INDIGENOUS PALM FLORA – 4

4.1. INTRODUCTION

Vegetation is the most valuable gift of nature which provides us all kinds of essential requirements for our survival, including food, fodder, medicine, fuel, timber, resins, oils etc. Natural resources survey like floristic study plays an important role in the economic improvement of developing country (Ganorkar and Kshirsagar 2013). Beside this, floristic study of a particular region is also reflects the picture of natural assemblage of plants, which include total information on numbers of family, genus and species, dominant genera, dominant families and major life-forms occupying a particular habitat (Sasidharan 2002). Likewise, knowledge of the floristic composition of any place is the necessary pre-requisite for the study of various ecosystems. Palms diversity in West Bengal is one of the most important requisites, not only from the taxonomic view point but to increase of our knowledge also for the benefit of science and the society. Various natural reservoirs like *in situ* conservatories of West Bengal are quite rich in different species of palms and rattans. The plains, Gangetic delta, western plateau are the houses of few species of rattans and palms but the forested areas of northern plains, sub-Himalayan terai, duars and hills of Darjeeling-Kalimpong are very much rich in diversified palm and rattans species with quite a good population sizes.

The earliest record of Indian palms appreciated in *Hortus Malabaricus* (Van Rheede 1678) where only 9 palms species were described with figures. About 71 species of palms and rattans were recorded from undivided India by Sir J. D. Hooker in his book *Flora of British India* (1892 -1893). Later on, various authors had worked and published different books on palm flora in undivided British India. Martius 1839 in his *Historia Naturalis Palmarum* had described 15 species in Indian palms and Griffith had been published *Palms of Britiish East India* in 1850. In nineteenth century, Beccari's (1908, 1913, 1914) had also been published series of monographs on palm flora of this region and *Palms of British India and Ceylon* was another important publication by Blatter (1926), gave huge information on local palms. After that, not much taxonomic works were not carried out till 1974 on palms. Botanical Survey of India, Howrah was studied considerable amount of work on the taxonomy and phytogeography of Indian

palms (Basu 1975). Some important scientific works (Table 7) regarding the taxonomy, phytogeography on Indian palms from different regions of India were published by various authors (Basu 1985, 1987, 1992, 1994; Thomas 1998; Renuka *et al.* 2003; Renuka 1999, 2011; Sreekumar 2005; Sreekumar *et al.* 2016; Joemon *et al.* 2008; Chowdhury 2009; Chowdhury 2017 Basu and Mondal 2013, Mondal and Chowdhury 2016, 2018, 2019; Mondal *et al*. 2017a and 2017b, 2019)

Table 7: Previous works on palms with reported species number from India

Sl. No	Authors	Year	No. of Species
1	Van Rheede	1678	9
2	K. F. Martius	1832–1853	15
3	William Griffith	1850	15
4	J. D. Hooker	1892–1893	71
5	O. Beccari	1906-1918	56
6	S. K. Basu	1994	128
7	C. Renuka	2011	102
8	S. K. Basu (NE India)	2013	56

Roxburgh (1814) and Voight's (1845) first time acconted palms species among others in his catalogue of indigenous and exotic palms from the boundary of undivided Bengal. David Prain (1903) recorded about 26 species from undivided Bengal. A. T. Gages (1911) recorded indigenous and exotic palms of Bengal in the catalogue of Non-Herbaceous Phangrogams. Sen & Naskar 1965) catalogue of Non-Herbaceous Phanograms also listed palms of West Bengal. In recent times taxonomic delimitation of indigenous and exotic palms have been conducted in different regions of India and West Bengal by varius authors (Table 8). There were various district flora published by various author who also recorded a good number palm and cane species (Renuka 2011 and Basu 2013).

Table 8: Authors worked on palm and canes in West Bengal

Sl. No.	Name of the Author	Year
1	William Roxburgh	1814
2	J. D. Hooker	1892 -1893
3	E. Voight	1845
4	David Prain	1903
5	A. T. Gages	1911
6	J. N. Naskar	1965
7	S. K. Basu and R. K. Chakraverty	1994
8	H. J. Noltie	1994

Sub-Himalayan terai, duars, Darjeeling and Kalimpong hills of West Bengal are falling under the IUCN recognized *'Himalaya Biodiversity Hotspot'* (Conservation International 2005). The vegetation of West Bengal is composed of all kinds of floral element including rich palms diversity (Chatterjee 1940). Unfortunately, no any complete account of palm flora is available for this region. So, it is now imminent to record the palm flora of this region as the natural vegetation is dwindling very fast. Present present study attempted to investigate the detail status and phytogeography of palms in five broad geographical region of West Bengal.

4.2. Result

From the present survey the occurrence of 49 species belonging to 17 genera of indigenous palms and canes were recorded from the various natural habitats of West Bengal. Artificial dichotomous Keys for the recorded genera and species ware constructed based on significant reliable and easily observable vegetative, flower and fruit characters. All these species were enumerated below along with their sub-family and tribes, genus and species accompanied by local names, salient features, exsiccatus, availability status, flowering and fruiting periods and distribution.

4.3. Check List of recorded Indigenous Palms and canes

Sub family: Coryphoideae

Tribe: Corypheae

Licuala peltata, Livistona jenkinsiana, Trachycarpus fortunei, Trachycarpus martianus, Corypha utan, Corypha taliera, Corypha umbraculifera, Phoenix rupicola, Phoenix acaulis, Phoenix loureirii, Phoenix sylvestris, Phoenix paludosa

Tribe: Borasseae:

Borassus flabellifer

Sub family: Calamoideae

Tribe: Calameae (Ecirrate)

Calamus acanthospathus, Calamus arborescens, Calamus erectus, Calamus flagellum, Calamus floribundus, Calamus gracilis, Calamus guruba, Calamus leptospadix, Calamus longisetus, Calamus tenuis, Calamus viminalis, Calamus pseudoerectus

Tribe: Calameae (Cirrate)

Calamus inermis, Calamus latifolius, Calamus nambariensis, Calamus khasianus, Daemonorops jenkinsianus, Daemonorops teraiensis, Plectocomia assamica, Plectocomia bractealis, Plectocomia himalayana and *Salacca secunda*

Subfamily: Nypoideae

Nypa fruticans

Sub family: Arecoideae

Tribe: Caryoteae

Arenga micrantha, Caryota urens, Caryota obtusa, Caryota mitis, Wallichia disticha, Wallichia caryotoides, Wallichia oblongifolia

Tribe: Areceae

Areca catechu, Areca triandra, Pinanga gracilis, Pinanga griffithii

Tribe: Cocoeae

Cocos nucifera

4.4. Enumeration

Key to the Sub-families

1a. Leaves palmate, costa palmate, rarely entire or pinnate (*Phoenix*), without spines or bristles on stem and leaf surface, flowers solitary, never in triads..…….....
…….Coryphoideae

1b. Leaves pinnate, bipinnate or entire or pinnate ribbed, reduplicate in folding, with spines or bristles on stem and leaf surface, flowers solitary or clustered, mostly in triads…….... 2

2a. Cirus or flagella present; flowers hermaphrodite or unisexual, rarely dimorphic, arranged single or in dyads……...Calamoideae

2b. Cirus or flagella absent; flowers always unisexual, often dimorphic, arrange in triads or in pairs derived from triad…….Arecoideae

Subfamily: Coryphoideae

Key to the tribes

1a. Leaves palmate, costa-palmate or entire, acanthophyll absent……...2

1b. Leaves pinnate, leaflets induplicate folded, acanthophyll present…..Phoeniceae

2a. Flowers hermaphrodite or polygamodiocious, rarely dioecious, if dioecious flowers not or only singly dimorphic, rachillae lacking deep pits; endocarp usually thin, crustaceous or cartilaginous..…….Corypheae

2b. Flowers dioecious, strongly dimorphic, staminate and sometimes pistillate flowers borne in deep pits form by the connation and adnation of the rachillae bracts; endocarp thick and hard……. Borasseae

Tribe: Borasseae

Borassus L., Sp. Pl. 2: 1187. 1753; Roxb., Pl. Coromaldel 98: 50. 1795 & Enum. Pl. 221. 1841; Brandis, Forest Fl. N.W. C. Ind. 544. 1874; Prain, Beng. Pl. 2: 1092. 1903; Blatter, Palms Brit. East Ceylon 930. 1912; Uhl & Dransfield, Gen. Palm. 222. 1987; Zoysa, Fl. Ceylon 48. 2000.

Dioecious palms; leaves palmate or costa-palmate, induplicate. Staminate flowers solitary, usually in cincinnus of two to many flowers; stamens in male flowers exerted from the pits by the elongation of the floral receptacle between the calyx and corolla; pistillate flowers solitary, bracteolate; fruits 1-3 seeded with thick, hard endocarp.

Distribution: The genus is cosmopolitan in distributed and the exact natural distribution of the genus is not sure due to its long history of cultivation. Five species of *Borassus* have been recognized and commonly occurs in Africa, Madagascar, NE Arabia, SW Asia, India, New Guinea and Australia. *Borassus flabellifer* is only representative of this genus in India.

Note: The name of the genus originated from the Greek word '*Borassos*' refer to 'inappropriately', to the date palms. The genus can be recognized by the large stiff costapalmate leaves with both adaxial and abaxial hastula and by the large irregular teeth on the petiole.

Borassus flabellifer L., Sp. Pl. 2: 1187. 1753; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 482. 1892; Mart., Hist. Nat. Palm. 3: 221. Pl. 108, 121, 162. 1823-1853; Dalzell & Gibson, Bombay Fl. 278. 1861; Prain, Beng. Pl. 2: 1092. 1903; Parkinson, Forest Fl. Andaman Isl. 268. 1923; Basu & Chakraverty, Manu. Cult. Palms in Ind. 71. 1994. ***'Tad, Taal'*** [Fig. 26]

Robust trees, 25–40 m tall, pleonanthic, dioecious; stem solitary, columnar, massive, 1m in diameter at base, next 4m high conical, there after followed by cylindrical, 40–50 cm in diameter, occasionally branched; upper part covered by leaf bases, lower part tough with ringe of leaf scars, base swollen, fringed with dense mass adventitious roots. Leaves strongly costspalmate, leathery, induplicate; leaf segments 60–80, arranged spirally, sheath open when young, later with a wide triangular cleft at the base of the petiole. petiole woody, 60–120 cm long, deeply channeled above, rounded below; leaf blade dentate at margins, irregular, sub orbicular to flabellate, 1–1.5 m in diameter, divided along adaxial folds (induplicate), linear lanceolate, rigidly folded, bifid at apices with conspicuous interfold filaments. *Male spadix* massive, up to 2m long, consisting of about 8 partial racemes of three spike rachillae each; fleshy, 30 – 45cm long; bracts imbricate, spirally arrange. Staminate inflorescence branched, peduncle sheathed with open bract, upper subtending branches terminating in 1 – 4 rachillae, green to brown, catkin like, 24–50 cm long and 1.6–2.7 cm in diameter, rachillae bracts

forming pits containing a cincinnus of 4–8 flowers. Pistillate inflorescence usually spicate, sparingly branched, flower bearing portion 10–80 cm long with 4–2 solitary flowers arranged spirally; male flowers exserted from pits individually, 0.4–0.8 cm long, bracteoles 0.3–0.8 cm long, 0.1–0.4 cm wide; calyx 0.3 cm long, 0.15 cm wide and shallowly divided into three sepals, narrow cuneate; petals shorter than sepals, imbricate, petals lobes 0.1cm long, 0.1 cm wide; stamens 6 with very short filaments, 0.2 cm long, 0.03 cm wide, anthers 0.05 cm long, linear; pistillode minute; female flowers, globose, entire, 3–5 celled, ovule basilar, erect, stigamas 3, sessile, recurved. Fruits massive, 6 × 14–6.5 × 16 cm, subglobose, rounded or flattened at the apex, green when mature, dark purple when ripe, epicarp coriaceous, mesocarp fibrous, pulp thick, yellow; pyrenes 1–4, 5–12 cm × 4.6–8 cm × 3.2–4.8 cm, young endosperm juicy and edible.

Flowering: March – April **Fruiting**: July – September; sometimes flowering occurs in the month of November – December also.

Status: Abundant and frequent; Least Concern (Renuka 2011)

Distribution: *Borassus flabellifer* mainly found in S & SE Asia (India, Sri Lanka, Bangladesh, Myanmar, Thailand, Malaysia, Indonesia, China, Vietnam). In India it is widely distributed in Andhra Pradesh, Tamil Nadu, Kerala and Orissa as a dominant semi wild palm and in West Bengal, throughout plains except hilly region.

Ecology: *Borassus flabellifer* growing naturally in dried part of West Bengal. It also grows in per-humid and survives water logging areas.

Specimen examined: West Bengal, South 24 Parganas, Canning. 20.10.2016, Mondal and Chowdhury, 1011 (Acc. No. 10185, NBU). *Other specimens*: Gangineni, Andhra Pradesh, 12.3.1985, male fl., Venkanna 5572 (MH); Varangal, Andhra Pradesh, 6.4.1988, Ramarao & Ravishankar 86111 (MH); Maharashtra, 12.05.1960, John Cherian 68256 (CAL); Agarthala, 12.4.1921, Debbarman 1237 (CAL); Indravati Tiger Reserve, Batar, Madhya Pradesh 27.05.1987, Anand Kumar 16369 (CAL); Agarthala, 12.4.1921, Debbarman1237 (CAL); Ramanathapuram, Coimbatore, Tamil Naidu, 26.6.1978, Nair 57392 (MH).

Uses: One of the most economic palms of India. It yields edible sweet sap from the peduncle of both male and female inflorescence, endosperm. The wood and leaves are also used as fuel and thatching matarials.

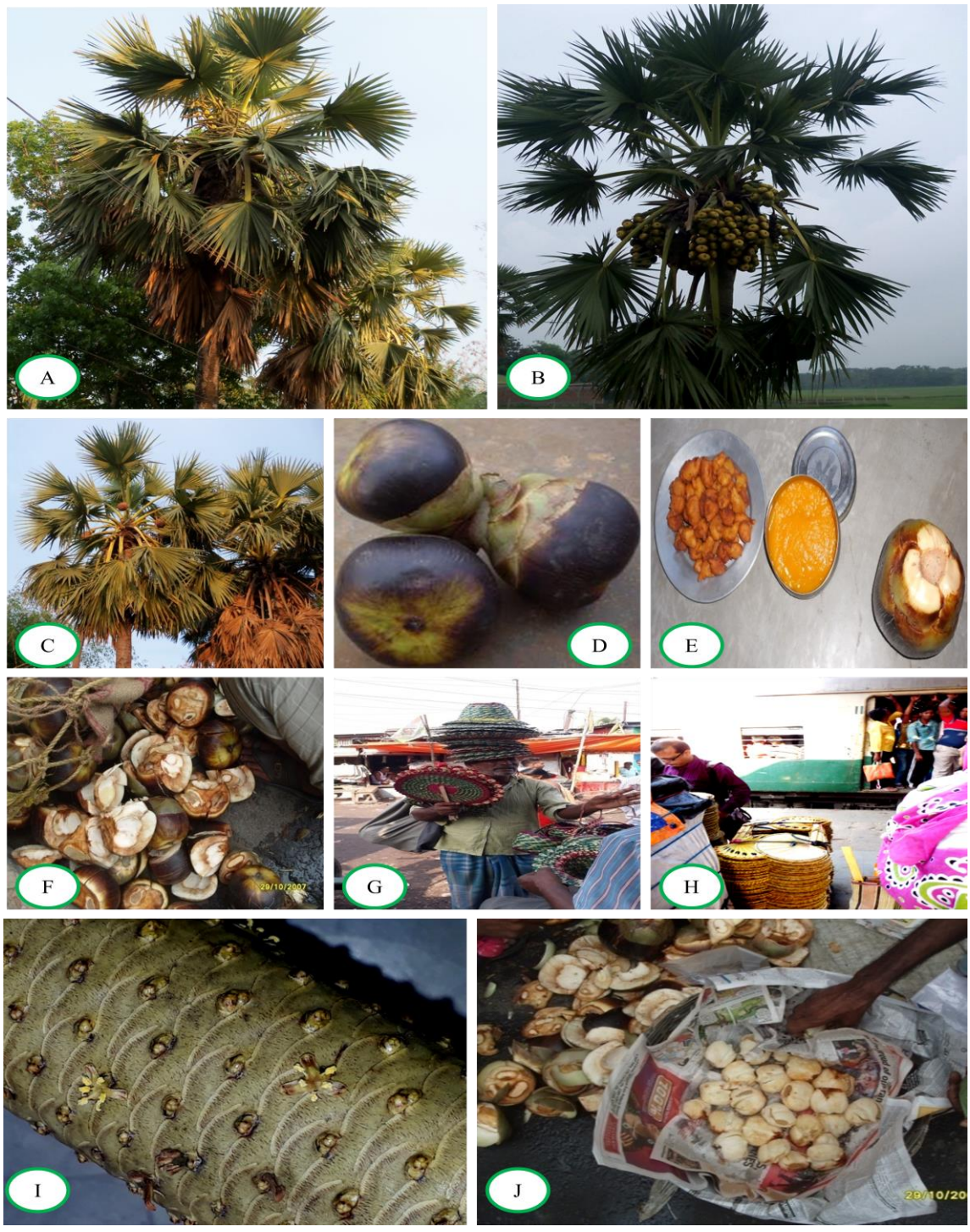

Fig. 26: *Borassus flabellifer* L. **A.** Male plant **B.** Female plant **C.** Male and female plant **D.** Young fruits **E.** Ripe fruits **F & J.** Endosperm (Talsas) **G & H.** Handicrafts **I.** Male inflorescence

Tribe: Corypheae

Leaves palmate, costapalmate or undivided and induplicately folded. Inflorescence terminal or axillary, simply branched or branched with many orders, with many peduncular and rachis bracts, rachillae lacking deep pits, fruits usually 1-seeded, endocarp usually thin, crustaceous or cartilaginous.

Key to the Genera

1a. Monocarpic palms; stem always single, massive; leaves costapalmate .....*Corypha*

1b. Pleonanthic palms; stem slender to moderately robust, single or cluster forming; leaves palmate or costa palmate..... 2

2a. Leaf blade palmate; seeds reniform or globose, not deeply channeled……..…*Trachycarpus*

2b. Leaf blade costapalmate; seeds globose, deeply furrowed…….…. 3

3a. Leaf blade deeply divided or entire; inflorescence simply branched or with several order of branches……*Licuala*

3b. Leaf blade not deeply divided; inflorescence always multibranched…….……..*Livistona*

Corypha L., Sp. Pl. 2: 1187. 1753 & Gen. Pl. ed. 5: 494. 1754; Becc., Ann. Roy. Bot. Gar. Cal. 13: 15. 1933; Basu, J. Econ. Tax. Bot. 11: 477. 1987; Basu & Chakraverty, Manu. Cult. Palms in Ind. 36. 1994.

Monocarpic palm; trunk solitary, robust, columnar, with or without distinct spiral marking by the fallen leaf scars and large crown of costapalmate leaves. Leaf blade massive with distinct hastula persistent on the adaxial side, lamina distinctly plicate, dissected to various depths into segments; segments bi-lobed at apices; petiole heavy, long, deeply channeled above, armed at margin with strong teeth. Terminal inflorescence, pyramidal decompounds; main inflorescence axis tightly covered with leathery bracts (spathes); primary flower branches bracteates as base, ultimate flower branches (rachillae) slender, flowers borne in cluster, elongated and arranged in regular

spiral along rachillae. Flowers bisexual, sessile to sub-sessile or falsely pedicillate by elongation of solid base of calyx; calyx more or less 3 lobed or sub truncate; corolla with 3 distinct petals; stamens 6, 3 alternate and 3 opposite to petals, filaments adnate to corolla at base, unequal; ovary superior, globose, semiglobose to terminate, with 3 joined carpels. Fruits 1 seeded globose, semi- globose, sessile or pedicillate; seeds globose, endosperm white, homogeneous. Eophyll lanceolate.

Distribution: Eight species (Beccari 1933) were globally reported from S and SE Asia (India, Sri Lanka, Bangladesh, Myanmar, Malaysia, China, Indonesia, Philippines, Papua New Guinea) and NE Australia; 4 species reported from India; 3 species are naturalized in West Bengal.

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 … …… *C. utan*

2a. Leafblade large, leaf segments overlapping at the petiolar region; primary branches of inflorescence emerge from the mouth of the peduncular bract; ripe fruits deep green, 3-3.6 cm in diameter……..… *C. taliera*

2b. Leafblade very large, leaf segments non overlapping at the petiolar region, primary branches of inflorescence pierce throughout the respective basal bracts; ripe fruits pale green, 2-2.4 cm in diameter…….....*C. umbraculifera*

Corypha taliera Roxb., Pl. Coromandel 3: 51. 1820; Mart., Hist. Nat. Palm. 3: 231. 1823-1853; Griff., Cal. J. Nat. Hist. 5: 317. 1845 & Palms Brit. E. Ind. 114t. 220. E. F. 1850; Wall. Cal. 8616; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 428. 1892; Brandis, Ind. Trees, 658. 1906. *Taliera bengalensis* Spreng., Syst. Veg. 2: 18. 1825. *Corypha martiana* Becc. *ex* Hook. *f*., Fl. Brit. Ind. 6: 429. 1892; Basu & Chakraverty, Man. Cult. Palms in Ind. 38–39. 1994. **'*Tara, Tallier (Beng)*'** [Fig. 49A]

Stem solitary, erect about 10 m long, 60–70 cm in diameter near base. Leaves costapalmate, 6 m long, leafbase does not split at the base; petiole 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 segments mostly 80 in number; free segments, 125 cm long, to 14 cm broad at middle; middle segments unequally bilobed at apices; lateral segments acuminate. Inflorescence terminal, pyramidal, 6 m long, ultimate flower branches pale yellow, 40–80 cm long, slightly angular at sterile basal part. Flower in clusters of 4–6, each 5 mm long, pale yellow, calyx 2.5mm long, lobes unequal, obtuse, hyaline; petals slightly incurved; filaments 2 mm long, anthers dorsifixed, ovate – oblong, 1.5–2mm long. Fruits shortly pedicellate by thickening of receptacle, mesocarp non- fibrous, greenish yellow; seeds 2.5 cm in diameter.

Flowering: Ocotober – November **Fruiting:** December – February; the palm gives flower once in its lifetime and dies out after the maturity of fruits.

Status: Rare; Extinct in the Wild (IUCN *ver 2.3*)

Distribution: Native and Endemic to India and Bangladesh (Roxburgh 1832); naturalized in Myanmer; few trees were seen in the AJC Indian Botanic Garden, Howrah and Santiniketan of Birbhum district of West Bengal.

Specimen examined: West Bengal, Howrah, 11.09.2015, Mondal and Chowdhury, 1050 (Acc. No. 10206, NBU).

Uses: Leaves are used for writing upon with pointed steel bodkins and strong and durable sheath fibres are used for tying the rafters at native houses in different of parts of country.

Corypha utan Lamk., Encyl. Bot. 2: 131. 1786; Merrill, Interp. Amb. 110. 1917. *Corypha elata* Roxb., Fl. Ind. 2: 176. 1832; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 428. 1892 & Ann. Roy. Bot. Gard. Cal. 13: 22. 1933; Basu, J. Econ. tax. Bot. 2: 479. 1978; Basu & Chakraverty, Manu. Cult. Palms in Ind. 39. 1994. *Corypha gebanga* Bl., Rumphia 2: 59. t. 97. 98. 105. 1836. *Corypha elata* Roxb., Fl. Ind. ed. 2: 176. 1832. *Corypha macrophylla* Roster, Bull. Soc. Tosc. Ortic. 29: 81. 1904. *Livistona vidalii* Becc., Webbia 1: 343.1905. ***'Gebang Palm, Buri Palm'***

Stem solitary, erect, dark grey, spiral marking distinct, about 15–20 m long, 30–40 cm in diameter at base. Leaves costapalmate, typically ascending from the stem; petiole slender, 3–5 m long, upper most part of the petiole triangular in cross section; leafblade

half orbicular, deeply divided, 2–2.5 m long segments, 80–90 in number, outer segments acuminate, splitted in to two slender points, middle segments broad with two obtuse lobes at apices. Inflorescence terminal, pyramidal, about 4–4.5 m long, ultimate flower branches (rachillae) 8–15 cm long, pale yellow when fresh. Flowers bisexual, in clusters of 4–7, each 4.5mm long, pale yellow in anthesis, calyx 2.5 mm long, lobes rounded, fleshy, solid basal part elongates after anthesis; petals boat shaped, 3 × 1.5 mm; stamens 3–4 mm long, opposite filaments incurved, subulate, anthers cordate-ovate; ovary 2.5 mm long, style 1–1.5 mm long, stigma 3 dentate. Fruits falsely pedicellate, pedicel 2–3 mm long, abortive tuberculiform carpels conspicuous. Seeds globose, 1–1.5 cm in diameter.

