3-4 cm long, black subulate spines and scattered, needle-like spines; longer spines jointed at base; ocrea papery; petiole deeply channelled upper, to 40 cm long, 2.5 cm broad at middle; upper side of the petiole thickly covered with needle-like black spines and lower side armed with strong, 2-3 cm long, flat, black, subulate spines; rachis armed below with whorls of flattened yellowish spines; leaflets ensiform, green on both surface, often in groups of 3-4 leaflets projecting in different directions; each, to 90 cm long, 3 cm wide at middle. Inflorescence flagelliform, to 7 m long or more; primary bracts elongate thinly leathery in texture, very closely sheathing; male rachillae, to 15 cm long, male flowers densely distichous; female rachillae simple, alternate about 15 cm long. Fruits obconical to ellipsoid, 3 cm long, narrowed into a strong solid beak; fruit scales flattened, yellowish with distinct dark brown band appearing like tiger skin. Seed one, oblong, superficially furrowed on the back, smooth and more or less flat on other side. Endosperm homogeneous.

Distribution : India (South Andamans), Bangladesh, Burma (Myanmar), Thailand, Malaya Peninsula. Common in the deep forests of the plains or on low hills.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah, since 1810. It is cultivated in the Experimental garden of the Forest Research Institute of Bangladesh, in Chittagong. This species thrives well in the climate of lower Bengal and prefers damp soil for luxuriant growth. A moderately fast growing cane and yields profuse fruits in each fruiting season. Fruits mature in August. Squirrels are fond of eating ripe fruits (Basu & Basu 1987).

Uses : Cane is not very strong, therefore has limited use to making rough baskets.

Calamus guruba (Buch.-Ham.) ex Mart.

Clusterforming slender climber. Stem with leafsheath, to 2.5 cm in diameter, internodes, to 30 cm long. Leaves without cirrus, pinnate, to 120 cm long; leafsheath with prominent knee and about 2.5 m long delicate flagellum, armed with subulate spines; leaflets numerous, bifarious, equidistant, alternate to subopposite, linear, prominently 3 nerved, to 60 cm long, to 2.5 cm broad at middle, green on both sides. Inflorescences flagelliform, 2-3 m long; primary bracts conspicuous, split longitudinally into long free ribbon like appendage, longer than the respective partial inflorescence. Fruits pea-like or rounded, to 7 mm in diameter; fruiting perianth shortly pedicelliform. Seed hard, deep red to blackish in colour, surface rough and pitted, flat on one side.

Distribution : India (West Bengal, Assam, Meghalaya), Bangladesh, Burma, Thailand.

Cultivation : Experimental cultivation exists in Jalpaiguri under North Silviculture Division. Also cultivated in the Indian Botanic Garden, Howrah. This species is easily propagated through offsets or through seed germination. A slow growing cane.

Uses : Cane is largely used for making rough baskets. Split canes are good materials for making chairbottoms. One of the most commercially exploited canes of India.

Calamus tenuis Roxb.

Clusterforming slender climber. Stem with leafsheath 1 cm - 2.5 cm in diameter. Leaves without cirrus, pinnate, to 1 m long; leafsheath with conspicuous knee, armed outside with very small, broad based spines in rows, jointed at their base; petiole short, slender; rachis armed on upper side with 2-2.5 cm long curved spines and along both sides with 2-2.5 cm long straight, needle-like spines; leaflets narrowly lanceolate, to 35 cm long, to 15 mm broad at middle, equidistant, gradually smaller towards apex; uppermost leaflets smallest. Inflorescence flagelliform, slender; rachillae in male inflorescence 2-3 cm long, with 2 series of 6-10 male flowers; rachillae in female inflorescence incurved; female flowers distinctly 4 seriate with a well developed neuter flower along with each female flower. Fruits globose, about 11 mm in diameter, straw coloured, shortly and actuely beaked; fruits narrowly channelled at middle. Seed globose.

Distribution : INDIA (Uttar Pradesh, eastward to West Bengal, Assam, Meghalaya, Manipur, Tripura, Nagaland). BANGLADESH, BURMA (Myanmar). SOUTH VIETNAM. Common in lower hill valleys and seasonal swamps.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah and Forest Research Institute, Dehra Dun. It is also cultivated in the trial plots of Kerala Forest Research Institure, Peechi, Kerala and Forest Research Institute of Bangladesh, in Chittagong. This species is easily propagated through offsets and seeds.

Uses : One of the most commercially exploited canes of the Indian subcontinent. Ripe fruits are edible and sold in the village markets of Bengal. Locally known as *Pani bet*.

Calamus rotang Linn.

Clusterforming slender climber, forms huge colony of slender stems. Stem with leafsheath 8-16 mm in diameter; internodes, to 40 cm long. Leaves without cirrus, pinnate: leafsheath with distinct knee, armed with scattered, broad based about 1 cm long yellowish spines, each pointing downward; leafsheath flagellum slender about 2 m long; petiole absent; leaflets numerous, equidistant or

subequidistant, linear to lanceolate, prominently 1-nerved, to 15 cm long, 1.5 cm broad at middle; midnerve with small hooks on upper side, uniformly spinulose below; uppermost leaflets smallest. Inflorescence flagelliform, axial portion strongly aculeate; rachillae in male inflorescence scorpioid, 12-35 cm long; rachillae in female inflorescence curving. Fruits globose, apiculate, about 1.5 cm in diameter; fruit scales pale green in colour, faintly channelled at middle. Seed flattened, about 8 mm in diameter.

Distribution : INDIA (Andhra Pradesh, Tamil nadu, Kerala) SRI LANKA. Common in coastal fresh water swamp forests, frequent along the fresh water streams of lower hill valleys.

Cultivation: Cultivated in the Indian Botanic Garden, Howrah. It is also cultivated in the trial plots of Kerala Forest Reserach Institute, Peechi, Kerala. Propagated through suckers and offsets and through seeds.

Uses : Cane is used for making rough baskets. Split cane is used for making chairbottoms.

Calamus unifarius Wendl. var. **pentong** Becc.

Moderately robust climber. Stem with leafsheath about 5 cm in diameter; naked stem light yellow in colour. Leaves ending in a cirrus; leafsheath greenish yellow, with distinct knee, covered with closely packed 5-10 mm long, bulbous based, non seriate spines; petiole very short in adult plant; lower side of rachis centrally ridged, armed with bulbous based straight spines; leaflets broadly lanceolate, not many per leaf, subequidistant on rachis; each about 30 cm long, 5 cm broad at middle, 5-7 nerved; nerves smooth on both sides. Rachillae in male inflorescence arching from base, to 3 cm long, with 5-15 distichous male flowers, rachillae in female inflorescence slender, to 8 cm long. Fruit globose, about 1 cm in diameter; fruit scales green, distinctly channelled at middle; fruiting perianth pedicelliform. Seed pitted.

Distribution : INDIA (Andaman Islands). Frequent in the coastal moist forests.

Cultivation : Introduced from Andaman Islands to the Indian Botanic Garden, Howrah in the year 1971. Raised and propagated in the Garden where two large bushes exist, one in the Large Palm House and other in the Palmetum.

Uses : Cane is not strong and durable. It is seen from the cultivated specimens that the mature cane splits after drying.

Calamus viminalis Willd.

Clusterforming slender climber. Stem with leafsheath 2.5 cm to 3 cm in diameter. Leaves without cirrus, pinnate, to 1.5 m long; leafsheath with distinct knee and long flagellum, coated with light brown to blackish felt, armed along margin with straight yellowish spines; leaflets lanceolate, pointed at apex, to 30 cm long, to 2.5 cm broad at middle, distinctly grouped on each side of the rachis, sometimes alternate; nerves distinctly bristly on upper side. Inflorescence flagelliform, leaf opposite; rachillae in male inflorescence filiform, to 20 cm long; rachillae in female inflorescence alternate, zig-zag, to 25 cm long. Fruits globose, profuse, to 9 mm in diameter, with distinct columner beak; fruit scale light green to yellowish, channelled at middle. Seed compressed, rounded.

Distribution : INDIA (West Bengal, Bihar, Orissa, Andhra Pradesh, Maharashtra, Sikkim, Tripura, possibly in other states in north east India and Andaman Islands). BANGLADESH, BURMA, THAILAND, MALAYA PENINSULA, JAVA. Mostly as thickets in the cleared forests. In Andaman Islands it is a component of the frequently flooded forests of low lying areas. Very variable in its vegetative characters. Insular species are more vigorous in habit with larger leaflets and thicker stem.

Cultivation: Cultivated in the Indian Botanic Garden, Howrah, Forest Research Institute, Dehra Dun, Kerala Forest Research Institute, Peechi,Kerala and Nandan Kanan in Bhubaneswar, Orissa. Most common cultivated cane in India. It is also grown as ornamental palm.

Uses : It is the most used cane of India. The strong canes are used for making baskets and various other articles of local uses. Split canes are used as chairbottom. Its fruits are edible and pith from the lower part of the stem can be eaten as vegetable. leaves are also used as fodder for elephants.

Subfamily : Nypoideae

Monoecious, pleonanthic palm; stem prostrate, branching dichotomously; leaves pinnate, reduplicately folded. Inflorescences terminated by a pistillate head and lateral branches grow beyond the head and form cat-kin like curving male rachillae.

Nypa Steck

Distribution : Species 1, distributed in INDOMALAYSIA, ASIA, PHILIPPINES, MELANESIA, OCEANIA, AUSTRALIA (Moore 1973).

Nypa fruticans Wurmb. *Gol Pata* (Beng.).

Stem mostly subterrenian. Leaves pinnate, 6-7 m long, erect, uppermost part arching; petiole terete, smooth with long sheathing leafbase; rachis, to 2.5 m long;

leaflets linear, alternate, reduplicate, to 1 m long, acute to attenuate at tips, about 40 in pair par leaf; midnerve prominent on lower side with paired scales at intervals; upper surface of leaflets glossy green, lower surface pale green. Inflorescence interfoliar, bisexual, 70-80 cm long; primary axis covered under sheathing bracts; prophyll, peduncular and rachis bracts variously adnate with the axis; upper part free, bright yellow when fresh with light green stripes on outer side. Primary flower branches 4, distichously arranged, almost in similar pattern with the whole inflorescence; axillary branches bear 1-8 finger like staminate spikes; terminal axis ends in a head of pistillate flowers subtended by many small imbricate bracts. Male flowers densely crowded, subtended by subulate bracts with outer and inner series of oblanceolate about 3 mm long perianths; outer segments obtuse or rounded, inner slightly prolonged into blunt points; stamens 3, fused into a column; filaments 3 mm long; anthers basifixed. Pistillode absent. Female flowers terminal; perianth 6, vestigial, scale-like; staminodes absent; carpels 3, greatly enlarged; each carpel has a terminal small slit; ovule solitary, erect; style large, slightly angular. Fruits crowded in a globose mass, 8-10 cm long 20 cm in diameter, 2-4 angled, ovoid to obcordate; epicarp smooth, mesocarp spongy and fibrous. Seed 1 cm long.

Flowering : September-November. *Fruiting* : May-June.

Distribution : INDOMALAYSIA, ASIA, PHILIPPINES, N.E. AUSTRALIA, INDIA, BANGLADESH.

Cultivation : In India it is naturally occuring in Sunderbans and Andaman Islands. Rarely cultivated as ornamental palm. A good healthy colony of this palm is seen in the Governer's House Garden in Calcutta and the garden of the Theosophical Society, Adyar, Madras. A healthy colony is also seen in a residential garden located in South Calcutta.

Uses : Leaves are used as thatch. A well developed inflorescence yields huge quantity of sugary sap from the peduncle for a period of about 10 days.

Subfamily : Ceroxyloideae

Tall, moderate or small, solitary or clustered, unarmed palms, hermaphroditic, monoecious or dioecious; leaves regularly or irregularly pinnate, bifid or entire and pinnately ribbed, reduplicate; crownshaft present or absent. Inflorescence with prophyll, usually with many peduncular bracts. Flowers when unisexual only slightly dimorphic, solitary or in acervulus or 3 flowers, gynoecium syncarpus, triovulated.

Tribe : Hyophorbeae

Monoecious or dioecious palms. Crownshaft present or absent; flowers sessile, usually ebracteolate at anthesis, borne singly or in acervuli of a pistillate and

two to many staminate or in lines of staminate flowers or rarely pistillate flowers. Stamens included within the staminate flower until or sometimes at anthesis.

Hyophorbe Gaertn.

Monoecious palm. Stem solitary, cylindrical or unequally thick or swollen at the middle or near the base, distinctly annulate. Leaves pinnate, arching, with distinct crownshaft, green or pale green; leaflets linear, subopposite, sometimes expanded at base, reduplicately folded, midnerve and anstomosing nerves yellowish; petiole rounded below, flattened and grooved on upper side. Inflorescence infrafoliar; prophyll and peduncular bracts boat shaped, caducous; flowers in acervuli; male flowers distal in a row; stamens 6, filaments broad at base; pistillode conspicuous; female flowers solitary in the acervulus, proximal, staminodes conspicuous, connate to form a ring with 6 prominent projection.

Distribution : MADAGASCAR, MAURITIUS, SEYCHELLES, MASCARENE ISLANDS. 5 species. (Moore 1976). 2 species cultivated in India.

Pollen grains : Elliptic monosulcate.

Key to the Species

1a. Stem narrow above, sometimes bottle shaped, petiole short, ridged on upper side; rachis twisted to one side, green. Inflorescence diffused; flower branches (rachillae) straight, fruits ovoid . . . *lagenicaulis*

1b. Stem more or less cylindrical; petiole long, rachis not twisted to one side; a prominent median orange yellow line runs all along the lower side of the petiole to rachis. Flower branches (rachillae) drooping at anthesis. Fruits oblong . . . *verschaffeltii*

Hyophorbe lagenicaulis (L. H. Bailey) H.E. Moore, *Mascarena lagenicaulis* L. H. Bailey

Stem solitary, swollen at base, sometimes bottle shaped, closely annulate, about 4 m long. Crownshaft distinct. Leaves stout; rachis firm, leaflets stiff, not in same plane on the rachis, closely placed; middle leaflets, to 60 cm long, 4 cm wide at middle, dull green in colour; midnerve and lateral nerves yellowish. Inflorescence, to 80 cm long; prophyll and peduncular bracts boat shaped, caducous; basal flower branches twice divided; upper flower branches solitary, alternate, slightly twisted. Ultimate flower branches (rachillae) swollen at base, smooth, to 20 cm long, slightly adnate at base. Male flowers 4-8, each 4 mm long at anthesis; stamens 6, filaments subulate, anthers not exserted from the petal lobes at anthesis; female flowers 4 mm long; calyx cupular, fleshy, irregularly 3-lobed; corolla 3-lobed, lobes broadly

ovate, yellowish, 2 mm × 2 mm, obtuse; ovary globose, conical, 2 mm long; stigmas 3, reflexed, inner papillose; staminodes 6, subulate, connate, 1.5 mm long. Fruits ovoid, 1-seeded.

Flowering : February-April (May-June). *Fruiting* : Sept.-January.

Distribution : Mascarene Islands, Mauritius.

Cultivation : Uncommon in cultivation. Mostly grown as pot plant. A few mature plants exist in the Indian Botanic Garden, Howrah and in some private gardens in Calcutta. Inflorescences develop cauliflorously and spirally on the upper part of the stem. Inflorescences developing at the beginning of the flowering season only bear fruits. The twisted rachis of the leaf is very characteristic of this species.

Hyophorbe verschaffeltii Wendl.

Stem solitary, erect about 6 m long, about 30 cm diameter near base. Leaves pinnate, arching about 2 m long; crownshaft cylindrical, slightly bulged at base; petiole half round below, grooved above; leaflets linear, diffused, to 50 cm long, to 3 cm wide at middle; tip of the leaflets slightly drooping; midnerve on lower side minutely scurfy. Inflorescence infrafoliar, to 80 cm long; flower branches slender. Male flowers 5 mm long, stamens 6, pistillode columner. Fruit oblong, 1.5 cm long, 8 mm in diameter at middle, blunt at stigmatic end; perianth persistent.

Flowering : February-March. *Fruiting* : July-September.

During flowering season a typical brush-like inflorescences develop from the dormant axillary buds below the crownshaft and open in ascending spiral order.

Distribution : Mascarene Islands.

Cultivation : A very popular ornamental palm in India, it is mostly grown in pots or in the Green Houses. Some old well-grown trees are found in the Agricultural and Horticultural Society's Garden in Calcutta. This species is also grown in other parts of India.

Chamaedorea elegans Mart.

A very delicate looking dioecious palm. Stem 2-3 cm in diameter near base, often reaches about 2 m in height, sometimes throws out adventitious roots little above the base. Leaves pinnate, about 60 cm long, usually 6-8 in number; leaflets about 14, alternate, lanceolate, 10-20 cm long, green on both sides, pointed at apex. Inflorescence interfoliar, panicle. Flowers yellow, unisexual. Ripe fruits small, reddish brown in colour.

Distribution : Mexico, Guatemala.

Cultivation : Mostly cultivated in pots. In the local climate it prefers shade and frequent watering. A very handsome palm for interior decoration. Exposure to sun in hot months is harmful and plant may loose its beautiful foliages.

Subfamily : Arecoideae

Key to the Tribes

1a. Leaves pinnate or bipinnate, induplicate. Inflorescence hapaxanthic or pleonanthic, monoecious, rarely dioecious; mostly prophyll and many peduncular bracts . . . *Caryoteae*

1b. Leaves pinnate or pinnately ribbed, reduplicate. Inflorescence unisexual or bisexual with a prophyll and a large peduncular bract . . . 2

2a. Fruit with bony endocarp with 3 distinct pores below or above the middle . . . *Cocoeae*

2b. Fruit without bony endocarp or pores . . . *Areceae*

Tribe : Caryoteae

Key to the Genera

1a. Leaves bipinnate in adult plants. Inflorescence always solitary in each node, bisexual. Fruits mostly globose, 1-2 seeded; endosperm ruminate . . . *Caryota*

1b. Leaves 1-pinnate in adult plants. Inflorescence not always solitary in each node, unisexual or bisexual. Fruits not globose, 1-3 seeded; endosperm homogeneous . . . 2

2a. Inflorescence always solitary in each node, always unisexual; petals in female flowers connate at base to form a solid cylinder. . . *Wallichia*

2b. Inflorescence not always solitary at each node, bisexual, sometimes unisexual by suppression of one sex; petals in female flowers connate to about the middle from base but do not form a solid cylinder . . . *Arenga*

Arenga Labill.

Solitary or clusterforming, tall or bushy, monoecious, monocarpic, hapaxanthic, rarely pleonanthic palms. Leaves pinnate, simple in very young plants; leaflets shallowly induplicate, terminal leaflets usually jointed; leaf sheath tubular with coarsely fibrous upper part. Inflorescence terminal and axillary with inconspicuous

Calamus arborescens Griff.

Calamus arborescens Griff.

Calamus ciliaris Bl.

Calamus erectus Roxb.

Calamus longisetus Griff.

Calamus unifarius Wendl.
var. *pentong* Becc.

Nypa fruticans Wurmb

Arenga englerii Becc.

prophyll and many sheathing fibrous peduncular bracts; flower branches (rachillae) simple; emergence of inflorescence mostly basipetal rarely accropetal; flower clusters mostly triad of two lateral male flowers and a middle female flower or paired males or solitary males; female flowers spirally disposed on the rachillae. Male flowers with 3, imbricate sepals and 3 valvate petals; stamens numerous; pistillode absent; female flowers with 3 imbricate sepals and 3 valvate petals; staminodes sometimes present; fruit oblong to ovoid, 3 seeded; fruit pulp irritating to skin; seed flattened on one side with homogeneous endosperm.

Distribution : The Himalaya to Hainan, and Malesia east to New Guinea, about 20 species. 4 species wild in India (Northeast India, Weastern Ghats, Andaman Islands). 6 species cultivated. Grows in moist forests and wet mountain slopes.

Key to the Species

1a. Stem solitary . . . 2

1b. Stem culsterforming . . . 3

2a. Leaflets 4 fariously fascicled, floppy, bi-auriculate at base, stem always covered with persistent leafsheaths and fibres . . *pinnata*

2b. Leaflets not fascicled, regular, in one plane, unequally 2-auriculate at base. Stem barren from lower to middle . . . *westerhoutii*

3a. Stem slender; leaflets lobed, linear, exauriculate at base . . . 4

3b. Stem more or less robust; leaflets linear, auriculate at base . . . 5

4a. Leaflets panduraeformly lobed; inflorescence simple . . . *nana*

4b. Leaflets linear; inflorescence multiple per axil, branched . . . *englerii*

5a. Basal auricles of leaflets more or less equal in length . . . 6

5b. Basal auricles of leaflets extend beyond rachis . . . *wightii*

6a. Leaflets undulated along margins, petals in male flower green . . . *undulatifolia*

6b. Leaflets not undulated at margins; petals in male flowers deep crimson . . . *obtusifolia*

Arenga englerii Becc.