Flowering: November – December **Fruiting:** February – April; the palm gives flower once in its lifetime and dies out after the maturity of fruits.

Status: Rare occurrence; Least Concern (IUCN *ver 3.1*)

Distribution: India (West Bengal, Assam, Andaman Islands), Myanmar, Malaysia, Indonesia, Philippines, Papua New Gunea, NE Australia; in West Bengal it is found near hoogly rives bank in Howrah district.

Ecology: *Corypha utan* commonly grows in lowlands along the river banks and moist swampy areas. It is one of the palm species that can sustain extreme water logged condition.

Uses: Dried leaves are used as thatch. The coarse fiber 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.

Corypha umbraculifera L., Sp. Pl. 1178. 1753; Griff., Palms. Brit. E. Ind. 116. 1850; Mart., Hist. Nat. Palm. 3: 232, Pl. 108, 127. 1823-1853; Gaertn., Fruct. 1. 18, Pl. 7. 1792; Griff., Cal. J. Nat. Hist. 5: 319. 1845; Becc. & Hook. *f.*, Fl. Brit. Ind. 6: 428. 1892; Blatt., Palms Brit. Ind. 72. 1926; Gamble, Fl. Pres. Madras 561. 1931. *Corypha guineensis* L., Mant. Pl. 1: 137. 1767. *Bessia sanguinolenta* Raf., Sylva Tellur. 13. 1838; Basu & Chakraverty, Manu. Cult. Palms in Ind. 37. 1994. ***'Talipot Palm, Bene Tali, Shri Tali'*** [Fig. 49C]

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

Flowering: November – December **Fruiting:** February – April; the palm gives flower once in its lifetime and dies out after the maturity of fruits.

Status: Rare occurrence; Data Deficient (IUCN Red list. 2019.1)

Distribution: Native and endemic to India and Sri Lanka; recently cultivated in Cambodia, Myanmar and Thailand; rarely distributed at Santiniketan, Birbhum district of West Bengal.

Specimen examined: West Bengal, Howrah, 11.09.2015, Mondal and Chowdhury, 1051 (Acc. No. 10205, NBU). *Other specimens*: Monipally, Kottayam, Kerala, 22.07.1993, fl., Vijayakumaran and Renuka 7048 (KFRI); Panamkutty, Idukki, 4.5.1984, fl., Mohan 81780 (MH).

Note: Roxburgh (1814) noted that this species was introduced in the AJC Bose 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 also.

Uses: A mature tree also yields about 100 liters of sweet sap per day and about 100 kg of edible starch from the cutting inflorescence. Leaves are used for covering the roof of grain storages, mud huts ctc. The tender leaves are used for making mats, hats, and umbrellas. Stem fibers are strong, can be used for making ropes.

Licuala Thunb., Kongliga Vetenskaps Acadamiens Nya Handlingar 3: 286. 1782; *Pericyla* Bl., Rumphia 2: 47. 1938; Basu & Chakraverty, Man. Cult. Palms in Ind. 40. 1994.

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 dented along margins, hastula conspicuous on adaxial side, leafblade orbicular, entire or deeply divided along the abaxial rib to form single to multifolded segments, apical leaflets bifid at apex. Inflorescence interfoliar, pleonenthic, 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, bracteates, calyx cupular, 3 fid; corolla longer than calyx, 3 lobed, hairy outside; stamens 6, epipetalous, filaments flattened, connate at base to from a cup with 6 projections, each bearing an anther; ovary 3 carpellate, nearly free, 1 ovule in each carpel. Fruits globose, ovoid, endocarp crustaceous. Seed basally attached endosperm homogeneous.

Distribution: About 108 species were reported globally and mainly distributed in India, China, Malaysia and Australia. In India, (Bihar, West Bengal, NE India, Andaman and Nicobar Islands); only three species have natural distribution and the exotic species *Licuala grandis* is extensively cultivated as ornamental palm in West Bengal.

Note: The genus can be easily identified by the wedge- shaped marginally reduplicate segments of the leaves of most species. Morphologically closely related to *Livistona* which differs mainly in leaf form as noted.

Licuala peltata Roxb. *ex* Buch.-Ham., Mem. Wern. Soc. 5: 313. 1826; Griff., Cal. J. Nat Hist. 5: 325. 1845; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 430. 1892; Prain, Beng. Pl. 2: 1091. 1903; Parkinson, Forest Fl. Andaman Isl. 269. 1923; Griff., Palms Brit. Ind. 88. 1926; Noltie. Fl. Bhutan 3(1): 413. 1994; Basu & Chakraverty, Manu. Cult. Palms in Ind. 42. 1994. ***'Chatapat'*** [Fig. 27B & 28]

Stem solitary, erect, 2–3m long, slender, 15 cm in diameter near base, leaf bases persistent on upper part of stem. Leaf blade palmate, orbicular, 12 to 30 partite, 1.5 m in diameter, segments variously connate, many toothed at margins; petiole strongly armed with curved spines from base to upper portion, 1.2 m or more long, plano-convex in cross section. Inflorescences with long stout peduncle, base flattened, erect from the leaf axil, much longer than leaves, peduncle long, stout, primary axis cane like, and covered with series of 15–30 cm long leathery bracts, each scurfy outside. Flower solitary from node, pendulous, axillary to fertile bracts, 40 cm long, thickly tomentose outside. Flowers solitary, in loose spirals, pedicillate, thickly tomentose, unopened flowers about 1 cm long, calyx campanulate, with 3 short marginal projections, densely ciliate; corolla deeply 3-lobed, each lobe about 1 cm long, lanceolate, reflexed, densely ciliate; stamens with filaments connate at base, adnate to corolla; ovary turbinate, carpels coherent by their apices; ovules solitary, erect, style filiform, stigmas 3, at the same level with anthers, placentation basal. Ripe fruits ellipsoid, 1-seeded, deep orange, perianth persistent.

Flowering: September – November **Fruiting:** April – May

Status: Rare ocurence; Critically Endangered (Renuka 2011), Vulnerable in India (Basu 2013).

Distribution: India (West Bengal, Assam, Meghalaya, Arunachal Pradesh, Tripura and Manipur) and Bangladesh; rarely occur in valleys near Teesta River, Darjeeling (upto 1830m) of West Bengal.

Ecology: Lower hill forest, upto 1830m, wetlands, water courses, flood plains and grasslands. Mostly found under the cover of tree canopy, Flower branches hang high above the canopy of leaves.

Specimen examined: West Bengal, Teesta River bank, 22.03.2017, Mondal & Chowdhury, 1001 (Acc. No. 10190, NBU). *Other specimens*: Baratang Island, 19.9.2008, fl., Linto & Manohara 25007 (KFRI); North Andamans, 7. 4. 2001, fr., Sreekumar & James 22619 (KFRI); Chittagong, march 1880, fl., Coll. No.7889, Acc. 52699 (MH); Diglipur, North Andamans, 16. 10. 2008, Linto & Manohara 25012 (KFRI); Baratang Islands, 7.4.2001, Sreekumar & James 22619 (KFRI). Darjeeling. W.B. 09. 02. 1849. 493100 (CAL); Fl of Bengal. 1845 Hooker. 495174 (CAL).

Uses: leaves used for making hats, mats etc. and as thatching matarials.

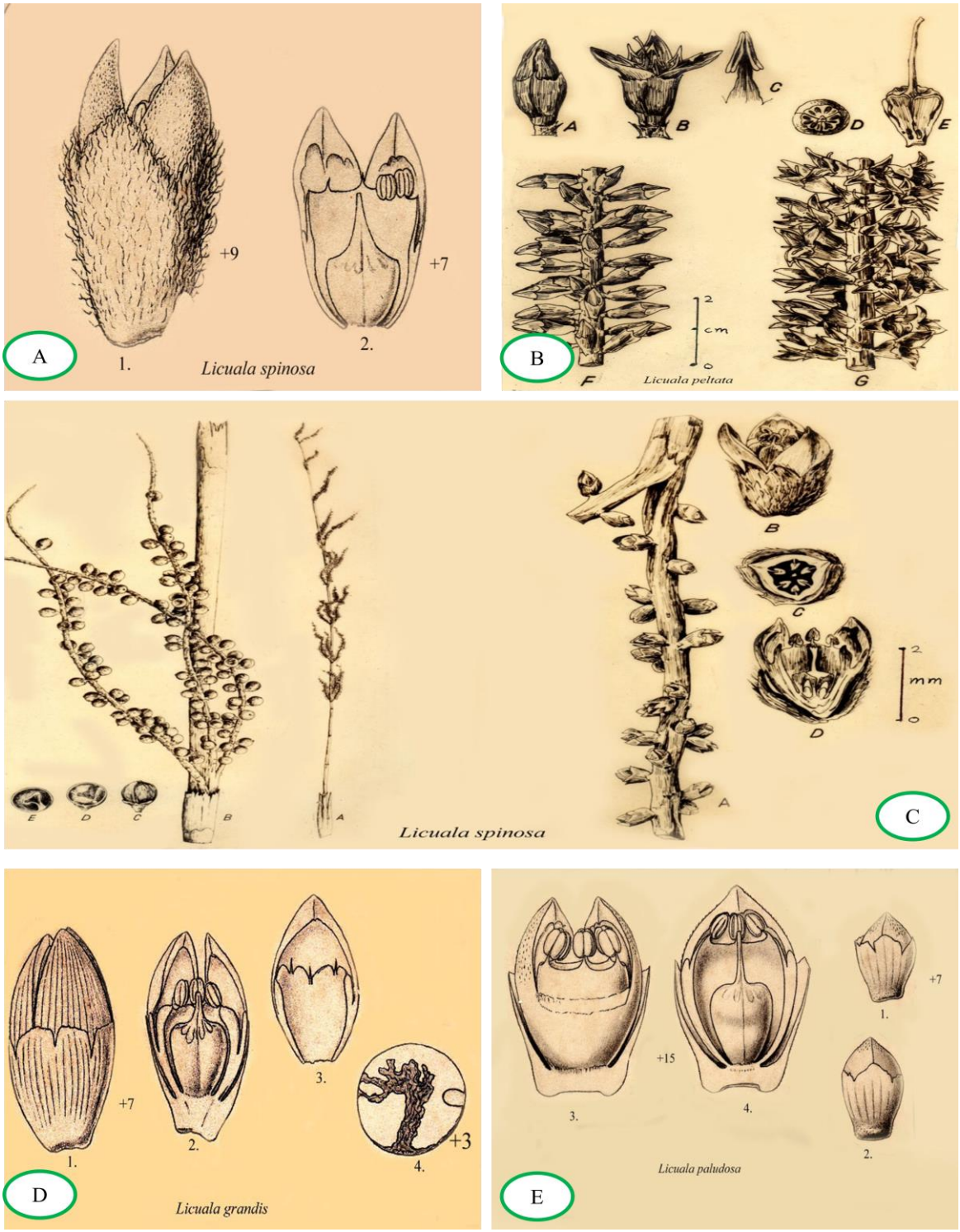

Fig. 27: A. *Licuala spinosa* Thunb. flowers **B.** *Licuala peltata* Roxb. flower **C.** *Licuala spinosa* Thunb. (Portion in inflorescence and dissected flowers) **D.** Dissected floral drawing of *L. paludosa* Griff. **E.** Dissected floral drawing of *L.grandis* Wendl.,© *Dr. S. K. Basu*

Fig. 28: A. *Licuala peltata* Griff. **B.** Flowering plant **C.** Inflorescence **D.** Petiole of *Licuala peltata* (strong spines on petiole). **E.** Mature leaf **F.** Flower **G** Illustration of Flower © *Dr. S. K. Basu* **H**. Androecium **I.** Mature fruits **J.** Infrutiscence **K.** Seedlings

Livistona R. Br., Prodr. Fl. Nov. Holl. 267. 1810; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 435. 1892; Becc., Ann. Roy. Bot. Gard. Cal. 13: 43. 1933; Basu & Chakraverty, in Manu. Cult. Palms Ind. 44. 1994.

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

Distribution: 36 species were widespread but scattered from the horn of Africa, India, China, Philippines, New Guinea, Solomon Islands, Japan and Australia; only 6 species reported from India and 1 species found in Darjeeling Himalayan region of West Bengal.

Livistona jenkinsiana Griff., Cal. J. Nat. Hist. 5: 334. 1845; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 435. 1832; Rao & Joseph, Principes 6: 103. 1962; Blatt., Palms Brit. Ind. 101. 1926. *Saribus jenkensii* (Griff.) Kuntze, Revis. Gen. Pl. 2: 242. 1849. *Livistona speciosa* Kurz., J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43(2): 204. 1874. *Saribus speciosus* (Kurz.) Kuntze, Revis. Gen. Pl. 2: 736. 1891; Noltie, Fl. Bhutan 3(1): 412. 1994; Prain, Beng. Pl. 2: 1091. 1903; Basu & Chakraverty, Manu. Cult. Palms in Ind. 47. 1994. ***'Toa-ck, Tokon, Talainyom, Purbong (Lepcha)'*** [Fig. 29F]

Single stemmed palm, 35 – 40 m height, stem more or less erect, base 25–40 cm in diameter, stem surface rough, dull grey, without prominent leaf scar and leafsheath, crown large with evenly spreading leaves. Leaves 2–2.5 m long, leaf blade costa palmate, shining green above, dull bluish below, leaf segments 65 – 80 in number, 1–1.5 m long, upper free part of segments bilobed, lateral segments deeply bifid at apices; petiole channeled above, strongly dentate at margins, hastula cordate. Inflorescence interfoliar, 1.5 m long, peduncle strong, flattened, 4–6 cm long, prophyll reddish

brown, hard, bicarinate, peduncular bracts and bracts on rachis leathery, basal flower branches twice or thrice branched to form alternate, bright yellow coloured rachillae (flower bearing ultimate branches). Flower bisexual, creamy white, sessile, about 3 mm long, borne on short tubercle, solitary or paired on distal portion of the rachilla, calyx cupular, 3 mm long, 3–lobed; corolla, twice longer than calyx, 3 lobed, lobes triangular; stamens with short filaments, anthers oblong; overy obconical, yellow with a depressed red spot, carpels coherent, style filiform. Ripe fruits globose, red to copper blue, base slightly attenuate each 2.5 cm in diameter. Seed globose with broad raphae like line, endosperm horny, embryo whitish, lateral to sub lateral.

Flowering: February – March **Fruiting:** September – December

Status: Rare; Near Threatened (Renuka 2011)

Distribution: This beautiful fan palm is distributed in the sub tropics of NE India including Sikkim and Darjeeling district of West Bengal, Assam, Arunachal Pradesh, Meghalaya, Manipur and Nagaland; common in Kungbheek Jhora, along the Teesta rivers bed and Sevoke Hills (upto 910 m) of Darjeeling districts of West Bengal.

Note: Emergence of inflorescences take place from the lower leaf axils to upper and all inflorescences emerge out within a span of 30-to 35 days. Anthesis in flowers takes place in besipetal order.

Ecology: Grow as under storey plant in the moist forests. This species is susceptible to dry warm climate. It grows up to an elevation of 910 m. Its natural habitat is in tropical evergreen forest and sub tropical broad leaved forests.

Specimen examined: West Bengal, Mirik, 12.08.2014, Mondal and Chowdhury, 1002 (Acc. No. 10192, NBU). *Other specimens*: Rikshabari block, Kurzeong, W. Bengal, 1.12.1993, fr., Vijayakumarn T.T., 7052 (KFRI); Maklay, Rani, Guwahati Assam, 7.12.93, fr., Vijayakumaran T.T., 7060(KFRI); Lower toridu range, Lataguri, North Bengal, 3.12.93, Vijayakumaran T.T., 7055 (KFRI); Taliamara Division, Ambassa, Tripura, 19.4.94, fr., Renuka, Vijayakumaran & Mohandas 7065(KFRI); Lailad unling range, Meghalaya, 24.4.94, Renuka & Vijayakumaran 7072(KFRI); Lakhimpur Assam, 11.3.1942, DC 20932 (BSI Shillong).

Uses: This palm great importance to the life of tribal people of the north east India. It is extensively used in the state of Arunachal Pradesh, Nagaland and Sikkim. Parts used are stem, leaves, fibres and fruits. Leaves after drying are used as thatch that remains intact for five years. Dry leaves called *'Donga'* used to make temporary rain coat by local poor farmers. Leaves are also used to make hand fans known as *'Bichani'*.

Trachycarpus Wendl., Bull. Soc. Bot. Fr. 8: 429. 1862; Becc. in Hook. *f.*, Fl. Brit. Ind. 6: 436. 1892; Becc., Ann. Roy. Bot. Gard. Calc. 13: 272 & 286. 1933; Basu and Chakraverty, Manu. Cult. Palms in Ind. 57. 1994.

Stem solitary or rarely sucker forming, more or less clean or covered with thick layer of leafsheath fibers. Leaves palmate, leafblade orbicular or reniform, leaf segments narrow. Inflorescence interfolier, shorter than leaves, prophyll semi woody, hidden under leafsheath, peduncular bracts many, alternate, sheathing, leathery, highly tomentose out side. Flowers bisexual or 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: 9 species found in Nepal, Bhutan, China and India; 5 species reported from NE India; only 2 species distributed in Darjeeling Himalaya.

Key to the species

1a. Fruits oblong; stem irregularly annulated, upper part with leaf bases……. *T. martianus*

1b. Fruits reniform; stem covered with loosely arranged fibers …… *T. fortunei*

Trachycarpus fortunei (Hook.) H. Wendl., Bull. Soc. Bot. Fr. 8: 429. 1861; Becc. & Hook. *f.*, Fl. Brit. Ind. 6: 436. 1832; Noltie, Fl. Bhutan 3(1): 412. 1994; Basu & Chakraverty, Manu. Cult. Palms in Ind. 59. 1994. [Fig. 29A,B]

Stem solitary, erect, thickly covered with loosely arranged black leaf sheath fibres, exposing ribbon- like appendages. Leaves spreading in all direction; petiole to 30–40 cm long, flat above, convex below; leaf blade dark green upper, lower side bluish green, 60 cm long from tip of the petiole to the margin, bilobed at apices. Flowers

mostly in clusters of four or less, on upper portion of rachillae, each borne on short tubercle, yellow, stamens 6, filament attached at the base of the petals. Ripe fruits 3 lobed, kidney shaped (reniform), 1 cm long, dark blue in colour.

Flowering: March – April **Fruiting:** September – November

Status: Rare occurence

Distribution: India (Sikkim, West Bengal and Arunachal Pradesh), Nepal, Bhutan Myanmar, China, Vietnam; infrequent and rarely occur in Temparate forest of Darjeeling and Kalimpong Himalaya of West Bengal.

Ecology: This palm prefers cooler, temperate areas and sometime grown at sub-tropics as struggle. It prefers sunlight and moist climate with well drained soil and cold tolarent. The seeds are easy to germinate but only few seedlings reach the mature plants.

Specimen examined: West Bengal, Darjeeling, 14.09.2016, Mondal and Chowdhury, 1003 (Acc. No. 10192, NBU).

Uses: Fresh flowers are edible and the seeds are used as animal feed. Trunk is used as house pillar.

Trachycarpus martianus (Wall. *ex.* Mart.) H. Wendl., Bull. Soc. Bot. Fr. 8: 429. 1861; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 436. 1832; Griff., Cal. J. Nat. Hist. 5: 339. 1845. *Chamaerops martiana* Wall. *ex* Mart. in Wall., Pl. Asiat. Rat. 3: 5. 1931; Basu & Chakraverty, Manu. Cult. Palms in Ind. 58. 1994. [Fig. 29C,D]

Stem solitary, slender, irregularly annulated, 8–10 m long, upper part retaining leaf bases, lower part otherwise bare of leaf bases. Leaf appendage broadly triangular, petiole unarmed, slightly twisted. Leaf blade palmate, reniform, 75–90 cm long from the tip of petiole to tip of leaf blade, leafblade split at middle into 70–80 segments, shallowly bifid at apices, bluish green below, free segments obliquely bilobed at apices, lateral segments acuminate, tips narrowly bilobed, young petiole and half opened leaves covered with white tomentum, leaf about 120 cm wide. Inflorescence interfoliar, 1–1.5 m long, peduncle about 25–30 cm long, prophyll bicarinate, 25–50 cm long, semi tufted at apex, rachillae 2–5 cm long. Flower solitary, white, in pairs, minutely bracteates, calyx 3–lobed, lobe ovate or sub–obtuse; petals 3, ovate-orbicular; stamens

6, as long as corolla; anthers linear oblong; overy 3 folded, wooly outside, stigma capitate. Ripe fruits oblong, epicarp glossy, blue, 1–1.5 cm long.

Flowering: March – April **Fruiting:** August – September

Status: Rare occurence; Near Threatened (Renuka 2011)

Distribution: India (West Bengal, Assam, Meghalaya, Manipur), Nepal, Myanmar, S China; this species is a very slow growing palm, recently recorded in Darjeeling hills near Lloyd's Botanical Garden.

Note: The most obvious feature of this species is the naked trunk, caused by the fibrous leaf sheaths falling with the leaves. Absence of leaf sheaths on the stem, the trunk appears quite slender. Leaves of this species in their natural habitats appear dark green and shinny

Ecology: Grows mostly on bare rock and cracks on the south facing and on sun baked cliffs and prefer slightly acidic soil.

Specimen examined: Way to Darjeeling Lloyd's Botanical Garden, West Bengal 17.06.2014 Mondal & Chowdhury, 1004 (Acc. No. 10046, NBU); Kurseong, West Bengal 12.03.2018, Mondal and Chowdhury, 1053 (Acc. No.10191, NBU).

Fig. 29: **A.** *Trachycarpus fortunei* (Hook.) H. Wendl., with inflorescence **B.** *Trachycarpus fortunei* with mature fruits **C.** *Trachycarpus martianus* (Wall. *ex.* Mart.) H. Wendl., fruiting stage **D.** *Trachycarpus martianus* with male inflorescence **E.** *Pinanga gracilis* Bl. **F.** *Livistona jenkinsiana* Griff.

Tribe: Phoeniceae

Dioceous palm. Leaves pinnate, leaflets induplicately folded, tip acute or spinous. Inflorescence bearing single prophyll, branched; flowers solitary, dimorphic; fruits with inconspicuous endocarp; seed with deep longitudinal furrow.

Phoenix L., Sp. Pl .2: 1188. 1753; Willd. in Sp. Pl. (ed.4), 4(2): 730. 1806; Buch.-Ham., Trans. Linn. Soc. London 15: 82. 1827; Roxb., Fl. Ind. ed. 2: 783. 1832; Kunth, Enum Pl. 3: 254. 1841; Griff., Cal. J. Nat. Hist. 5: 344. 1845; Mart., Hist. Nat. Palm. 3: 257. 1849; Griff., Palms Brit. E. Ind. 136-147. 1850; Becc. in Hook. *f.*, Fl. Brit. Ind. 6: 425. 1892; Basu & Chakraverty, Manu. Cult. Palms in Ind. 62. 1994.

Dioecious palms. Leaves pinnate, induplicate, leaflets with acute tips, proximal leaflets sometimes develops as spines. Inflorescence axillary, interfoliar, bearing a strong, leathery or semi woody prophyll, flowers solitary, dimorphic. Fruit ovoid to oblong, 1 seeded; seed elongate, terete or plano-convex, ventrally grooved, eophyll entire.

Distribution: About 17 species distributed in Canary Island through subtropical and tropical Africa, Arabian Pinunsular, the Indian subcontinent and Indochina to Hong Kong; many species were widely cultivated as ornamentals; in India the genus is represented 7 species with 2 varieties; 5 species distributed in West Bengal from plains to hills of Darjeeling and Kalimpong (upto 1500m).

Key to the species

1a. Stem mostly grows below the ground, short above; leaves almost erect from the ground; fruits orange, red to black……. *P. acaulis*

1b. Stem mostly grows above the ground, erect, mostly solitary, leaves on erect from the ground; fruits green, brownish ……..2

2a. Stem smooth, without leaf base; leaflets non spiny, bifarious ……..…*P. rupicola*

2b. Stem with persistent leaf base at upper part; leaflets spiny, 4–fariously fascicled……..*P. paludosa*

3a. Stem tall; leaves arching; ripe fruits oblong, orange yellow…… *P. sylvestris*

3b. Stem dwarf; leaves short, non- arching; ripe fruits cherry red…….. *P. loureirii*

Phoenix acaulis Buch.-Ham. *ex* Roxb., Hort. Beng. 73. 1814; Roxb., Fl. Ind. ed. 2, 3: 783. 1832; Kunth, Enum. Pl. 3: 257. 1841; Griff., Cal. J. Nat. Hist. 5: 344. 1845; Mart., Hist. Nat. Palm. 3: 274. 1849; Becc. & Hook. *f.*, Fl. Brit. Ind. 6: 426. 1892; Brandis,

Ind. Trees 645. 1906; Noltie, Fl. Bhutan 3(1): 235. 1994; Prain, Beng. Pl. 2: 1096. 1903; Basu & Chakraverty, Man. Cult. Palms in Ind. 63. 1994. *P. acaulis* var. *melanocarpa* Griff., Cal. J. Nat. Hist. 5: 346. 1845 & Palms Brit. E. Ind. 138, t. 227 1850. [Fig. 30A]

Acaulescent to sub acaulescent palms. Stem bulbous, 80–90 cm high, densely covered with persistent leaf base stumps. Leaves pinnate, erect, 90 cm long, stiff, fascicled, induplicately folded, prominently nerved along margins, leaflets tip with sharp spines; petiolar spines 25–30 cm long, stiff, sharply pointed, leaf sheath reddish- brown, fibrous. Inflorescence interfoliar, erect from the leaf axil, 50–60 cm long, flower branches alternate irregularly or horizontally deflected from the rachis, swollen at base, prophyll semi woody; male flowers about 6 mm long, pale yellow at anthesis, calyx copular; petals 3, each obliquely lanceolate, 6 × 3 mm, acute; stamens 6, each to 3.5 mm long, filaments almost nil; female inflorescence accresant after pollination, peduncle grows to a great length, remain almost erect from the leaf axil, fruiting branches irregularly disposed, sometimes forked. Fruits 3 cm long, ellipsoid, slightly mucronate, deep red to brownish when fully ripe.

Flowering: January – April **Fruiting:** May – June

Status: Rare occurrence; Near Threatened (IUCN *ver 3.1*)

Distribution: India (West Bengal, Assam, Meghalaya, Nagaland and Tripura), Nepal, Myanmar; commonly growing in the districts of Bardhaman, Birbhum, Asansol, Bankura, Purulia, Kalimpong and Darjeeling Himalaya (upto 1400m) of West Bengal.

Ecology: Griffith (1845) noted that, *P. acaulis* grows in clay soil on elevated plains of North of the Ganges river. The species occurs in open forest, scrublands, savannahs and pine forest understorey at 400-1500 m.; growing as luxuriant bushes, in lower hill valleys, especially on poor clay soil, and on open grassy field.

Specimen examined: West Bengal, Darjeeling, 14.06.2016, Mondal and Chowdhury, 1007 (Acc. No. 10187, NBU); West Bengal, Birbhum, 30.04.2014, Mondal and Chowdhury, 1054 (Acc. No. 10947, NBU). *Other specimens:* Baidayanathpur, 29.7.1966, male fl., Basak 523 (CAL) ; Chattisgarh: Bastar, 22.5.1983, fr., Roy & Dixit 31980 (CAL); Meghayala Barapani, BSI, Shillong, 27.4.2009, fr., Madhya Pradesh: Manohara 25029 (KFRI); Korba, Bilaspur, 18.4.1965, fl., Orissa: Panigrahi & Arora 8729 (CAL); Gharhaon, 28.6.1957, Panigrahi 8397(CAL); Nigirda, Orissa,

18.2.1958, West Bengal: Panigrahi 12569 (CAL); Ilam bazaar, 24.4.1966, fr., Basak 231 (CAL); Durgapur belt, Allahabad, 25.7.1973, fr., Mukerjee 18789 (CAL).

Uses: Fleshy sweet pulp of the fruit is eaten by the tribes in NE India. Rope is made in certain localities from the beaten leaves. Leaves are also used as thatch, mat and baskets for local use.

Phoenix loureirii Kunth, Enum. Pl. 3: 257. 1841; Prain, Beng. Pl. 2: 1096. 1903; Moore, Principes 7: 157. 1963; Basu & Chakraverty, Manu. Cult. Palms in Ind. 66. 1994; Noltie, Fl. Bhutan 3(1): 415. 1994. [Fig. 30B]

Stem solitary, cylindrical, dwarf, 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 4 cm long straight spines, leaflets irregularly placed on the rachis, upper pale green, glaucous below, stiff, sharply pointed at tips. Inflorescence interfoliar, 30 cm long, prophyll yellowish orange, carinate, margins fringed. Male flowers, 5 mm long, yellowish at anthesis, stamens 6, filaments inconspicuous, adnate to the base of petals. Ripe fruits, ovoid oblong, 12 mm × 6 mm, deep scarlet, perianth persistent, deep green.

Flowering: January – April **Fruiting:** May **–** August

Status: Common; Least Concern (Renuka 2011)

Distribution: Pakistan, India (West Bengal, Assam, Meghalaya), Myanmer, Thailand, China, Philippines, Taiwan; commonly growning in open forests of Dhupguri, Salugara, terai and hills of Darjeeling and Kalimpong, West Bengal (upto 2000m).

Ecology: It is growing between 200 – 2000 m altitudes (Gamble 1967) on the hills region. Grassy, steep slopes are its favorite habitat.

Specimen examined: West Bengal, Siliguri, Darjeeling, 16.07.2016 Mondal and Chowdhury, 1008 (Acc. No. 10199, NBU).

Uses: The soft foliage of *P. loureirii* is largely used for making household brooms.

Phoenix paludosa Roxb., Hort. Bengal. 73. 1814 & Fl. Ind. 3: 789. 1832; Griff., Cal. J. Nat. Hist. 5: 353. 1845; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 427. 1892; Prain, Beng. Pl. 2: 1096. 1903; Brandis, Ind. Trees, 646. 1906; Parkinson, Forest Fl. Andaman Isl. 263. 1923; Basu & Chakraverty, Manu. Cult. Palms in Ind. 66. 1994. ***'Hetal'*** [Fig. 30C]

Cluster forming palms; stem slender, annulate, 6 m long, 15–16 cm in circumference near base. Leaves arching, pinnate, 100–120 cm long or more, leafsheath fibrous, redish; petiole redish brown, scurfy outside, petiolar spines not very stiff, 5–9 cm long, channeled at middle, leaflets linear, induplicate, 60 in number. Inflorescence interfolier, erect from the leaf axil, prophyll compressed reddish brown; 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:** May – July

Status: Common; Near Threatened (IUCN *ver 3.1*)

Distribution: India to Malaysia; a component of the estuarine mangrove swamps. In India it is naturally found in Andaman and Nicobar Islands, Mahanadi Delta of Orissa and Sunderbans of West Bengal.

Ecology: These species grown in costal esturine mangrove forest where salinity is high.

Specimens Examined: West Bengal, South 24 Parganas, Jharkhali, 12.06.2015 Mondal and Chowdhury, 1010 (Acc. No. 10188, NBU) & 12.03.2016 Mondal and Chowdhury, 1055 (Acc. No. 09868 NBU) & Bonicamp, 12.08.2016 Mondal and Chowdhury, 1056 (Acc. No. 09858 NBU). *Other specimens:* Baratang Island, S. Andamans, 9.4.2001, Sreekumar & James 22622 (KFRI); North Andamans, 10.4.2001, Sreekumar 22623(KFRI); Orissa, 2.5.2002, fr., Sreekumar & Dinesh 22677(KFRI); Namkhana, 24PGS(S), Fl. W.B. 03.06.1965. A. K. Mukherjee. 3424 (CAL).

Uses: 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 rupicola T. Anders., Jour. Linn. Soc. 11: 13. 1869; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 425. 1892; Becc., Malesia. 3: 395. 1890; Prain, Beng. Pl. 2: 1096. 1903; Blatt., Palms Brit. Ind. 14. 1926; Moore, Principes 7(4): 157. 1963; Noltie, Fl. Bhutan 3(1): 415. 1994. Basu & Chakraverty, Manu. Cult. Palms in Ind. 69. 1994. [Fig. 30F]

A graceful ornamental palm. Stem solitary, about 6–7 m long, 25–30 cm diameter near base. Stem surface without persistent leaf bases, more or less smooth on outer surface, clean, deep grey in color. Leaves gracefully arching, 2.5–3 m long; petiolar spines deep green, not stiff. Leaflets linear, deep green, glossy, soft, bifarious on rachis, each 40–50 cm long, leaf ends with a terminal leaflet. Inflorescence interfoliar, 60–70 cm long,

prophyll fusiform, scurfy outside, greenish yellow, opens by longitudinal split; male flowers pale yellow; female flowers 3–4 mm long, globose, calyx copular, petals oblong, imbricate or twisted. Fruits oblong, deep crimson to chocolate brown, 2–2.5 cm long.

Flowering: April – August **Fruiting:** September – November

Status: Less common; Lower Risk / near threatened (IUCN *ver 2.3*)

Distribution: S and SE Asia; India (Sikkim, Assam, Arunachal Pradesh, Meghalaya and West Bengal); common in hills of Darjeeling, Kalimpong and Kurseong of West Bengal (upto 1000 m).

Ecology: It is an endemic palm thrives among the rocks and cliffs in the Himalayan Mountains. Due to its adaptation to this kind of habitat, it tolerates poor, rocky soils. Natural stands of this species in the lower Himalayas are getting depleted and its existence in the wild is reduced to some isolated patches in Meghalaya and Arunachal Pradesh.

Specimen examined: West Bengal, Darjeeling, Kurseong, 16.08.2016 Mondal and Chowdhury, 1006 (Acc. No. 10194, NBU). West Bengal, Jaldhaka, Bindu, 30.04.2018 Mondal and Chowdhury, 1057 (Acc. No. 09859, NBU). *Other specimens:* Kimin, 14.05.2009, fl., Manohara 25051 (KFRI); Kimin, Arunachal Pradesh, 14.05.2009, Manohara 25052 (KFRI); India. Assam. Shillong, Kimin to Khunipahad, 25 Sept. 1959 (pist.), Panigrahi 19485 (CALI). Sikkim. 24June 1876 (ster.), King s.n. (BMI, CALI); 19Jan. 1877 (ster.), Davis & Gamble 2387a (CALI). West Bengal. Sivoka, Teesta valley, 23 Feb. 1867 (pist.), Herb. Sikkimensis Anderson s.n. (type CALI).Sillim: Rainmatong, 26.3.1945, Mukerjee 1396 (CAL); Numbong, Sikkim, 3.6.1909. male fl., Lepeha Collection 2100(CAL); Culcutta: BSI Botanic garden, Howrah, 24.05.2009, fl., Manohara 25054 (KFRI); BSI Botanic garden, Howrah, 24.05.2009, Arunachal Pradesh: Manohara 25055 (KFRI).

Uses: Core of the stem contains starchy materials and for extraction trees are felled. It is very ornamental and therefore is mainly used accent of specimen palm in both residential and commercial landscape in warm climate.

Fig. 30: **A.** *Phoenix acaulis* Buch.–Ham. *ex* Roxb. **B.** *Phoenix loureiroi* Kunth **C.** *Pheonix paludosa* Roxb. **D.** *Phoenix dactylifera* L. **E.** *Phoenix sylvestris* Roxb. **F.** *Phoenix rupicola* T. Anders.

Phoenix sylvestris (L.) Roxb., Hort. Beng. 73. 1814 & Fl. Ind. ed. 2: 787. 1832; Griff., Cal. J. Nat. Hist. 5: 350. 1845 & Palms Brit. E. Ind.141, t. 228. 1850; Aitch., Cat. Pl. Punjab Sindh 143. 1869; Brandis, Forest Fl. N. W. Ind. 554. 1874; Becc., Malesia 3: 364, t. 43,3 f. 25-36. 1890; Prain, Beng. Pl. 2: 1096.1903; Blatt., Palms Brit. Ind. 3, pl. 2, 3, 1926. *Elate sylvestris* L., Sp. Pl. 2: 1189. 1753; Noltie, Fl. Bhutan 3(1): 416. 1990; Basu & Chakraverty, Manu. Cult. Palms in Ind. 69. 1994. ***'Khejur'*** [Fig. 30E]

Stem solitary, mostly robust, erect, 16–18 m long, covered with compact leaf bases. Leaves about 4–5 m long, lower leaves arching; petiole short, flattened, strongly spinuous at margins, petiolar spines 6–8 cm long, stiff, sharply pointed, triangular in cross section, leaflets stiff, induplicate, sharply pointed at tips, each 70–80 cm long. Inflorescence inter foliar about 30–40 cm long, prophyll semi woody, scurfy out side, opens; peduncle flat, stout, flower branches simple, fasciculate, bright orange, 25–30 cm long; male flowers white about 4–6 mm long, calyx with 3 prominent points; petals 3, much longer than calyx, stamens 6, adnate to petals at base, anthers linear; female flowers alternately disposed, calyx copular with 3 prominent points, petals 3 imbricate. Fruits about 3 cm long, about 1–1.5 cm broad at middle, deep brown when ripe.

Flowering: December – January **Fruiting:** April – June

Status: Common; Least Concern (Renuka 2011)

Distribution: Pakistan, India, Sri Lanka and Bangladesh; very common throughout the West Bengal except Himalayan region**.**

Ecology: Common as semi wild palm in the plains of India. Adapted to various ecological conditions and those growing on marshy land have more or less exposed stem.

Specimen examined: West Bengal, South 24 parganas, Canning, Kulpi, 04.05.2015 Mondal and Chowdhury, 1009 (Acc. No. 10189, NBU); West Bengal, Siliguri, NBU Campus, 26.09.2017 Mondal and Chowdhury, 1058 (Acc. No. 09863, NBU). *Other specimens:* W.B., Chigleput, 25.2.1976, Henry 47014 (MH); Sindhuvalli, Mysore, 21.7.2009, fl., Manohara 25058(KFRI); Subansiri F, D., Kimin to Khunipahad, Arunachal Pradesh, 25.9.1959, panigrahi 19485 (CAL); Burla, 26.8.1986, Sauris Panda & Das 207 (CAL); Balugan, Orissa, 7.5.02,fr., Sreekumar and Dinesh22676 (KFRI); Lalacheruvu, Andhra Pradesh, 28.5.02,fr., Sreekumar and Dinesh, 22695 (KFRI);

Jagathalpur, Chathisgarh, 21.5.02, fr., Sreekumar, 22687 (KFRI); Manjeri, Andaman, 8.4.01, Sreekumar and James 22621 (KFRI); S.K. University campus, Anantapur, 24.5.1982, leaf, Yesoda 516 (MH); W. Godavari, 31.1.1934, fl., Jacob 457 (MH); Bunds of Vedanthangal.

Uses: One of the most useful semi wild palms. Leaves have local uses, crushed, and beaten, and made into brooms or stipes is woven to make chattai, basket etc. Old and unproductive trees are cut and pieces of stems are used as fuel for burning tiles, pots etc.

Subfamily: Calamoideae

Tribe: Calameae

Key to the genera

1a. Hapaxanthic cane grows to great height; inflorescence develops in the axil of upper reduced leaves……...*Plectocomia*

1b. Pleonanthic cane, mostly high climbers; inflorescence mostly in the axil of normal leaves.....2

2a. Inflorescence with tight, sheathing, persistent bracts…….3

2b. Inflorescence with loose, boat shaped or spatulate non-sheathing bracts…...……. *Daemonorops*

3a. Fruit ovoid, ellipsoid or globose; one seeded……...*Calamus*

3b. Fruit obovoid, or pear–shaped; usually three seeded……*Salacca*

Calamus L., Sp. Pl. 1: 325.1753; Becc., Gen. Pl. ed. 5. 152. 1754; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 436. 1894; Prain, Beng. Pl. 2: 1096. 1903; Becc., Ann., Roy. Bot. Gard. Cal. 11: 73. 1908; Uhl & Dransfield, Gen. Palmarum 237. 1987; Basu, Rattans in Ind. Monogr. Rev. 46. 1992; Noltie, Fl. Bhutan 3(1):416. 1994.

Dioecious palm, stem mostly clustered or less often solitary, mostly slender and climbing or erect, occasionally non climbing and then either short and subterranean or free standing, tightly covered with leafsheaths which are armed with delicate to strong, scattered or organized spines. Leaves pinnate spiny, ecirrate or cirrate, leaf sheath with or without whip-like spinous climbing organ (flagellum), leaf sheath knee present or

absent, petiole short to long sometimes armed with short to long spines, sheaths closed in climbing stems, open in non-climbers, variously hairy and spiny, hairs of young sheaths soon wearing off, sheath spines scattered or densely arranged or in rows, occasionally hairy on margins, variously shaped and coloured, sometimes arranged in overlapping, interlocking and forming chambers; rachis mostly armed below with digitate to half whorled claws and spines. In some species rachis extended into a whip-like appendage known as cirrus. Leaflets mostly linear-ensiform, or linear-lanceolate or lanceolate, variously arranged on rachis. Inflorescence axillary panicle, usually elongate, branched 3 orders, male inflorescence more branched than female once; branched and rachillae covered with overlapping bracts with clawed spines on outer surfaces in climbers; male flower borne along opposite sides of rachillae, female flowers borne in pairs with a sterile male flower, along opposite sides rachillae; Male and female inflorescence apparently similar, male inflorescence with one more order of branches, axial part of inflorescence in some species slender, very long and spiny, ending in a spiniferous flagellum, bracts tubular at base, mostly armed with short to long spines; partial inflorescence subtended by primary bracts, involucre conspicuous in female inflorescence. In male flower calyx cupular, distinctly 3–lobed; corolla split to the base to form 3 distinct petals; stamens 6, pistillode minute. In female flower calyx shallowly 3–lobed; petals 3; staminodes joined at base to form a ring; overy covered with refluxed scales, 3 loculed, 1–ovule in each locule, stigmas 3, reflexed, each female flower accompanied by a small neuter flower, appearing like a male flower, but without pollen in the anthers. Fruit mostly small, variously shaped and coloured, ovoid, ellipsoid or globose, with or without beak, covered with medially channeled or flat scales. Seed mostly one, sometimes pedicellate covered with sarcotesta, exposed seeds (diaspore) pitted or grooved, endosperm homogeneous or ruminate, germination adjacent, eophylls or pinnate, embryo basal or lateral.

Distribution: About 370 species distributed in Asia, Africa and Australia; 38 species wild in India; 17 species reported from West Bengal.

Key to the species

1a. Leaf ending with cirrus ……...2

1b. Leaf ecirrate.....……..5

2a. Leafsheath smooth outside unarmed…….. *inermis*

2b. Leaf sheath armed with short to long spines ……..…..……3

3a. Leaflets remotely subequidistant on rachis……*C. nambariensis*

3b. Leaflets alternate or subopposite……..4

4a. Leaf sheath more or less smooth on upper part, lower part infrequently armed with flattened, subulate spines…… *C. khasianus*

4b. Leaf sheath spines subulate, seriate to subseriate, closely packed……..…..……6

5a. Stem climbing; leafsheath with flagellum…… 7

5a. Stem erect; leafsheath without flagellum……*C. erectus*

6a. Prophyll tubular, 20–30cm long; seeds yellowish, 1.2×0.6 cm……..*C. arborescence*

6b. Prophyll slightly tubular, 14–32 cm; seed brownish, 0.5×0.1 cm….*C. pseudoerectus*

7a. Leaf sheath with heavily armed, strong; 6–7 m long flagellum……*C. flagellum*

7b. Leafsheath with sparsely armed; flagellum up to 2–3m long……. 8

8a. Male and female flower rachillae scorpioid……*C. leptospadix*

8b. Male and female rachillae decompounds……9

9a. Leafsheath armed with scattered, needle-like, bulbous-based to 2 cm long spines……. …...*C. tenuis*

9b. Leafsheath armed with small, broad based spines in rows … …...……10

10a. Primary bracts after opening from a laminar appendage …..……...*C. guruba*

10b. Primary bracts do not from laminar appendage…….……..….....11

11a. Leafsheath with broad based black spine; fruit scales tiger striped, not channeled at middle ……*C. longisetus*

11b. Leafsheath with subulate spines; fruits scale not tiger striped, deeply channeled at middle ……..12

12a. Uppermost leaflets digitately grouped ……*C. gracilis*

12b. Uppermost leaflets not digitately grouped or fascicled……..…… 13

13a. Terminal leaflets conspicuously connate at base ……..… 14

13b. Terminal leaflets slightly connate at base……*C. kingianus*

14a. Leaflets lanceolate, distinctly grouped, irregular with 2 – 3 leaflets in each group……*C. viminalis*

14b. Leaflets oblanceolate, in regular opposite group of 2 – 5 leaflets on each side…… …15

15a. Leafsheath thickly covered with small tuberculate spines, leaflets broadly lanceolate ……...*C. acanthospathus*

15b. Leafsheath thickly covered with long flattened spines, leaflets equidistant, alternate to sub opposite broadly lanceolate ……..……16

16a. Fruit globose, dull brown to blackish, scale deeply channelled……*C. latifolius*

16b. Fruit sub ovate, yellow to dark brown, scale slightly channeled…..…*C. floribundus*

Tribe: Calameae (Ecirrate)

Calamus acanthospathus Griff., Cal. J. Nat. Hist. 5: 39. 1845; Becc., Ann. Roy. Bot. Gard. Cal. 11: 283. 1908 & Appendix Pl. 105.1913. *Palmijuncus montanus* (T. Anders.) Kuntze, Revis. Gen. Pl. 2: 733. 1891. *Calamus yunnanensis* Govaerts, World Checklist Seed Pl. 3(1): 11. 1999. *Calamus feanus* Becc. in Hook. *f*., Fl. Brit. Ind. 6: 448. 1892; Basu, Rattans in Ind. Monogr. Rev. 126. 1992; Noltie, Fl. Bhutan 3(1): 421. 1994. ***'Mathu beth'*** [Fig. 45F]

Moderately robust rattan, stem solitary, sometimes weakly cluster forming, climbing, 10–12 m height, with leaf sheath 3–4 cm in diameter, without leaf sheath 2.5–3 cm in diameter, smooth. Leaves ecirrate, 1.5–2 m long, petiole inconspicuous; leaf sheath mostly covered with small tuberculate or flattened spines, 1.5cm long, margins sinuous, base broad, solitary confluent spines; leaflets regular alternate, 6–9 nerved, 46 cm long, 5–7 cm broad at middle, broadly lanceolate, terminal leaflets slightly connate at base; flagellum 1.5–2 m long. Inflorescence 3–4 m long, flagelliform, bracts tubular, rachillae short and strongly recurved, primary bracts leathery, closely sheathing; female rachillae arching, sub scorpioid, 5–7 cm long, rachilla with 10–15 flowers. Fruit yellowish brown, broadly ovoid to ellipsoid, suddenly beaked, scales grooved, 2.6 cm long, 1.6 cm broad at middle. Ripe fruits dull orange, scales in 16 series, shinning, superficially channeled at middle; seed densly pitted on dorsal side, endosperm sub ruminate, embryo basal.

Flowering: April – May **Fruiting:** June – September

Status: Less commom in terai and lower hills of Darjeeling and Kalimpong.

Distribution: India (West Bengal, Sikkim, Assam, Meghalaya and Arunachal Pradesh), Bhutan and China; in West Bengal common in hills of Darjeeling and Kalimpong district (upto 1500m).

Eecology: Strong climbers growing at lower and middle hills forest of Eastern Himalaya upto 1500 m of altitude.

Specimen examined: West Bengal, Kurseong, 20.06.2016, Mondal and Chowdhury, 1012 (Acc. No. 09858, NBU). *Other specimens:* W. B: Baradabari, 27.4.1961, Indo-Russian Expedition no. 336 (CAL); Dzeleuke, Nagaland, 8.5.1994, male fl., Renuka & Vijayakumaran, 7079 (KFRI); Ahey gang, Jan 1912, Toppin 6191 (CAL); Ahey gang, Jan 1912, Toppin 6191 (CAL); Sikkim: Lower Chumbi, 6000-7200ft Dec. 1904, Searight 72 (CAL).