A clusterforming dwarf to bushy hapaxanthic palm. Stem, to 2 m long, to 6 cm in diameter near base; leafsheath fibres persistent on the stem. Leaves pinnate, arching, to 2.5 m long, slightly twisted to one side; petiole nearly rounded, grooved at middle, scurfy out side, about 60 cm long; rachis triangular in cross

section, bifaced on upper side; leaflets stiff, elongated; basal leaflets in fascicles; middle to upper leaflets subopposite to alternate; margins spinescent; lower surface whitish; terminal leaflets narrowly cuneate, 3 lobed at apex, prominently 3 nerved. Staminate inflorescence axillary, extra axillary staminate inflorescences present; male flowers clavate; anthers short. Pistillate inflorescence terminal; flower branches simple, alternate, each, to 15 cm long, slightly adnate to primary axis at base. Female flowers 2 bracteate, spirally disposed; bracts reniform. Ripe fruits globose, orange yellow in colour, about 1.8 cm in diameter, 3 seeded; seed with oblique outer side.

Distribution : TAIWAN, RYUKYU ISLAND.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. Grows luxuriantly in the Green Houses and in moist shady condition. Not very popular in cultivation.

Arenga nana (Griff.) H. E. Moore

A clusterforming dwarf hapaxanthic palm. Stem slender with leafsheath 5 cm in diameter, to 1.5 m long. Leaves pinnate, to 80 cm long, petiole slender, to 40 cm long, 7 mm broad; leafsheaths with anastomosing fibres from margins, liguliform at upper part; leaflets alternate to subopposite, obliquely trapezoid in shape, about 20 cm long. Inflorescence terminal and axillary. Staminate inflorescence with 2-3 slender simple rachillae; male flowers crowded on the rachilla, 5 mm × 4 mm, calyx saucer shaped, with 3 half-orbicular lobes; petals 3, oblong, navicular, 4.5 mm × 3 mm; stamens about 14 in number, inserted on a small torus, slightly shorter than petals. Pistillate inflorescence terminal; female flower ovoid, 4 mm long; calyx deeply 3 lobed, greenish; corolla with 3 broadly ovate, striated thick petals; ovary trigonous at lower part, 2 loculed, 1 ovalate. Fruits white, obliquely oblong, 10 mm × 7 mm.

Distribution : INDIA (Assam, Meghalaya, Arunachal Pradesh), BURMA (Myanmar). Frequent in the moist hill slopes of Guahati hills, Khasia hills and Dhapla hills.

Cultivation : Rare in cultivation. This species can be grown in the Green Houses as ornamental plant.

Arenga obtusifolia Mart.

A clusterforming pleonanthic palm. Stem erect, to 8 m long, about 30 cm in diameter near base; exposed portion of the stem dull grey, distinctly ringed and with distinct leaf scar marks. Leaves pinnate, slightly ascending, to 4 m long; petiole stout more or less rounded, to 50 cm long, 9 cm in diameter near base; leaflets alternate to subopposite, linear, sessile, biauriculate at base; lower leaflets without auricle; middle leaflets, to 1.5 m long, 2.3 cm broad at middle,

2 fid at apices; upper margins and tip of the leaflets erose dentate. Inflorescence accropetal in emergence: peduncle stout, bright green, incurved: to 30 cm long: peduncular bracts boat shaped, leathery; flower branches simple, fastigiate, deep green in colour; each, to 50 cm long; male flowers mostly in pairs, oblong, 1.7 mm × 1 cm; sepals 3, broadly orbicular, imbricate; petals fleshy, broadly ovate, valvate, 1.5 cm × 1.3 cm, 1/3rd connate from base; stamens shorter than corolla about 190 in number; filaments purple; anthers linear, bilobed, aristate. Female flowers subturbinate 1.2 cm × 1.5 cm. Fruit subglobose, faintly 3 ridged on upper side, 3 seeded, deep crimson when ripe, to 4 cm in diameter; seed, to 3 cm long.

Distribution : INDONESIA (Java).

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. Unlike most *Arenga* species, here emergence of inflorescences takes place in accropetal order and each stem in the cluster is functionally dioecious. The shape of the leaflets are also variable, some leaflets have distinct bilobed tips, some are obliquely lobed or truncate. Juice from the mesocarp of fruits is highly irritating to the skin. This species can also be grown as pot plant.

Arenga pinnata (Wurmb) Merr. *Sugar Palm.*

A single stemmed monocarpic palm about 10 m long. Stem massive, completely covered with black coarse leafsheath fibres and bristles and portion of persistent leafbases. Leaves pinnate, massive, to 10 m long; upper leaves ascending, petiole heavy, deep green in colour, rounded, to 1.5 m long; leaflets narrowly oblong, to 60 cm long, 4.4 cm - 5 cm broad at middle, deep green upper, whitish below; margins distinctly toothed, arranged in fascicles in 6 ranks, middle and upper leaflets auriculate at base, truncate at apices. Inflorescence terminal and axillary, basipetal in emergence; each 2-3 m long; peduncle stout, roundish, deep green, covered with many boatshaped fibrous bracts; pistillate inflorescence terminal; flower branches simple, pendulous, to 110 cm long; flowers basically in triads; male flowers oblong, 2.5 cm × 1.5 cm; sepals 3 orbicular about 9 mm long; petals ovate-oblong, 14-6 mm × 8-40 mm; stamens numerous; filaments about 9 mm long; anthers apiculate. Female flowers subglobose, 1.5 cm × 1 cm; sepals transversely ovate; petals ovate-cordate, 2.5 cm × 1 cm, fleshy, 1/4th connate; ovary subtrigonous, 3 ridged above; stigma 3 fid. Fruits acutely trigonous, obovoid, apically truncate, 4 cm × 3.5 cm, brightly yellow when ripe, 3 seeded; seed narrowly ovoid, longitudinally flattended.

Distribution : INDIA (Semi-wild in Andaman Islands), MALAYSIA, INDONESIA and PHILIPPINES.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah where this species was introduced during the earlier part of the 19th century.

Uses : The core of the stem yields huge quantity of edible starch, the terminal bud (cabbage) is eaten as vegetable, the sap collected from the peduncle of inflorescences after boiling is made into jaggary or fermented into toddy. The endosperm of the seed after soaking in lime water and boiling becomes edible. Leafsheath fibres are used for making brush, rope, mats etc.

Arenga undulatifolia Becc.

A clusterforming hapaxanthic palm. Stem about 5 m long, about 30 cm wide at base; upper part of the stem under cover of persistant leafsheaths conspicuous by horse hair like black fibrous out growths and bristles. Leaves pinnate, arching about 8 m long; petiole rounded, channelled above; leaflets alternate to subopposite, linear, 1 auriculate at base, dentate at apices, about 90 cm long, 15 cm broad at middle; margins of leaflets wavy; upper surface deep green, lower surface whitish; midnerve prominent on lower side; lower leaflets in fascicles, wedge shaped. Inflorescences terminal and axillary, to 150 cm long; rachillae simple, to 80 cm long; terminal inflorescence and a few in immediate lower axils are fruit bearing; male flowers mostly in pairs, some times solitary; stamens numerous; anthers linear, aristate, orange yellow in colour when fresh. Female flowers spirally disposed, depressed globose, 1 cm × 1.4 cm. Fruit subglobose, distinctly trigonous on upper side, 3 cm × 2.5 cm, deep red in colour when ripe.

Distribution : INDONESIA (Borneo, Celebes).

Cultivation : Cultivated in the Indian Botanic Garden, Howrah.

Arenga wightii Griff. *Alam Panei* (Tam.), *Alathil Tenga, Malam Tengu* (Mal.).

Solitary or sometimes cluster forming hapaxanthic palm. Stem about 4 m long, with leafsheath about 30 cm in width near base; upper part of the stem covered with persistent leafsheaths conspicuous by their fibrous outgrowths from the margins. Leaves pinnate about 5 m long; petiole roundish, to 1 m long; leaflets alternate to sub-opposite, in one plane, linear ensiform, 1-1.5 m long, 3-4 cm broad at middle; upper surface light green, lower surface whitish. Inflorescence terminal and axillary, basipetal in emergence, to 1.5 m long; male flowers oblong, 20 mm × 8 mm; sepals transversely orbicular, 5 mm × 8 mm; petals elliptic-oblong, 18 mm × 6 mm; stamens with very short filaments; anthers bilobed, 9 mm × 1 mm. Female flowers subglobose, 13 mm × 12 mm; sepals broadly orbicular, 4 mm × 6 mm, imbricate; petals obcordate, obtuse, 8 mm × 8 mm, 1/3 connate from base; ovary subglobose, with 3 distinct upper ridges. Fruits subglobose, slightly trigonous, to 3 cm in diameter, yellowish green in colour when ripe; seed convex, equally bifacing; endosperm horny; embryo on the outer end of the convex face.

Distribution : INDIA (Western Ghats to Tamil nadu, Kerala and Karnataka). Grows naturally in the moist hill forest particularly on the slopes between 150-1000 m.

Cultivation : Rarely cultivated as ornamental plant. Cultivated in the Indian Botanic Garden, Howrah.

Uses : Leaves are used as thatch. Sap from the peduncle is fermented to make toddy.

Arenga westerhoutii Griff.

Solitary monocarpic palm, stem about 5 m long, dark grey in colour; upper part of the stem with persistent leafsheaths. Leaves pinnate, 8-10 m long, slightly ascending; leaflets regular, bifarious, deflected in one plane, often with drooping apices, narrowly oblong, upper surface green, grey to light brown below, 60-80 cm long, 2.5 cm broad at middle. Inflorescence terminal and axillary, basipetal in emergence; flower branches simple, mostly pendulous, flower clusters basically triads. Male flowers oblong, about 1 cm long, stamens numerous; filaments shorter than corolla; anthers aristate. Fruit semiglobose, 3 seeded, faintly 3 angular, 3.5 cm × 2 cm; seed convex, bifaced, endosperm horny.

Distribution : INDIA (Arunachal Pradesh, Manipur, North Andaman), MALAYA PENINSULA, BURMA.

Clutivation : Cultivated in the Indian Botanic Garden, Howrah. This species is close to *Arenga pinnata* but differs in the arrangement of leaflets on the rachis, shape of the fruit and more or less clean stem without persistent leafsheaths, at least at the lower to middle part of the stem.

Caryota L.

Monoecious monocarpic or hapaxanthic palm. Stem solitary or clusterforming, tall to dwarf mostly covered with persistent leafbases at least on the upper part; naked part with long internodes. Leaves twice pinnate, induplicate, with fan or fish tail like terminal leaflets, sometimes split along middle; ultimate leaflets widening outward to a blunt jagged tip with diverging nerves from base to margin. Inflorescence terminal and axillary besipetal in emergence. Flowers in triads of two lateral male flowers and a middle female flower, spirally disposed on the rachilla. In male flowers sepals 3, imbricate; petals 3, valvate; stamens numerous; filaments very short, adnate to corolla; anthers sagittate; pistillode absent. In female flowers sepals 3, imbriate; petals 3, valvate; staminodes usually 3-6. Fruit 1-2 seeded. Seed globose; endosperm ruminate. Eophyll bifid.

Distribution : INDOMALAYSIA, SOLOMON ISLANDS, NORTHERN AUSTRALIA. About 12 species. 3 species wild in India. Cultivated species 3. Occurs in various habitats from sea level to about 1500 m altitude. Common in moist forests; thrives best in loam with plenty of moisture. Some species are widely cultivated as ornamental plants.

Key to the Species

1a. Stem solitary, columner, robust, distinctly annulate, more or less clean; leaflets drooping; inflorescence large, resembles a huge docked horse tail . . . 2

1b. Stem cluster forming, not robust; leafsheath mostly persistent; inflorescence not large, with short peduncle and slender flower branches (rachillae) . . . *mitis*

2a. Terminal leaflets deeply incised, papery, sharply toothed at margins. Ripe fruits deep red; stem robust, swollen at lower middle . . . *urens*

2b. Terminal leaflets not deeply incised, obtuse dentate at margins. Ripe fruits pink; stem tall columner, uniform . . . *obtusa*

Caryota mitis Lour.

Clusterforming monoecious, hapaxanthic palm. Stem cylindrical, to 5 m long, with persistent greyish leafsheaths. Leaves spreading horizontally, long, persistent, to 3 m long; leafblade broadly triangular, flat; leaflets flattish, irregularly wedge shaped, jagged and toothed at margins; leafsheath and petiole coated with thick layer of felt. Inflorescence terminal and axillary, besipetal in emergence, to 90 cm long; peduncular bracts about 5 in number; each pointed at their apex; flower branches (rachillae) simple, spirally disposed, about 105 in number, to 45 cm long; flowers in triads of two lateral male flowers and a middle female flower; male flowers oblong in bud, caducous after anthesis, petals bright pink outside on opening. Ripe fruits globose, red, about 1.2 cm in diameter; inner fleshy portion highly irritating to the skin; seed globose, about 5 mm in diameter.

Distribution : INDOCHINA, BURMA, THAILAND, MALAYA AND INDIA (Andaman Islands). Grows in lowland moist regions, prefers to grow in shade.

Cultivation : It is among the widely cultivated ornamental palms.

Uses : Cultivated in the gardens for beautification of landscape. The core of the stem contains starch. Leaves are used by the old settlers of Andamans as thatches and for making fancy items. Splitted cane is also used for making garlands and for decorating places of religious ceremonies.

Caryota obtusa Griff.

Very tall single stemmed monocarpic palm reaching about 30 m. Stem cylindrical about 90 cm in circumference near base with numerous roots emerging from bole, with distinct nodes and long internodes. Leaves very large more or less ascending about 3 m long; leaflets cuneate, leathery, dull green; marginal teeth short, very obtuse. Inflorescence with many closely packed drooping flower branches (rachillae); each about 2 m long. Flowers in triads; male flowers oblong, about 1 cm long; sepals 3 rounded, scurfy outside, ciliate; petals 3, about double the length of sepals; stamens about 100, or more; female flowers semiglobose, about 5 mm in diameter; petals 3, broadly triangular. Fruits globose, to 3 cm in diameter, pink to red according to ripeness, 1 seeded; seed 1.5 cm in diameter, greyish black in colour.

Distribution : INDIA (Assam, Arunachal Pradesh, Meghalaya, Tripura etc.).

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. Large number of trees were also found on the hill slopes on way to Mussouri. Not common in cultivation. Very distinct from *Caryota urens*.

Caryota urens L. *Bherli Mad, Kittul.*

Single stemmed robust monocarpic palm. Stem, to 20 m long, to 60 cm in diameter near base, light brown in colour; surface smooth. Leaves about 5 m long; ultimate leaflets one nerved; leaf sheath broad, semiwoody; margins converge and form two elevated confluent lines on upper side of petiole. Inflorescence terminal and axillary, about 4 m long, flower branches pendulous from the main axis. Prophyll and bracts semi woody, tubular at base, acuminate at tips. Flower branches (rachillae) about 50 ; each about 3 m long, alternate. Male flowers prominently 2 bracteate, 1.5 cm long, cylindrical in bud, sepals 3, orbicular, ciliated at margins, imbricate petals oblong, twice as long as sepals, valvate. Stamens about 40 in number; filaments short, connate; anthers basifixed; pistillode absent. Female flowers with two scale like bracts; stigma conspicuous; staminodes 3, opposite to petals. Fruits globose, to 1.8 cm in diameter, apiculate, 2-seeded; testa adherent.

Distribution : INDIA (Assam, Arunachal Pradesh, Meghalaya, Manipur, Bihar, Orissa, North Kanara, Nilgiri etc.), NEPAL, BANGLADESH, BURMA, SRI LANKA.

Cultivation : Widely cultivated in large gardens and parks for landscape beautification. The palm reaches maturity in about 15 years and once started flowering the tree looses its beautiful shape. The terminal inflorescence and

2-3 inflorescences below the terminal bear fruits. Unlike *Arenga pinnata* or *Cryota mitis* the development of inflorescence never takes place from the lower leaf axils.

Uses : Leafsheath fibres are strong and used for making ropes, brushes etc. The core of the stem contains huge quantity of edible starch, the sap from the cut end of the peduncle is sweet and made into jaggary or fermented into toddy. The very young leafbud is edible. Karbis (Mikirs) of Assam uses the seed as masticatory.

Wallichia Roxb.

Solitary or suckering, monoecious, monocarpic or hapaxanthic palm. Stem mostly slender coverd with persistent leafsheaths and leafsheath fibres. Leaves pinnate, alternate or distichous; leaflets deep green above, whitish below, ex-auriculate at base, mostly cuneate; blade of the leaflets elongate, deltoid or trapezoid; margins mostly sinuate, slightly spinescent at upper margins and apices. Inflorescence solitary par axil, basipetal in emergence; pistillate inflorescence terminal; staminate axillary with many sterile bracts on the peduncle. Male flowers mostly in pairs; calyx cuplike or cylindrical at base, truncate or 3 lobed at upper part; corolla much longer than calyx; petals 3, connate at base to form cylindrical tube; stamens 3-6 in number sometimes upto 15 in number; filaments connate at base; anthers linear, sagittate; pistillode absent. Female flowers bracteate at base; calyx 3-lobed, imbricate; petals 3, valvate; staminodes 3, or absent; ovule 1-3 loculed. Fruit 1-2 seeded; seed with homogeneous endosperm.

Distribution : India, Bangladesh, Nepal, Bhutan, Burma, South China, Indo China, Malaya Peninsula. About 7 species. 4 species wild in India, 3 species in cultivation. Mostly in the rain forests upto 1350 m altitude.

Key to the Species

1a. Stem mostly solitary, arborescent; leaves distichous in arrangement; leaflets elongated . . . *disticha*

1b. Stem cluster forming, dwarf to bushy; leaves not distichous, leaflets mostly lobed . . . 2

2a. Leaflets oblong to linear oblong; margins wavy . . *densiflora*

2b. Leaflets panduriformly lobed or trapezoid, broadly cuneate at base . . . 3

3a. In male flowers stamens 6 in number . . . *caryotoides*

3b. In male flowers stamens 3 in number . . . *triandra*

Wallichia caryotoides Roxb.

Suckering bushy hapaxanthic palm. Stem very low, very slender, coverd with thick mat of leafsheath fibres; leaves almost radical, pinnate, to 2.5 m long; sheathing at base; petiole slender; rachis dorsally bifaced, ventrally convex; basal leaflets in groups, 3 on each side, wedge shaped, to 30 cm long , to 9 cm broad at middle; middle leaflets alternate, lobed, praemorsed, to 40 cm long; terminal leaflets deeply 3 lobed. Male inflorescence axillary, to 40 cm long with many large alternate, papery, peduncular bracts; rachillae simple, numerous, filiform, 15-20 cm long. Male flowers single or paired, sessile, 6 mm × 2 mm; stamens 6 in number. Female inflorescence terminal, to 40 cm long with large peduncular bracts; rachillae caudiform, alternate, 12-14 in number, to 40 cm long. Female flowers 3-bracteate; ovary 3 loculed. Fruit obpyriform, 2 seeded, 15 mm × 6 mm; seed plenoconvex.

Distribution : INDIA, BANGLADESH, BURMA (Myanmar), SOUTH CHINA. A component of the tropical moist forest, mostly grows as undergrowth.

Cultivation : Not common in cultivation. It can be grown as ornamental plant in the Green House or under the shade. This species was earlier cultivated in the Indian Botanic Garden, Howrah. Live specimens were seen in the University Botanic Garden at Dhaka, Bangladesh.

Wallichia densiflora (Mart.) Mart.

Suckering, bushy hapaxanthic palm. Stem low, slender, covered with mat of leafsheath and leafsheath fibres. Leaves, to 3 m long, arching from base; basal leaflets oblong, in groups of 2-3 leaflets on each side of rachis; each 10-20 cm long, 3-7 cm broad at middle; deep green upper, whitish below; middle leaflets linear-oblong, to 60 cm long, to 8 cm broad; midnerve on lower side light orange in colour; terminal leaflets jointed, lobed at upper margin. Male inflorescence axillary, pendulous, to 50 cm long, with many densely imbricated papery peduncular bracts; rachillae filiform. Male flowers 5 mm × 1.2 mm, yellow when fresh; stamens 6, anther 3 mm long. Female inflorescence terminal, to 50 cm long, erect; prophyll and peduncular bract cylindrical at base; tip of the outer peduncular bract sometimes pinnately foliar; rachillae caudiform, to 40 cm long, olive green in colour. Female flowers spirally disposed, 2.5 mm × 3 mm; calyx irregularly lobed; corolla shortly 3 lobed. Fruit oblong, 2 seeded, 16 mm × 18 mm; seed plano-convex, 12 mm × 4 mm.