Uses: This species is highly valued for its excellent quality small diameter strong cane used for making baskets for tea plucking. Cane is collectively used for making cane bridges over mountain streams.

Calamus arborescens Griff., Cal. J. Nat. Hist. 5: 33. 1845; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 439. 1892; Becc., Ann. Roy. Bot. Gard. Cal. 11: 70. 1908 & Appendix Pl. 1. 1913; Basu, Rattans in Ind. Monogr. Rev. 72. 1992. Mitra & Sharma, J. Bamboo and Rattan 4: 399. 2005. ***'Bet, Seng bet, Jati bet'*** [Fig. 34F]

A non–climbing colony forming rattan; stem erect, strong, 3–6 m long, 4–7 cm in diameter near base, annulate. Leaves arching, 3 m long, leafsheath, petiole and rachis covered with thick, black, subulste, seriate to pectinate, 1.6 cm long black spines; leaflets equidistant, 60–84 cm long, acuminate, thinly bristly at apices, prominently bristly on upper and lower nerves, deep green, whitish beneath. Inflorescence interfoliar, 2–2.5 m long, pendulous, peduncle smooth, compressed, green, bracts 20–32 cm long, thickly spiny below; male rachillae scorpiod, male flowers distichous, anthers pistillode, linear, angular with 3 abortive carpels united upto the middle. Fruits oblong or ovoid, prominently beaked with stigmatic projection, scales yellowish.

Flowering: November – December **Fruiting:** April – May

Status: Rare occurrence; Vulnerable (Basu 2013)

Distribution: India (West Bengal, Manipur), China, Myanmar and Malaysia; in West Bengal it is found in Howrah (introduced).

Note: This species has restricted distribution in India; it was introduced in the Indian Botanic Garden, Howrah in 1810 from Pegu, Burma (Myanmar). In Manipur this species is locally known as Lithit. Reported from the locality of Ando, Imphal East at an altitude of 790 m (Meitram and Sharma 2005).

Ecology: This species can be grown in large earthen pots as ornamental palm. Its beautiful dark green foliages are very attractive. It prefers to grow along the pond or lake if planted in the open.

Specimen examined: West Bengal, Howrah, 12.09.2016, Mondal and Chowdhury, 1013 (Acc. No. 09872, NBU). *Other specimens:* Kamorta, Nicobar Islands, 1875 Kurz (CAL); Nongmaigin, Manipur, 4.4.54, Singha 2206 (CAL); Mannarghat, South Andamans, 1.4.1993, fr., Renuka & Vijayakumaran 7032 (KFRI); Baratang island, 1.5.1964. Thothatri 10846 (CAL); Sipighat, 25.11.1978, Basu 7067 (CAL & ANC).

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 be used as handle of hatchets etc.

Calamus erectus Roxb., Fl. Ind. 3: 774. 1832; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 438. 1892; Becc., Ann. Roy. Bot. Gard. Cal. 11. 126. 1908 & Appendix pl. 2 & 11. *Palmijuncus erectus* (Roxb.) Kuntze, Revis. Gen Pl. 2: 733. 1891. *Calamus macrocarpus* Griff. *ex* Mart., Hist. Nat. Palm. 3: 333. 1853. *Calamus erectus* var. *birmanicus* Becc., Rec. Bot. Surv. Ind. 2: 197. 1902. *Calamus erectus* ver. *schizospathus* (Griff.) Becc., Ann. Roy. Bot. Gard. Cal. 11: 125. 1908; Basu, Rattans in Ind. Monogr. Rev. 69. 1992. ***'Bet, seng bet, jati bet'*** [Fig. 31 & 32]

A shrubby, non flagellate, cluster forming, short, dioecious forest understorey, non climbing, erect palm. Stem with leaf sheath 3.5–6 cm in diameter, leaf sheath deep brown, armed with flat, spines sharp, 2–2.8cm long, oblique semicircular lines, ocrea well developed, petiole very prominent, 9.5 cm long, exposed stem green and smooth, inter nodes 10–12 cm long. Leaves ecirrate, 3–4.9 m long; leaf sheath 3–7 m long,

armed with black spines, ocrea conspicuously auriculate; petiole 1.4–1.7 m long, sub terete, covered with irregular whorled spines; leaflets linear ensiform, equidistant, opposite to alternate, 25–62 × 2.5–4.7 cm, elongate ensiform, 18–38 on both sides; rachis armed below with irregular to whorled straight spines. Inflorescence interfoliar, up to 1–1.5 m long; partial inflorescence 8–10, alternate, 50–60 cm long, compact; primary bract elongate, tubular, lacerate in upper part; peduncle strongly armed with black flattened comb like spines; male and female inflorescence similar; male flowers bifarious, narrowly oblong, obscurely 3 angled at base, calyx campanulate, 3 lobed; corolla with 3 distinct petals, distichous in recurved rachillae up to 25–30 cm long; rachillae in female inflorescence recurved, 16–20 cm long. Fruit shortly stalked, 4.5 × 2.0–2.5 cm, ellipsoid, covered by 12 vertical rows of shining scales cordate- trapezoid, scales reddish brown with light patches, deeply channeled, 3 × 2 cm, beak prominent, conical; seed oblong to ovoid, endosperm ruminate, embryo basal.

Flowering: April – May and August – September **Fruiting:** October – February

Status: Less common; Vulnerable (Renuka 2011)

Distribution: India (West Bengal, Sikkim, Assam, Meghalaya, Manipur), Bangladesh, Myanmar and Thailand; in West Bengal common in tropical and sub tropical forests of terai (Bangdubi, Sevoke, Gulma, Lataguri) upto temperate froests of Dajeeling and Kalimpong Himalaya up to 600m.

Ecology: Lowland or mountain rain forests or drier forests usually on steep slopes; grows in the lower hill forests especially on the dry slopes.

Specimen examined: West Bengal, Darjeeing, Bangdubi, 02.05.2016 Mondal and Chowdhury, 1014 (Acc. No. 09862, NBU); West Bengal, Darjeeling, Kalijhora, 16.11.2017 Mondal and Chowdhury, 1059 (Acc. No. 09807, NBU); West Bengal, Jaldhaka, 30.04.2018 Mondal and Chowdhury, 1060 (Acc. No. 10178, NBU). *Other specimens:* Hamaupuri, 22. 1. 1962, fl., D.B Deb27023 (CAL); berreck block, North Bengal, 2.12.1993, female fl., fr., Vijayakumaran 7053 (KFRI); Sevoke Hills, Himalaya, North Bengal, 28.10.1975, 197 A, Acc. 52705 (MH).

Uses: Due to shorter internodes, the cane is not commercially utilized for furniture making. Seeds are used as medicine among the hilly tribes to treat diabetes and hypertension.

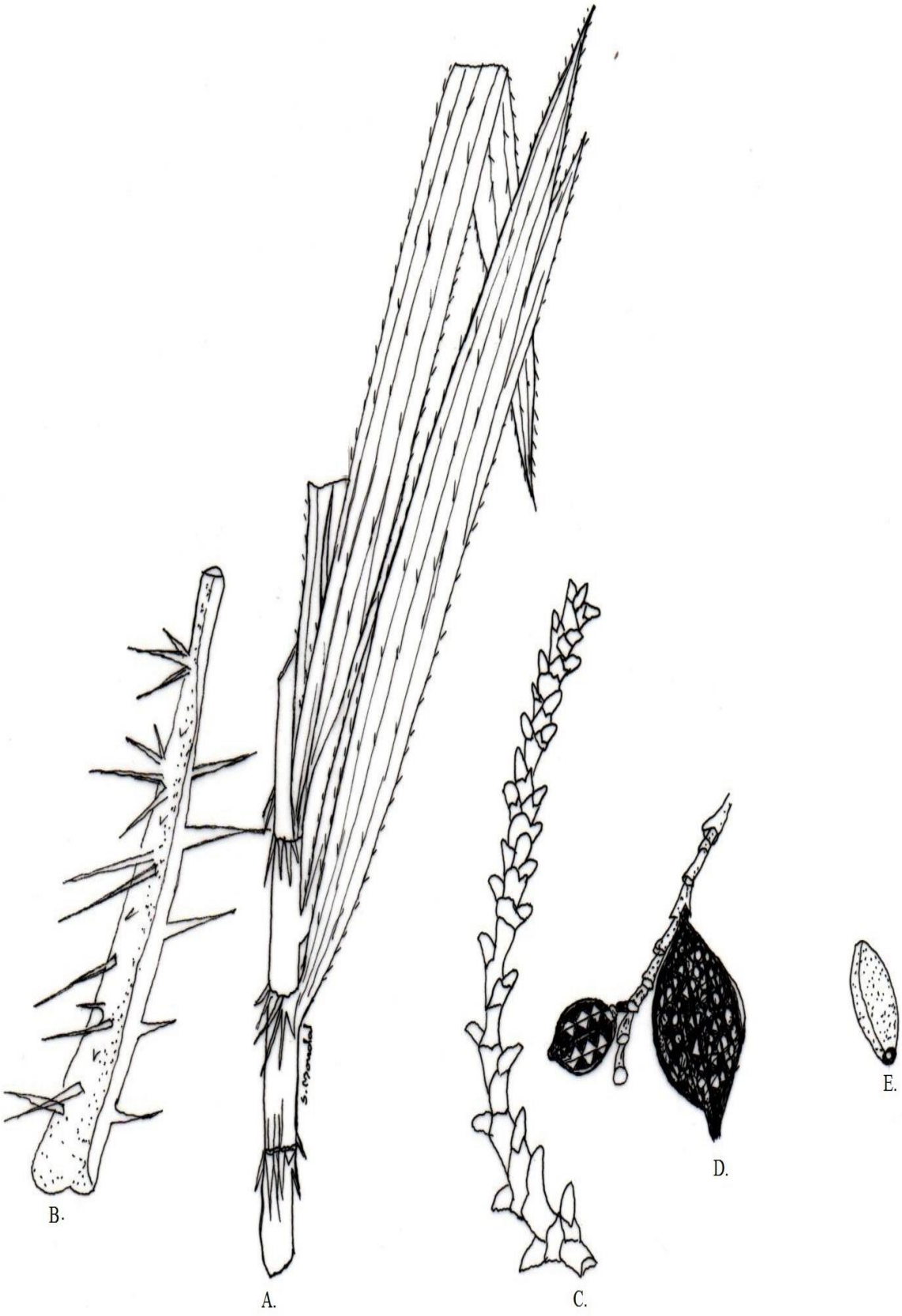

Fig. 31: *Calamus erectus* Roxb. **A.** Portion of stem showing leaflet **B.** Petiole **C.** Part of the male inflorescence **D.** Fruit **E.** Seed

Fig. 32: A. *Calamus erectus* Roxb. **B.** Mature fruits **C & D.** Spine ornamentation on petiole and rachis **E.** Female rachillae **F.** Male rachillae **G.** Herbarium specimen

Calamus flagellum Griff. *ex* Mart., Cal. J. Nat. Hist. 3: 333 1853; Griff., Palms, Brit. E. Ind. 1850; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 439. 1832; Becc., Ann. Roy. Bot. Gard. Cal. 11. 127. 1908 & Appendix pl. 4 & 5. 1913; Basu, Rattan in Ind. Monogr. Rev. 74. 1992. ***'Putli bet, Rab bet, Reem'*** [Fig. 34C, D]

Clustering, large diameter rattans; stem with sheath 5 cm in diameter, without sheath 4.8 cm in diameter. Leaves ecirrate, ocrea marcescent; petiole terete, about 1 cm in diameter, armed with subulate spines whorls, 1–3 cm long, leaf lets equidistant, many, 27–37 linear – lanceolate pinnate per side, regularly or irregularly arranged broadly ensiform, prominently 1 nerved on upper side, middle leaflets longer, 60–65 cm long; uppermost leaflets connate up to the middle, midnerve and marginal nerves with bristle; rachis heavily armed on lower side with strong claws on lower side at intervals, 3–4 m long. Inflorescence 7–7.5 m long, flagellate, bracts tubular, tattering at apices; male and female inflorescences flagelliform, 5–7 m long, simply decompound, partial inflorescences about 1–2 m long, with 3–5 rachillae on each side; primary bracts tubular, closely sheathing, fibrous; secondary bracts unarmed, tubular, narrowly funnel shaped; rachillae 8–24 cm long, slightly compressed, each bearing 9–29 distichous to remote flowers, involucre copular, male flowers 8–12 × 4 mm, curved outside; female rachillae remote, 18–27 cm long, involucrophorum unilaterally cupular, involucre cupular, projected from the basal bract, truncate entirely sunken in involucrophorum; female flowers 6–8 mm long, calyx ovate, 3 dentate; petals lanceolate. Fruits 2.7–3 × 1.8–2.2 cm, yellowish or brownish, broadly ovoidscales slightly channeled at middle; seeds terete in the cross section, embryo basal.

Flowering: June – August **Fruiting:** September **–** Novenber

Status: Rare occurrence; Endangered (Renuka 2011)

Distribution: India (West Bengal, Sikkim, Assam, Meghalaya,), Bangladesh, Bhutan; common in the sub–tropical and tropical to temperate forests terai, duars, Darjeeling and Kalimpong (upto700 m) of West Bengal.

Ecology: A component of the mixed evergreen forests on the lower or middle Himalayan ranges.

Specimen examined: West Bengal, Mirik, 20.07.2015 Mondal and Chowdhury, 1015 (Acc. No. 09853, NBU); West Bengal, Alipurduar, Dalgaon forest 20.09.2017 Mondal

and Chowdhury, 1061 (Acc. No. 09855, NBU). *Other specimens:* Kamlao, Manmao Division, Arunachal Pradesh, 9.6.1989, female fl., Renuka, 6606 (KFRI); fl., Gamble, 455B & 455B (MH); Sikkim, 3.12.1908, Craib 506 (CAL)

Uses: Large canes similar to *Calamus inermis* commonly used in furniture industry; it is also a raw material for basketry. Fruits are edible, leaves are used as thatches.

Calamus floribundus Griff., Cal. J. Nat. Hist. 5: 56. 1845; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 444. 1892; *Palmijuncus floribundus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891. *Calamus mishmeensis* Griff., Cal. J. Nat. Hist. 5: 55. 1845. *Calamus floribundus var. depauperatus* Becc., Ann. Roy. Bot. Gard. Cal. 11: 79. 1908; Basu, Rattan in Ind. Monogr. Rev. 115-116. 1992. [Fig. 45G]

Clustering, medium sized rattans; stem with sheath 4–5 cm in diameter, without sheath 2–2.5 cm in diameter. Leaves ecirrate, leaf sheath armed, spines horizontal to deflexed, mostly seriate or scattered, 2–3 cm long, subulate; petiole strongly armed, spines straight, 3–4 cm long, flagellum armed with black tipped claws, leaflets equidistant, lanceolate, 4–6 nerved, 50–55 × 3–5 cm, upper leaflets crowded, terminal leaflets free. Male inflorescence flagelliform, 1.5–2 m long, partial inflorescences 35–42 cm long, thrice branched; primary bracts tubular, 2–3 edged, armed with scattered straight spines; secondary bracts tubular, non spiny, funnel like opening; flower branches alternate, inserted at the mouth or just above the mouth of the respective bracts, each holding alternate, 3 cm long rachillae; male flowers distichous, ovoid, 2–6 mm long, calyx rounded, almost smooth at base with 3 acute lobes; corolla twice longer than calyx; female inflorescence 17–32 cm long; partial inflorescences inserted within the primary bracts; rachillae 3–7 on each side, 6–10 cm long, female flowers 4–6 mm long, ovoid. Fruit drupe, globose, beaked, 6–8 mm in diameter, scales in 14 series, obtuse, shinning, superficially channeled at middle, gray yellow; seed sub orbicular.

Flowering: April – May **Fruiting:** June – August

Status: Rare occurrence; Endangered (Renuka 2011)

Distribution: India (West Bengal, Assam, Meghalaya, Arunachal Pradesh, Mizoram and Nagaland), Bangladesh, Myanmar; commonly found in forests of Darjeeling and Kalimpong Himalaya (upto1500 m) of West Bengal.

Ecology: Grows in the moist forests of the plains and lower hills and along the riverbanks, land or mountain rain forests below the 1500 m of altitudes.

Specimen examined: West Bengal, Darjeeling, Shivkhola 27.03.2018 Mondal and Chowdhury, 1016 (Acc. No. 09856, NBU). *Other specimens:* Kobo towords Povomuch, Assam, 5.12.1911, malefl., Burkill 37036 (CAL); Kumpang, Arunachal Pradesh, 25.11.1958, Rao 18027 (CAL); Thakama, February 1906, fl., Meebold 5556 (CAL); Dibru forest, Assam, 7.6.1989, fr., Renuka 6602 (KFRI); Makum,21.11.1919, Burkhil 35743 (CAL); Povomuch, Assam, 5.12.1911, male fl., Burkill 37036 (CAL).

Uses: Cane is not preferred for construction or furniture making due to its brittle nature, however, it is used for making of baskets and other handicrafts, rope etc. The young shoot is used as vegetable.

Calamus gracilis Roxb., Fl. Ind. ed. 3: 781. 1832; Becc. in Hook. *f.*, Fl. Brit. Ind 6: 453. 1893; Becc., Ann. Roy. Bot. Gard. Cal. 11. 318. Pl. 124. 1908. *Palmijuncus gracilis* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 733. 1891. *Calamus hainanensis* C. Chang & L. G. Xu *ex* R.H.Miau, Acta Sci. Nat. Uni. Sunyatseni 1981(3): 116. 1981; Basu, Rattans in Ind. Monogr. Rev. 111. 1992. ***'Chulibet'*** [Fig. 39C]

A slender, climbing rattans; stem cluster forming 30 m long or more, with sheath 2.5–5 cm in diameter, without sheath 1.5–3 cm diameter, dark green. Leaves ecirrate, 60–75 cm long; leaf sheath with flagellum armed with long and short needle like spines; ocrea small; knees present, with distinct hairy projection; petiole 1–3 cm long, margins armed, straight, rachis armed below, spines straight, base bulbous, rachis 0.7 m long, 8–15 linear or lanceolate pinnate leaflets per side, deflected in one plane, narrowly oblanceolate, longer leaflets 45–55 cm long, 1–1.5 cm wide at broadest part, lowermost leaflets 27 cm long, 3–6 nerved on upper side, nerves more or less smooth on upper side, bristly on lower side, terminal leaflets two third connate from base. Both male and female inflorescence flagelliform, delicately branched, axial part aculeate, male rachillae 3–6 cm long; male flowers distichous, 6 × 2 mm; female flowers horizontally projected from rachillae. Ripe fruits broadly ovoid or elliptic, 2.7–3.2 × 1.5–1.8 cm, equally rounded on both sides, scales orange but straw yellow when dry, deeply channeled at middle, 3 × 1 cm and stalked scale, grooved, arranged in 23 series; seed ovoid, endosperm ruminate.

Flowering: Apri – August **Fruiting:** November – February

Status: Rare occurrence; Near Threatened (Renuka 2011)

Distribution: India (West Bengal, Assam, Meghalaya, Arunachal Pradesh, Nagaland Manipur), and Bangladesh; common in forests of Terai and Duars, lower hills of Darjeeling and Kalimpong below the altitudes of 850 m.

Ecology: In evergreen forest, mostly at 300–1200 m in lower to middle hill forests of Eastern Himalaya.

Specimen examined: West Bengal, Dajeeling, Mahananda Wild Life Sanctuary, 17.06.2017 Mondal and Chowdhury, 1017 (Acc. No. 09852, NBU). *Other specimens:* Lailad, Khasi hills, Meghalaya, 25.4.1994, fr., Renuka and Vijayakumaran, 7074 (KFRI); Namgao, Arunachal Pradesh 10.6.1989 Renuka, 6608 (KFRI). Oct. 1892, Prain's 89 (CAL); North lakhimpore, Koki Researve Forest, 22.11.1957, Panigrahi, 397 (CAL).

Uses: Ballast baskets, for caning chair and seats. It is a very important cane for furniture and handicrafts industry. Fruits edible and leaves used in various religious rituals.

Calamus guruba Buch.-Ham. *ex* Mart., Hist. Nat. Palm. 3: 211. 1853; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 449. 1892; Becc., Ann. Roy. Bot. Gard. Cal. 11: 299. 1908 & appendix pl. 114. 1913; Prains, Beng. Pl, 2: 1099. 1903; *Calamus nitidus* Mart., Hist. Nat. Palm. 3: 211. 1838. *Daemonorops guruba* (Buch.-Ham.) Mart., Hist. Nat. Palm 3: 330. 1853. *Calamus multirameus* Ridl., Mart. Fl. Malaya. Penins. 2: 202. 1907; Basu, Rattan in Ind. Monogr. Rev. 94. 1992. ***'Sundi Bet, Orna Bet, Jali Bet, Jai Bet, Jati Bet'*** [Fig. 45D]

A high slender thicket cluster forming climber rattans; stem 5–5.5 m long, leaf sheath 2.5–3cm long and 2.4 cm in diameter, dull green with rusty brown indumentums, covered by 1–1.5 cm long spines, internodes to 30 cm long, mouth of the sheath with extra-long slender, needle like spines, ocrea lacerated. Leaves ecirrate, 110–125 cm long with petiole, 25–30 cm long, rachis with rusty indumentums, back with irregularly arranged stout recurved spines; knee prominent with delicate armed flagellum, 2.6 m long, spines subulate, triangular, dark reddish brown tipped, spines; leaf lets numerous,

equidistant, alternate to opposite, linear, prominently 3–nerved, 35–45 cm long, 2.7 cm broad at middle, green on both sides. Male and female inflorescences flagelliform, 1–3 m long, with 5–8 alternate remote partial inflorescences, primary bracts conspicuous; male flowers on rachillae, 8 cm long; female flowers on 2–3 cm long rachillae. Fruits rounded, pea like, greenish brown, apiculate, 6 mm in diameter, perianth shortly pedicelliform; scales deep red to blackish, in 17–18 rows, endosperm not ruminate

Flowering: November – December **Fruiting:** April – May

Status: Rare occurrence; Near Threatened (Renuka 2011)

Distribution: India (West Bengal, Assam, Arunachal Pradesh, Meghalaya and Tripura) and Bangladesh; commonly found in the forests of Terai and Duars (Khoerbari range, Alipurduar), Darjeeling and Kalimpong hills (upto 1200m), West Bengal.

Ecology: A component of the forests of Eastern Himalaya up to an altitude of 1200 m. Sometimes found in the same locality where *Licuala peltata* grows. This species was also found under the canopy of *Tectona grandis*, *Lagerstroemia speciosa* and *Alstonia sp* from same locality.

Specimen examined: West Bengal, Alipurduar, Khoerbari range 29.04.2018 Mondal and Chowdhury, 1018 (Acc. No. 10170, NBU). *Other specimen:* Teliamur, 22.2.1960, fl., Deb 2306 (CAL); Irong Manipur, February 1906, Meebold 552 a (CAL); Manu Division, Tripura, 20.4.1994, Renuka and Vijayakumaran 7070 (KFRI); fl., S. Coll. M. H. Acc. No 52736 (MH); fr., S. Coll. M.H. Acc. No.52838 (MH); Mangalore, March 1911, Meebold 14310 (CAL); Watkyi, 1911, fl., Meebold 17145 (CAL); Myitkyina, 25.1.1914, fr., Gilbert Rogers 315 (CAL); Soondari river, 11.04.1908, male fl., Ribu 692 (CAL); Gajaldoba, Jalpaiguri, 26.4.1962,fr., Mukerjee 5596 (CAL); Rajabhat Khawa, Depot road, 14.5.1949, V. Narayana Swamy 2402 (CAL); Calcutta, 6.3.1915, Debbarman 10812 (CAL).

Uses: One of the most commercially exploited cane of India that has commercial used. Split canes are used in basket making, weaving chair bottoms, furniture panels and binding edges of bamboo basket. Its young shoot is used for food (Basu 1992).

Calamus leptospadix Griff., Cal. J. Nat. Hist. 5: 49. 1845; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 44. 1832; Becc., Ann. Roy. Bot. Gard. Cal.11: 142. 1908 & Apendix pl. 14.

1913. *Palmijuncus leptospadix* (Griff.) Kuntze, revis. Gen. Pl. 2: 733. 1891; Basu, Rattans in Ind. Monogr. Rev. 77. 1992. ***'Dhangri Bet, Rab Bet, Rani Bet, Mugri Bet'*** [Fig. 45E]

Cluster forming, small diameter climber rattan; stem 8–10 m long, with sheaths 2–4 cm in diameter, without sheaths 1–2 cm. Leaves ecirrus, 80–120 cm long, leaf sheath with flagellum, green, scurfy, 2.5–3 cm long, partly seriate; knee present; ocrea present, petiole 40–45cm long, petiole and rachis armed with scattered spines, spines 3–4 cm long, rachis covered with indumentums; leaflets 25 × 1.6 cm, linear ensiform, alternate to sub-opposite, distinctly 3-nerved, acuminate to bristly subulate at apex, uppermost leaflets short. Male inflorescence shorter, flagelliform, decompounds, male rachilla scorpiod, 1–2.5 cm long, with 6–14 flowers, male flowers 4–6.5 × 1.7 mm, calyx tubular, 3 oblong segments. Female inflorescence similar to males, female rachillae erect from base, arching above, 1.7–2.2 cm long, each with 5–9 female flowers. Fruit globose, 1.7 mm in diameter, scales yellowish with a reddish brown margins, deeply channeled at middle; seed globose and endosperm homogeneous.

Flowering: March – May **Fruiting:** June – October

Status: Rare occurrence; Vulnerable (Renuka 2011)

Distribution: India (West Bengal, Sikkim, Assam, Meghalaya, Manipur, Nagaland, Arunachal Pradesh) and Bhutan; common in the forests of Jalpaiguri, Lataguri, North Bengal University Campus (130 – 250 m).

Ecology: Mostly on damp river plans, forming big thickets and becomes a cluster forming high climber when grows in moist places among tall trees.

Specimen examined: West Bengal, Siliguri, North Bengal University Campus, 20.08.2014 Mondal and Chowdhury, 1019 (Acc. No.10174, NBU). *Other specimens:* Kobo, 5.12.1911, fr., Burkill 37035 (CAL); Dhasi Khati village, inner NEFA border, Assam, 16.02.1957, Panigrahi 5657 (BSI Shillong); William Nagar,Meghalaya, 2.5.94, Renuka, Vijayakumaran and Mohandas,7078 a (KFRI); William Nagar, Meghalaya, 2.5.94, female fl., Renuka, Vijayakumaran and Mohandas 7078 (KFRI); Berreck Block, Kurzeong Division, North Andamans, 2.12.93, Vijayakumaran 7054 (KFRI); Tinkopani Reserve Forest, Assam, 10.6.89, female fl., Renuka 6609(KFRI); Barata,

Manipur, February 1906, fl., Meebol 5557 (CAL); Duphla hills, 1875, fl., Listen 277 (CAL); Duar reserve, Assam, 22.4.1958, male fl., nath 13218 (CAL).

Uses: Cane is mainly used for rough baskets for tea plucking and for other uses. Split canes are strong and durable and used for making chair bottoms.

Calamus longisetus Griff., Cal. J. Nat. Hist. 5: 36. 1845; Becc. in Hook. *f.*, Fl. Brit. Ind. 6: 440. 1832; Becc., Ann. Roy. Bot. Gard. Cal. 11 : 134. 1908 & Appendix Pl. 9. 1913; Basu, Rattans in Ind. Monogr. Rev. 102. 1992; Renuka, Manu. Rattan, Anda. l. 42. 1995. *Palmijunncus longisetus* (Griff.) Kuntze, Revis. Gen. Pl. 2: 733. 1891. *Calamus tigrinus* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43 (2): 211. 1874. *Palmijunncus tigrinus* (Kurz) Kuntze, Revis. Gen Pl. 2: 733. 1891. ***'Alimasjid, Kadakachan, Jungli Kyein, Jungli Bet, Udham Bet'*** [Fig. 33 & 34A, B]

A strong climber rattan,18–20 m long; stem deep green, internodes 35–45 cm long, with leaf sheath 4.5 cm in diameter. Leaves ecirrate, 4–5.5m long, leaf sheath covered with deep brown to blackish coating; scattered black needle-like spines, subulate, 1–2 cm long, longer spines jointed at base, ocrea papery, upper leaf sheath 5–7cm long straight to wavy; petiole deeply channeled, 40–45 cm long, 3.5 cm wide at middle, upper surface on the petiole covered with needle like blackish spines, lower surface flat, blackish spines; leaflets ensiform, elongate, equidistant on rachis, often in groups of 3–6 leaflets projecting in different direction, 75–85 cm long, 3–4 cm wide at middle, bristly on upper nerves and margins. Male and female inflorescences flagelliform, 7–8 m long, pendulous; partial inflorescences branched, simple, caudiform at apices, primary bract thinly leathery in surface, very closely sheathing, elongate, secondary bracts un-armed; male rachillae 17 cm long; male flowers tightly distichous on the rachillae; female rachillae 16 cm long, alternate, simple, basal part of rachillae not deeply enclosed within the basal bract. Fruits ovoid, 3.5 cm long, narrow, beak prominant, scales flattened, arranged in 11–12 longitudinal series, yellowish; seed oblong, superficially furrowed on the back, flat on the rapheal side, smooth , endosperm homogeneous.

Flowering: November – December **Fruiting:** April – May

Status: Rare occurrence; Least Concern (Renuka 2011)

Distribution: *Calamus longisetus* mainly found in India (West Bengal, Assam, Arunachal Predash and South Andaman), Bangladesh, Myanmar and Thailand; widely distributed in the forests of Darjeeling and Terai- Duars region of West Bengal, upto 350 m of altitudes.

Ecology: Common in moist forest and damp slopes on lower hills.

Specimen examined: West Bengal, Darjeeling, Kalijhora, 16.11.2017 Mondal and Chowdhury, 1020 (Acc. No. 09864, NBU). *Other specimens:* Ray hills, North Andaman, 27.10.1964, Ellis and Ramamurthy 18965 (MH); S. Andaman, 22.12.1982, Dr. King's Collector, Acc. No., 53174 (MH); Middle c, 4.5.1974, fr., Balakrishnan 1350 (CAL); Dong Islands, Andamans, 15.12.1915, male fl., Parkinson 780 (CAL); Wumberleygumg, South Andamans, 6.4.88, fr., Renuka 4060 (KFRI); Mannarghat, South andamans, 4.4.92, fr., Vijayakumaran 6626 (KFRI).

Uses: The tribal people eates the ripe fruits and used leaves for thatching. Its commercial utilization is limited to making rough baskets and other articles for local uses.

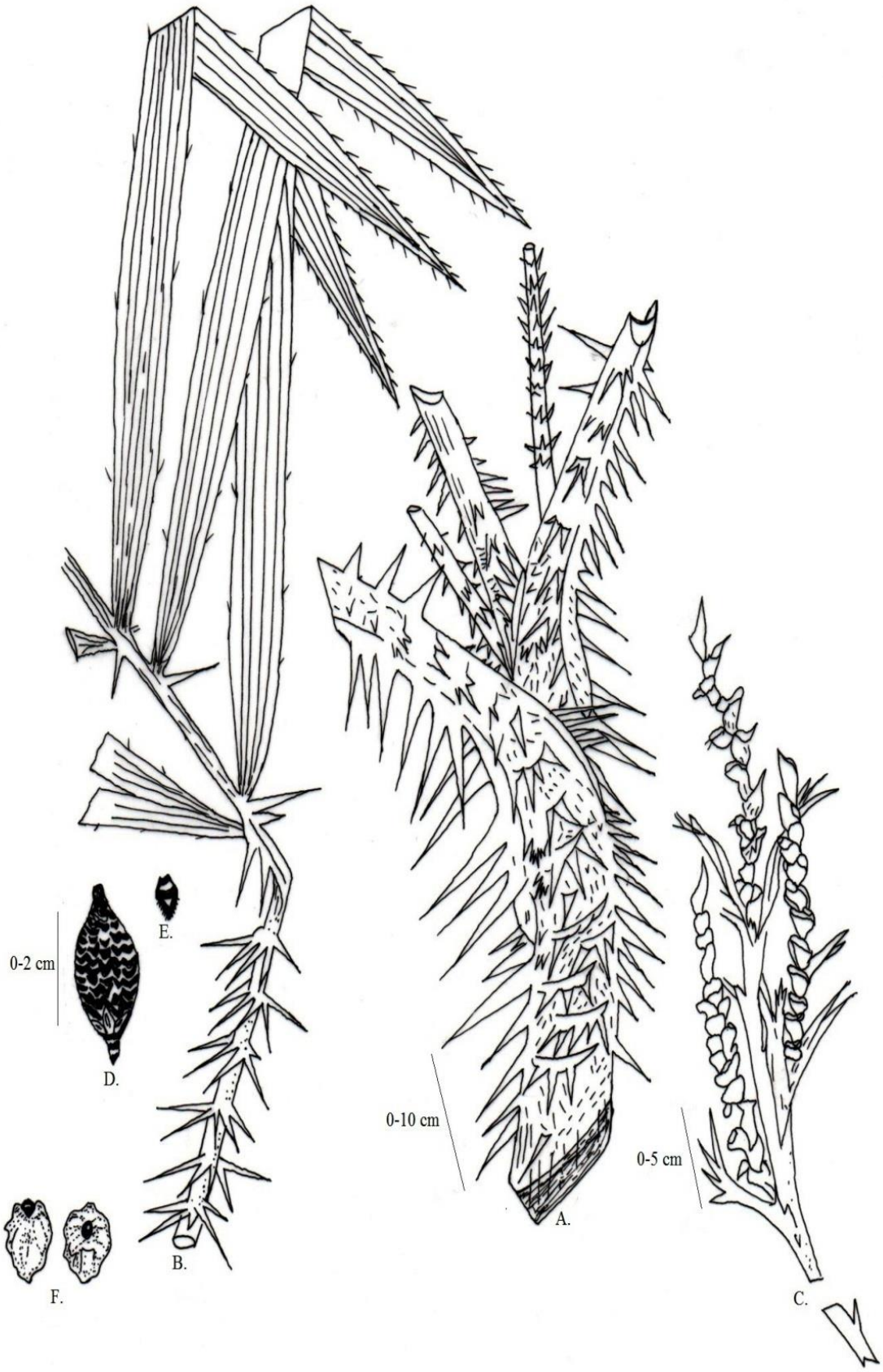

Fig. 33: *Calamus longisetus* Griff. **A.** Spine ornamentation **B.** Rachis with leaf **C.** Male inflorescence **D.** Mature fruit **E.** Fruit scale **F.** Seed

Fig. 34: A. *Calamus longisetus* Griff. with fruits **B.** *Calamus longisetus* Griff. with male inflorescence **C & D.** *Calamus flagellum* Griff. **E.** *Calamus tenuis* Roxb. **F.** *Calamus arborescens* Griff.

Calamus pseudoerectus Sujit Mondal, S. K. Basu & M. Chowdhury, *J Threatened Taxa* 11(5): 13605. 2019. ***'Betgara, Otla bet'*** [Fig. 35 & 36]

Erect, Cluster forming canes, up to 11m long. Stem solid, sheaths 18 – 20 cm diameter, without sheaths 12–13.5 cm diameter; internodes 5 – 9.8 cm long, 12.1 – 13.2 cm diameter. Leaf ecirrate, 1.56 – 3.37 m long; fagella absent; sheath blackish-brown, caducous scales, sparsely variable sized blackish-brown armed with minute and few long fat spines along zone of adnaton between inforescence and sheath; knee absent; petole 1 – 1.2 m long, young petole with white powdery dust, mature petole base with dense brown dust, covered with irregular small spines, base fat, leaf sheath closed with spongy, thick sheath fbers on both edges; leafets 38–43 on each side of rachis; rachis 1.3 – 1.8 m long; glabrous, rarely spines on both edges, leafets linearensiform, 41 – 75 cm × 2.1 – 4.1 cm, leafets alternate in equidistance at base and terminal part, but opposite at middle; green beneath, narrowly elliptc to linear, mid leafets 71 – 76.5 cm × 4.8 – 5.6 cm; apical leafets 39.6 – 41.8 cm × 1.6 – 2.1 cm, apical leafet scarcely united at base; fne spines 3 – 6 mm long, on major veins of both abaxial and adaxial surfaces; inforescences long, looping, 2.10 – 2.40 m long, non-fagelliform, branched to 1 order, one pistllate and one staminate fower lies in each node; pistllate fowers deeply embedded on rachis node, sterile staminate fowers lies at base of pistllate fowers; prophyll strictly tubular, 14 – 32 cm × 4.8 – 3.1 cm tghtly sheathing, opening asymmetrically at apex, with brown indumentums similar to that of the sheath, very sparsely armed with minute recurved spines, sometmes with fne bristles around bract opening; peduncular bracts one or two, peduncular up to 1.12m long, 1.3cm diameter, with irregular spine on margin and adaxial surface, rachis bract 5.6 – 14.4 cm × 3.3 – 5.2 cm, similar to prophylls; primary branches (rachillae) 25.6 – 134.2 cm apart, rachillae 2 – 3 at each nodes; rachillae alternate, straight, 10.3 – 27.6 mm × 1.6 – 2.5 mm; rachilla bracts 1.3 – 1.6 cm × 2.3 – 2.8 cm, similar to prophylls; foral bracteoles tubular, 0.7 – 1.4 cm × 1.8 – 2.5 cm, asymmetrically opened; pistllate fowers oval, 0.6 – 0.4 cm × 0.4 – 0.5 cm, sessile, lacking indumentums; calyx 0.4cm diameter, connate at base, three-lobed; lobes 0.6cm × 0.4cm; corollatubular at base, 0.4 – 1.1 cm × 1.6cm long, tp three-lobed; lobes triangular, 0.6mm long; ovary globose; stgma three, prominent; sterile staminate fower narrow, 0.7cm × 0.3cm, solitary, sessile, atached at base of pistllate fowers, calyx 0.4cm diameter, connate at base, three–lobed; lobes 0.6cm × 0.4cm; tubular at base, corolla 0.4 – 1.1 cm × 1.6cm, tp three-lobed; lobes

triangle, 0.6cm long; sterile stamens six; separate fertle male plants not seen. Fruits very small, ellipsoid, 0.7 – 0.8 mm × 0.3 – 0.4 mm, rusty brown, with three distnct stgmatc projecton, 0.1 – 0.2 mm long, covered with longitudinal rows of scales, reddish brown, 0.4 – 0.8 mm × 0.3 – 0.5 mm, scales not regular, fan-shaped, margins fmbriate, arranged in nine rows; one-seeded; seeds oblong, 0.5cm × 0.1cm, brown.

Flowering: December – February **Fruiting:** February – May

Status: Endangered (Mondal *et al.* 2019)

Distribution: India; endemic and rarely distributed in tropical lowers hills forests of Darjeeling district (upto 800m), West Bengal.

Ecology: Hill slopes tropical forests at lower hills.

Specimen Examined: West Bengal, Darjeeling district, Muktikhola hill slopes, 08.02.2018, S. Mondal & M. Chowdhury, 1024 (Acc. No. 10044, NBU); Shivkhola hill slopes, 12.04.2018, S. Mondal & M. Chowdhury, 1062 *(*Acc. No. 10212, NBU).

Uses: Leaves are used as thatch; local peoples use fruits for diabetes.

Notes: *Calamus pseudoerectus* is presently known from Darjeeling District of West Bengal.

Fig. 35: *Calamus pseudoerectus* Sujit Mondal, S. K. Basu & M. Chowdhury **A & B.** Habit **C.** Stem **D.** Inflorescence **E.** Sheath **F.** Petiole **G & H.** Sheath with fibre **I.** Rachillae **J.** Pistillate flower **K.** Sterile staminate flower **L.** Sterile stamens **M.** Mature fruit **N.** Fimbriare scale **O.** Seed

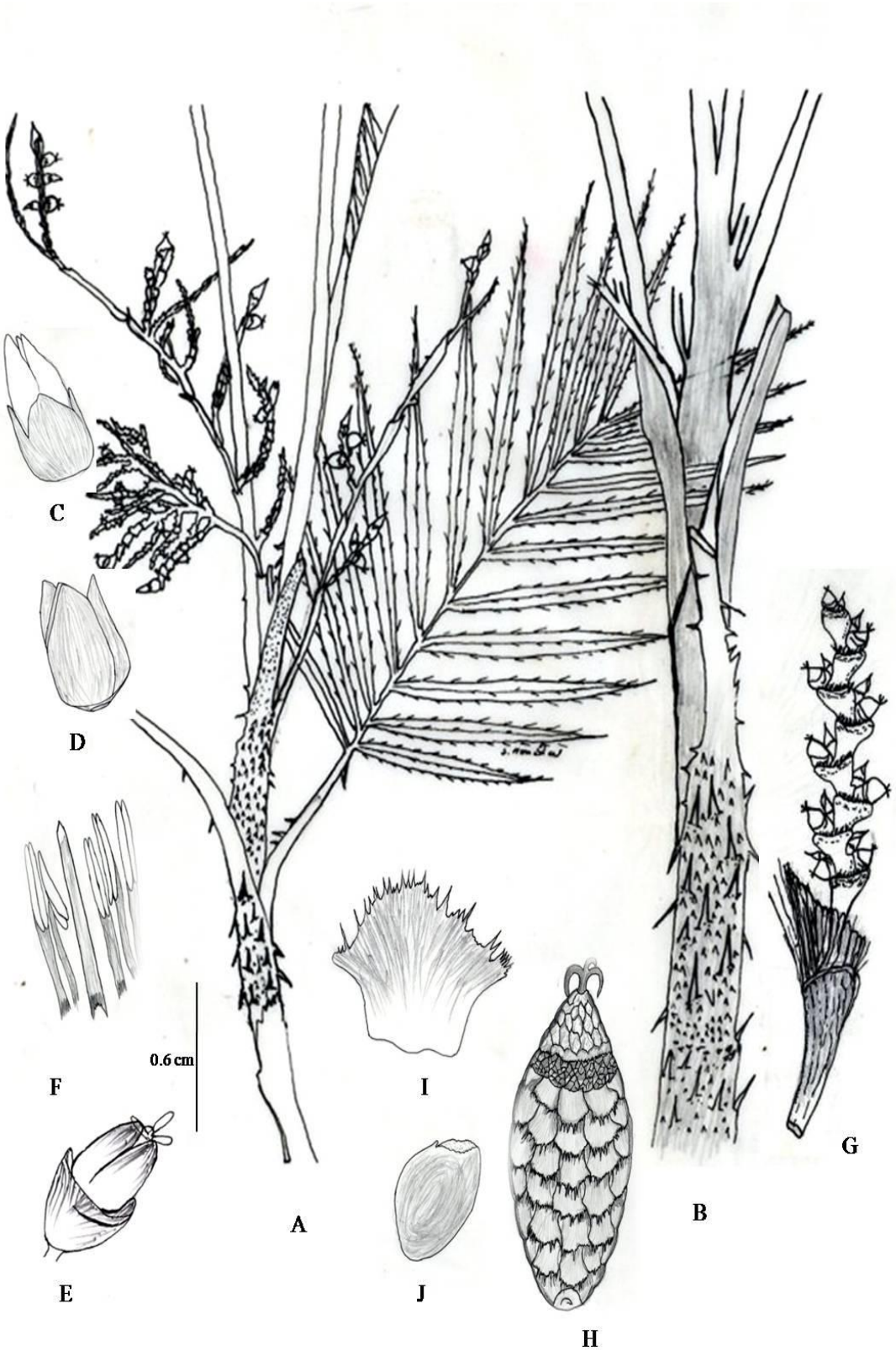

Fig. 36: *Calamus pseudoerectus* Sujit Mondal, S. K. Basu & M. Chowdhury **A & B.** Habit with leaf sheaths, leaves, and inflorescence **C.** Sterile staminate flower **D.** Calyx **E.** Pistillate flowers **F.** Sterile stamens **G.** Rachilla with female and sterile male flower **H.** Mature fruit **I.** Scales **J.** Seed.

Calamus tenuis Roxb., Fl. Ind. 3: 780. 1832; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 447. 1832; Becc., Ann. Roy. Bot. Gard. Cal. 11: 262. 1908 & Appendix Pl. 94. 1013; *Calamus amarus* Lour., Fl. Cochinch. 210. 1790. *Calamus helitropium* Buch.-Ham.. *ex* Kunth, enum. Pl. 3: 210. 1841. *Calamus royleanus* Griff., Cal. J. Nat. Hist. 5: 40. 1845; Prain, Beng. Pl. 2: 1098. 1903; Basu, Rattan in Ind. Monogr. Rev. 84. 1992. ***'Jati bet, Pani bet, Sanchi bet'*** [Fig. 37, 34E, 39B, D]

Slender climber rattan; stem cluster forming, with leaf sheath 2–2.5 cm in diameter, without leaf sheath to 4–15 mm in diameter. Leaves ecirrate, 1.5 m long, leaf sheath with prominent knee, armed, small flat based black spines; petiole well developed, 13–16 cm long, rachis armed on upper side, 1.5–3 cm long, curved needle like spines spines, 1.8–3 cm long; leaflets linear ensiform to 28–34 cm long, 14 – 16 mm broad at middle; terminal leaflets not joined at the base. Male inflorescence flagelliform, slender, decompound, rachillae 2–5 cm long with two series of 6–12 male flowers, male flowers 3.5–4 mm long. Female inflorescence long flagellate, slender, simply decompounds, partial inflorescences 17–25 cm long, 6–12 incurved rachillae on both side, female flowers 4–5-seriate in young inflorescence. Fruit globose, 10–12 mm in diameter, grey white coloured, shortly beaked, scales 14–15 vertical rows, closely channeled at middle; seed globose, endosperm not ruminate.

Flowering: September – October **Fruiting:** April – May

Status: Rare occurrence; Least Concern (IUCN *ver 3.1*)

Distribution: India (West Bengal, Assam, Meghalaya, Manipur, Tripura, Nagaland and Myanmar), Bangladesh and South Vietnam; common in road side bushes in Bengal plains (Malda, Siliguri and Mahananda WLS) up to 150 m of altitudes.

Ecology: Commonly grows near water bodies and swamps.

Specimen examined: West Bengal, Malda, 20.08.2017, Mondal and Chowdhury, 1021 (Acc. No. 10172, NBU). *Other Specimens:* Thinnevely District, Male fl., Sebastian 9925 (CAL); Niashangarha, utter Pradesh, 10.12.1986, Khanna and Saran 38625 (CAL); Dharama Nagar Tripura, 2104.1994 fr., Renuka 7071 b (KFRI); Jagadappur, 21.5.02, Sreekumar and Dinesh 22686 (KFRI); motturonwalab, 4.11.1921, fl., Ramachandrasethi 145 (MH); Sri Lanka, S. Coll. M.H Acc. No. 62064 &62065 (MH); Chttagong Hill Tracts, Bangladesh, 1880, Male fl., gamble 7768 (MH).

Uses: *Calamus tenuis* is used for making rough baskets and useful raw material for furniture and handicrafts industry. The young and tender shoots, fruits are used as food; the ripe fruit is sold in village market; Matigara haat, Siliguri, Darjeeling, West Bengal.