Distribution : BANGLADESH, NEPAL, BHUTAN, BURMA (Myanmar). INDIA (Central Himal, Sikkim, West Bengal, Assam, Arunachal Pradesh, Manipur, Tripura, Mizoram, Nagaland).

Cultivation : Not common in cultivation. This species can be grown as ornamental plant and thrives best on moist soil under the shade. Cultivated in the Indian Botanic Garden, Howrah.

Wallichia disticha T. Anders.

Solitary, sometimes suckering hapaxanthic palm; stem erect, arborescent, to 5 m long, 20-30 cm in diameter near base; leaves ascending from the stem, to 2.5 m long; leafsheath semiwoody, extremely fibrous at margins, with conspicuous black bristles on the inner side; petiole rounded, to 30 cm long, 2.5 cm in diameter, with conspicuous groove at middle on lower side; leaflets linear, notched at margins, bluish green in colour, 60-90 cm long, arranged in groups on rachis, each deflected to different plane; terminal leaflets broadly 3 lobed. Male inflorescence axillary, 1.5 m long with stout rounded peduncle; rachillae slender, to 30 cm long. Male flowers mostly in pairs with a rudimentary female flower bud; stamens 6, 1.5 to 2 mm long. Female inflorescence terminal. Female flowers bracteolate; calyx obscurely 3 lobed; corolla 3 partite almost cover the pistil; stigma mamillate, 2 fid. Fruit oblong, reddish brown when ripe, 2-2.2 cm × 1.5 cm.

Distribution : INDIA, BANGLADESH, BHUTAN, BURMA (Myanmar).

Cultivation : This species was earlier cultivated in the Indian Botanic Garden, Howrah and Eden Gardens, Calcutta and lost from both the places after flowering and fruiting. Live specimens were seen in some private gardens in Kurseong,of Darjeeling District.

Uses : This species is very ornamental in appearance therefore can be introduced in the gardens for beautification of the landscape. It thrives best in moist soil and not under direct sun where day temperature is high. The core of the stem contains starch and consumed largely by the tribals of Arunachal Pradesh.

Wallichia triandra (Joseph) S. K. Basu

Suckering, bushy, hapaxanthic palm. Stem more or less uniformly thick, densely covered with dark brown leafsheath fibres; taller stems, to 3 m long, 3.5 cm in diameter. Leaves, to 2 m long; leafsheath with stiff bristle like out-growths from the margins; leaflets opposite to subopposite and alternate, 11-19 in number per leaf; each irregularly trapezoid, to 40 cm long, 10 cm broad at middle, obliquely toothed and wavy at margins. Male inflorescence axillary, curved, to 35 cm long; peduncle covered with large overlapping, ovate to narrowly lanceolate dull brown leathery bracts; rachillae numerous, to 16 cm long, filiform. Male flowers narrowly cylindrical, to 9 mm long, deep purple at anthesis; calyx cylindrical, truncate or wavy at margins; corolla longer than calyx; petals fleshy, narrowly lanceolate, valvate, to 8 mm long; stamens 3; filaments subulate, connate to form a short column. Female inflorescence terminal; peduncle stout; rachillae many, caudiform, to 30 cm long.

Female flowers subglobose, spirally disposed on rachillae; each 4 mm × 4 mm. calyx saucer shaped, obscurely 3-lobed; petal lobes ovate, obtuse, valvate; ovary functionally 1 loculed, 1 ovuled. Fruit oblong, ellipsoid, 13 mm × 9 mm, deep red to purple when ripe; seed single; endosperm homogeneous.

Distribution : INDIA (Arunachal Pradesh). Common in dense forests on humid soil as large bushes.

Cultivation : This species can be grown as ornamental plant in the Green Houses. Efforts are on to cultivate this endemic palm in the Indian Botanic Garden, Howrah.

Tribe : Cocoeae

Slender to robust, acaulescent to erect palm. Sometimes climber. Crownshaft absent. Leaves pinnate, pinnately ribbed, reduplicate. Inflorescence interfoliar mostly, unisexual or bisexual. Fruit generally with hard endocarp, with 3 distinct germ pores; seed usually with very oily endosperm.

Key to the Genera

1a. Stem mostly robust, columner, unarmed . . . 2

1b. Stem not robust, erect or as climber, armed with spines . . . 6

2a. Inflorescence bisexual . . . 3

2b. Inflorescence unisexual . . . 4

3a. Inflorescence compact with short stout peduncle. Female flowers proximal in the rachillae, much larger than distal male flowers. Fruits very large, with thick husk . . . *Cocos*

3b. Inflorescence with long peduncle. Female flowers not restricted to the basal part of the rachillae, slightly larger or equal in size with male. Fruits not large, with thin, fibrous mesocarp . . . *Syagrus*

4a. Stem robust with persistent leafbases; petiole spiny at margins; prophyll and peduncular bract fibrous. Female inflorescence compact. Fruits with thick, oily mesocarp . . . *Elaeis*

4b. Stem more or less clean, sometimes with persistent leafbases only on the upper part of the stem; petiole smooth at margins; prophyll and peduncular bract woody. Fruits egg shaped with dry non oily mesocarp . . . 5

5a. In male flowers petals linear; stamens 6, much shorter than petals . . . *Scheelea*

5b. In male flowers petals ovate-oblong, lanceolate; stamens many . . . *Orbignya*

6a. Stem climbing . . . *Desmoncus*

6b. Stem erect . . . 7

7a. Stem solitary; leaflets lanceolate to quadrangular, truncate at apices; prophyll flattened; peduncular bract cylindric, spiny outside; calyx triphyllous, membranous in female flowers . . . *Aiphanes*

7b. Stem mostly cluster forming; leaflets linear, spiny below, not truncate at apices; peduncular bract much larger than prophyll, cymbiform, thickly spiny outside . . . *Bactris*

Aiphanes Willd.

Solitary, erect, monoecious palm. Stem always uniform in diameter. Leaves pinnate or pinnatisect; leaflets truncate at tips, more or less spiny, sometimes broad at upper part, strongly toothed at apices. Inflorescence interfoliar, extremely spiny on peduncle; flower clusters mostly in triad of two lateral male flowers and a middle female flower or as paired males. Male flowers simple, calyx-3 lobed; corolla with 3 distinct petals; stamens 6; filaments subulate; anthers linear, erect; staminodes in a low dentate ring; ovary 3-loculed; stigmas 3. Fruit globose, fleshy, cherry red when ripe.

Distribution : Tropical America. Species 40. 2 species cultivated in the Indian Botanic Garden, Howrah and other public and private gardens in India.

Pollen grains : Monosulcate, exine foveolate, fosulate or regulate (semi-tectate).

Cultivation : Cultivated as ornamental plant. Mostly grown in pots. A few older plants are seen in the Indian Botanic Garden, Howrah.

Uses : It is reported that the sweet exterior portion of the fruit is edible and consumed by the tribal people of tropical America.

Key to the Species

1a. Stem stout, tall, armed with thick layer of about 5 cm long, black needle-like spines; leaflets elongated, closely and regularly placed on the midrib in one plane . . . *acanthophylla*

1b. Stem slender, not tall, armed with about 4 cm long black bristles; leaflets cuneate, broader outside, irregularly placed on the midrib . . . *caryotaefolia*

Aiphanes acanthophylla (Mart.) Burret.

Solitary, pinnate leaved monoecious palm. Stem, to 15 m long, about 20 cm in diameter near base, dull grey in colour, covered with black needle-like spines; crownshaft absent. Leaves pinnate, about 2.5 m long; leafsheaths highly prickly outside; leaflets regularly placed, close to each other, multinerved, elongate, broad at middle, tapering at base, obliquely truncate at apex, deep green above, light; green below; lateral leaflets 60-70 cm long with conspicuous needle like spines on lower and upper side; terminal leaflets jointed; petiole and lower to middle portion of the midrib highly spiny outside. Inflorescence interfoliar, about 1.5 m long; prophyll semi-woody, bicarinate; peduncular bract much longer than prophyll, almost tubular; rachillae simple, numerous, alternate or fascicled, each 12-24 cm long with filiform upper part. Flower clusters in triad of two lateral male flowers and a middle female flower; female flowers missing in the upper flower clusters. Flowers pale green to whitish. Male flowers angular at base, compressed, about 3 mm long, slightly above the female flower. Female flowers about 2.5 mm wide at middle, semi-globose. Fruits globose, about 1.5 cm in diameter, bright red in colour, glossy outside; mesocarp thin, fleshy. Seed globose, pitted.

Flowering & Fruiting : August-September; May-June.

Distribution : Puerto Rico. It grows naturally in a variety of habitats, in the undergrowth of tropical rain forests at low elevation to montane forests.

Cultivation : Cultivated as ornamental plant. Mostly seen as pot grown plants. A tall old tree exists in the Large Palm House of the Indian Botanic Garden, Howrah which has emerged out of the canopy and now started flowering and fruiting. The chance of getting the ripe fruits is remote because birds and squirrels are fond of eating the unripe fruits and seeds. Freshly collected seeds germinate in about 60 days. In the local climate seedlings prefer shade and regular watering.

Aiphanes caryotaefolia (H.B.K.) Wendl.

Solitary, slender, pinnate leaved, monoecious palm. Stem highly prickly outside, dull grey in colour, about 5 m long, about 5 cm in diameter near the base; crown shaft absent. Leaves about 15 in number per crown, each 2-3 m long, leafsheath triangular, petiole slender; leafsheath and petiole armed with black, needle-like spines; leaflets in fascicles, fish-tail like in shape, 20-30 cm long, 8-12 cm broad at upper part, bright green upper and slightly whitish below, profusely spiny on nerves. Inflorescence interfoliar, 60-65 cm long; prophyll semiwoody, spiny outside; peduncular bract tubular when unopened, longer than prophyll, spiny outside; rachillae green, simple, alternate, 3-30 cm long. Male flowers angular in bud; calyx deeply 3 partite, sepal lobes ovate, acute; corolla 4 times longer than calyx;

lobes oblanceolate, acute, longitudinally striated on inner side; stamens 6, filaments short, white, anthers linear. Female flowers from base to the middle of the rachillae; calyx lobes broadly ovate; corolla twice as long as clyax, lobes ovate, acute, concave; staminodes 6, membranous; style almost absent; stigmas 3, pyramidal. Fruit globose, 1-5 cm in diameter, cherry red in colour.

Flowering & Fruiting : April - December ; October - June.

Distribution : COLUMBIA.

Cultivation : Not common in cultivation in India. This species is mostly grown by the amateur plant growers and they prefer to grow this curious-looking palm in pots for indoor decoration. It can be grown in the green houses under moist condition. Indian Botanic Garden, Howrah had a few plants growing in the Palmetum under the shade of big trees. A very slow growing palm.

Imperfectly known *Aiphanes* in cultivation

In addition to above mentioned two *Aiphanes* species which often seen in cultivation in India, we have further seen a few pots of *Aiphanes* in the Calcutta flower shows which are slightly different from *Aiphanes acanthophylla* and *Aiphanes caryotaefolia*, having their leaflets intermediate in length, lower surface whitish and more spiny on upper side.

Bactris N. J. Jacquin

Distribution : TROPICAL AMERICA, WEST INDIES. About 200 species. 1 species cultivated in India.

Pollen grains : Monosulcate, exine smooth or scabrous (tectate), foveolate or finely reticulate (semi-tectate).

Cultivation : Not common in cultivation excepting *Bactris gasipaes* H. B. K. which is largely grown in the western tropics for its edible fruits. Its Peach - like fruits are important food among the local people. Eaten when boiled or roasted or the pulp is fermented into alcoholic drink. *Bactris gasipaes* is yet to be introduced in India. According to Braun (1968), some species of *Bactris* furnish valuable wood for carpentry. Straight stems of several species are utilised for making walking sticks. The tribal people use the fleshy fruits of some species to make vinegar.

Bactris major (Jacq.)

Clusterforming, pinnate leaved, monoecious palm. Stems several, attain height of 3-6 m, grow as close colony; each stem about 4 cm in diameter, strongly armed; crownshaft absent. Leaves pinnate, slightly ascending, about 4 in number per crown; leafsheath 20-25 cm long, 4.5 cm wide, armed with numerous fine needle-like black spines and with interrupted groups of 2.5 cm long black to deep brown spines; petiole about 18 cm long, about 1 cm broad above the base, thickly coverd with 3-7 cm long deep brown spines; rachis (midrib) armed on both sides with pointed black to deep brown, to 10 cm long strong spines; leaflets uniformly placed, subopposite to opposite, linear, deep green upper, whitish below; middle leaflets about 25 cm long, 2 cm wide at middle, armed at margins with sharply pointed spines. Inflorescence interfoliar; peduncular bract cymbiform; peduncle curving, laterally compressed, about 25 cm long; rachillae pale yellow just after emergence from peduncular bract, usually 8 in number, each 7-12 cm long, 3 mm in diameter. Male flowers about 6 mm long, compressed, bright yellow in colour at anthesis; calyx with 3 narrow lobes; corolla deeply 3 lobed; female flowers larger than males; calyx and corolla cup-like, with crenulate margins; staminodal ring membraneous. Fruit ellipsoid to ovoid, about 3.5 cm long, 2.4 cm wide at middle, orange red in colour; seed oblong to roundish 1.8 cm x 2.1 cm, dark brown in colour.

Flowering & Fruiting : June-August; December-January.

Distribution : Central and Northern South America. Trinidad and Tobago. In its natural habitats it grows on open sites as well as in forests but always in moist to flooded grounds (Braun 1968).

Cultivation : Fresh seeds take about 60-75 days to germinate (Basu and Mukherji 1972). Not common in cultivation in India although very well suited for home gardens and parks. Indian Botanic Garden, Howrah has several colonies of this species growing in the open. This species withstands water logging for several days. Almost all *Bactris* colonies in the Indian Botanic Garden, Howrah are along the lakes, these lakes regularly overflow during heavy rains and cause water logging. It even withstand partial draught, the underground creeping rhizome throws out new shoots when favourable weather returns. The large peduncular bract after unfurling remains attached with the peduncle like just the hood of a snake. When dried, the peduncular bract rolls sideways in a characteristic fashion.

Uses : Seeds are edible to squirrels and birds.

Cocos L.

Coconut Tree, Nariel (Hindi), *Narikel* (Beng.).

Distribution : PANTROPIC. Species 1.

Pollen grains : Monosulcate; exine smooth or scabrous (tectate), foveolate or finely reticulate (semi-tectate).

Cocos nucifera L. *Coconut Tree, Nariel* (Hindi), *Narikel* (Beng.).

Solitary, pinnate leaved, monoecious palm. Stem erect or inclined, curved, irregularly ringed, attains a height of 30 m; lower part of the stem at man height 50-70 cm in diameter. Leaves pinnate borne in a terminal crown, 5-7 m long, arching, drooping; leafsheath heavy, semiwoody, form thick nets along the margins; petiole grooved on upper side with smooth margins; leaflets oblong-lanceolate, pleated, about 1 m long, about 200 pairs per leaf; midnerve prominent on upper side. Inflorescence interfoliar; peduncular bract large, woody; peduncle stout; flower branches simple, stiff, borne on short axis; female flowers basal, very large, globose to conical with 6 staminodes forming a low ring. Fruits large about 30 cm long, 1-seeded with bony endocarp having 3 pores near the base; mesocarp with dense layer of fibres; epicarp smooth, light green, pale green or yellowish green in colour turning to light brown when ripe; endosperm homogeneous, white, surrounding transparent homogeneous fluid.

Flowering & Fruiting : Almost round the year.

Distribution : PANTROPIC. Grows mostly near the seacoasts.

Cultivation : One of the most economically exploited cultivated palm.

Note : Sometimes it manifest a false suckering habit by the simultaneous development of 2-3 active embryos in the nut. Normally a seed has one embryo.

Uses : The white endosperm is delicious and nutritious and eaten raw as wholesome food; endosperm after drying is shredded and consumed after mixing with other dry fruits. After drying the endosperm separates out from the endocarp along with its outer coating and the whole thing is called copra. The dried copra is utilised for extraction of coconut oil which is used as cooking medium or used for making soap, cosmetics, shampoos, shaving creams etc. Coconut oil cake is an excellent food for livestock. Coconut water is a refreshing drink. The sweet sap extracted from the peduncle is made into jaggery or for brewing into wine and vinegar. The rough fibre (coir) extracted from the husk of the fruits is used for making ropes, mats, carpets or blended with rubber for making soft durable bed mattresses. The strong mid nerve of the leaflets is extracted

and used for making brooms, baskets, brushes and various other household items employing rural artisans. Leaflets are used for thatching village homes. The hard wood sliced out from the stem of old trees is extensively used in South India for cabinet making, for concrete shuttering or used as fuel. It is reported that apart from coconut water, root, bark, flowers and leaf charcoal have medicinal properties. The soft downy substance from the lower surface of the leaves is used as styptic. The astringent roots are used for curing dysentery and other intestinal ailments. There are several varieties of Coconut trees seen in India characteristic by their dwarf or tallness, mode and duration of fruiting season, size of the fruits and yield.

Desmoncus Mart.

Strongly armed, climbing, monoecious palm. Stem more or less slender. Leaves mostly irregularly pinnate, tip ending in a series of hooks by means of which the plant climbs; leaflets narrow to broad, lanceolate to ovate, with conspicuous pointed spines on the lower side along the midnerve. Inflorescence axillary; peduncular bract usually cymbiform, spiny outside; flowers sessile on undulating rachillae; female flowers mostly at the basal portion of the rachillae; ovary 3-locular, style short, stigmas 3. In male flowers stamens 6 in number. Fruit 1 seeded, with bony endocarp and 3 pores near the middle; endosperm homogeneous; embryo below one of the pores.

Distribution : Hot moist Regions of Tropical America. Species 40. 2 species cultivated in the Indian Botanic Garden, Howrah.

Key to the Species

1a. Leaves more or less regularly pinnate; leaflets narrowly lanceolate, nearly opposite on upper part of the leaf . . . *horridus*

1b. Leaves irregularly pinnate; leaflets broadly lanceolate, unevenly spaced although the midrib . . . *orthacanthos*

Desmoncus horridus Splitg.

Climbing palm, growing up to 20 m or more. Stem densely armed, with spiniferous tubular leafsheaths; leafsheaths without knee; leaves about 1.5 m long including the terminal 40-50 cm long cirri; leaflets, to 20 in number on either side of the leaf, 20-25 cm long, 2.5 cm broad at middle; midnerve on lower side armed with 1-3 cm long prickles. Inflorescence axillary; rachillae 30-40 in number; each 9-12 cm long. Fruit elliptical, about 16 mm long, 10 mm in diameter.

Distribution : Tropical South America.

Cultivation : This tropical American climbing palm is rare in India. Cultivated only in the Indian Botanic Garden, Howrah where it is growing as a big bush. It is not in record when this species was introduced in the Indian Botanic Garden, Howrah, its presence was recorded by Blatter (1926) by a picture taken from the Garden. In general, *Desmoncus* are fast grower under favourable condition. It needs good nutritive soil mixed with coarse-grained sand and frequent watering. Manure and fertilisers should be applied during rainy season only.

Desmoncus orthacanthos Mart.

Stem strongly armed, completely covered with leafsheaths; petiole strongly armed with long, pointed, black spines each spaced irregularly. Leaves pinnate; leaflets unevenly arranged, 8-9 pairs per leaf; each broadly lanceolate, 14-16 cm long, 3-6 cm broad at middle; leafsheath 30-40 cm long. Inflorescence axillary; rachillae 10-15 in number, each 6-8 cm long. Fruits not seen.

Distribution : Tropical South America

Cultivation : Rare in cultivation in India. Two bushes are seen in the Indian Botanic Garden, Howrah, one is in the Palmatum and the other in area where rattan palms are growing. A very vigorously growing climber.

Elaeis Jacq.

Distribution : Tropical South America and Tropical Africa. Species 2, 1 species cultivated in India.

Pollen grains : Monosulcate, exine foveolate, fossulate or regulate (semi-tectate).

Uses : Mesocarp of the fruits and kernel contain high percentage of oil.