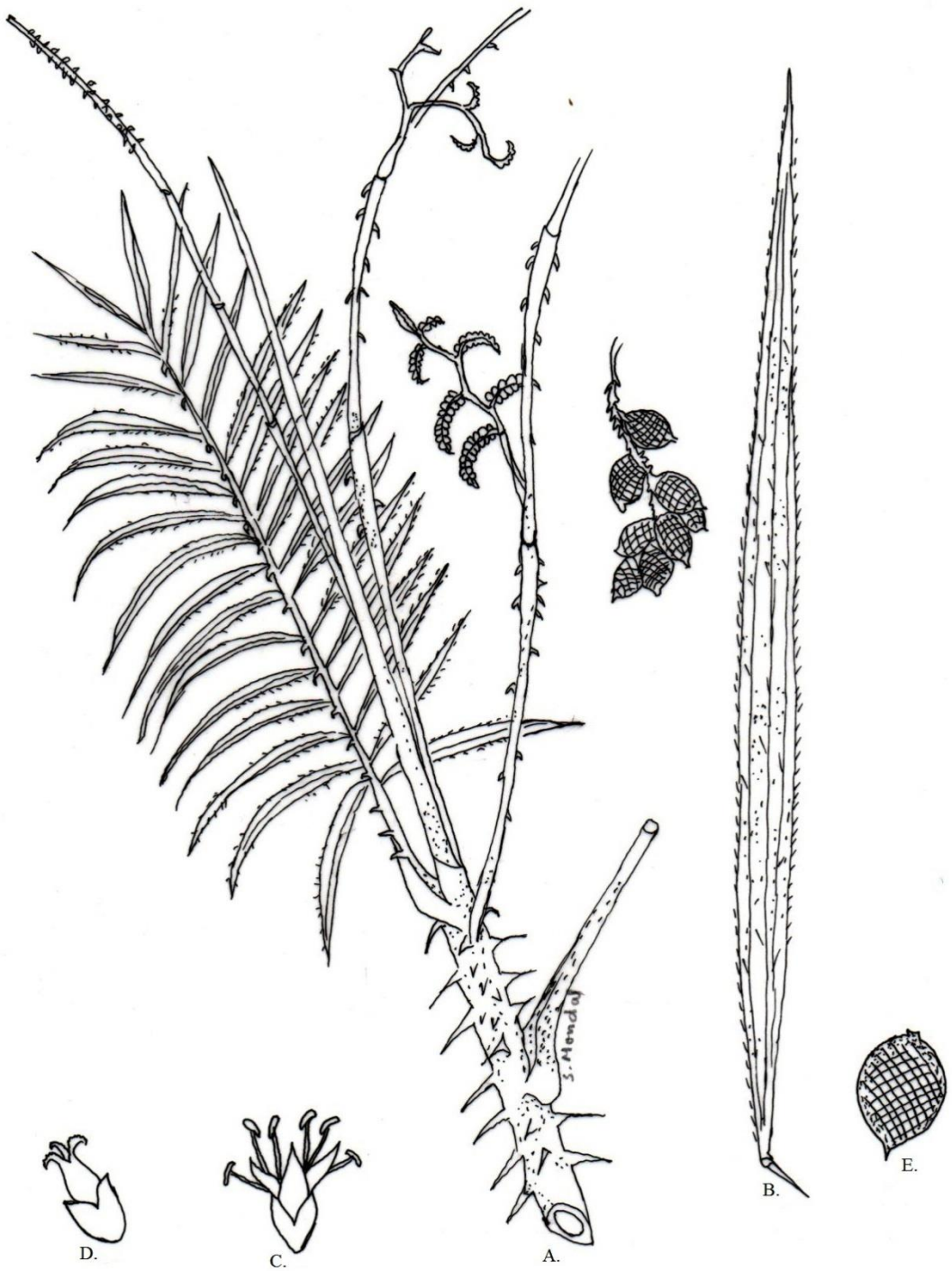

Fig. 37: *Calamus tenuis* Roxb. **A.** Portion of stem with leafsheath **B.** Silgle leaflet **C.** Male flower **D.** Female flower **E.** Mature fruit

Calamus viminalis Willd., Sp. Pl. 2: 203. 1799. *Calamus viminalis* var. *fasciculatus* (Griff) Becc. in Hook. *f*., Fl. Brit. Ind. 6: 444. 1892; Becc., Ann. Roy. Bot. Gard. Cal. 11: 206. 1908. *Calamus fasciculatus* Roxb., Fl. Ind. ed. 3: 779. 1832. *Calamus litoralis* Bl., Rumphia 3: 43. 1847. *Calamus pseudorotang* Mart. *ex* Kunth, Enum. Pl. 3: 207. 1841. *Rotang viminalis* (Willd.) Baill., Hist. Pl. 13: 299. 1895; Prain, Beng. Pl. 2: 1098. 1903; Basu, Rattans in Ind. Monogr. Rev. 117. 1992. ***'Boro Bet, Hasali Bet, Kiring Bet, Korak Bet, Korkoira Bet, Phekri Bet, and Baghi Bet'*** [Fig. 38 & 45B]

A thicket clustering, medium- diameter climbers. Stem 15–18 m long and with sheath 3–4 cm in diameter, without sheath 1.3–1.8 cm diameter. Leaves ecirrate, 1–1.5m long, leaf sheath green, distinct knee with long flagellum, stem and sheath covered with white powder, armed with spine, spines 1.5–2.5 cm long, leaflets lanceolate, attenuate at apices, 25–32 cm long, 2–3 cm broad at middle, fasciculate, distinctly grouped with 2–4 leaflets in each middle to upper part, nerves prominently bristly on upper side and veins, dry ocrea with no spines or bristle. Inflorescence flagelliform, partial inflorescence about 1.7–2 m long, each with 7–9 alternate rachillae, primary bract diagonally truncate at apex, spines 0.7 cm long, apiculate on outer side, male rachillae filiform, 17–22 cm long, female partial inflorescence alternate, zig zag rachillae, 22–26 cm long, involucrophorum sub discoid, involucre orbicular; female flowers 4.5–6 mm long, calyx 3 lobed; corolla as long as calyx. Fruit pea like, 8.5–10 mm in diameter, beak distinct, scale greenish to yellowish, channeled, arranged in 17–18 longitudinal series; seed globose, slightly compressed, 5.5–6.5 mm wide, endosperm homogeneous, eophyll digitate, leaflets 6 in number.

Flowering: November – December **Fruiting:** April – May

Status: Rare occurrence; Least Concern (Renuka 2011)

Distribution: India (Andhra Pradesh, Bihar, Orissa, West Bengal, Assam, Tripura, Mizoram,), Bangladesh, Myanmar, Thailand, Java; common in the forests of Duars and terai (Sukna forest) and lower Himalaya (250 – 1200 m) of West Bengal.

Ecology: Mostly grows as thickets in cleared forests.

Specimen examined: West Bengal, Darjeeling, Sukna range 20.01.2018 Mondal and Chowdhury, 1022 (Acc. No. 10182, NBU). *Other specimens:* Forest near Iranegedda, 18.5.1979, fr., Subba Rao 62464 (MH); Andra, 17.10.1986, male fl., Rao and

Narasimhan 84370 (CAL);Wrightmyo, South Andamans, 5.4.1988, Renuka 4054(KFRI);Wumberleygung, South Andamans, 6.4.1988,fr., Renuka 4061(KFRI); Mannarghat South Andamans, 7.4.1992, fr., Vijayakumaran 6630 (KFRI); Long Island, Andamans, 22.1.1959, fr., Thothathri 9115 (MH); Near Vedurupalli, Vishakapattnam, Andhra, 27.10.1972, fl., Subba Rao 42756 (MH).

Uses: It is the most used cane in India. The strong cane is used for various purposes, for making baskets, chair bottoms, and various other articles of local uses.

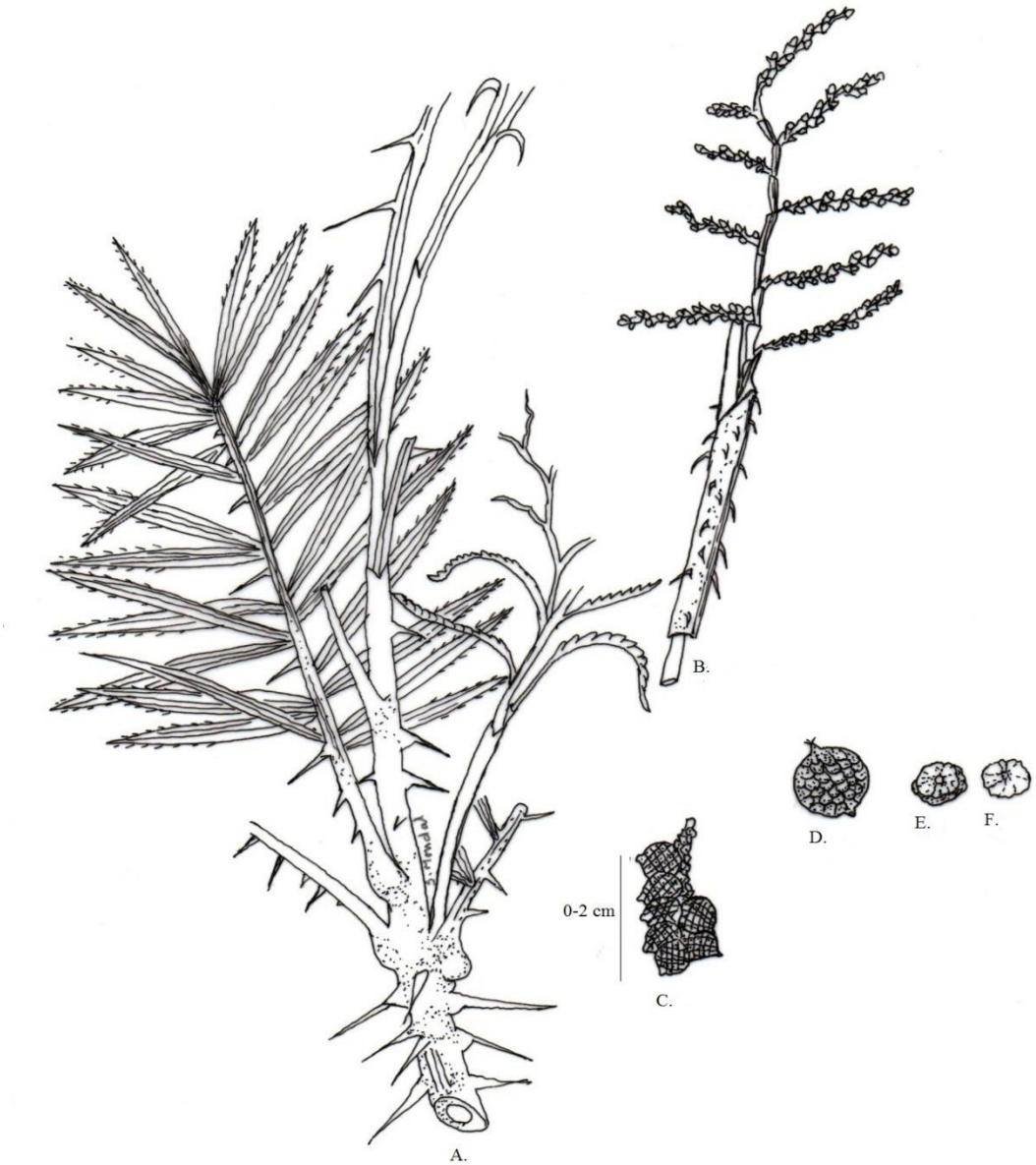

Fig. 38: *Calamus viminalis* Willd. **A.** Portion of stem with leaf and flagella **B.** Partial male inflorescence **C.** Fragment of inflorescence with fruit **D.** Mature fruit **E & F.** Seed

Fig. 39: A. *Salacca secunda* Griff. **B.** *Calamus tenuis* Roxb. **C.** *Calamus gracilis* Roxb.**D.** *Calamus tenuis* Roxb. habit **E.** *Plectocomia bractealis* Becc. **F.** *Plectocomia himalayana* Griff.

Tribe Calamae (Cirrate)

Calamus inermis T. Anders**.**, Journ. Linn. Soc. 21: 11. 1869; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 455. 1893; Becc., Ann. Roy. Bot. Gard. Cal. 11: 436. 1908; Basu, Rattans in Ind. Monogr. Rev. 53. 1992.

Apparently non-clump forming robust climbing canes. Stem cluster forming, 4.5–7 cm diameter with leaf sheath, unarmed; knee present, base with prominent wrinkles. Leaves cirrate, leaf blade excluding cirrus 1 – 3 m long, leaf sheath smooth to sparsely armed with spines on outer surface, leaflets linear lanceolate, numerous, in pairs on each side of the rachis, leaflets 55–65 cm long, 3–6 cm broad at middle, margins spinulose. Male inflorescence not seen; female inflorescence 1–1.5 m long, partial inflorescences without basal cushion, rachillae 7–12 cm long, inserted within the mouth of the respective basal bracts, fertile part of the rachillae sinuous, 6–12 flowers on both side. Fruit ellipsoid, 2–3.5 cm long, 1–6 cm wide at middle, scales in 17–18 rows, deeply channeled at middle.

Flowering: January – April **Fruiting:** May **–** October

Status: Rare occurrence

Distribution: India (West Bengal, Sikkim, Assam, Arunachal Pradesh) and Bhutan; common in the forests of terai and lowers hills of Darjeeling (Rongtong) and Kalimpong of West Bengal.

Ecology: This robust cane species is localized in the mixed forest and lower hill forests up to 800 m.

Specimen examined: West Bengal, Rongtong, 24.12.2017, Mondal & Chowdhury, 1025 (Acc. No. 5817, NBU). *Other specimens:* Sikkim: Rangeet, Oct. 1865 Kurz s.n. 494086-88(CAL); Sikkim Himalaya (300 – 600m) Anderson s.n (CAL).

Uses: A strong and hard cane used for several purposes. Used for making chair frames and used for police sticks.

Calamus khasianus Becc., Ann. Roy. Bot. Gard. Cal. 11: 431. 1908 & Appendix pl. 192. 1913; Basu, Rattan in Ind Monogr. Rev. 61. 1992. [Fig. 40]

Cluster forming, medium diameter rattans; with leafsheath 2 – 6 cm in diameter, stem covered with large broad based spines and intermingled with small spines. Leaves ecirrate, 5 – 6 m long, leaf sheath with prominent knee, lower part conspicuously armed with flattened, subulate spines, spines 1–1.5 cm long, rachis sub-terete at lower part, armed below with series of paired or solitary hooks; leaf lets numerous, lanceolate, in groups of 2–6 leaflets on both side of the rachis with long vacant spaces in between the groups, 50–55 × 5–6 cm broad at middle, 3–6 nerved, nerves mostly smooth on both sides of the leaf. Female inflorescence 1.5–3 m long, partial inflorescences arching from the axis with distinct cushion at the point of attachment with the axis, rachillae sinuous, 22cm long, 10–16 female flowers on each side. Fruit globose, 2–3.5 × 2–3 cm in diameter, fruiting perianth cylindrical, scales in 16–18 rows, deeply channeled at middle; seed globose, centrally pitted, endosperm ruminate, embryo basal.

Flowering: November – Deceember **Fruiting:** April – May

Status: Rare occurrence; Near Threatened (Renuka 2011)

Distribution: India (West Bengal, Assam and Meghalaya) and Bhutan; less common in road side bushes and forests of duars areas (Birpara to Jaldapara Wildlife Sanctuary and Buxa forest) of West Bengal.

Specimen examined: West Bengal, Alipurduar, Buxa 29.04.2018 Mondal and Chowdhury, 1028 (Acc. No. 10180, NBU). *Other specimens:* Rangeet, Sikkim, Oct 1865 Kurz s.n. (CAL Acc. No. 494086-88); Sikkim Himalayana (300-600 m) Anderson s.n. (CAL); William Nagar, Meghalaya, 2.5.1994, Renuka and Vijayakumaran 7077 (KFRI).

Uses: Very strong cane, used in handicraft and furniture industry for making chair bottoms and frame works.

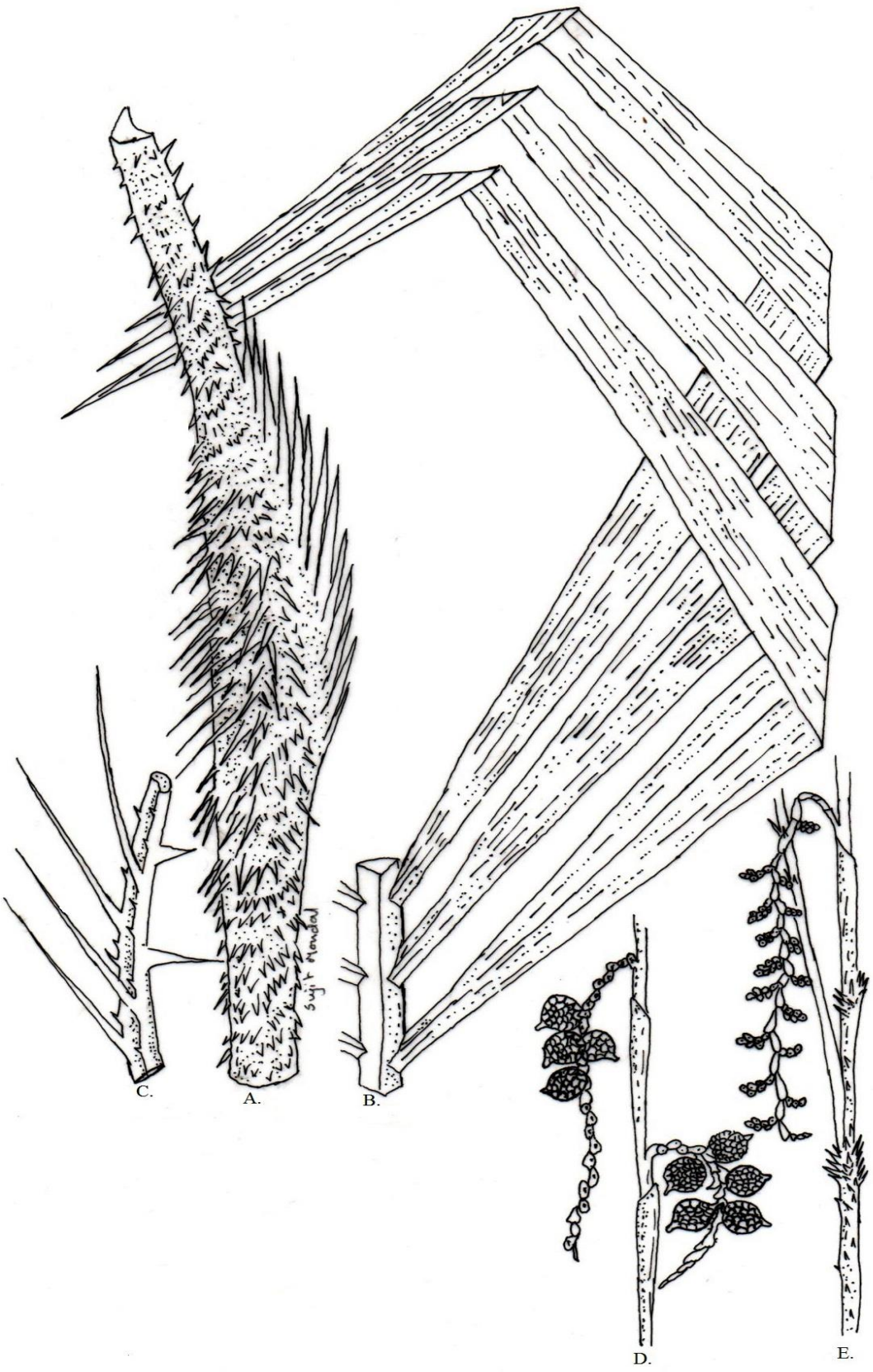

Fig. 40: *Calamus khasianus* Becc. **A.** Stem with sheath **B.** Leaflets **C.** Petiole with spines **D.** Female inflorescence **E.** Male inflorescence

Calamus kingianus Becc., Ann. Roy. Bot. Gard. Cal. 11: 107. 1908 & Appendix Pl. 53. 1913; Basu, Rattan in Ind. Monogr. Rev. 119. 1992.

Cluster forming rattans; stem with leafsheath 08–14 mm in diameter. Leaves cirrate, 60–75 cm long; flagellum long, knee distinct, armed out side with closely short, straight spines; ocrea with blakish hairy, caduceus; petiole about 14–18 cm long; lower leaflets alternate, paired, middle leaflets opposite, distantly disposed, 18–26 cm long, 2.5–3.5 cm wide at middle, 5 nerved; uppermost leaflets digitate; terminal leaflets joined at the base. Male inflorescence simply branched, primary bract tubular closely sheathing, elongate, flattened on both sides, armed with straight spines intermingled with short hooks; partial inflorescence with long terminal rachillae, 3–6 pendulous rachillae on each side below, rachillae 3–9 cm long, male flowers acute, ovate, 4–5 mm long, 18–24 in number on both side of the rachilla; calyx cylindrical with 3 roughly triangular acute lobes; corolla twice longer than calyx; female inflorescence branched, partial inflorescence delicate, spines scattered on the tubular primary bracts, rachillae 8–12 in number, alternate. Fruits globose, 0.8–1 cm in diameter, scales greenish with deep brown margins, channeled at middle.

Status: Rare occurrence

Distribution: India (Assam and West Bengal); rare in forests of duars (Khoirabari range, Alipurduar) and Lower hills of Darjeeling and Kalimpong hills (upto 500m) of West Bengal.

Habitat: This thin-stemmed bushy cane prefers to grow prostrate on moist alluvium or evergreen forest upto 500m.

Uses: The rattan is very thin and delicate so has no commercial value. Fruit pulp is used by local people for food.

Specimen Examined: West Bengal, Alipurduar, Khoirabari range, 12.02.2017, Mondal and Chowdhury, 1052 (Acc. No. 10689, NBU). *Other specimens:* Lailad, Umling range, Meghalaya, 25.4.1994, female fl., Renuka and Vijayakumaran 7075 (KFRI); Naja hills, Manipur, Collected during the government demarcation survey 1881-1882, Watt 7459 (CAL); South Guwahati, Assam, 8.12.1993, female fl., Vijayakumaran 7081 (KFRI).

Calamus latifolius Roxb., Fl. Ind. 3: 775. 1832; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 445.1892; Becc., Ann. Roy. Bot. Gard. Cal. 11: 406. 1908; Appendix Pl. 171. 1913; *Palmijuncus latifolius* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 732. 1891. *Calamus humilis* Roxb., Fl. Ind. ed. 3: 773. 1832. *Calamus inermis* (T. Anders.) Kuntze, Revis. Gen. Pl. 2: 732. 1891. *Calamus macracanthus* T. Ander., J. Linn. Soc., Bot. 11: 10. 1869. *Palmijuncus macracanthus* (T. Anders.) Kuntze, Revis. Gen. Pl. 2: 733. 1891; Prain, Beng. Pl. 2: 1099. 1903; Basu, Rattan in Ind. Monogr. Rev. 65. 1992. ***'Korak Bet, Horna Bet'***

Moderately robust climbers, more than 50 m in length; stem cluster forming, with leaf sheath about 3–4.5 cm in diameter, without leaf sheath 2.5–3.5 cm in diameter, leaf sheath yellowish green, pubescent with brown hairs, densely covered with flat, stout, spines; knee prominent, unarmed. Leaves cirrate, 2–4 m long, armed with subulate, sub regularly verticillate, dark brown, 1.5–3 cm long spines, ocrea liguliform; rachis terete in cross secion, without claws on the ventral side, armed only with small spicules, papery, leaflets not many, in equidistant on rachis, elliptic lanceolate, or broadly lanceolate slightly, 45–50 cm long, 7–11cm wide at broadest part, 5–9 nerved. Male inflorescence simply decompounds, 150–180 cm long, 6–8 in number on a single plant, partial inflorescence twice branched, rachillae 3–5 cm long, with 7–12 male flowers on each side, male flowers 4–6 mm long, ovoid in bud; calyx striated, divided up to the middle to form 3 acute lobes; female inflorescence simply decompound, rigid, not very diffused, each 55–95 cm long, partial inflorescences 4 in number, each 45–22 cm long, with 3–6 rachillae on each side, caudiform at their apices, rachillae inserted just at the mouth of the respective basal bracts, each 5–7 cm long, sinuous with 6–10 flowers on each side, involucrophorum enclosed in its bracts, copular, involucres concealed in the involucrophorum, visible only by the two projecting teeth on the side of neuter flower; female flowers 4–5 mm long, calyx finely striated, deeply divided into broad, semi ovate, acute lobes; corolla lobes narrower than calyx lobes. Fruiting perianth not distinctly pedicelliform, fruit globose, 1–seeded, brown to blakish, to 1.7 cm in diameter, scales flattened, not prominently channeled at middle; seed globose, blackish, roughly pitted.

Flowering: July– August **Fruiting:** September – November

Status: Rare occurrence

Distribution: India (West Bengal, Assam, Sikkim, Arunachal Pradesh, Meghalaya, Nagaland), Bangladesh, Bhutan, Myanmar; less common in forests of duars and lower hills of Darjeeling and Kalimpong distrcts (upto 1000m) of West Bengal.

Ecology: A component of moist lower hill forests up to 1000 m mostly near the fresh water swamps.