Elaeis guineensis Jacq. *Oil Palm.*

Solitary, robust, pinnate leaved monoecious palm. Stem about 10 m long, 40-60 cm in diameter near base. Crown large. Leaves steeply arching, about 6 m long, with numerous pairs of linear leaflets arranged in 4 ranks; leaflets, to 1.5 m long, 4 cm broad at middle; each thickened at base; basal leaflets reduced to spines. Inflorescence interfoliar. Male and female inflorescence separate. Male inflorescence with flat whitish peduncle; prophyll completely hidden below the leafsheaths, peduncular bract extremely fibrous, acuminate at tip; upper part of the peduncle with successive triangular, sterile bracts; flower branches catkin-like, crowded, bracteate at base; each ending into a claw. In male flowers sepals

3, linear - lanceolate, concave, imbricate; petals 3, valvate; staminal tube funnel shaped; anthers 2-2.5 mm long. Female inflorescence robust, partially hidden in leafbases. Female flowes larger than males, bracteolate; sepal 3, oblong about 9 mm long; petals 3, slightly larger than sepals; staminodal ring inconspicuous; pistil 2 cm long; stigmas 3, ripe fruits deep purple in colour, slightly angular due to compression, about 3 cm long, 2.5 cm broad at middle; mesocarp oily; endocarp hard, endosperm white, homogeneous.

Flowering & Fruiting : March-June; December-February.

Distribution : Tropical West Africa.

Cultivation : Introduced in the Indian Botanic Garden, Howrah during the earliest part of the last century for economic exploitation possibly for encouraging cultivation of this very high oil yielding palm of West Africa. Large number of trees of this species now exist in the Garden including some very old tall, original plants. We have observed that in each flowering season, staminate inflorescences emerge first from the respective leaf axils and female inflorescences emerge later. This species now being cultivated in Kerala on commercial basis under the banner of Oil Palm India Limited for extraction and marketing of Palm oil. According to the nature of the fruits, the thick shelled ones are termed as *dura,* where the spikelet of the bunch ends in short spines instead of long spines. The *dura* fruits are larger with thick pulp but contain less oil in the mesocarp. The thin shelled *tenera* fruits yield more oil from the mesocarp therefore *tenera* variety is mostly cultivated for commercial production of palm oil (Hartley 1977).

Orbignya Mart.

Distribution : Central and South America, From Mexico to Peru. Bolivia and Brazil. About 20 species. 1 species cultivated in India. Component of the humid tropical rain forest to savannah. Some species are adapted to periodic flooding.

Uses : Nuts of some species yield huge quantity of edible oil.

Orbignya cohune (Mart.) Dahlgren ex Standley *Babassunut Palm.*

Solitary robust palm. Stem erect, columner, to 8 m long and about 30 cm in diameter at the middle, obscurely marked with large triangular leaf scars. Leaves erect to arching at the tip, pinnate, about 10 m long; sheath thick, massive, margins coarsely fibrous; petiole short, flat above, rounded below, rachis abaxially rounded, variously tomentose; leaflets numerous, single

fold, regularly arranged, linear-lanceolate, all in the same plane; each about 1.5 m long, 7 cm wide; basal leaflets shorter about 1 m long, 1 cm wide; midnerve prominent on upper side. Inflorescence solitary, interfoliar, erect at emergence; peduncle about 2 m long; rachis, to 1 m long; prophyll woody, flattened, 2 keeled; peduncular bract gradually swollen at the middle, semiwoody, with a solid beak, splitting abaxially, deeply grooved outside; subsequent peduncular bracts small, more or less triangular; rachillae numerous, each subtended by a small acute to acuminate bract. Male flowers asymmetrical, sepals 3; petals 3, much longer than sepals, broadly ovate; stamens many; anthers irregular; female flowers much larger than the males; sepals 3 distinct, ovate, imbricate, tomentose outside; petal 3, distinct, imbricate, slightly longer than sepals; stigmas hard, reflexed. Fruits ovoid, 8 cm × 4 cm; broadest just above the base, with persistent perianth and staminodal ring. Seed basally attached, ellipsoid; endosperm homogeneous.

Flowering & Fruiting : May-June; February-March.

Distribution : Hondurus.

Cultivation : Introduced in the Indian Botanic Garden, Howrah during the earlier part of the nineteenth century for exploitation of oil from the endosperm. Although this species thrived well in the moist climate of lower Bengal but it was not taken as a commercial crop. Some large trees exist in the Garden and almost all of them are fertile.

Uses : This species has many local uses in Hondurus. Babasu Kernel is the main source of edible oil to the rural people of tropical America.

Scheelea Karsten

Distribution : Central America South to Brazil, Bolivia and Peru. 28 species. 1 species cultivated in the Indian Botanic Garden, Howrah. In nature, it grows in open savannah in drier regions, several species also occur in the rain forests.

Note: This genus is distinguished from *Orbignya* by the staminate flowers with terete petals, stamens are shorter than petals and have straight anthers.

Scheelea insignis (Mart.) Karsten

Solitary, robust, tall, columnar, pinnate leaved, monoecious palm. Stem about 10 m long, about 50 cm in diameter near base. Leaves ascending to arching at upper part, about 15 m long; petiole short, plano-convex in cross-section; rachis semi-terete below, medianly grooved, sharply edged at apex, scurfy outside; leaflets

linear with unequal apical portion, arranged in series or in groups; each 1.5-2 m long, smooth and green; midnerve prominent on upper side. Inflorescence interfoliar; first peduncular bract of inflorescence hard, semi-woody, tubular, entirely enclosing the inflorescence with a long terminal beak; splitting abaxially, deeply grooved outside. Male flowers bracteolate, sessile; petal 3, about 2 cm long, 3 mm wide, yellowish orange in colour; stamens 6, much shorter than petals; anthers linear; pistillode rudimentary. Female flowers subsessile, 2 bracteolate; bracteoles much longer than female flowers; ovary conical; style subcylindric; stigmas 3, obconical. Fruits ovoid, 7 cm × 4 cm.

Flowering & Fruiting : May-June; February-March.

Distribution : BRAZIL, COLUMBIA.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah, probably introduced during the early part of the last century. Not common in cultivation elsewhere outside Indian Botanic Garden, Howrah. Due to its massive size it is not preferred for beautification of small gardens. Propagated through seeds only.

Uses : Nut contain good quantity of oil in it.

Syagrus Mart.

Stem slender to robust, unarmed. Leaves pinnate; leaflets linear, reduplicate, regular, alternate or in clusters on rachis; petiole slender to robust with fibrous outgrowth or dentation from margins. Inflorescence interfoliar, bisexual, pleonanthic; peduncle short to long, slender to moderately stout, with conspicuous semiwoody peduncular bract. Flower branches (rachillae) simple, stiff at base; flowers unisexual, in clusters of 2 male flowers and one female flower or paired males. In male flowers, sepals 3, scale-like; petals 3, longer than sepals; stamens 6, connate at base with petals. In female flowers, sepals 3, imbricate, petals 3, imbricate; pistil with 3 fused carpels. Fruit drupe; endocarp with 3 distinct pores; endosperm homogeneous or ruminate.

Distribution : TROPICAL AMERICA, LESSER ANTILLES. 32 species. 2 species cultivated in India. Most acaulescent species are confined to dry or semi-arid areas. The taller species are component of the rain forests.

Key to the Species

1a. Moderately robust palm. Leaves longer; leafbases non persistent on the stem; leaflets clustered and projected to different planes; petiole margin

non spiny. Inflorescence with stout heavy peduncle. . . *romanzoffiana*

1b. Slender palm. Leaves shorter, more or less ascending; leafbases persistent on the stem for longer period; leaflets projected in one plane; petiole armed with short, curved spines for most length. Inflorescence with long slender peduncle . . . *schizophylla*

Syagrus romanzoffiana (Cham.) Glassman

Solitary, monoecious, pinnate leaves palm, about 15 m long; to 40 cm in diameter, more or less clean from middle to lower part; no crownshaft. Leaves arching, to 4 m long; petiole heavy, expanded at base, set in fibrous mat, about 1 m long; leaflets clustered, linear; middle leaflets about 90 cm long, 2-3 cm wide, mostly with acuminate tips, drooping from the middle. Inflorescence interfoliar; peduncle heavy, bright yellow, tomentose outside, expanded portion of the inflorescence about 125 cm long; rachillae simple, upto 80 in number; each upto 60 cm long. Male flowers 7-10 mm long on upper part, 11-16 mm long on lower part; female flowers ovoid, 4.5-6 mm long, 4-6 mm wide at middle. Ripe fruits orange-yellow in colour, ovoid, 2-2.6 cm long, 1.2-1.6 cm wide at middle, slightly beaked, mesocarp fleshy fibrous; endocarp thick, very irregular in shape; endosperm cavity very small.

Flowering & Fruiting : March-May; October-February.

Distribution : Brazil.

Cultivation : It is not exactly known when this species was introduced in India. Two old trees are seen in the Garden in front of Geological Survey of India's Head Office on Chowringhee Road, Calcutta, also in the Indian Botanic Garden, Howrah. A small avenue of this species is seen in Lalbag Garden, Bangalore.This species was reintroduced in the Indian Botanic Garden, Howrah in 1978. The younger batch of trees are seen in the Palmetum and in division 25, all are fertile now. It prefers to grow in areas with moist soil and plenty of sunshine. A moderately fast growing palm.

Syagrus schizophylla (Mart.) Glassman *Arikury Palm.*

Solitary, slender, graceful, pinnate leaves, monoecious palm. Stem about 2-4 m long, covered with old dried, somewhat erect leaf bases arranged in distinct spiral fashion. Leaves, to 2.5 m long, slightly erect to arching at tips; petiole slender, about 1 m long, armed with short, curved spines for most of length; leaflets dark green, linear about 50 on each side of the rachis, unclustered; each 60-68 cm long, about 5 cm wide at middle, oblique at apices. Inflorescence

interfoliar, to 150 cm long; peduncular bract with long slender stalk, pale yellow, beaked at apex; fertile portion of inflorescence, to 60 cm long; rachillae simple on the upper part of the long peduncle; each, to 30 cm long, pale yellow in colour. Male flowers, to 7 mm long; pistillode conspicuous. Female flowers ovoid, slightly larger than males, about 16 in number per rachilla. Fruits bright orange-yellow in colour, ellipsoid, 2 cm × 1 cm. Seed with endocarp globose with 3 distinct pores; endosperm ruminate.

Flowering & Fruiting : July-October; December-March.

Distribution : BRAZIL.

Cultivation : Not common in cultivation. A small number of trees exist in the Indian Botanic Garden, Howrah. Thrives best on moist loamy soil in partial shade. Very slow growing palm therefore best suited for growing in pots.

Tribe : Areceae

Slender to robust, acaulescent, creeping or erect, pleonanthic, Leaves pinnate or pinnately ribbed; reduplicate. Inflorescence bisexual, prophyll usually large, bicarinate or small enclosed within leafsheath, with large peduncular bract or with only prophyll. Inflorescence spicate or branched; pistillate flower almost always with imbricate sepals and petals. Fruit mostly 1–seeded, rarely 2–seeded.

Key to the Genera

1a. Inflorescence infrafoliar (below the crown); crownshaft distinct. . . 2

1b. Inflorescence interfoliar (within the crown); crownshaft not distinct or absent . . . 17

2a. Endosperm in seed ruminate . . . 3

2b. Endosperm in seed homogeneous . . . 12

3a. Inflorescence with only large prophyll . . . 4

3b. Inflorescence with prophyll and distinct peduncular bracts . . . 5

4a. Female flowers larger than males, situated mostly from base to middle of the rachillae. Male flowers mostly distal . . ***Areca***

4b. Female flowers smaller than males or equal to males but not restricted to basal portion of the rachillae only . . ***Pinanga***

5a. In male flowers stamens more than six in number . . . 6

5b. In male flowers stamens not more than six in number . . . 10

6a. Leaflets strongly 1 nerved, acuminate, attenuate at apices . . . 7

6b. Leaflets many nerved, jagged or praemorsed at apices . . . 9

7a. Fruits ovoid, more than 3 cm long . . . 8

7b. Fruits globose, less than 2 cm in diameter . . . *Archontophoenix*

8a. Female flowers larger than males, protogynous. Fruits ovoid, deep scarlet in colour 5-7 cm × 4 cm . . . *Actinorhytis*

8b. Female flowers not larger than males, not protogynous. Fruits ovoid, deep crimson in colour, 3-3.5 × 1.5 cm . . . *Veitchia*

9a. Leaflets broadly jagged and splitted into smaller 1 nerved narrow segments . . . *Normanbya*

9b. Leaflets tapering at both ends, undivided, truncate at apices . . . *Ptychosperma (elegans)*

10a. Leaflets regularly pinnate, 1-3 nerved, acuminate, terminal leaflets not confluent . . . 11

10b. Leaflets irregularly pinnate, usually 5 nerved, obliquely truncate at apices; terminal leaflets confluent . . . *Hydriastele*

11a. Leaflets prominently 1 nerved; crownshaft tubular, compact. Mature fruits ellipsoid, deep green to blackish in colour . . . *Dictyosperma*

11b. Leaflets prominently 3 nerved; crownshaft loose not perfectly tubular . . . *Rhopaloblaste*

12a. Stem cluster forming or solitary; leaflets praemorse at apices. Seed sulcate . . . *Ptychosperma*

12b. Stem always solitary. columner. Seed non sulcate . . . 13

13a. Leaves entire, ovate, many nerved; free marginal portion bifid; petiole and rachis covered with long and short spines . . . *Phoenicophorium*

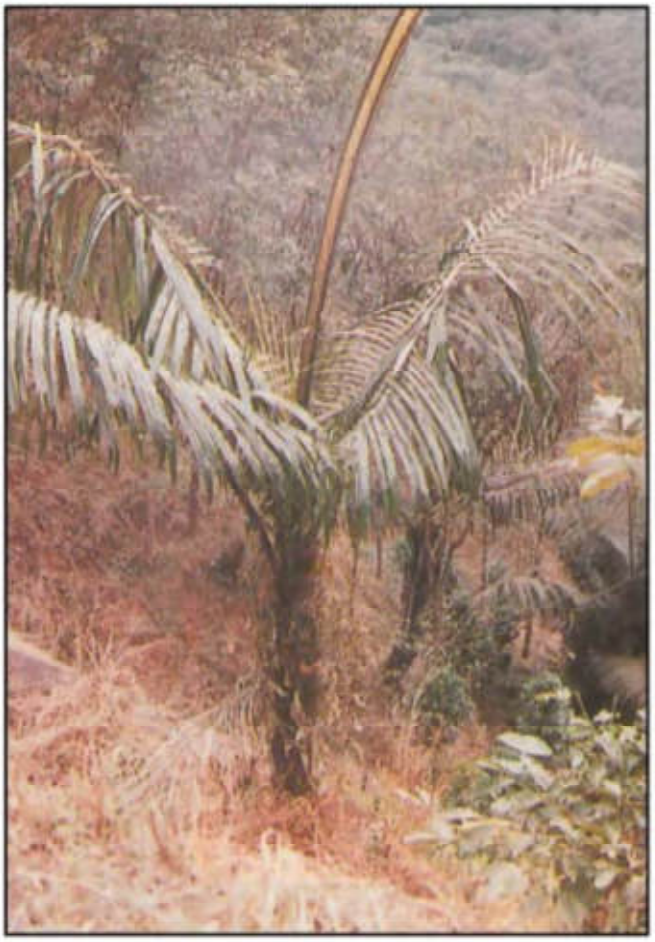
13b. Leaves regularly pinnate; petiole and rachis smooth . . . 14

14a. Flower clusters pitted . . . *Bentinckia*

14b. Flower clusters superficial . . . 15

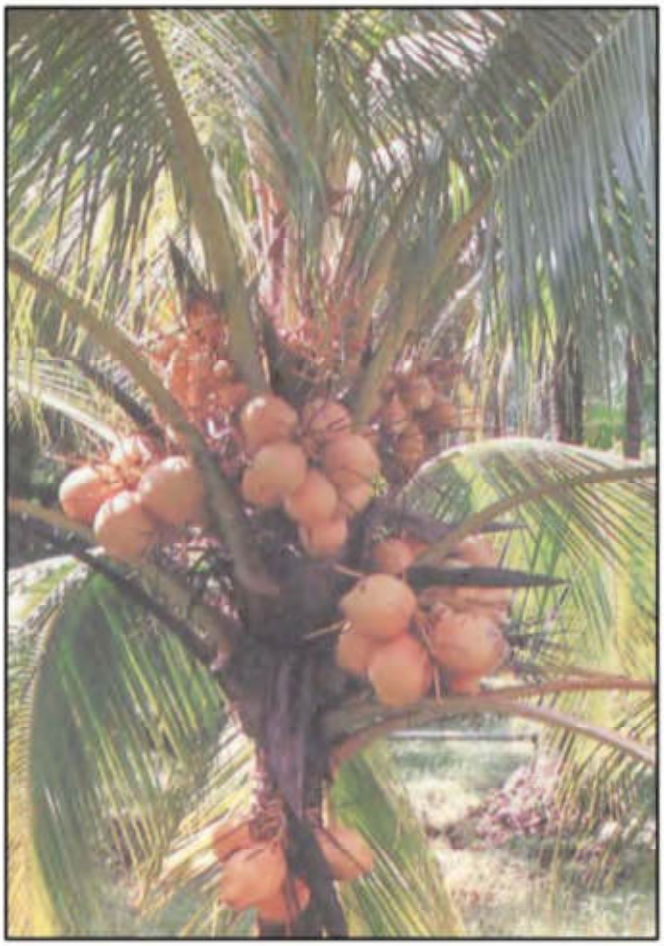
15a. Leaflets acuminate, splitted at apices . . . 16

Arenga wightii Griff.



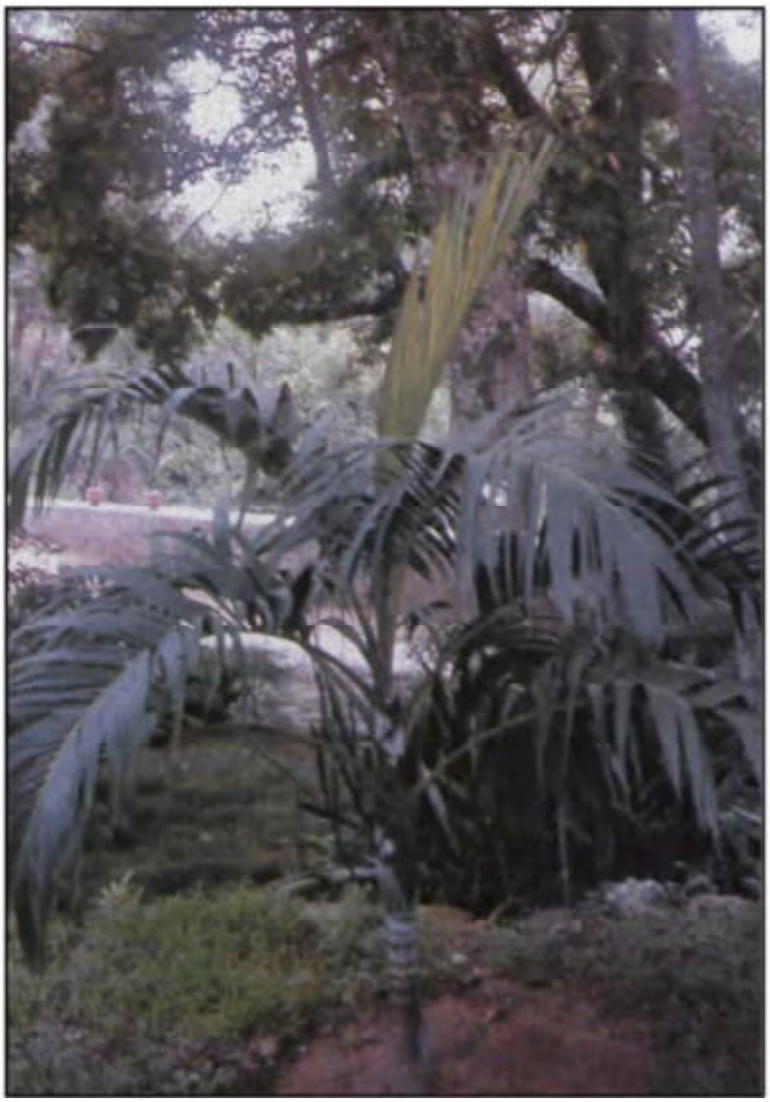
Caryota obtusa Griff.

Bactris major jacq.



Cocos nucifera L.

Desmoncus orthacanthos Mart.



Bentinckia condapanna Berry ex Roxb.

Chrysalidocarpus lutescens Wdendl.

Dictyosperma album (Borg.) Wendl.

15b. Leaflets acuminate, not splitted at apices, mostly erosed; crownshaft loose, not perfectly tubular . . . *Carpentaria*

16a. Stem tall, columner with very large cylindrical crownshaft . . . *Roystonea*

16b. Stem not tall and robust; crownshaft not cylindrical, more or less swollen at middle; leaves ascending . . . *Rhopalostylis*

17a. Inflorescence simple, spicate; crownshaft not distinct. . . *Calyptrocalyx*

17b. Inflorescence much branched . . . 18

18a. Inflorescence with short peduncle and many simple spicate flower branches . . . *Howeia*

18b. Inflorescence compact, decompound . . . 19

19a. Stem clusterforming, rarely solitary. Mature fruits broadly ellipsoid or obliquely ellipsoid, pale green to deep green in colour; endosperm white homogeneous . . . *Chrysalidocarpus*

19b. Stem solitary. Mature fruits pale green, pisiform, endosperm ruminate . . . *Heterospathe*

Actinorhytis Wendl. et Drude

Solitary palms, mostly tall with elongated, green, slender crownshaft. Inflorescence infrafoliar, much branched, held horizontally; prophyll large, bicarinate, green, 1st bract also large, both cover the flower branches for a long time after exposure from leaf sheath. Flowers spirally disposed on rachillae, in triads, at least from base to middle portion of the rachilla; distal flowers are paired males. Fruits large, ovoid, smooth outside. Seed with lateral car ; endosperm deeply ruminate.

Distribution : Solomon Islands, New Guinea. 1 species cultivated in the Indian Botanic Garden, Howrah and Experimental Gardens of Central Plantation Crops Research Institute, Kasaragod, Kerala.

Uses : Seed is consumed as masticatory and sometimes used as substitute of Arecanut.

Actinorhytis calapparia (Bl.) Wendl.

Tall, slender, monoecious palm. Stem, to 20 m long, about 30 cm in diameter near the base, distinctly annulate, light brown in colour. Crownshaft slender, long, not swollen at base. Leaves very graceful about 3 m long, held more or less horizontally, with the middle to upper part curved inwards; leaflets crowded

on the rachis, linear-lanceolate, acuminate, 60-80 cm long, about 4 cm broad at middle, slightly bluish-green in colour. Inflorescence infrafoliar, about 1.5 cm long when fully open; prophyll and first peduncular bract green, papery, caducous, 30-40 cm long; flower branches creamy white, slightly drooping; flower clusters in triads with 2 lateral male flowers and a middle female flowers or paired males at the distal part of the rachilla. Male flowers about 8 mm long; sepals 3, thick, reniform, imbricate; petals deeply 3 partite; stamens about 30 in number, anthers linear. Female flowers much longer than males, subglobose; sepals 3, scale like; petals 3 slightly longer than sepals; staminodes conspicuous. Ripe fruits egg shaped, orange red to deep scarlet in colour 7-8 cm × 4 cm, seed globose about 2.5 cm in diameter; endosperm deeply ruminate.

Flowering & Fruiting : February-April; September - December. (Mode of anthesis protogynous).

Distribution : Solomon Islands, New Guinea.

Cultivation : Not common in cultivation in India. A few adult trees were seen in the Experimental Gardens of Central Plantation Crops Research Institute, Kasaragod and Vittal. This species can be grown for landscape beautification. This elegant palm is easily confused with the *Areca catechu*.

Uses : Broken seeds are adulturated with betel nuts.

Archontophoenix Wendl.

Tall unarmed, solitary, monoecious, pinnate leaved palm; crownshaft distinct. Stem columner, sometimes with bole at base, upperpart distinctly annulate. Leaves pinnate, arching; leaflets linear, green, reduplicately folded; tip of the leaflets stiff or drooping. Inflorescence infrafoliar; unopened inflorescence covered with large green prophyll and larger bicarinate peduncular bracts; flower branches much ramified, satin white in colour. Flower clusters in triads with a middle female flower and lateral male flowers, protandrous, lilac to white in colour at anthesis. Male flowers 3, angled in bud, not exactly in the same line with the female flowers; sepals 3, imbricate, petals 3, valvate; stamens 8-24; pistillode prominent. Female flowers smaller than males; sepals and petals 3 each, imbricate, almost similar in size; ovary 3 angled. Ripe fruits globose, 1-seeded, deep red in colour; mesocarp fibrous, thin layered; endosperm in seed ruminate. Eophyll bilobed.

Distribution : Eastern Australia, 2 species. Both the species are cultivated in India.

Key to the Species

1a. Stem distinctly annulate; leaflets deep green above, pale green below; lateral nerves in leaflets prominent on upperside, flowers white . . . *alexandrae*

1b. Stem faintly annulate; leaflets deep green on both sides, lateral nerves less conspicuous; flowers white to lilac at anthesis. . . *cunninghamiana*

Archontophoenix alexandrae (F. Muell.) Wendl. et Drude *King Plam.*

Solitary pinnate leaved monoecious palm. Stem erect about 6 m long, about 35 cm in diameter near base, distinctly annulate, greyish, smooth with distinct bole at base. Leaves pinnate, erect to arching, about 2.5 m long; crownshaft cylindrical, compact about 1.5 m long; leaflets linear, bifarious, alternate, to 90 cm long, 5 cm broad at middle, reduplicately folded at base, deep green upper, pale green below; midnerve and lateral nerves conspicuous on upper side; tip of the leaflets stiff. Inflorescence infrafoliar ; prophyll large, bicarinate, spatuliform, deep green in colour, leathery, about 60 cm long when unopened; peduncular bract large, leathery, green; both prophyll and peduncular bract caducous; flower branches decompound, pendulous, flattened, turning to deep green in fruiting; flower clusters in triad of 2 lateral male flowers and a middle female flower, protandrous. Male flowers slightly angular in bud, white about 8 mm long; stamens many, pistillode filamentous slightly longer than stamens. Female flowers smaller than males; stigma expands at anthesis. Ripe fruits globose, deep red in colour, 1.4 cm in diameter; mesocarp pulpy, with anastomosing fibres slightly adhering to seed coat; seed one, globose; endocarp brittle.

Flowering & Fruiting : February-September ; December-January.

Distribution : Eastern Australia. In its natural habitats is commonly found in creeks and in riverine closed forests.

Cultivation : Introduced in the Indian Botanic Garden, Howrah in 1978 through seeds received from the Brisbane Botanic Garden, Australia. A moderately fast growing palm, its pinnate leaves are ornamental and graceful. In the local climate it grows in the open where the soil is sufficiently moist. This species is useful for planting along the drive-ways, paths etc. New leaves emerge from February.

Uses : Other uses unknown.

Archontophoenix cunninghamiana (Wendl.) Wendl. et Drude

Solitary, pinnate leaves monoecious palm. Stem slender, erect, 18-15 m long, about 30 cm in diameter near base, not deeply annulate, bole not conspicuous.

Leaves pinnate, arching, 3-5 m long; leaflets linear-lanceolate, bifarious, 1.2 m long, 3.5 cm broad at middle, light green in colour, smooth, pointed at apices; midnerve conspicuous on both sides, scurfy on lower side; lateral nerves inconspicuous. Inflorescence infrafoliar, slightly ascending at emergence, decompound; prophyll large green, bicarinate encloses the peduncular bract; peduncular bract leathery almost same size of prophyll; rachillae satin white in colour, smooth to slightly pubescent; flower clusters in triad of 2 lateral male flowers and a middle female flower; male flowers angular in bud, about 5 mm long; petals levender coloured; stamens many; female flowers more or less globose. Ripe fruits globose; cherry red in colour, 1.5 cm in diameter; measocarp pulpy with loose anastomosing fibres not adherent to seed coat.

Flowering & Fruiting : February-August.

Distribution : Eastern Australia.

Cultivation : Introduced in the Indian Botanic Garden, Howrah in 1971 through seeds received from the Brisbane Botanic Garden, Australia. This species thrives well in open and appears slenderer than *Archontophoanix alexandrae*. In each fruiting season, trees produce enormous ripe fruits/seeds that easily germinate after sowing. It is expected that within next few years this species will be common in cultivation. In the local climate the prophyll covering the peduncular bract does not split and fall, the peduncular bract enclosing the young flower branches is pushed out through a slit made on the upper part of the prophyll, the dry prophyll and peduncle bract remain attached with the peduncle for some time.

Uses : Unknown.

Areca L.

Solitary or cluster-forming, pinnate leaved, monoecious palm. Stem mostly erect, annulate, smooth; crownshaft distinct. Leaves with prominent basal sheath; leaflets often jointed. Inflorescence infrafoliar, monoecious, decompound with solitary prophyll acts as cover of the growing inflorescence; prophyll large, green, bicarinate, leathery to papery, caducous; peduncular bract absent; female flowers mostly to the basal portion of the ultimate flower branches (rachilla) larger than males ; ovary 1 - loculed ; male flowers minute, distal on the filiform ultimate flower branches (rachilla); stamens 3-6. Fruits ovoid, oblong or ellipsoid; mesocarp fibrous; seed with thin endocarp; endosperm deeply ruminate.

Distribution : Indo-Malaysia, Asia, Philippines, Melanesia, Oceania, Australia. 48 species. 3 species wild and semiwild in India and 4 species cultivated as ornamental or economic palms.

Uses : The genus contains palms of economic importance. Seeds contain several useful alkaloids of medicinal and industrial importance.

Key to the Species

1a. Stem solitary, deeply annulate . . . 3

1b. Stem mostly sucker forming, rarely solitary . . . 2

2a. Stem erect or slightly inclined, slender leafblade with mostly jointed pinnae, sometimes pale green; ripe fruits ellipsoid, bright red in colour, truncate at base . . . *triandra*

2b. Stem not tufted, sometimes solitary, erect; leaf with pinnae free, many nerved; ripes fruits deep red, ellipsoid, tapering at both ends . . . *nagensis*

3a. Stem olive green in colour, tall; pinnae more or less regularly multinerved; ripe fruits ovoid, bright scarlet in colour, 3-4 cm long, tip of the fruit mamillate . . . *catechu*

3b. Stem yellow to yellowish green, dwarf; pinnae mostly jointed multinerved segments; ripe fruits ellipsoid, yellowish orange in colour, about 4 cm long, 2.5 cm wide; tip of the fruit some what incurved... *macrocalyx*

Areca catechu Linn. *Betelnut Palm, Supari* (Beng.) *Gua* (Assam).

Stem solitary, erect about 10 m long, to 15 cm in diameter near base; basal portion of the stem sometimes turns to dull grey; crownshaft cylindrical to ventricose when flowering, deep green in colour. Leaves pinnate with various lengths, erect to arching, rather short petioled; pinnae linear about 1 m long, closely packed, stiff, deflecting above the midrib. Inflorescence infrafoliar, opens after detatchment of large, green bicarinate prophyll; flower branches light green to deep green; rachillae filiform; flower clusters filling into depressions of the rachillae; male flowers numerous, lemon yellow in colour, mostly in pairs and closely packed at the distal part of rachilla, faintly odorous at anthesis; female flowers much larger than males, mostly proximal, tiny male flowers on two sides of female flowers are highly deciduous; ripe fruits ovoid 4 cm × 3 cm; mesocarp highly fibrous; seed globose to subglobose, 1.5-2 cm in diameter; endosperm deeply ruminate.

Flowering & Fruiting : June-December.

Distribution : Tropical Asia.

Cultivation : One of the most widely cultivated economic palms.

Uses : The hard seed is largely chewed as masticatory along with a betel leaf *(Pan)*, catechu *(Khoir)* and lime *(Chun)*. The Khasi tribals old and young, consume fermented endosperm of the nut along with betel leaf and lime. It is considered to be weak narcotic and helps warming up of the body during cold season. Dried immature nuts are also chewed by the local people in Darjeeling for warming up of the body during severe cold. *Areca catechu* nuts are also chewed by the tribals of Andaman and Nicobar Islands. Mature stems of unproductive trees are used for making pillars, roof beams of thatched huts. On a field trip in South India one of the authors (SKB) along with his companion were served food in a village house using nicely cut leaf sheaths of *Areca catechu* as plates. Seeds also contain several alkaloids that have medicinal use.

Areca macrocalyx Zipp. ex Bl.

Stem solitary, slender, to 5 m long about 15 cm in diameter near base; crownshaft distinct, cylindrical, deep green in colour. Leaves pinnate, ascending with a short stout petiole; leaflets linear closely packed, or unequally jointed segments; each acuminate at apex about 1 m long; terminal leaflets jointed by their sides to form two large multinerved lobes, cuspidate at their tips. Inflorescence infrafoliar, about 30 cm long, simply branched; prophyll bicarinate; male flowers minute, distal, female flowers many times larger than males; ripe fruits ellipsoid to ovoid, 4 cm × 2 cm ; stigmatic portion somewhat incurved, attenuate with rounded projection in the middle; seed conical, 2 cm long; endosperm deeply ruminate.

Flowering & Fruiting : February-November.

Distribution : New Guinea.

Cultivation : Very rare in cultivation. Introduced in the Indian Botanic Garden, Howrah in the year 1973 through seeds received Papua New Guinea. This species is also introduced in the Experimental Gardens of Central Plantation Crops Research Institute at Vittal, South Kanara. Ripe fruits rarely occur in the Indian Botanic Garden. Not yet propagated from seeds. Germination adjacent ligular type; fresh seeds takes about 40 days to sprout.

Areca nagensis Griff. *Naga Gua*

Mostly single stemmed palm, attached to the soil with numerous black superficial roots. Stem slender, to 16 m long. Leaves pinnate, pinnatisect; petiole about 1 m long; rachis 1.5 m long, leaflets subopposite, alternate, falcate, very acuminate, to 60 cm long, about 4 cm broad at middle, prominently 3 nerved on upper side; terminal leaflets deeply bilobed, variously divided, each division bidentate at apices; the less divided broader part of the blade obliquely truncate and irregularly

dentate. Inflorescence infrafoliar, to 60 cm long when unopened from prophyll; peduncle compressed. Male flowers in pairs, minute, mostly distal; female flowers much larger than males. Ripe fruits ellipsoid, 2.5 cm × 1 cm, attenuate at both ends; stigmatic portion rostrate, mamillate; seed erect, ovoid, endosperm ruminate.

Flowering & Fruiting : March-June; September.

Distribution : INDIA (Naga Hill).

Cultivation : Not widely cultivated. A solitary specimen exist in the Large Palm House of the Indian Botanic Garden, Howrah. This species is very close to *Areca triandra*, excepting its stems are taller and having well dissected leaves.

Uses : Nuts are edible as masticatory.

Notes : Due to absence of recent collection its present population in the wild is unknown. Some fragmentary collections are available without flower and fruits.

Areca triandra Roxb. *Bon Gua* (Assam).

A clusterforming dwarf to bushy palm; stem slender, erect or slightly bent, to 3 m long, 3-3.5 cm in diameter near base; crownshaft slightly ventricose, green. Leaves pinnate, arching, light green in colour to 3 m long; leaflets subopposite, alternate, linear-ensiform, acuminate, broad at base, prominently nerved on upper side; terminal leaflets jointed, broad, deeply divided, lobed; each lobe truncate with bidentate margins. Inflorescence infrafoliar, to 40 cm long when unopened; prophyll light green, leathery, bicarinate; flower branches pale yellow to whitish when opened; rachillae filiform; male flowers minute, in pairs, creamy white, odorous at anthesis; sepals 3, minute ovate; petals 3, oblong, obtuse, valvate; stamens 3, opposite to petals; filaments short, connate at base; pistillode rudimentary; female flowers many times larger than males, proximal; sepals 3, deep green, more or less circular in outline, imbricate; petals 3, imbricate or rarely twisted; staminodes 6, conspicuous; ovary 1-loculed, 1-ovuled; stigma with unequal lobes.

Flowering & Fruiting : February-June; September-November.

Distribution : INDIA TO MALAYA.

Cultivation : Cultivated as ornamental green house plant. This species is common in the Indian Botanic Garden, Howrah where it is mostly grown on moist soil under the shade of large trees.

Uses : Nuts are favourite to the tribals of Andaman and Nicobar Islands, they use it as masticatory.

Bentinckia Berry ex Roxb.

Tall, solitary, pinnate leaved monoecious palm. Stem tall, annulate, swollen at base; crownshaft distinct, cylindrical, green. Leaves light green, pinnate, arching, with persistent lorae, petiole stout, short, rounded below. Inflorescence infrafoliar, monoecious, decompound, on a short flattened peduncle; rachis compressed; flower branches white; prophyll large bicarinate, with large solitary peduncular bract acts as cover; both caducous after emergence of flower branches; flowers in clusters, bracteolate, pitted; each pit with 2-marginal lip-like structure; male flowers glumaceous, sepals 3, oblong, obtuse, connate at base, imbricate; petals 3, connate; stamens 6, anthers versatile, pistillode conical; female flowers ovoid; sepals 3, obtuse; petals 3, convolute; staminodes 6, minute; fruits ovoid to subglobose, deep scarlet to deep brown when ripe; seed globose; endosperm white, homogeneous.

Distribution : INDIA (Nicobar Islands and Western Ghats of the mainland of India). 2 species.

Cultivation : Not widely cultivated.

Uses : Endosperm contains good amount of fat and taste like dry coconut meat. Tree squirrels and bats are fond of eating the fruits.

Key to the Sepecies

1a. Stem robust ; leaves long, arching ; flower branches yellowish-white. Ripe fruits sub-globose, deep brown . . . *nicobarica*

1b. Stem slender; leaves smaller than other species, not perfectly arching, evenly projected from the top of the stem. Flower branches light pink around pits. Ripe fruits deep scarlet, ovoid slightly compressed . . . *condapanna*

Bentinckia condapanna Berry ex Roxb. *Condapani* (Tamil).

Solitary slender stemmed monoecious palm; stem erect, to 8 m long, about 20 cm in diameter near base; crownshaft cylindrical about 1 m long. Leaves pinnate, 1-1.5 m long, ascending to spreading in all direction; leaflets linear, acuminate, deep green in colour, to 80 cm long, to 4 cm broad at middle, reduplicately

folded near the point of attachment; midnerve conspicuous on upper side; tip of the leaflets bifurcating into long narrow lobes. Inflorescence infrafoliar, decompound; prophyll and peduncular bract large bicarinate, 25-30 cm long, fall off after emergence of flower branches; peduncle flattened, deep green in colour, about 4.5 cm long; basal flower branches bracteate, divided upto 4th order. In male flowers petals slightly purple in colour, twice longer than sepals; female flowers ovoid to globose; staminodes 6, minute. Fruit ovoid, 1.4 × 7-8 mm with perianth persistent in ripe fruits; seed ovoid, 6 mm long; endocarp brittle; endosperm white, homogeneous.

Flowering & Fruiting : April-September; November-March.

Distribution : India (Western Ghats). Endemic.

Cultivation : Not common in cultivation. A small number of trees exist in Bonachord Estate in Kerala. It is also cultivated in the Indian Botanic Garden, Howrah and in the Experimental Garden of Botanical Survey of India at Yarcaud, Tamil Nadu.

Uses : This species can be grown as ornamental palm in large and small gardens in the coastal areas of India. It is susceptible to drought.

Note : *Bentinckia condapanna* occurs in the border areas of Tamil Nadu and Kerala, naturally grows on the slopes of moist hills. The specific epithet is derieved from two Malayalam words, 'Conda' and 'Pana'. The word Conda applied to casual knot in the hair styles of South Indian woman probably for its apparent similarity with the shape of just emerged flower branches of the inflorescence. The word Pana means palm.

Bentinckia nicobarica (Kurz) Becc.

Solitary tall palm; stem columner, distinctly annulate, to 20 m long, to 40 cm in diameter near base; crownshaft cylindrical, green, about 1 m long. Leaves ascending to arching, about 2.5 m long; leaflets closely packed, linear-lanceolate, acuminate, alternate to subopposite in adult trees; laterally jointed in younger plants, 50-60 cm long with conspicuous midnerve on upper side; terminal leaflets jointed. Inflorescence infrafoliar, decompound; prophyll and peduncular bract large, green, bicarinate, spatuliform; flower branches greenish yellow; ultimate flower branches (rachillae) slightly inserted at the point of attachment; flowers bracteolate. In female flower sepals orbicular, imbricate; petals 3, orbicular, obtuse, leathery, light brown in colour, each about 3 mm long. Ripe fruits subglobose, deep brown in colour ; mesocarp fibrous; endocarp brittle; seed ovoid 8-9 mm long; endosperm white, homogeneous.