Specimen examined: West Bengal, Darjeeling, Rongtong, 20.08.2016, Mondal and Chowdhury, 1026 (Acc. No. 10179, NBU). *Other specimens:* Narpooh Reserve, Assam, 21.7.1957, fr., Deka 101117 (CAL); Triap, Arunachal Pradesh, 1.9.1958, Panigrahi 15027 (CAL); Jorain, Assam, 23.7.1957, Deka 10150 (CAL); Dhonpur, Buxa Tiger Reserve Forest, North Bengal, 5.12.1993, Vijayakumaran 7059 (KFRI); Jorain, Assam, 23.7.1957, deka, 10150 (CAL); 200-400 ft. Hook. *f.* & Thomson, 494083 (CAL).

Uses: Cane is moderately strong and used for making rough baskets, walking sticks and cane furniture frames. This is one of the most commercially exploited canes from NE India and North Bengal. Its population in the wild is already depleted and supply of raw semi processed cane to the traders. (Information received from a supplier and consumer of Siliguri, West Bengal.)

Calamus nambariensis Becc., Ann. Roy. Bot. Gard. Cal. 11: 433.1908 & Appendix Pl. 193, 194. 1913. *Calamus nambariensis* var. *clpinus* S. J. Pei & S. Y. Chen, Acta Phytotax. Sin. 27: 141. 1989. *Calamus nambariensis* var. *fufuraceus* S. J. Pei & S.Y.Chen, Acta Phytotax. Sin. 27: 142.1989. Basu, Rattan in Ind. Monogr. Rev. 56. 1992; Mondal & Chowdhury, Ad. Plant Sci. 31 (2):159. 2018. [Fig. 45A]

Robust, climbing rattans; stem cluster forming, up to 20 m long, with leaf sheath 3–5 cm in diameter, dull green in colour. Leaves cirrate, 2–3 cm long, leaf sheath with prominant knee, armed with broadly subulate spines, yellow-green with dull redish tips, small ocrea has no spines or bristles; petiole about 25–30 cm long, flattened, armed at margins with 1–4 cm long, subulate spines; leaflets ensiform, lanceolate, remotely sub equidistant, 40 – 50 cm long, 2–4 cm broad at middle, usually 4–5 nerved, more or less smooth. Male inflorescence simply decompounds; partial inflorescence alternate, with 2–5 cm long rachillae; each with distinct cushion at the base, arching above, male flowers 2–3 mm long, 12–16 male flowers on each side of the rachillae; female

rachillae sinuous, incurved about 5–12 cm long, attached at the mouth of the basal bract. Fruit whitish to yellowish brown, globose to ovoid or ellipsoid, stalked, 2.8 cm in diameter, scales in 20–21 rows, fruiting perianth pedicelliform**.**

Flowering: February – April **Fruiting:** May – June

Status: Less common; Critically Endangered (IUCN *3.1*)

Distribution: India (West Bengal, Assam, Arunachal Pradesh), Nepal, Bhutan, Bangladesh, Myanmer, China, Vietnam and Thailand; less common in forests of terai (Bengduri forest), duars (Dalgaon forest, Alipurduar) and lower hills of Darjeeling and Kalimpong districts (upto 500m) of West Bengal.

Specimen examined: West Bengal, Dalgaon range, Alipurduar 20.02.2017 Mondal and Chowdhury, 1027 (Acc. No. 10183, NBU). *Other specimens:* Kamlao, Manmao Division, Arunachal Pradesh, 9.06.1989, Renuka 6607 (KFRI).

Uses: Cane is strong, and exported from Assam to other states for making furniture frames. It has attractive reddish brown colour. Excessive extraction over the last one or two decades coupled with poor natural regeneration has made this species one of the most endangered taxa of this region.

Genus: ***Daemonorops*** Bl.

Daemonorops Bl. in Schultes *f*. & J.H Schultes, Syst. Veg. 7:1333. 1830. Becc. in Hook. *f*., Fl. Brit. Ind. 6:642. 1893; in Ann. Roy. Bot. Gard. Cal. 12: 25. 1911.

High climbing rattans, pleonanthic, dioecious, rarely hapaxanthic. Stem cluster forming, with long internodes. Leaves cirrate, leafsheaths densely armed, spines scattered, 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 mostly bristly. Male and female inflorescence 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; flower branches usually compact, ramify upto the fourth order to form rachillae. Male flowers solitary in each bract, calyx 3, copular, dentate; corolla longer than calyx, lobes 3; stamens 6. Female flowers larger than male, each with a sterile

male flower, calyx 3, truncate, dentate; corolla twice longer than calyx with 3 distinct thicker petals; staminodes 6, connate, copular with 3 rudimentary anthers. Fruit ovoid or ellipsoid, distinctly beaked, covered with raflexed scales; seed with deeply ruminate endosperm.

Distribution: India, Myanmer, China, Malaysia, Indonesia, Laos, Vietnam, Cambodia, Brunei, Philippines. About 115 species in World; 5 species in India; two species recorded from West Bengal (Mondal and Chowdhuy 2018).

Key to the species

1. Cirrus upto 5 m long; stem without sheath 2–3 cm diameter; female rachillae 6–10 cm long, 6–7 in number on each side; fruit 5–5.5 mm long ……*D. jenkinsiana*

2. Cirrus upto 3 m long; stem without sheath up to 8–10.4 cm diameter; female rachillae 6–9 mm long, 2–3 in number on each side; fruit 4–5 mm long……*D. teraiensis*

Daemonorops jenkinsiana (Griff.) Mart., Hist. Nat. Palm. 3: 327. 1850; Becc., Hook. *f*., Fl. Brit. Ind. 6: 462. 1893; Becc., Ann. Roy. Bot. Gard. Cal. 12: 1911. Pl. 1. Part II. 1911. *Calamus jenkinsianus* Griff., Cal. J. Nat. Hist. 5: 81. 145. *Daemonorops nutantiflora* (Griff.) Mart., Hist. Nat. Palm. 3: 326. 1853. *Daemonorops pierreana* Becc., Rec. Bot. Surv. Ind. 2: 220. 1902*;* Prain, Beng. Pl. 2: 1099. 1903; Basu, Rattan in Ind. Monogr. Rev. 40. 1992. ***'Golak Bet, Golla Bet, Cheka Bet, Dudhia Bet, Dangri Bet'*** [Fig. 41, 42]

High climbing rattans; leaf sheath with stem 4–5 cm in diameter, without sheath 2–3 cm diameter internodes 16–20 cm long, striate. Leaves cirrate, leaf blade excluding cirrus 3–5m long, leaf sheath yellowish to greenish, covered with brown scurf, armed with thin, flattened, brown to blackish needle-like spines in series or scattered; knee distinct; petiole 14–20 cm long, scurfy, channeled above, convex bellow, armed below with strong digitate claws straight spines at margins; leaflets ensiform, alternate to sub-opposite, 45–55 cm long. Inflorescence cymbiform, subaxillary or not more broadly fusiform, after opening inserted above mouth of their sheaths, peduncle 4 – 8 cm long, outer bract tapering into a long beak, reddish to reddish brown, densely scurfy flower branches at base. Male flowers oblong, 4 × 3.5 mm, calyx cupular, hairy, corolla 3,

oblanceolate, stamens 6, anthers subulate, connate, thickened at base; female rachillae 6–10 cm long, sinuous, female flowers 5–7 on each side, each 6–6.5 mm long, calyx cupular, truncate, ovary globose to ovoid, stigmas 3, papillose inside. Fruit globose, ftuit 5–5.5 mm long, 1.7 cm in diameter, scales yellowish brown with; seed globose, 9 mm in diameter, endosperms ruminate.

Flowering: July – September **Fruiting:** December – May

Status: Less common; Near Threatened (Renuka 2011)

Distribution: India (West Bengal, Sikkim, Assam, Meghalaya, Arunachal Pradesh, Manipur), Bangladesh, China, Thailand, Vietnam; common in the forests of terai (Bangdubi, Gulma forests), duars and lower hills of Darjeeling and Kalimpong (upto 700m) of Northern West Bengal.

Ecology: In the eastern Himalaya it is common in the mixed forest up to 700m. *Daemonorops jenkinsianus* grows in evergreen forests and scrub jungle at 100 m – 700 m along streams.

Specimen examined: West Bengal, Darjeeling, Bangdubi forest 12.01.2018 Mondal and Chowdhury, 1029 (Acc. No. 10198, NBU); West Bengal, Darjeeling, 12.04.2017 Mondal and Chowdhury, 1063 (Acc. No. 09873, NBU). *Other specimens:* Chirang Reserve Forest, Near Hultagoan, 22.4.1957, Rolla Seshagiri Rao 7124 (CAL); Nambur forest, Assam, feb. 1906, fr., Meebold 10861 (CAL); Danaur, Assam, 8.4.1914, fl.,Upendranath Kanjilal 3765 (CAL); Rikshabari Block, kurzeong West Bengal, 1.12.1993, fr., Vijayakumarn 7052(KFRI); Lower toridu Range , Lataguri, North Bengal, 3.12.93, Vijayakumarn 7055(KFRI); Taliamara Division, Ambassa, Tripura 19.4.94, fr., Renuka, Vijayakumarn and Mohandas 7065 (KFRI); Lailad umling range, Meghalaya, 25.4.94, Renuka and Vijayakumarn 7072 (KFRI); Chekoparra, 2.2.1879, fl., Gamble 6659 A (MH).

Uses: It is one of the most useful rattan species utilized as raw material for making furnitures and handicrafts. The tender shoots of *Daemonorops jenkinsiana* are used as vegetable and fruits were eaten by wild elephants.

Fig. 41: A. Habit of *Daemonorops jenkinsiana* (Griff.) Mart. **B.** Fruiting stage **C & G.** Spine ornamentation **D & F.** Spine of rachis **E & H.** Spine ornamentation on spadix length.

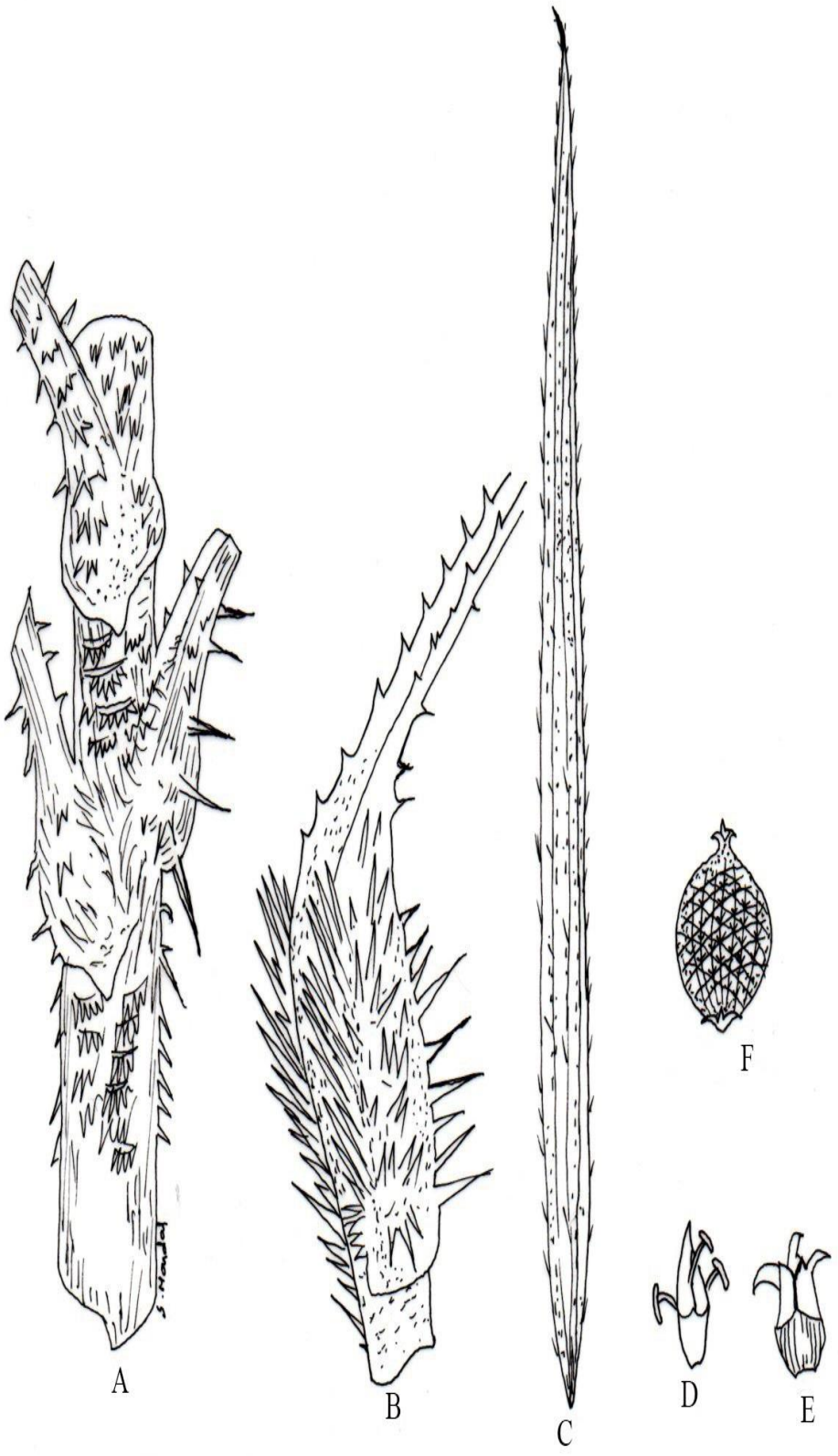

Fig. 42: *Daemonorops jenkinsiana* (Griff.) Mart. **A.** Portion of leafsheath **B.** Single leafsheath **C.** Single leaflet **D.** Male flower **E.** Female flower **F.** Fruit

Daemonorops teraiensis Sujit Mondal & M. Chowdhury, Pl. Archives 19(2): 758–761. 2019. '***Kanra bet (Nepali)'*** [Fig. 43, 44]

Climbing rattans, 6–8 m tall; stem erect, internodes 10–12cm long; with sheath 8–12cm in diameter, without sheath up to 10.4 cm in diameter, sheath tubular, 16–26 cm long, covered with dense, light brown with flat, papery spines, 0.8–4.2cm long, base conical. Leaves cirrate; leaf excluding cirrus 1.85–2.43m long, cirrus 1–1.19 m long; knee conspicuous, covered with dense brown scurf, spines except both longitudinal side, spines flattened, deep brown to blackish spines in series or scattered, petiole 8.5–13 cm long, 2–2.8 cm broad at middle, scurfy outside, flat to slightly convex above, 5–6 rows of dense spines on abaxial and adaxial surface, margin without spines; rachis with strong digitate dense spines on adaxial surface and claw shaped on abaxial surface, spines at concave side 2–8 mm and convex side 2–18 mm long, ocrea conspicuous, scarcely developed, tightly sheathing, mouth with fine short rusty bristles, up to 3.4 cm long, rachis 1.90–2.14 m long; leaflets 72–80 on each side of rachis, equidistant, alternate to sub opposite, 18–24 × 48–52 cm long, apical leaflets 0.6–1 × 1.8–2.2 cm, 3 nerved, each with fine bristles, bristles 0.4–1.2cm long, bristles on both surfaces on mid-veins, sparsely spinous on lower edges, spine 4–6, hook shaped, joined at the base, 4 – 9 mm. Inflorescence subaxillary not very broadly fusiform or inserted above the mouth of their sheaths, not very broadly fusiform after opening, male flowers oblong, 2 × 5 mm; calyx cupular, with yellow powdery dust, corolla 3, oblanceolate, 3–4 × 1–2 mm; stamens 6, 2–3 mm long, subulate, connate and thickened at base; female flowers 2–3 on each side, 4–5 mm long, calyx cupular, 2–3 mm long, truncate, corolla distinctly veined, petals lanceolate, deeply divided each 3.5–4.5 × 1–2 mm, ovary ovoid to globose, stigmas 3. Fruits globose, 1.8 cm in diameter. Seeds 2–3 mm long.

Flowering: March – May **Fruiting:** April – June

Status: Endemic to West Bengal and Endangered (Mondal & Chowdhury 2019)

Distribution: India (West Bengal); common in Bangdubi forests of terai, West Bengal; endemic to West Bengal.

Habitat: Sub–tropical forest in the Terai of Darjeeling, West Bengal, India.

Uses: Local tribal people eat the tender shoots and use dried leaf as fuel. Fruits are favorite food of wild elephants.

Specimen examined: India, West Bengal, Darjeeling district, Dalkajhar forest at terai of Darjeeling, 01.05.2018, S. Mondal & M. Chowdhury, 1030 (Acc. No. 0070, NBU).

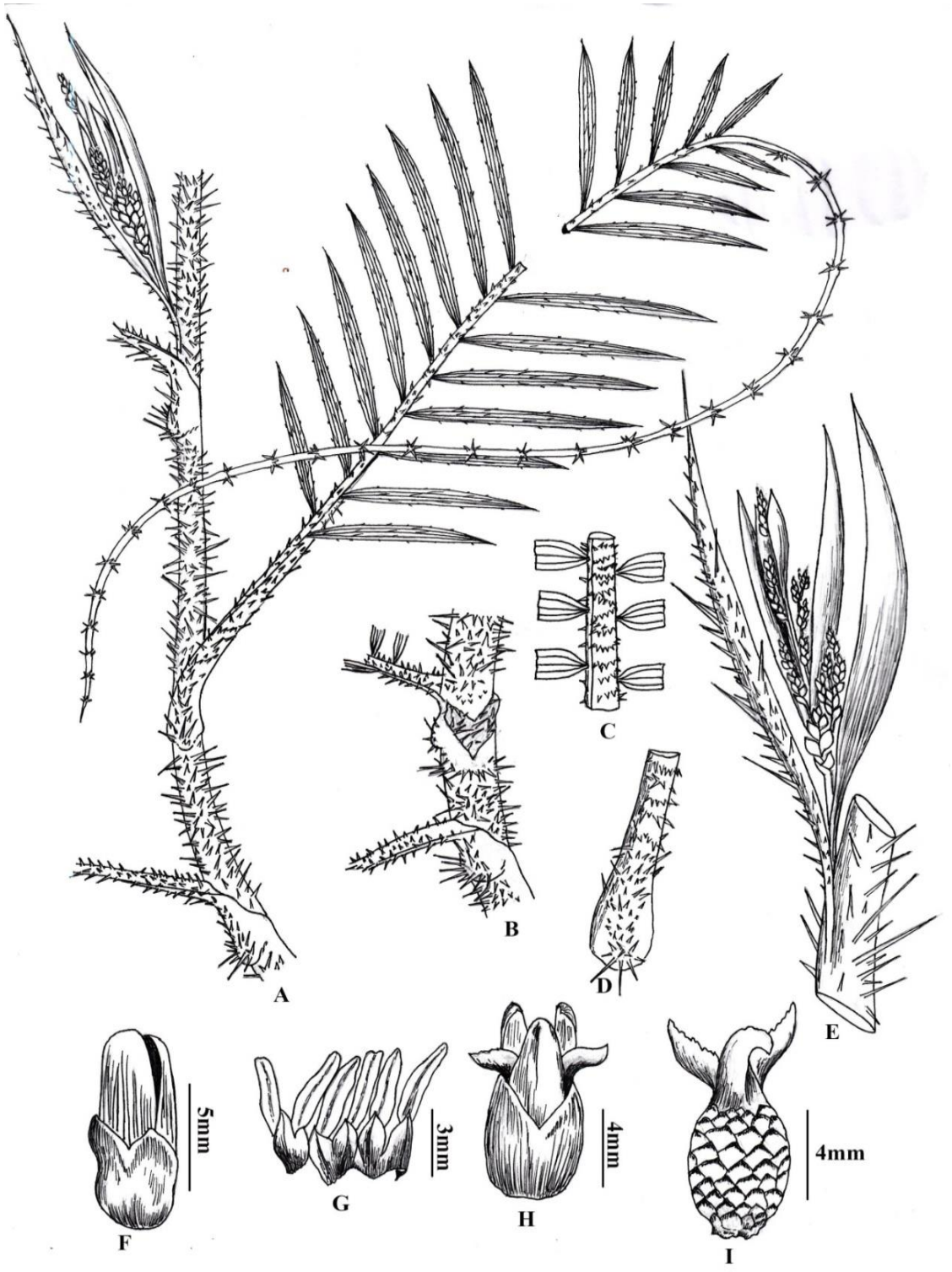

Fig. 43: *Daemonorops teraiensis* Sujit Mondal & M. Chowdhury; **A & B.** Habit sketch **C.** Armature on adaxial surface of petiole & rachis **D.** Armature on abaxial surface of petiole & rachis **E.** Inflorescence **F.** Male flower **G.** Anther **H.** Female flower **I.** Fruit © *Papiya Saha*

Fig. 44: *Daemonorops teraiensis* Sujit Mondal & M. Chowdhury **A & B.** Habit, **C.** Armature of abaxial surface of petiole & rachis **D.** Armature of abaxial surface of petiole & rachis **E.** Shapes of male spadix **F.** Shapes of female spadix **G.** Male flower **H.** Female flower **I.** Fruit.

Fig. 45: A. *Calamus nambariensis* Becc. **B.** *Calamus viminalis* Willd. **C.** *Daemonorops jenkinsiana* (Griff.) Mart. **D.** *Calamus guruba* (Buch.–Ham.) *ex* Mart. **E.** *Calamus leptospadix* Griff. **F.** *Calamus acanthospathus* Griff. **G.** *Calamus floribundus* Griff. **H.** *Plectocomia himalayana* Griff.

Genus: *Salacca* Reinwardt

Salacca Reinwardt in Hornschuch, Syll. Pl. Nov. 2: 3. 1825.

Almost stemless caespitose, spinupus, dioecious rattans. Leaves pinnate, ecirrate, leaflets linear, lanceolate, sigmoid, falcately acuminate, usually 3-nerved, rachis with long spines. Inflorescence interfoliar, both staminate inflorescence and pistillate inflorescence dissimilar, bracts membrane like, mostly lacerated; male inflorescence bearsing catkins like rachillae, male flowers oblong or ovate, bracteoles hairy or wooly, calyx deeply 3 partite, corolla longer than calyx, stamens 6, filaments short, Subulate; female inflorescence less branched, female rachillae with pistillate and neuter flower in each dyad, female flowers ovoid, calyx membrane like, 3 partite, corolla leathery, slightly longer than calyx, with a cup like base and 3 valvate segments, staminodes 6, overy distinctly 3 celled, ovoid. Fruit mostly globose, 1 – 3 seeded, covered with reversed scales with tuft points.

Distribution: About 7 species distributed from India, Myanmer, Thailand, Malaysia, Philippines and Indonesia; 3 species found in India; among them one species found in West Bengal.

Salacca secunda Griff., Cal. J. Nat. Hist. 5: 12. 1845; Fuetado in Gard., J. Singapore 12: 378. 1949; Basu and Chakraverty, Manu. Cult. Palms in Ind. 80. 1994. [Fig. 39A]

Acculecent, busy rattans. Leaves pinnate 8–10 m long, petiole coverd with dense, rusty indumentums, leaflets alternate, groups of 2–4 on each side of the rachis on lower part; upper part of the rachis unarmed, trigonous, straight, lanceolate, distinctly 3 nerved, bristly spinous on upper nerves; middle leaflets 70–95 cm long, 4–7 cm broad; lower leaflets very short, narrow. Male inflorescence with a robust axis, bracts and prophyll covered with rusty indumentums, acuminate, lanceolate, primary branches very long, each bearing rachillae, rachilla coming out from the opening of fertile bract, each 5–9 cm long, 12–16 mm diameter, flowers 6–8 mm long, exerted from the bracts, calyx deeply 3 lobed, corolla little longer than calyx, divided into 3 segments, stamens 6, anthers linear oblong. Fruit obovoid, 3–4 cm in diameter, pericarp thin, scales dark brown, 5–11 mm long, 2–4 mm broad at base.

Flowering: March – April **Fruiting:** August – September

Status: Rare occurrence

Distribution: India (West Bengal, Assam and Arunachal Pradesh), Myanmer, Thailand, Malaysia to Indonesia; less common in the forests of duars (Dalgaon forest) of Northern West Bengal.

Specimen Examined: West Bengal, Birpara, Dalgaon range 20.08.2016 Mondal and Chowdhury, 1035 (Acc. No. 10690, NBU).

Plectocomia Mart. *ex* J. H. Schultes & Schultes *f*., Syst. Veg. 7(2): 1333. 1830; Hook. *f.* in Benth. & Hook. *f*., Gen. Pl. 3: 934. 1883; Becc., Ann. Roy. Bot. Gard. Cal. 12(2): 26. 1918; Dransfield, Man. Rat. Mal. Pen. 55. 1979; Basu, Rattan in Ind. Monogr. Rev. 29. 1992.