Flowering & Fruiting : April-September; November-March.

Distribution : INDIA (Nicobar Islands). Endemic.

Cultivation : Cultivated as ornamental palm in the Indian Botanic Gaden, Howrah and other major gardens in India.

Uses : This species can be grown as avenue trees along the path ways, driveways etc. It is also susceptible to draught.

Calyptrocalyx spicatus (Lamk.) Bl.

Solitary tall palm. Stem erect, faintly annulate, about 18 cm in diameter near base, dark grey in colour. Crownshaft absent. Leaves pinnate, ascending to horizontal from the stem; leafblade oblong in outline, about 2 m long; leafsheath leathery, short, scurfy outside; leaflets bifarious, linear, to 90 cm long, 4-5 cm broad at middle, slightly drooping from the rachis; tip of the leaflets divided into short, unequal teeth; basal and apical leaflets shorter and narrower. Inflorescence interfoliar, simple, whip-like, about 2 m long; prophyll shorter than peduncular bract, permanently attached with the peduncle and hidden under the leafsheath. Flowers unisexual, sunken in cavities; each cavity with a lip-like outgrowth on lower side. Male flowers angular, about 5 mm long; sepals 3, unequal, fleshy, imbricate; innermost sepal obovate; petals 3, twice longer than sepals; stamens many, borne on fleshy disc; pistillode with 3 conspicuous points; female flowers shorter than males, globose. Fruits not seen.

Flowering & Fruiting : January-February. No setting of fruits seen in the plant cultivated in the Large Palm House of the Indian Botanic Garden, Howrah.

Distribution : NEW GUINEA.

Cultivation : Rare in India. Difficult to grow in the open.

Uses : Unknown.

Carpentaria acuminata Becc.

Solitary tall palm. Stem columner with distinct bole at base, prominently annulate, to 15 m long, 25 cm in diameter near base; crownshaft not compact more or less ventricose in shape. Leaves pinnate, to 3 m long, shortly petioled; leaflets linear, flaccid, numerous, to 1 m long, 3.4 cm broad at middle, prominently 1-nerved on upper side; tip of the leaflets unequally bifid, praemorsed or sharply toothed at apices. Inflorescence infrafoliar, decompound; prophyll large, spatuliform,

leathery, bicarinate, about 60 cm long, to 20 cm broad at middle; rachillae satin white in colour; flower clusters in triads of two lateral male flowers and a middle female flower; flower clusters spirally disposed. Male flower bud ellipsoid, 11 mm × 5 mm; stamens exserted at anthesis; filaments filiform; pistillode filiform, longer than filaments; sepals 3, scale-like, imbricate, petals 3, about 6 mm long, oblong; female flowers globose, sepals and petals imbricate. Ripe fruits deep crimson in colour, ovoid, 2 cm × 1.5 cm, with distinct tuberculate stigmatic remains; mesocarp thinly pulpy; endocarp brittle; seed ovoid; endosperm white, homogeneous; fruiting perianth bright yellow in colour.

Flowering & Fruiting : April-October.

Distribution : AUSTRALIA. In its natural habitat it grows along the bank of streams at low elevation usually along brakish water estuaries.

Cultivation : A fast growing palm, prefers to grow in semishade and on moist soil but not on water logged soil. A handsome ornamental palm of the humid tropics. For long years this species was insufficiently known to the botanists. Its identity was correctly established after its rediscovery from the northern teritory of Australia (Moore 1973).

Chambeyronia macrocarpa (A. Brogniert) Vieillard ex Becc.

Solitary unarmed, pleonanthic, monoecious palm; stem erect annulate, swollen at base. Leaves regularly pinnate, curved; young leaves with reddish leafsheaths; petiole channelled above, rounded below; lower surface covered with minute scales; leaflets linear-oblong, to 90 cm long, acute to acuminate at apices (staminate flowers asymmetrical; sepals acute; petals angled; pistillode absent. Fruit globose; mesocarp with dispersed tanin cells, fibres often thickened, adherent to endocarp throughout).

Flowering & Fruiting : Not yet flowering or fruiting in the Indian Botanic Garden, Howrah.

Distribution : NEW CALEDONIA. Endemic.

Cultivation : A single potted plant exist in the Indian Botanic Garden, Howrah, introduced in 1982 through seed.

Chrysalidocarpus Wendl.

Clusterforming or rarely solitary, pinnate leaved monoecious palm. Stem slender to moderately thick, sometimes erect, columner, mostly annulate; crownshaft distinct

but not perfectly cylindrical or well defined. Leaves pinnate; leaflets linear, narrow, sometimes forked at epices, deflected from this rachis in different planes. Inflorescence interfoliar, decompound, monoecious; prophyll leathery, smaller than first peduncular bract; flower clusters mostly in triad of 2 lateral male flowers and a middle female flower or paired male flowers arranged spirally. Male flowers globose in bud; sepals 3, imbricate, petals 3, much longer than sepals, valvate; stamens 6, anthers sagittate at base, versatile. Female flowers smaller than males; sepals 3, imbricate, petals 3 imbricate; ovary 3 loculed with 2 abortive carpels. Fruits 1-seeded, fleshy, ovoid, oblong; seed oblong; endosperm white, homogeneous.

Distribution : PEMBA, COMOROS ISLAND, MADAGASCAR. Also found largely in cultivation. 20 species. 2 species and a variety exist in the Indian Botanic Garden, Howrah.

Pollen grains : Elliptic monosulcate, rarely triangular monosulcate.

Key to the Species

1a. Leaflets in pairs on each side of the rachis, equidistant. Inflorescence interfoliar at emergence, infrafoliar in fruiting; peduncle long, flat, yellowish in colour; ultimate flower branches simple. Ripe fruits ovoid, bright yellow in colour . . . *lutescens*

1b. Leaflets in groups, projecting to different planes from the rachis. Inflorescence always interfoliar; peduncle shorter, heavy, green, thickly covered with dark brown scurfs; flower branches much ramified. Ripe fruits obliquely oblong, green . . . *madagascariensis*

Chrysalidocarpus lutescens Wendl.

Clusterforming, monoecious, pinnate leaved palm. Stem yellowish green in colour, more or less smooth outside, about 6 m long, about 5 cm in diameter near base; cleaner portion of the stem distinctly annulate, with numerous sucker shoots developing from the base. Leaves pinnate, arching, 6-7 in number per crown; leafsheath cylindrical about 40 cm long, yellowish-green in colour; leaflets yellowish-green, to 60 cm long, about 3 cm broad at middle, more or less stiff, acuminate, unequally bifid at apices; midnerve yellowish, prominent on upper side. Inflorescence interfoliar at emergence; peduncle and flower branches arching and pendulous, about 1 m long; first peduncular bract bicarinate, caducous. Male flowers 3.5 mm long; sepals 3, each about 1 mm long, orbicular, imbricate; petals 3, longer than sepals, obtuse, incurved, valvate; stamens 6; filaments filiform; pistillode as long as stamens. Female flowers about 3 mm long, curved; sepals and petals imbricate. Ripe fruit ovoid about 2 cm long, 1 cm broad at middle; seed ovoid.

Flowering & Fruiting : January-March; May-July.

Distribution : MADAGASCAR.

Cultivation : One of the most widely cultivated ornamental palms. This species can be grown as indoor potted plant and for decorating varandah, patio etc. Prefers to grow healthy in semishade. Forking of stem near the ground level and above is a common feature in this palm.

Uses : Other uses unknown.

Chrysalidocarpus madagascariensis Becc.

Clusterforming, pinnate leaved monoecious palm. Stem slender, annulate on upper part, 6-7 cm in diameter near base. Leaves ascending to arching, densely pinnate; leaflets deep green in colour, linear, acuminate, to 60 cm long, 1.5 cm broad at middle, midnerve prominent on upper side, margins ribbed, tip of the leaflets bifid. Inflorescence interfoliar, decompound about 120 cm long; prophyll and 1st peduncular bract leathery, pale green in colour, scurfy near base; primary flower branches slightly angular, light green in colour; ultimate flower branches (rachillae) filiform, to 20 cm long. Flower clusters in triads, spirally arranged on rachillae. Male flowers globose, sepals 3, orbicular, petals 3, double the length of sepals; stamens 6, anthers oblong; pistillode trigonous. Femle flowers ovoid; sepals 3, orbicular; petals 3, orbicular, much longer than sepals, broad apiculate; stigma triangular, staminodes 6, conspicuous. Ripe fruits ovoid with attenuate tip; mesocarp fibrous; seed rounded in cross section (terete); endosperm deeply furrowed on one side containing spongy tissue, otherwise white, homogeneous.

Flowering & Fruiting : January-June; August-October.

Distribution : MADAGASCAR.

Cultivation : Very common in cultivation. Can be grown outside in warm areas of high humidity. Cultivated in the Indian Botanic Garden, Howrah and many private and public gardens in Calcutta. Inflorescences that emerge from the later part of the flowering season bear only paired male flowers with obscure female flower in the middle of the flower clusters. These inflorescences wither after completion of male anthesis. This apparent unisexual nature of the inflorescence leads to the misconception that the species is dioecious.

Chrysalidocarpus madagascariensis Becc. var. **lucubensis** Becc.

Stem solitary, erect, robust, distinctly annulate, about 25 cm in diameter near base. Leaves longer with thicker leafsheaths. Inflorescence interfoliar, massive, decompound.

Distribution : MADAGASCAR.

Cultivation : Not common in cultivation. A few single stemmed robust form exist in the Indian Botanic Garden, Howrah.

Cyrtostachys lakka Becc. *Sealing Wax Palm.*

Clustrforming palm. Stem slender with brilliantly red crownshafts, to 10 m long, more or less erect, distinctly annulate, deep green in colour. Leaves pinnate, ascending, about 1.5 m long; leafsheaths, petiole, rachis; midnerves of leaflets brilliantly red in colour; leaflets linear, stiff, slightly projected upward, deep green upper, greyish below, tip of the leaflets pointed. Inflorescence infrafoliar; prophyll and peduncular bract about 60 cm long, boat shaped; flower branches twice or thrice divided to form the rachillae; flower clusters in triad, slightly sunken, spirally disposed. Male flowers with 15 stamens; filaments connate at base. Ripe fruits ellipsoid to ovoid, black with scarlet base about 2 cm long; seed ovoid about 8 mm long; endosperm homogeneous.

Distribution : MALAYA PENINSULA, SINGAPORE.

Cultivation : This species is of recent introduction and mostly grown in pots. A few healthy clumps were seen in the garden of the water supply department on Shiruvani hill in Tamil Nadu, said to have been introduced in 1978. Seeds germinates easily without treatment but seedlings die in pots if the soil does not contain laterite necessary to produce vigorous and healthy seedlings. Peat moss does not work well. This species can be grown successfully in a place with full sun, warm, with plenty of moisture in the soil. It grows naturally in acid soil therefore acid fertilizers supplied frequently in non-acid soil keep the sealing wax palm healthy. Frequent sprays or soaking with nutritional sprays and also with iron compound keep the colour bright. Watering should be done 2-3 times a day during dry months. In colder months a slightly warm water should be used for soaking the soil because the plant loves heat and encourages vigorous suckering and growth.

Dictyosperma album (Bory) Wendl.

Solitary, erect, pinnate leaved monoecious palm. Stem dark grey in colour, closely and prominently annulate, about 15 m long, about 20 cm in diameter near base; crownshaft greyish with powdery coating 1 m long. Leaves pinnate, arching, 2.5 to 3 m long, 5-6 in number per crown; leaflets bifarious, linear lanceolate, attenuate, to 50 cm long, 2.5 cm wide at middle; midnerve prominent on upper side; terminal leaflets confluent; emerging leaflets are jointed at their apical part; detaches and free when fully expanded. Inflorescence infrafoliar, 50-60 cm long, simply branched; prophyll bicarinate, leathery, 35-40 cm long, 12 cm wide at middle, deep green in colour; peduncular bract large, about 1.5 cm above the prophyll; peduncle and flower branches deep green; flower branches bracteolate at base; flower clusters in triads, borne alternately in depression; male flowers asymmetrical, 1 cm long, angular in bud, deep green in colour; sepals 3, imbricate, scale-like, green; petals 3 about 5 mm long, valvate; stamens 6, anthers linear, large; pistillode shorter than filaments, obscurely 3 dentate; female flowers globose, sepals and petals 3 each, imbricate; stigma 3 fid; staminodes 6 dentate. Ripe fruits deep green to blackish, oblong-ellipsoid, 1.5-2 cm × 7 mm, stigmatic remains protruded; mesocarp fibrous, endocarp shall-like; seed coat anastomosing, endosperm coarsely ruminate.

Flowering & Fruiting : November-April; July-September.

Distribution : Mascarene Islands.

Cultivation : Common in cultivation. According to Moore (1979) this species is threatened in its natural habitats and wild plants are rarely seen in the Mascarene Islands. Very easy to grow in pots but require partial shade for keeping the leaves green. Plants require regular watering if planted in the open, direct exposure to sun is harmful to the palm in places where day temperature is high and humidity is poor. Very young plants have dark green leaves with bright red nerves or in some may have orange coloured nerves. Some varieties have shorter and slender stem, flowers are pinkish and petiole and rachis slightly pubescent on lower side.

Uses : Very useful for planting in the gardens as ornamental plant.

Heterospathe Scheff.

Distribution : Indo-Malaysia, Asia, Philippines, Melanesia, Oceania, Australia (Moore 1973). 32 species. 1 species cultivated in the Indian Botanic Garden, Howrah.

Heterospathe elata Scheff.

Solitary, tall, pinnate leaved monoecious palm; crownshaft not distinct. Stem slender, more or less smooth on outer surface, faintly annulate, dull grey in colour, 5-7 m long to 30 cm in diameter near base. Leaves pinnate, to 4 m long; leafsheath non-tubular, leathery, olive green in colour with fibrous outgrowth from margins; petiole slender more or less rounded, green in colour, scurfy outside; leaflets about 65 pairs, evenly spaced, linear with long pointed tip; each about 1 m long, about 4 cm wide at middle, arranged in one plane on rachis, plicate at base; emerging leaflets are slightly pinkish brown in colour. Inflorescence interfoliar at emergence, monoecious, about 160 cm long; unopened inflorescence ensiform; prophyll narrow, falcate, to 40 cm long, leathery, densely acutely out side; peduncular bract about 15 cm above the prophyll; flower branches smooth, white to pale yellow; flower clusters in triad of two lateral male flowers and a middle female flower. Male flowers white; sepals 3, imbricate, margins minutely ciliate; petals 3, ovate; stamens 6, filaments exserted, anthers oblong; pistillode truncate; female flowers about 3 mm long, slightly ovoid; sepals and petals 3 each, imbricate; staminodes 3; stigma curved. Ripe fruit green to pale green, pisiform (pealike), about 8 mm in diameter; seed globose, about 5 mm in diameter, endocarp scale like; endosperm ruminate.

Flowring & Fruiting : July-September; January-March.

Distribution : AMBOINA.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. Not common in cultivation. A moderately fast growing palms, grows in the semishade condition with plenty of moisture in the soil. Benthal (1946) misinterpreted this palm as *Euterpe* sp.

Uses : Unknown.

Howeia Becc.

Solitary, pinnate leaved, monoecious palm; stem cylindrical erect, slender; crownshaft absent. Leaves ascending to arching; petiole short or long; leaflets linear, ascending from the rachis, bifarious. Inflorescence monoecious, simple, spicate, or of multiple spikes arising from a common stalk. Fruits ovoid to oblong.

Distribution : MELANESIA, OCEANIA AND MELANESIA, AUSTRALIA. **2 species. 2 species cultivated in the Indian Botanic Garden, Howrah.**

Key to the Species

1a. Petiole very short; leaves ascending and arching; leaflets somewhat upright from the rachis; midnerve prominent on upper side of the leaflets . . . *belmoreana*

1b. Petiole long, not strongly arching; lower leaves almost horizontal from the stem; leaflets not upright but flat; midnerve pominent on both sides of the leaflets . . . *fosteriana*

Howeia belmoreana (C. Moore & F. Muell.) Becc. *Sentry Palm.*

Solitary, slender, unarmed pinnate leaved palm. Stem erect, expanded at base, prominently ringed, 3-7 m long; crownshaft absent. Leaves pinnate, ascending, arching from upper part of the petiole, about 5 m long; petiole, to 60 cm long, 3-4 cm wide at middle, green on both sides; leaflets linear, projecting upwards from the rachis; closely placed, each 40-60 cm long, 3-4 cm wide at middle, not spotted or scaly underneath, acuminate at apex. Inflorescence interfoliar, spicate about 1.5 m long. Ripe fruits oblong, ovoid, 2.5-3 cm long, with solid beak.

Distribution : Lord Howe Islands

Cultivation : Rare in India. Difficult to grow in open. Introduced in the Indian Botanic Garden, Howrah in 1967. A very slow growing palm, performs best in shade, susceptible to water logging.

Howeia fosteriana (F. Muell.) Becc.

Solitary unarmed pinnate leaves monoecious palm. Stem erect, to 10 m long, not enlarged at base; crownshaft absent. Leaves pinnate about 3 m long, not prominently arching; leaflets linear, bifarious, alternate, arranged in one plane, green on both sides, each 30-80 cm long, spotted and scaly underneath. Inflorescence interfoliar, spicate. Fruit oblong, about 4 cm long, gradually tapering at apex, not beaked.

Distribution : Lord Howe Island. Endemic.

Cultivation : Rare in India. Difficult to grow in the open. A few plants exists in the Indian Botanic Garden, Howrah, introduced in 1967 Seeds of this species germinate without any special treatment but the rate of growth of the seedlings is very slow in comparison to most Arecoid species introduced in India so far. It can be best grown in the green houses. A very good ornamental palm. It prefers acid soil.

Uses : Unknown.

Hydriastele Wendl. et Drude

Distribution : MELANESIA, OCEANIA, AUSTRALIA. 8 species. (Moore 1973). 1 species cultivated in India.

Hydriastele microspadix (Becc.) Burret

Clusterforming, pinnate leaved monoecious palm. Stem erect, slender, greyish brown in colour, distinctly annulate at naked portion. Leafsheath leathery, outer surface thickly coated with dark brown felt and scales; upper part of the leafsheath 2-ligulate; petiole olive green in colour; leaflets linear, opposite to subopposite, obliquely truncate and praemorse at apices; terminal leaflets jointed. Inflorescence infrafoliar, about 35 cm long; prophyll oblong, to 35 cm long, 7 cm broad at middle; peduncle flat with two lateral notches at the point of attachment of prophyll and peduncular bract; flower branches (rachillae) simple, fastigiate, 15-19 cm long, anthesis protogynous. Flower clusters in triad, arranged in vertical rows; male flowers asymmetric, creamy white; sepals 3, unequal; petals 3, acute; stamens 6; pistillode absent; female flowers conic, smaller than males; ovary 1-ovulate. Ripe fruits deep crimson, ovoid 12 mm × 6 mm; mesocarp thinly pulpy, fibrous; endocarp brittle; seed ovoid, 8 mm × 5 mm; seed coat anastomosing; endosperm ruminate.

Flowering & Fruiting : February-September; January-February.

Distribution : NEWGUINEA.

Cultivation : A beautiful clusterforming palm almost like *Ptychosperma macarthurii* in its habit form, but its leaves are deep green with rust coloured scales on the petiole. Introduced in the Indian Botanic Garden, Howrah in 1965 through seeds received from New Guinea. This species grows luxuriantly in partial shade at a place with moist soil. Seeds germinate easily without any treatment only the seedlings require frequent watering.

Normanbya F. Muell. ex Becc.

Distribution : MELANESIA, OCEANIA, AUSTRALIA. 1 species (Moore 1973). 1 species cultivated in the Indian Botanic Garden, Howrah.

Normanbya normanbyi (Hill) Bailey

Solitary, pinnate leaved, monoecious palm. Stem erect, 5-8 m long, about 20 cm im diameter near base, with distinct bole; crownshaft distinct, cylindrical, green to greyish green in colour with felt like coating outside. Leaves pinnate about 2.5 m long; petiole almost absent; in mature leaves leaflets 20-40 cm long, arranged in groups of two or more leaflets; each attached at a common point, their tips deflected in different planes; leaflets cut off and jagged at apices, dark green above, whitish below. Inflorescence infrafoliar; peduncle short; prophyll green, bicarinate, 30 cm long, about 5 cm wide at middle; detaches after opening; peduncular bract green, elongated; primary flower branches angular, green in colour; ultimate flower branches (rachillae) fleshy; flower clusters spirally, disposed, in triad of 2 lateral male flowers and a middle female flower. Ripe fruits pear shaped, yellowish green, fleshy, 3-5 cm long, 1.5 cm wide at middle; seed ovoid, ridged outside, about 2 cm long; endosperm ruminate.

Flowering & Fruiting : February-September; January-March.

Distribution : AUSTRALIA. In its natural habitat it grows on moist soil close to river or stream in swampy areas and usually in gravelly alluvial soil in areas where dry periods are not more than 40 days long.

Cultivation : Introduced in the Indian Botanic Garden, Howrah in 1971 through seeds received from Brisbane Botanic Garden, Australia. The large seeds germinate after about 4 weeks. For getting good survival of the seedlings, seed should be planted separately in polythene bag containing garden loam. Partial shade is the best place for steady growth of the seedlings. A two year old seedling can be put in into a 30 cm diameter pot or may be planted directly in the garden soil but must not be planted where moisture level of the soil is scanty and likely to dry out. In hot and wet climate it grows quickly and adopt the typical multiplane leaflets after about 4 years. Fruiting starts after about 8 years of planting.

Uses : Seeds contain alkaloids similar to *Areca catechu*.

Phoenicophorium Wendl.

Distribution : MASCARENE and SEYCHELLES. species 1.1 species cultivated in India.

Phoenicophorium borsigianum (Koch) Stunz. *Stevensonia Palm.*

Solitary, pinnate leaved, spiny, monoecious palm. Stem spiny outside when young, annulate. Leaves simple, pinnate, margins entire, pinnately nerved, about

1-2 m long, 50-90 cm broad; tip of the blade forked; petiole, to 40 cm long with short black spines at basal portion; crownshaft indistinct; leafblade bright green above, orange green below; nerves yellowish; tip of the marginal segments bifid at apices; older leaves conspicuously mosaic. Flowering and fruiting not seen in palms cultivated in India. (Inflorescence infrafoliar much branched. Fruit oblong-ovoid 15 mm × 7 mm, greenish yellow to orange red in colour; endosperm of the seed ruminate).

Distribution : Seychelles. Endemic. In the natural habitat it occurs abundantly from sea level to altitude of about 300 m. It also occurs in pure stand.

Cultivation : Not common in cultivation, mostly grown in pots in the household gardens. This species is difficult to grow in Calcutta climate perhaps due to long dry season. We have never seen a plant in Calcutta which was more than 10 years old and very healthy in appearance. It gives good response when planted in acid soil.

Pinanga Bl.

Very small to robust, acaulescent, pleonanthic, monoecious palm. Stem cluster forming or solitary. Leaves pinnately ribbed or pinnate, without well developed crownshaft; leafsheath tubular; leaflets broad, opposite or alternate or unevenly spaced, many nerved, acute or acuminate. Inflorescence infrafoliar, shortly pedunculate; prophyll elongate, thin bicarinate; peduncular bract absent; inflorescence axis longer than peduncle; rachillae filiform to stout; flower clusters distichous or in 4 vertical rows. Male flowers symmetric, obliquely 3 edged; sepals 3 ovate, keeled; petals 3, linear-lanceolate, valvate; stamens 6 to many; anthers sub-sessile, basifixed; female flowers smaller than males, ovoid, or globose; sepals and petals 3 each, orbicular, imbricate; ovary 1-loculed; stigmas 3, ovule basally attached, anatropous. Fruit globose or ellipsoid to spindle shaped, brightly coloured; seed globose, ellipsoid; endosperm deeply ruminate or homogeneous; embryo basal. Germination adjacent ligular; eophyll bifid.

Distribution : India (Western Ghats, Andaman Islands and N. E. India) South China to New Guinea. Component of the moist forests and moist low mountain slopes. About 120 species (Uhl and Dransfield 1987). 6 species in India, rarely cultivated in the gardens.

Key to the Species

1a. Flower clusters disposed on rachillae in 4 vertical rows . . . 5

1b. Flower clusters disposed on rachillae in 2 vertical rows . . . 2

2a. Inflorescence large with many rachillae . . . 3

2b. Inflorescence small with a few rachillae . . . 4

3a. Stem solitary (Andaman Islands) . . . *manii*

3b. Stem clusterforming (Andaman Islands) . . . *andamanensis*

4a. Stem with underground runner, colony forming (W. Ghats). . .*dicksonii*

4b. Stem closely clusterforming (N. E. India) . . . *hookeriana*

5a. Stem delicate, more or less acaulescent, inflorescence simple (E. Himal.) . . . *gracilis*

5b. Stem erect; inflorescence subdigitately branched (N. E. India) . . . *griffithii*

Pinanga andamanensis Becc. *P. Kuhli* (Non Bl.) In Hook. f. F. B. I. 6 : 409. 1892.

Clusterforming, pinnate leaved monoecious palm. Stem slender, not delicate, 3-8 m long, to 10 cm in diameter near base. Leaves, to 2 m long; petiole minutely scurfy outside; leaflets many, falcate, linear to linear-lanceolate, finely acuminate, prominently 3 nerved on upper side; middle leaflets, to 60 cm long; upper leaflets jointed. Inflorescence simple branched; peduncle robust, reddish in colour; rachillae, to 30 cm long. Fruits broadly ellipsoid, shortly beaked, dark purple in colour, 13-15 mm long, 9 mm broad at middle; seed ellipsoid, 9 mm × 7 mm, adherent to pericarp.

Distribution : India (Andaman Islands). Endemic. Component of the moist hill forest, grows on soft loam near the stream. Uncommon in the Saddle Peak Range of North Andamans.

Cultivation : Very attractive palm for growing in the shade and Green Houses. Attempt has been made to domesticate this wild palm in the Indian Botanic Garden, Howrah.

Pinanga dicksonii Bl.

Stoloniferous pinnate leaved, monoecious palm. Stem slender, erect, to 8 m long, to 5 cm in diameter near base; leaves about 1.5 m long; leaflets many, sessile, elongate, broadly linear to falcate, acuminate or praemorsed, 5-7 nerved, to 60 cm long, about 3 cm broad at middle; light green in colour; uppermost leaflets jointed. Inflorescence infrafoliar; prophyll simple, boatshaped, caducous; peduncle about 4 cm long; flower branches simple, mostly 5-8 in number, densely covered with flower clusters. Male flowers pinkish; sepals 3, subulate, almost same length of petals; petals 3, ovate-cordate, tapering; stamens numerous; filaments

short; pistillode absent. In female flowers sepals and petals 3 each, reniform; staminodes 6, clavate, tips pointed. Ripe fruits ovoid-ellipsoid 1.5 cm × 1 cm, conical at stigmatic region; seed ovoid; endosperm ruminate.

Flowering & Fruiting : June-September ; December.

Distribution : INDIA (Western Ghats). Endemic. Wild in the Western Ghats from Maharashtra to Kerala. Grows mostly on the western slopes in deep ravines under the shade where there are sufficient soil depth. Although in the field the palm appears as a single stemmed, it actually part of a large spread out colony of erect shoots developed from underground stolon.

Cultivation : Not common in cultivation. One of the authors (SKB) introduced in 1989 a few wild root stocks in the Indian Botanic Garden, Howrah and Theosophical Society's Garden in Madras and delivered a few to the Experiental Garden of B. S. I. in Coimbatore. It prefers to grow in shade, therefore a very good ornamental palm for growing in the Green Houses.

Uses : Stem although slender is used for making fences. Leaves are used as thatches.

Pinanga gracilis Bl.

Clusterforming pinnate leaved monoecious palm. Stem slender reddish, to 4 m long, about 1 cm in diameter near middle. Leaves about 1.5 m long, sparingly pinnate; petiole and leafsheath scurfy outside; leaflets broad at base, acuminate, prominently 3 nerved, about 30 cm long; upper leaflets broader than middle, about 15 cm long, 5-7 nerved, praemorsed at apices. Inflorescence simple, reflexed; flower branches scarlet, 4-20 cm long; peduncle pubescent. Male flowers in 3 rows, broad and flat; calyx minute; petals 3, cuspidately acuminate, each 6 mm × 4 mm. Female flowers much smaller than males, spirally disposed; sepals and petals 3 each, almost same size and length; fruiting branches pendulous; fruits ellipsoid to fusiform, scarlet or light orange in colour, 10 mm long, about 6 mm broad at middle, tapering at stigmatic end.

Flowering & Fruiting : June-September ; January.

Distribution : INDIA (West Bengal, Assam, Meghalaya, Arunachal Pradesh, Manipur, Nagaland). Grows in the moist lower hill forests.

Cultivation : This species can be grown as potted ornamental palm. The dwarf nature of the stem is best suited for indoor culture or can be grown in the green houses.

Uses : Nuts are brownish white when dried. The Mikir tribes of Arunachal Pradesh and Assam consume both fresh and dried nuts as substitute of Arecanut.

Pinanga griffithii Becc.

Clusterforming, pinnate leaved, monoecious palm. Stem distinctly annulate, about 2 m long, about 2.5 cm in diameter; internodes, to 7 cm long, green in colour with dark brown spots. Leaves about 1 m long; lower leaflets irregularly disposed, broad based, falcate, acuminate, 3-6 nerved, about 60 cm long; middle leaflets, alternate, subfalcate, prominently nerved on upper side, about 40 cm long, 5 cm broad at middle; upper leaflets opposite to subopposite, broad based,sub-falcate, about 30 cm long, 3-5 nerved; tip of the upper leaflets with 3-5 bidentate lobes; terminal leaflets bilobed, 7-8 nerved, crenulate at apices. Inflorescence infrafoliar, about 35 cm long; peduncle about 5 cm long, reflexed, subdigitately branched; rachillae 3-5 in number; each about 30 cm long. Flower clusters spirally disposed. In male flowers calyx shorter than corolla. Ripe fruits reddish, disposed in 4 vertical rows, broadly ellipsoid, tapering at base, mammillate, 1.2 cm long, about 8 mm broad; endosperm deeply ruminate.

Distribution : INDIA (West Bengal, Assam, Meghalaya, Arunachal Pradesh, Manipur, Nagaland), BANGLADESH. Occur in the moist forests of lower hill valleys and ravines, along water courses.

Cultivation : Yet to be introduced in cultivation.

Pinanga hookeriana Becc.

Clusterforming, pinnate leaved, monoecious palm. Stem slender, annulate, about 2 m long; internodes clavate; young stem scurfy outside. Leaves about 1.5 m long; petiole about 20 cm long, scurfy outside; leaflets narrowly linear-lanceolate, sub-falcate, numerous, mostly opposite, 3-4 nerved, acuminate to obliquely acuminate; terminal leaflets bifid. Inflorescence about 15 cm long; peduncle slender; rachillae 4-5 in number, compressed, flexuose ; prophyll oblong, about 10 cm long; flower clusters crowded. In male flowers calyx membrane like 3 toothed, much shorter than petals; petals 3, unequal; stamens 15; pistillode absent. In female flowers sepals and petals 3 each, subequal; staminodes absent; stigma discoid. Ripe fruits ellipsoid, apiculate, tapering at stigmatic end, about 15 mm long, 8 mm wide, at middle; seed ellipsoid.

Distribution : INDIA (Assam, Meghalaya). Endemic. Infrequent now in Khasia Hills. Grows in the moist hill forests between 700-1500 m.

Cultivation : Yet to be introduced in cultivation.

Uses : Fleshy sweet pulp of the ripe fruit is eaten by the tribals of North Eastern India.

Pinanga manii Becc.

Stem robust about 10 m long, about 14 cm in diameter. Leaves pinnate about 3 m long; leaflets many, ensiform; middle leaflets longer, about 30 cm long, 4-6 cm broad at middle; 2-3 partite, deep green above, pale green below, prominently 3 nerved on upper side. Inflorescence much branched; peduncle stout; rachillae about 40 in number, slender, to 40 cm long. Flower clusters in two vertical rows. In male flowers sepals and petals 3 each, are of same length. Ripe fruits broadly ellipsoid with acute base, 15 mm long, 8 mm broad at middle; pericarp thin; seed with reticulate raphae; endosperm not deeply ruminate.

Flowering & Fruiting : January-February; July-August.

Distribution : INDIA (Andaman Islands). Endemic.

Cultivation : Yet to be introduced in cultivation.

Uses : Leaves are used as thatch, stems as posts. Nuts are consumed by the tribals as masticatory.

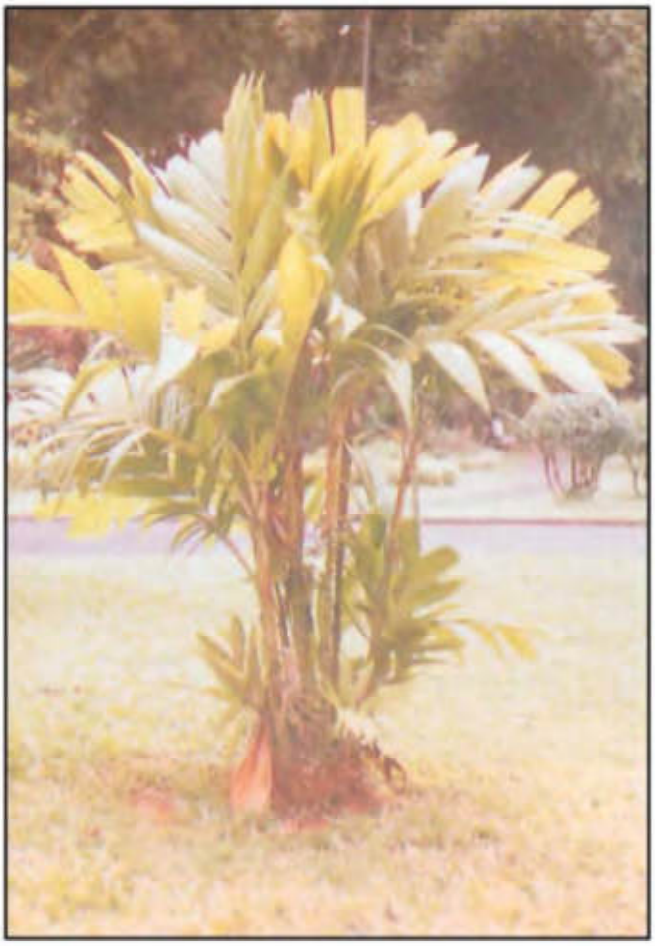
Ptychosperma Labill.

Solitary or clusterforming, pinnate leaved, monoecious palm. Stem slender, erect annulate, unarmed. Leaves pinnate; leaflets reduplicate; tip of the leaflets obliquely truncate, toothed; middle and marginal nerves prominent. Crownshaft tubular, distinct. Inflorescence infrafoliar, monoecious; prophyll large, green, bicarinate, leathery, caducous; prophyll and peduncular bract act as cover of the growing flower branches; primary flower branches sometimes prominently bracteate at base; flower clusters spirally disposed, in triad of 2 lateral male flowers and a middle female flower; flowers bracteolate at base, protandrous. In male flower sepals 3, imbricate; petals 3 longer than sepals, valvate; stamens many, pistillode conspicuously filiform. In female flowers sepals 3, scalelike, green, imbricate; petals 3, larger than sepals, imbricate; staminodes 3-6. Fruits ovoid, ellipsoid, pointed at stigmatic end, mostly red in colour, sometimes deep brown; mesocarp thin, fibrous, endocarp hard; seed variously sulcate; endosperm hard, homogeneous or slightly ruminate.

Distribution : MELANESIA, OCEANIA, AUSTRALIA. 44 species (Moore 1973), 4 species cultivated in India.

Hydriastele microspadix (Becc.) Burret

Pinanga andamanensis Becc.



Pinanga sp.

Pinanga sp.

Ptychosperma sanderanum
Ridley

Rhopalostylis sapida
Wendl. et Drude

Roystonea oleracea
(Jacq.) Cook.

Roystonea Avenue
at Indian Botanic Garden

Key to the Species

1a. Stem clusterforming . . . 2

1b. Stem erect, solitary . . . *elegans*

2a. Leaflets very narrow about 1 cm wide. Fruits densely crowded on rachillae. Ripe fruits orange red in colour . . . *sanderanum*

2b. Leaflets more than 3.5 cm wide. Flowers and fruits not densely crowded . . . 3

3a. Leaflets regularly arranged. Flower branches covered with deep brown scales. Ripe fruits with distinct stigmatic projection. . . *macarthurii*

3b. Leaflets irregular on rachis. Flower branches thickly covered with dark brown scales . . . *propinquum*

Ptychosperma elegans (R. Brown) Bl.

Solitary pinnate leaved, monoecious palm. Stem slender, annulate, about 7 m long, 7-10 cm in diameter near base; crownshaft distinct more or less tubular, slightly swollen at middle, green in colour. Leaves 6-8 in number per crown, to 3 m long, bearing elongate, pale, twisted scales along the ribs on the lower surface; leaflets irregularly spaced on the rachis, 20-30 cm long, about 10 cm wide at middle; both ends tapering; smooth, dark green in colour; a few leaflets broadly truncate at apex. Inflorescence infrafoliar, decompound; prophyll large, boat shaped, 2 keeled (bicarinate), green obtuse, about 40 cm long, 10 cm wide at middle; peduncular bract large, about the same size of prophyll; peduncle heavy, flattened, holding very bushy and much branched flower branches; each ending in rachillae; flower clusters spirally disposed. Male flowers white, about 1 mm long; stamens about 30 in number, exserted at anthesis; anthers versatile, bifid at base, obtuse at apex; pistillode as long as stamens. Female flowers globose; staminodes minutely dentiform. Ripe fruits oblong, globose, with stigmatic projection about 1.5 cm long, fleshy, bright red in colour; endocarp slightly attached with the seed; seed not deeply sulcate; endosperm slightly ruminate.

Flowering & Fruiting : June-August; December-February.

Distribution : AUSTRALIA.

Cultivation : A moderately fast growing palm. Very attractive for its dark green foliages, prefers to grow in semishade condition. Very variable in vegetative form. Two forms are commonly seen in cultivation, one is slenderer form with shorter and ascending leaves and the other slightly robust with longer leaves. Introduced in the Indian Botanic Garden, Howrah in 1839.

Uses : A beautiful ornamental palm for garden decoration. This species can be grown in the palm grooves or as pot grown plant for interior decoration.

Pitychosperma macarthurii (Wendl.) Nichols.

Clusterforming, pinnate leaved, monoecious palm. Stem slender, erect, annulate, green, lower portion of the stem light brown in colour; mature stem 5-7 m long, 6-8 cm in diameter near base; crownshaft tubular, green. Leaves 7-8 in number per crown; leafsheath tubular, about 50 cm long, leathery, smooth outside with 2 deltoid projections on the top of the sheath; petiole 30-40 cm long; leaflets bright green, soft, glossy upper, dull green below; lower to middle leaflets, to 60 cm long, 5-8 cm broad at middle, truncate and praemorsed at apex; nerves many, conspicuous on upper side; terminal leaflets broad and jointed. Inflorescence infrafoliar, about 40 cm long; prophyll and peduncular bract large, boat shaped, deep green in colour, caducous after opening; flower branches pale yellow, short, twice branched to form rachillae; flower clusters in triad, spirally disposed, male flowers white, larger than females. Ripe fruits yellow to bright red, broadly ellipsoid with conspicuous stylar projection; deeply sulcate; endosperm homogeneous.

Flowering & Fruiting : June-August; December-February.

Distribution : New Guinea.

Cultivation : Common in cultivation in India. It prefers to grow in semishade condition on moist soil. Introduced in the Indian Botanic Garden, Howrah by the middle of nineteenth century. Several clumps are growing in the garden producing enormous ripe fruits and seeds every year. In the Indian Botanic Garden due to open pollination between the species some intermediate forms have appeared. In natural habitats this possibility is remote since there is distinct overlapping of anthesis of male and female flowers which ensures selfing within the species, or even in the same tree.

Uses : A very good ornamental palm mostly used for landscape beautification. This species can be grown in pot as indoor plant.

Ptychosperma propinquum (Becc.) Becc.

Clusterforming, pinnate leaved, monoecious palm. Leaflets irregularly arranged along the rachis, shorter than other species; tapering at base, upper part jagged, light green in colour. Inflorescence shorter, with less number of branches; prophyll and flower branches densely covered throughout with fine blackish wool like coating; fruits about 2 cm long along with styler projection; orange red when ripe, mesocarp thick, pulpy.

Flowering & Fruiting : June-August ; December-February.

Distribution : Indonesia.

Cultivation : Indian Botanic Garden, Howrah has one clump, source of which is untraceable. This *Ptychosperma* sp. has similarity with the description of Essig (1977), therefore identified with the name *Ptychosperma propinquum*. Not common in cultivation.

Ptychosperma sanderanum Ridley

Clusterforming, pinnate leaved, monoecious palm. Stem slender annulate about 6 m long, about 6 cm in diameter near base; upper part of the stem green and smooth; crownshaft tubular green. Leaves about 2.5 m long or more, mostly drooping and delicate in appearence; leaflets in one plane, biferious, closely placed, extremely narrow, linear, to 40 cm long, 1.0 cm broad at middle. Inflorescence infrafoliar with narrow bicarinate prophyll; flower clusters crowded on the rachillae; fruits orange to red when ripe.

Distribution : AUSTRALIA.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. This species is wrongly called as *Ptychosperma sanderianum*.

Rhopaloblaste Scheff.

Solitary, or cluster forming, pinnate leaved, monoecious palm. Stem slender to robust, distinctly annulate; crownshaft indistinct, not compact. Leaves arching; leaflets narrow, caudate, acuminate, deep green in colour. Inflorescence infrafoliar, simple or paniculately branched; flower clusters in triad, bracteate at base; spirally disposed on rachillae. Male flowers symmetric, speals 3, green outside, rounded, imbricate; petals 3, valvaty at tips, much longer than sepals; stamens 6, pistillode conical, columner. Female flowers bracteolate; sepals 3, rounded, imbricate; petals 3, imbricate, sometimes valvate at tips; staminodes 6; ovary ovoid. Ripe fruits ovoid, ellipsoid; seed oblong with a deep linear groove along one side, endosperm deeply ruminate, embryo basal.

Distribution : INDIA (Nicobar Islands), SINGAPORE, PHILIPPINES. 3 species. 1 species in India.

Key to the Species

1a. Stem solitary, tall, columner. Inflorescence decompound, large; flower branches green. Ripe fruits ovoid, pink . . . *augusta*

1b. Stem cluster forming; inflorescence short, delicate. Fruit broadly ellipsoid, deep red . . . *singaporensis*

Rhopaloblaste augusta (Kurz) Moore

Solitary, pinnate leaved monoecious palm. Stem erect, annulate, about 20 m long, about 30 cm diameter near base, dull grey in colour, surface more or less smooth. Leaves about 4 m long, deep green in colour; upper leaves ascending by their midrib with conspicuously drooping leaflets; leaflets linear, alternate to subopposite in one plane on the rachis; each, to 1 m long, 3-4 cm broad, pointed at their apices; petiole short, more or less rounded; petiole and rachis distinctly scurfy outside. Inflorescence infrafoliar, about 1 m long; prophyll and peduncular bract very large, flattened, leathery, greyish green in colour; flower branches much ramified, deep green in colour, each thickened at base; flower clusters spirally disposed; each cluster subtended by more or less reflexed lip-like bracts. Male flowers oblong in bud, about 2 mm long. Female flowers smaller than males; sepals and petals 3 each, more or less equal in size; staminodes united into a membranous 6 lobed ring. Mature fruits ovoid, 2.5 cm × 1.4 cm; stigmatic region slightly mamillate; mesocarp pulpy, fibrous, mostly 1-2 seeded, rarely 3-4 seeded; 2 seeded fruits have distinct longitudinal septum at middle; seed ovoid, endocarp shell-like; endosperm deeply ruminate. Eophyll paripinnate, 7-11 cm long.

Flowering & Fruiting : June-August ; January-March.

Distribution : INDIA (Nicobar Islands). Grows in the moist hill valleys and slopes of high rainfall areas.

Cultivation : This species was introduced in the Indian Botanic Garden, Howrah in the later part of the nineteenth century. In a recent report (Basu 1986) this arecoid palm species has been declared as threatened at its natural habitat. In the Calcutta climate it does not thrive in the open; the strong midday sun from March to June quickly dessicates the luxuriant green foliages. This species thrives best in green houses in warm humid atmosphere. A very slow growing palm.

Rhopaloblaste singaporensis (Becc.) Moore

Clusterforming, pinnate leaved, monoecious palm. Stem slender, about 3 m long, about 2.5 cm in diameter near base, distinctly annulate; crownshaft indistinct. Leaves finely pinnate, about 1.5 m long; rachis coated with dark brown scales on the back; leaflets numerous, narrow, pointed, stiff, to 50 cm long; midnerve and two lateral nerves conspicuous on upper side. Inflorescence interfoliar or infrafoliar, pendulous, about 40 cm long; peduncle about 6 cm long, holding about 5 flower branches; each scurfy with fine transverse ridge; prophyll bicarinate; peduncular bract woolly outside. Flower clusters in triad, spirally disposed. Flowers sessile, yellow; female flowers slightly larger than males. Fruit ovoid, orange yellow, turning to red, about 1.2 cm long; seed ovoid, endosperm ruminate, embryo basal.

Flowering & Fruiting : August; January-March.

Distribution : MALAYA PENINSULA, SINGAPORE. It grows as under growth in the moist forests.

Cultivation : Not common in cultivation in India, may be due to its susceptibility to hot dry climate. Sometimes potted plants are displayed in the flower shows. A good clump was seen in a private garden in Trivendrum, Kerala. Unlike most arecoid species its leaves are not self clearing from base along with the sheath, the upper part of the leaf gradually rot and falls off, the sheath remains attached for some more time untill it gets fully decayed.

Rhopalostylis Wendl. et Drude

Distribution : NEW ZEALAND. 2 species. 1 species cultivated in the Indian Gardens.

Rhopalostylis sapida Wendl. et Drude, *Nakau Palm.*

Solitary, pinnate leaved, monoecious palm. Stem erect, distinctly annulate, dull grey in colour, about 10 m long, 30 cm diameter near base; crownshaft distinct, slightly bulged at middle. Leaves ascending, 1.5-2 m long; petiole short, stout; leaflets linear, rigid on rachis, slightly projected upward; each 1 m long, 5 cm broad at middle; upper part of the leaflets narrow with stiff splitted points. Inflorescence infrafoliar, about 60 cm long; prophyll bicarinate, caducous; prophyll and peduncular bract similar in size; flower branches simple, white to greenish white, smooth, each with a triangular bract at base. Flower clusters in triad; flowers bracteolate. In male flowers stamens 6, pistillode present; female flowers smaller than males, globose, staminodes minute. Fruits ovoid to broadly ellipsoid, deep crimson in colour 2 cm × 1.5 cm. Seed ovoid to oblong.

Flowering & Fruiting : March-June ; November.

Distribution : NEW ZEALAND. Grows on mountain slopes. It is one of the cold tolerent palms of *S. hemisphere* (Baily 1933).

Cultivation : Not common in cultivation in India. This species cannot be grown in open in regions where climate is warm and dry. In the Indian Botanic Garden, Howrah this species was in the Small Palm House. A very attractive palm. This cold temperate species can be tried at Pauri Garden or Lloyed Botanic Garden, Darjeeling.

Roystonea Cook. *Royal palm.*

Solitary, tall robust, pinnate leaved, monoecious palm. Stem columner with closely and finely annulate smooth surface; crownshaft massive, cylindrical,

green, smooth outside. Leaves very large with massive, leathery, leafsheath; leaflets narrow, regular, closely placed, deflected from the rachis in the same or different planes, more or less pointed at tips. Inflorescnece infrafoliar, much branched; flower branches slender, green; ultimate flower branches (rachillae) stiff at emergence, drooping later; prophyll green, bicarinate, caducous, peduncular bract longer than prophyll, flower clusters in triad of 2 lateral male flowers and a middle female flower, spirally disposed on rachillae. In male flowers stamens 6-9; filaments adnate at base to petals; pistillode distinct; columner. In female flowers sepals and petals 3 each; petals connate upto middle; ovary 3 loculed, surrounded by scale-like staminodes. Fruits fleshy, oblong or globose, pericarp thinly waxy; stigmatic remains near base; seed with endosperm homogeneous.

Distribution : Southern Florida, Caribean Islands. 12 species. 3 species common in India. 1 species recently introduced in the Indian Botanic Garden, Howrah.

Key to the Species

1a. Leaves flat at least in the middle; leaflets in one plane in two opposite rows. Fruits oblong, with straight sides . . . *oleracea*

1b. Leaves not flat; leaflets deflected in different planes; fruits globose or obovoid . . . 2

2a. Flower branches smooth; flowers scattered. Fruits globose. . . *regia*

2b. Flower branches pubescent; flowers densely disposed on flower branches. Fruits obovoid . . . *borinquena*

Roystonea borinquena Cook. *Purrto Rico Royal Palm.*

Solitary, pinnate leaved, monoecious palm. Stem columner, tall, about 50 cm in diameter near base, outer surface of the stem dull grey, smooth. Leaves appreading, arching about 3 m long; leafsheath light green in colour, about 1.2 m long; leaflets linear, attenuate at apex, prominently 3 nerved on upper side, reduplicately plicate at base, each 90 cm to 1 m long, about 5 cm wide at middle; middle to upper leaflets opposite to subopposite; terminal leaflets broadly lanceolate; each 45 cm long, distinctly 4 nerved on upper side; rachis terminates into fine thread. Unopened inflorescence about 1 m long; prophyll and peduncular bract caducous; peduncle and rachis densely pubescent. Flower branches simple, each 15-30 cm long. Male flowers 6-7 mm long; stamens 6-9, longer than petals. Fruits obovoid, 1.2-1.5 mm long, 9-11 mm broad at middle, 1-seeded; seed oblique on one side.

Flowering & Fruiting : August-September; April-June; February-March; October-December.

Distribution : This species was introduced in the Indian Botanic Garden, Howrah in 1960 through U.S. Department of Agriculture. In young plants, leaflets are very irregular in placement on the rachis but they remain in one plane. As the tree grows old the deflection of leaflets from midrib changes from one plane to different planes. Flowering irregular, good fruiting when warm moist weather persists.

Uses : A very good ornamental palm suitable for plantation in the open. Seed is oil yielding.

Germination notes : Fresh seeds take about 40 days to germinate. Eophyll entire, linear lanceolate, about 20 cm long, 1.3 cm broad at middle, tips of the eophyll narrowly truncate.

Roystonea oleracea (Jacq.) Cook. *Caribbean Royal Palm.*

Solitary, pinnate leaved, tall, monoecious palm. Stem coloumner, to 25 m long, to 60 cm in diameter near base; outer surface of the stem smooth, dull grey in colour; crownshaft about 2.5 m long, deep green in colour, smooth and shining. Crown with lower leaves more or less horizontal at the top of the crownshaft. Leaves, to 7 m long, flat at least at the middle with leaflets in 2 opposite rows; leaflets linear-lanceolate, to 90 cm long, about 5 cm broad at middle, attenuate at apex; midnerve prominent on upper side. Inflorescence infrafoliar, about 1 m long; peduncular bract fusiform, semi-woody; flower branches wavy, 30-50 cm long, smooth, scurfy at the base. Male flowers oblong, about 5 mm long, yellowish in colour; petals shorter than stamens. Female flowers conic, about 3 mm long; stigmas 3, short; staminodes cupular, 6 dentate. Fruits 1.5 cm long, ovoid to obovoid, slightly oblique; ripe fruits violet in colour with smooth outer surface. Seed with endocarp light yellow.

Flowering & Fruiting : August-September; April-June; February-March; October-December.

Distribution : TRINIDAD and BARBADOS. Cultivated throughout the tropics.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah. This species is slow growing in the local climate and takes longer time to come into flowering, perhaps the tallest among Roystonea palms, not common in India. Introduced in the Indian Botanic Garden in 1807.

Uses : A very good ornamental species. An excellent visual effect can be created if planted along the pathways or narrow roads. Very young leaf buds are consumed as vegetable in some parts of West Indies. Endosperm of the seed contains good percentage of oil.

Roystonea regia (H.B.K.) Cook. *Royal Palm of Cuba.*

Solitary, pinnate leaved, tall, monoecious palm. Stem columner, commonly bulging at middle and at base, to 20 m long, about 70 cm in diameter near base, outer surface smooth, dull grey in colour, faintly annulate; crownshaft cylindrical, massive, green, about 3 m long; crown roundish, base obscuring crownshaft. Leaves spreading to all direction; lower leaves droping, to 4 m long, not flat; leaflets, linear-lanceolate, to 1.5 m long, about 3 cm wide at middle, mostly arranged in 4 ranks. Inflorescence infrafoliar, about 1 m long; prophyll tubular, shorter than inner peduncular bract; flower branches straight, slightly swollen at base, once or twice branched; male flowers about 5 mm long; calyx inconspicuous; petals much longer than sepals, oblong, concave, blunt at apex; stamens 6, filaments as long as petals. Female flowers broadly conical, smaller than males; calyx lobes small; petals broadly ovate, valvate; staminodal ring with 6 obtuse lobes; ovary globose, 1-loculed. Fruits globose, 1-1.3 cm in diameter, brown to dark purple when ripe. Seed globose about 9 mm in diameter; endocarp white, brittle; endosperm white, plain.

Flowering & Fruiting : September-October; May-June; February-April; October-November.

Distribution : Cuba. Common in cultivation throughout the tropics.

Cultivation : Introduced in the Indian Botanic Garden, Howrah during the earlier part of nineteenth century. Now most common cultivated palm in India, excepting deserts and colder regions, it grows in every parts of India. The girth and shape of the trunk is variable. Bole conspicuous.

Germination notes : Fresh seed takes 38 days to germinats. Eophyll entire, linear; lanceolate about 20 cm long, 1.3 cm broad at middle.

Uses : Trunks are used as wharf-pillers and for construction works. Fruits are edible and also used as cattle feed in Cuba. The high fat content of the seeds helps in fattening of the livestocks (hogs). Very young leafbuds (cabbage) are consumed as vegetable. A very good ornamental palm for landscape beautification. It is grown along the avenues or as space dividers along the boundaries. Leaves are used as thatch.

Veitchia Wendl. et Seem.

Distribution : Philippines, New Hebrides, New Caledonia, Fiji. 18 species. 1 species introduced and cultivated in India.

Veitchia merrillii Becc.

Solitary, pinnate leaved, moderately tall, monoecious palm. Stem about 5 m long, about 20 cm in diameter near base, with very narrow internodes; crownshaft distinct, dull green about 1 m long with loose cover of deciduous scales. Leaves arching, dull green in colour, about 15 in number per crown; leaflets dull green in colour, crowded, flat with drooping tips, about 80 cm long, 5 cm wide at middle; lower midnerve conspicuous with persistent pale membranous scales. Inflorescence infrafoliar; prophyll bicarinate; flower branches dense and bushy, white to pale green. Flower clusters in triad with 2 lateral male flowers and a middle female flower or paired male flowers at the upper portion of the flower branch. Male flowers 10-12 mm long, sepals and petals 3 each, sepals fleshy, orbicular, scale like, imbricate; petals oblong, fleshy, valvate pistillode long as stamens; stamens numerous; female flowers mostly proximal, 4.5.-11 mm long. Ripe fruits about 3.2 cm × 2 cm, ovoid, deep crimson in colour; perianth white; seed somewhat pointed at tip with network of pale strands on seed coat; endosperm ruminate.

Flowering & Fruiting : February-June; September-December.

Distribution : Philippines.

Cultivation : Cultivated in the Indian Botanic Garden, Howrah and some private and public gardens in Calcutta. This species is difficult to grow in the drier and warmer parts of India. In the local climate it prefers to grow in semi-shade condition.

Uses : A very good ornamental palm for landscape beautification. In its native place leaves are used as thatch and the trunk as wood for rafters, spears and canoes. The young leaf bud is edible and consumed as salad. The nut is also edible and chewed as masticatory.

GLOSSARY OF BOTANICAL TERMS USED

Acanthophyll	:	longer spines derived from leaflets
Acaulescent	:	stem underground
Acervulue	:	flower cluster in a line
Accropetal	:	from below upward
Acuminate	:	tapering to a point
Adnate	:	attachment of two different kinds of organs
Anastomose	:	network formation
Anthesis	:	time of fertilisation of flower
Apiculate	:	ending in a sharp point
Apocarpous	:	with free carpels
Auricle	:	an ear-like lobe
Basipetal	:	from apex downward
Bicarinate	:	having two keels
Bract	:	modified leaf associated with inflorescence
Bracteole	:	a small bract borne on a flower stalk
Caducous	:	drooping off early
Caespitose	:	clustered
Capitate	:	head-like
Carpel	:	unit of the gynoecium
Catkin-like	:	cylindrical densely crowded rachilla
Ciliate	:	finely hairy
Connate	:	attachment of same organs
Coriaceous	:	leathery
Costa	:	mid rib or mid vein
Costapalmate	:	palmate leafblade with extended mid costa
Crownshaft	:	a conspicuous cylinder of tubular leafsheaths
Deciduous	:	shed periodically
Dichotomous	:	forking
Digitate	:	like fingers
Dioecious	:	when male and female flowers are borne on different plants
Distichous	:	arranged in two ranks
Divaricate	:	spread widely
Dyad	:	in pair

Emerginate	:	with a notch at the apex
Endocarp	:	the innermost layer of the fruit wall
Endosperm	:	the nutritive body of the seed
Eophyll	:	the first foliage leaf of the seedling
Epicarp	:	the outermost layer of the fruit wall
Filamentous	:	threadlike
Flabellate	:	fan-shaped
Flagellum	:	a whip-like climbing organ originating from leafsheath; sterile inflorescence
Glabrous	:	smooth
Glaucous	:	bluish
Glomerule	:	a knob-like cluster of flowers
Gynoecium	:	the ovule bearing organ of the flower composed of carpel/s, ovary, style, stigma
Hapaxanthic	:	when a shoot flower before dying
Hastula	:	an appendage at the junction of the blade and petiole, may be on the upperside, lower side or on both sides
Imbricate	:	not regular overlapping of perianth, one always outer and one inner
Imparipinnate	:	unevenly pinnate
Indumentum	:	clothing of hairs, scales, etc.
Inflorescence	:	the branch that bears the flowers including all bracts and bracteoles
Infrafoliar	:	borne below the leaves
Infructescence	:	Inflorescence with fruits
Interfoliar	:	borne among the leaves
Internode	:	the space between the two nodes
Knee	:	a swelling of the leafsheath at the base of the petiole
Lanceolate	:	narrow, tapering at ends, the basal end often broader
Ligule	:	a distal projection of the leafsheath
Linear	:	several times longer than wide, narrow
Locule	:	the cavity in which the ovule is borne
Mesocarp	:	the middle layer of the fruit
Monocarpic	:	flowering and fruiting once in the lifetime than dying
Monoecious	:	a plant bearing both male and female flowers
Monopodial	:	with a single main axis
Node	:	the region of the stem where leaf is attached
Obovoid	:	egg shaped

Obpyriform	:	pear-shaped but attached at the broad end
Ocrea	:	an extension of the leafsheath beyond the petiole insertion
Ovoid	:	egg shaped
Palman	:	the undivided middle part of the palmate leaf
Palmate	:	shaped like the palm of the hand
Paripinnate	:	evenly pinnate
Pedicel	:	stalk of the flower
Peduncle	:	stalk of the inflorescence
Peltate	:	round, attached at the centre
Perianth	:	the sepals and the petals together
Petiole	:	the stalk of the leaf
Pinna	:	leaflet
Pistillode	:	a sterile gynoecium
Pleonanthic	:	a shoot flowering continuously, not dying after flowering
Plicate	:	pleated
Praemorse	:	as if eaten by the goat
Prophyll	:	the primary or the first sterile bract borne on the inflorescence or flower branches
Protandrous	:	when pollens are shed before the stigma is receptive
Protogynous	:	when stigma becomes receptive before the shedding of pollens
Proximal	:	near the base
Pyrene	:	seed like body formed by the hard endocarp
Rachilla	:	the branch that bears the flowers
Rachis	:	the axis of a leaf beyond the petiole or the axis of an inflorescence beyond the first branch
Raphe	:	a ridge or depression on the seed
Rhizome	:	underground stem
Ruminate	:	infolding of the seed coat
Sarcotesta	:	a fleshy later developed from the outer seed coat
Sinuous	:	wavy
Soboliferous	:	producing shoots from the ground, clump forming
Stolon	:	a horizontal stem below surface of the ground that gives rise to shoots
Subulate	:	awl-shaped
Sulcate	:	furrowed lengthwise
Terete	:	circular in cross section
Tomentose	:	densely covered with short hairs

Triad	:	flower cluster with 2 lateral male flowers and a middle female flower
Truncate	:	as though cut of nearly straight across
Undulate	:	waved
Valvate	:	meeting side by side without overlapping
Ventricose	:	swollen at middle
Versatile	:	anthers attached near the middle
Whorl	:	three or more leaves, flower branches from one node

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