High climbing, hapaxanthic, dioecious rattans. Leaves cirrate, leafsheath without flagellum, leaflets arranged in groups on both sides of the rachis. Inflorescence in the axils, uppermost reduced to leaves, primary axis of inflorescence subtends pendulous flower branches, bracts in s, boat- shaped, non tubular, overlapping, coriaceous; in male flower calyx 3, cupular, dentate, , corolla divided into 3 distinct valvate petals, stamens 6, filaments connate at base, pistillode small; female flowers 7–10 in each bract, corolla 3, much longer than calys, acuminate. Fruit globose, 2–4 seeded, beaked, thin, erect with fleshy coat, endosperm homogeneous.

Distribution: About 16 species distributed from India, Thailand, China, Myanmer, Malaysia, Indonesia and Philippines. India represented with 3 sprecies; all three were recored from West Bengal.

Key to the species

1a. Leaflets green above, white below, acute or acuminate; bracts densely tomentose outside……2

1b. Leaflets green on both sides, apiculate; bracts finely tomentose outside…….*P. himalayana*

2a. Female flowers shortly pedicellate; bracteoles 4–5 mm long ……*P. assamica*

2b. Female flowers conspicuously pedicellate; bracteoles 10-15 mm long……*P. bractealis*

Plectocomia assamica Griff., Cal. J. Nat. Hist. 5: 97. 1845; Becc. in Hook. *f.*, Fl. Brit. Ind. 6: 479. 1893; Griff., Palm Brit. E. Ind. 107, Pl. 218 a.1850; Mart., Hist. Nat. Palm. 3, 199, Pl. 176 f. 11. 1853; Becc., Ann. Roy. Bot. Gard. Cal. 12(2): 38. 1918. Basu, Rattan in Ind. Monogr. Rev. 32. 1992.

Cluster forming rattans. Stem with leaf sheath 3.5–4 cm in diameter. Leaves cirrate, 1.7–2.5 m long; leaflets 30–75 × 6–7.5 cm broad at middle, nurved, petiole absent, rachis 3–5 cm broad, armed bellow. Inflorescence 1–2 m long, male flowers sessile, trigonous, 6–8 mm long, calyx smaller than petals, lanceolate, acuminate, stamen with bulbus filaments, anther linear, 4.5 mm long; female flower branches about 2 m long, thickly tomentum, bracts distichous, each cuneate, oblong with triangular tips, 6–8 × 2.6–3 cm, female flowers 4–8 in number in each bract, shortly pedicilate, bracteolate, 3–5 mm long, corolla with 3 concave acuminate petals, ovary globose, stigma sessile, trigonous. Fruits globose, slightly beaked, densely villous out side, 3.5 cm in diameter; seed globose, 1.6 cm in diameter.

Flowering: March – May **Fruiting:** June – September

Status: Rare occurrence; Vulnerable (Renuka 2011)

Distribution: India (West Bengal, Sikkim, Assam, Arunachal Pradesh); found in Darjeeling beside Darjeeling Zoo, West Bengal; endemic to Eastern Himalaya (up to 2250 m).

Ecology: A component of the moist hilly forest up to 1800 m.

Specimen examined: West Bengal, Darjeeling 20.08.2016 Mondal and Chowdhury, 1031 (Acc. No. 10201, NBU). *Other specimens:* S. Coll. M. H. Acc. No. 72650, March 1891(MH); Mamit, Mizoram, Sreekumar 24206 (KFRI).

Uses: The tribal people of the forests use longs canes for making high hanging bridges over small mountain streams and rivulets. Tender shoot is used as vegetable and available in hilly market.

Plectocomia bractealis Becc., Ann Roy. Gard. Cal. 12 (2): 22. 1818; Madulid, Kalikasan 10: 84. 1981; Basu, Rattan in Ind. Monogr. Rev 35. 1992. [Fig. 39E]

High climbing canes, hapaxanthic, dioecious. Leaves cirrate, 1–2 m long, leaflets 5 nurved, 25–65 cm x 4–7cm, whitish and scurfy below, non filamentous at apices, petiole absent in mature leaves, with marginal spines strong, smaller seriate spines on dorsal side, rachis 3–6 cm broad, armed bellow with single row. Inflorescence in the axils of the uppermost reduced leaves, primary axis of inflorescence subtends, with pendulous flower branches, female inflorescence 8–8.5 × 3 cm covered with indumentums; female flowers 5 in each bracts, pedicillate, bracteoles 7–16 mm long, acuminate, tomentose out side; calyx 3, triangular, elongate, acuminate, 11–14 mm long, each striated and puberulous outside, petals 3, lanceolate, broad based, acuminate, 1.2–1.9 cm long, outside of the ovary coarsely wooly, wools arise from the scales, style very short, conical, trigonous with sepals larger than subulate stigams, staminodes with narrowly sagittate aterile anthers. Fruits globose, slightly beaked, densely villous out side, 3.5 cm in diameter; seeds globose, 1.6 cm in diameter.

Distribution: India **(**West Bengal and Assam); less common only recorded on the way of Garidhura to Kurseong, Darjeeling up to 1650 m.

Status: Rare occurrence

Specimen examined: West Bengal, Darjeeling, 20.08.2016 Mondal and Chowdhury, 1032 (Acc. No. 10175, NBU). *Other specimen:* CAL. Masters s.n. CAL Acc. No. 495006.

Plectocomia himalayana Griff., Cal. Journ. Nat. Hist. 5:100. 1845; Becc. in Hook. *f.* Fl. Brit. Ind. 6: 478. 1893. & Ann. Roy. Bot. Gard. Cal. 12(2): 36. 1918; Basu, Rattans in Ind. Monogr. Rev. 32. 1992. *Plectocomia Montana* Griff. *ex* T. Anders., J. Linn. Soc. Bor. 11: 12. 1869. *Plectocomia Montana* Hook. *f.* & Thomson, Fl. Brit. Ind. 6: 478. 1893. *nom. Inval*. [Fig. 39F & 45H]

Cluster forming, medium diameter rattans. Stem with leaf sheath 3–4 cm in diameter. Leaves cirrate, 1.8–2.5 cm long, leaflets linear to lanceolate, 35–40×2–3.7 cm, acuminate, tip filiform, margins with spinescent teeth, petiole unarmed or margin spiny, rachis scurfy, hooked. Inflorescence with 1.5–2m long, primary flower branches pendulous, primary bracts tubular, obliquely truncate, appendages triangular on one side, base tomentose, flower branches 75–85 cm long, sinuous, slender, bracts alternate, acute to acuminate, triangular oblong, 3–6 cm long, 4.5 cm broad, bracteoles in male

rechillate subulate, male flower trigonous, sessile 6–8 mm long, petals much longer than calyx, acuminate, lanceolate, stamens with subulate filaments, anther broadly linear, 3–4 mm long, with 4 rudimentary papillate; female flowers 9–8 in each bract, biseriate, 7–9 mm long, calyx shortly cupular, with 3 long acuminate teeth, petals 3, concave, acuminate, ovary globose, stigma sessile, trigonous. Fruits 1.4 cm in diameter, not woody, scales arranged in longitudinal series with papillose margins, tips obtuse, depressed; seeds orbicular, 1–2 cm in diameter.

Flowering: March – May **Fruiting:** June – August

Status: Rare; Endangered (Renuka 2011)

Distribution: India (West Bengal**,** Arunachal Pradesh and Sikkim); common in temperate forests of Darjeeling beside the Zoological park of Darjeeling (alt.1500 – 2500 m), West Bengal.

Ecology: A dominant cane species in the middle and upper hill forests of Darjeeling Himalayas.

Specimen examined: West Bengal, Darjeeling 20.08.2016 Mondal and Chowdhury, 1033, 1064 (Acc. No. 09863, 09854 NBU). *Other specimens:* Darjeeling, Acc. 52763, Gamble 3312 B (MH); Loobah lake, 10.11.1912, fl., Upendranath Kanjilal 4699 (CAL).

Uses: Cane is soft therefore unsuitable for making furniture. Used by the local people for tying fences and making baskets used for tea plucking. Tender shoot is used as vegetable.

Sub family: Nypoideae

Genus: Nypa Steck

Nypa Steck, Sagu: 15. 1757; Tomlinson, Bot. Mangroves 295. 1986; Blatt., Palms Palms Brit. Ind. 553, 1926; Uhl & Dransfi., Genera palmarum 285. 1987; Sinha, Fl. Great Nicobar Isl. 463. 1999; Pie et al., Fl. China 23: 143. 2010. Basu & Chakraverty, Manu. Cult. Palm in Ind. 91. 1994.

Colonial, unarmed, pleonanthic, monoecious palms. Stem stout, subterranean, dorsally flattened, dichotomously branched, leafscar curved, internodes compressed. Leaves few, very large, erect, paripinnate; sheath soon splitting, glabrous, petiole long, stout, wide basally, elongate; leaflets numerous, single fold, reduplicate, sub-opposite to opposite, acute, coriaceous, midrib prominent, shining. Inflorescence interfoliar, solitary, erect, branched 4–6 orders, protogynous, prophyll tubular, 2– keeled, bract peduncular, rachis bracts tubular, inflated, subtending 6–10 branches, pedincle erect, rachis shorter than peduncle, distally with an aggregated head of pistillate flowers erect, terminateing in catking like rachillae of staminate flowers overhanging the pistillate head; staminate flowers solitary, sessile, sepals 3, distinct, narrow, oblanceolate, petals 3, distinct, slightly imbricate, stamen 3, anther elongate, extrose, pistillode lacking. Fruit in aggregated globose head, partially developed, compressed and irregularly angled, stigamatic remains terminal, pyramidal, epicarp smooth, mesocarp fibrous, endocarp thick with interwoven fibres, perianth not persistent. Seed broadly ovoid, grooved adaxially, endosperm homogeneous or rarely ruminate, with a central hollow; embryo basal.

Distribution: The genus contains only one species; *Nypa fruticans* distributed from Sri Lanka through SE Asia to Japan, Pacific islands and Australia.

Nypa fruticans Wurmb., Verh. Batav. Genootsch., Kunsten 1: 349. 1779. *Nipa fruticans* (Wurmb) Thumb., Kongl. Vetensk. Acad. Nya. Handl. 3: 231.1782; K.L. von Bl., illustration in Rumphia 2: pls 164, 165.1847; Mart., Hist. Nat. Palm. 3: 305, Pl. 208. 1850; Beec. & Hook. *f*., Fl. Brit. Ind. 6: 424. 1892; Parkinson, Forest Fl. Anda. Isl. 464. 1999; Basu & Chakraverty, Manu. Cult. Palms in Ind. 92. 1994. *Cocos nypa* Lour., Fl. Coch. 567. 1790. *Nypa litoralis* Blanco, Fl. Filip.: 662. 1837; Prain, Beng. Pl. 2: 1096. 1903. *Nypa arborescens* Wurmb *ex* H. Wendl., O.C.E.de Kerchove de Denterghem, palmiers 252. 1878; Mondal, Basu & Chowdhury, Phytotaxo.17: 39. 2017. ***'Gol Pata'*** [Fig. 46]

Stem mostly subterrenian. Leaves pinnate, 5–8 m long, erect, uppermost part arching, petiole terete, smooth with long sheathing leafbase, rachis 3.5 m long, leaflets 35–40 in pair, linear, alternate, reduplicate, midnerve prominent on lower side, paired scales at intervals, upper surface glossy green, lower surface pale green. Inflorescence interfoliar, bisexual, 70–80 cm long, primary axis covered under sheathing bracts,

prophyll peduncular, rachis bracts variously adnate with the axis, upper part free, bright yellow when fresh with light green strips on outer side, primary flower branches 4, distichously arranged, axillary branches bear 1–10 finger like staminate spikes, terminal axis ends in a head of pistillate flowers, subtended by subulate bracts, perianths in series, oblanceolate, 2–3 mm long, outer segments obtuse or rounded, inner slightly prolonged into blunt points, stamens 3, fused into a column, 3 mm long, anthers basifixed; female flowers terminal, perianth 6, vestigial, scale-like, staminoids absent, carpel 3, greatly enlarged, each carpel has a terminal small slit, ovule solitary, erect, style large, slightly angular. Fruits crowed in a globose mass, 8–12 cm in diameter, 2–6 angled, ovoid to obcordate, epicarp smooth, mesocarp spongy, fibrus. Seed 1–2 cm long.

Flowering: September – November **Fruiting:** May – June

Status: Rare occurrence; Least Concern (IUCN *ver 3.1*)

Distribution: Indomalaysia, India (estuarine mangrove forest of West Bengal, Andaman Nicobar Islands), Bangladesh, Philippines and Australia; common in the estuarine mangrove forests of Sundarban of West Bengal.

Specimen examined: West Bengal, South 24 Parganas, Jharkhali, 12.06.2015 Mondal and Chowdhury, 1036 (Acc. No. 10200, NBU); W.B, South 24 Parganas, 12.03.2064 Mondal and Chowdhury, 1065 (Acc. No. 09874, NBU); W.B, South 24 parganas, Bonicamp, 12.08.2074 Mondal and Chowdhury, 1066 (Acc. No. 009875, NBU). *Other specimens:* Car Nicobar, 7.4.93, Renuka and Vijayakumaran 7038(KFRI); Homfray gunj, South Andamans,14.4.1964,fl.,Ellis and Ramamurthy 18795(MH); Campel bay,Great Nicobar, 9. 3. 1966, female fl., Thothathri & Banerjee 11421(CAL).

Uses: Leaves are used as thatch. A well developed inflorescence yields huge quantity of sugary sap from the peduncle.

Note: In India it is naturally occurring in Sunderbans and Andaman Islands, rarely cultivated as ornamental palms. A good healthy colony of this palm is seen in the Governer's House in Calcutta and the garden of the Theosophical Society at Adyar, Chennai.

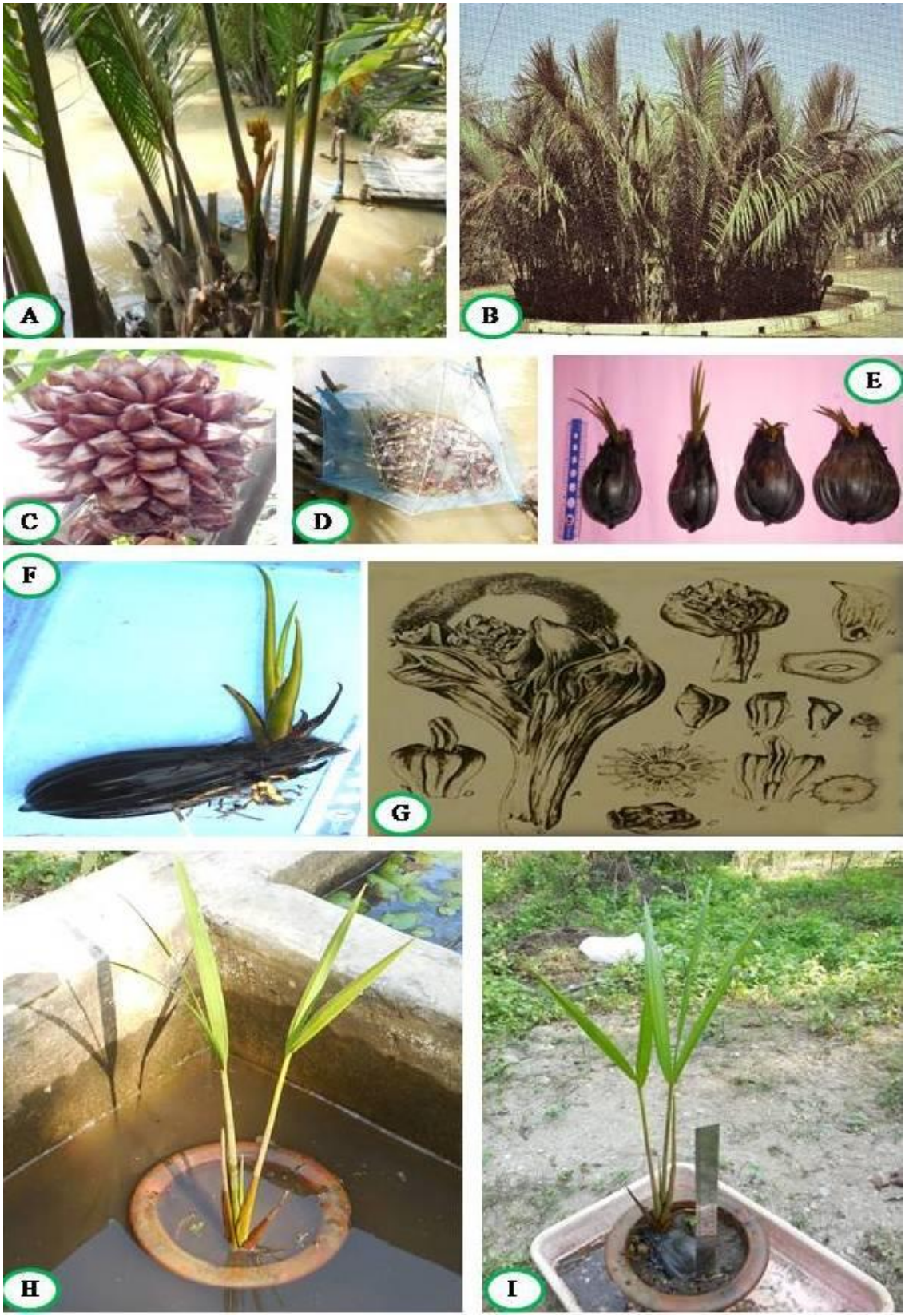

Fig. 46: A. *Nypa fruticans* in Sundarban Biosphere Reserve **B.** At Theosophical Society's Garden at Adyar in Chennai ©*Dr. S. K. Basu* **C.** Mature seeds **D.** germination technique of seeds **E & F.** Seedlings **G.** Illustration of Male and Female inflorescence ©*Dr. S. K. Basu* **H & I.** Young *Nypa* palm at North Bengal University

Sub family: Arecoideae

Key to the Tribes

1a. Inflorescence hapaxanthic or pleonanthic, monoecious, rarely dioecious, mostly with prophyll and many peduncular bracts; leaves pinnate or bi-pinnate, induplicate……..Caryoteae

1b. Inflorescence androgynous or unisexual with a prophyll and large peduncle bracts; leaves pinnate or pinnately ribbed, reduplicate. …… …… 2

2a. Fruits with bony endocarp, pores 3…… Cocoeae

2b. Fruits without bony endocarp or pores……Areceae

Tribe: Areceae

Slender to robust, acaulescent, creeping or erect, pleonanthic palms. Leaves pinnate or pinnately ribbed, reduplicate. Inflorescence bisexual, spicate or branched, prophyll usually large, bicarinate or small enclosed within leaf sheath, with large peduncular bract or with only prophyll, flowers almost always with imbricate sepals and petals. Fruits 1 – seeded, rarely 2 – seeded.

Key to the genera

1a. Female flowers larger than males, situated from base to middle of the rachillae; rachillae tip filiform; male flowers much smaller, at distal portion of rachilla .... ……...*Areca*

1b. Female flowers smaller than male flowers or equal in size of males and not restricted to the base portion of the rachilla; rachillae tip not filiform……...*Pinanga*

Genus: Areca L.

Areca L., Sp. Pl. 2: 1189. 1753; Gen. Pl. ed. 5: 495.1754; Becc. & Hook. *f.* in Hook., Fl. Brit. Ind. 6: 405. 1894; Blatter, J. Bomb. Nat. Hist. Soc. 24(2): 329. 1916; Benthall, Trees Cal. 457. 1946; Bailey, Man. Cult. Pl. 173.1966; Whitmore, Palms Mal. 33.1973.

Solitary or cluster forming, monoecious palms. Stem solitary erect, annulate, smooth, crownshaft distinct. Leaves pinnate, sheath prominent, basal, leaflets often joined. Inflorescence interfoliar, monoecious, decompounds, prophyll solitary, prophyll large, green, bicarinate, leathery to papery, caduceus, covering growing inflorescence, peduncular bract absent; male flowers minute, distal on the filiform ultimate flowers branches (rachilla), stamens 3 – 6; female flowers at basal portion of the annulate flower branches (rachilla) larger than males, ovary 1- loculed. Fruits ovoid, oblong or ellipsoid, mesocarp fibrous; seed with thin endocarp, endosperm deeply ruminate.

Distribution: Indo-Malaysia, Asia, Philippines, Oceania, Australia. 48 species in the World; 3 species wild and semi wild in India; two wild species and 4 ornamental species (exotic) recorded from West Bengal.

Key to the species

1a. Stem solitary, straight, tall; stamens 6; fruits 6 cm long, orange ……. *A. catechu*

1b. Stem cluster forming, rarely solitary; stamens 3; fruits 2.5 cm long, red...……*A. triandra*

Areca catechu L., Sp. Pl. 2: 1189. 1753; Mart., Hist. Nat. Palm. 3: 169, t. 102. 1823-1853; Griff., Cal. J. Nat. Hist. 5: 153. 1845 & Palms Brit. Ind. 47. 1850; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 405. 1893; Prain. Beng. Pl. 2: 1097. 1903; Perkinson, Forest Fl. Anda. Isl. 264. 1923; Fischer in Gamble, Fl. Pres. Madras 1555. 1931; Sinha., Fl. Great Nicobar Isl. 460. 1999; Basu &, Chakraverty, Manu. Cult. Palms in Ind. 125. 1994. *Areca faufel* Greatn., fruct. Sem. Pl. 1: 19. 1788. *Areca hortensis* Lour., Fl. Cochinch. 568. 1790. ***'Supari, Gua Supari'*** [Fig. 47]

Stem solitary, erect, unbranched about 10–22 m long, 14–20 cm in diameter near base. Leaves pinnate, erect to arching, 7–12 open leaves, petioled short, pinnae linear, 1 m long, closely packed, stiff, deflecting above the midrib. Inflorescence infrafoliar, opens after detachment of a single large, green bicarnate prophyll, flower branches light green to deep green, rachillae filiform, flower clusters filling into depression of the rachillae, male flowers numerous, sessile, without bract, calyx 1–leaved, small, corolla 3-parted, oblong, rigid striated, lemon yellow, mostly in pairs and closely packed at the distal part of the rachillae, faintly odorous at anthesis; female flowers much larger than males,

mostly proximal, tiny male flowers on two sides of the female flowers, highly deciduous, without bracts, sepals permanent, staminoids 6, connate, stigmas 3, short, triangular. Ripe fruits ovoid, monolocular, one seeded berry, 4 × 3 cm, mesocarp highly fibrous; seed globose to sub globose, 1.4–2 cm in diameter, endosperm deeply ruminate.

Flowering: June – August **Fruiting:** September – December / throughout the year

Status: Abundant and frequent; Least Concern (IUCN *3.1*)

Distribution: West Indies, Africa, India (West Bengal and NE India), Bangladesh, China, Philippines, Thailand, Vietnam, Malaysia, Indonesia, Cambodia, New Guinea; quite common mainly cultivated in plains and lowers hills of West Bengal.

Ecology: *Areca catechu* thrives in areas of high rainfall and tolerant to moderate elevation on mountains, Altitude mainly to 1000 m and soil must be deep to ensure a well developed root system.

Specimen examined: West Bengal, Darjeeling 12.08.2016, Mondal and Chowdhury, 1045 (Acc. No. 10184, NBU). *Other specimens:* Aickad, quilon, 21.2.1973, Mohanan 61173 (MH); Near Neyyar Dam, Thiruvananthapuram, 16.4.19973, fl., Joseph 44179 (MH); Bavani River side, Mukkali, Palghat, 9.3.1975, fl., Vajravelu 6250 (MH); Sirunellistae, Palghat, 9.3.1975, fr., Vajravelu 48848 (MH): Kallar, Nilgiri, Madras, 23.2.1963, fl., Vivekanandan 15693 (MH).

Uses: The hard seed is largely chewed as masticator along with betel leaf (Pan), catechu (Khoir), and lime (Chun). The Khasi tribals of NE India, consumed fermented endosperm of the nut along with Betel leaf and lime. Extract from Arecanut is used for treatment of leucoderma, leprosy, cough and cold, against worms, anemia and obesity (Bavappa et.al. 1982).

Note: The main city of Assam is Guwahati and the name is derived from the word *'Gua'* means Arecanut or *Areca catechu.*

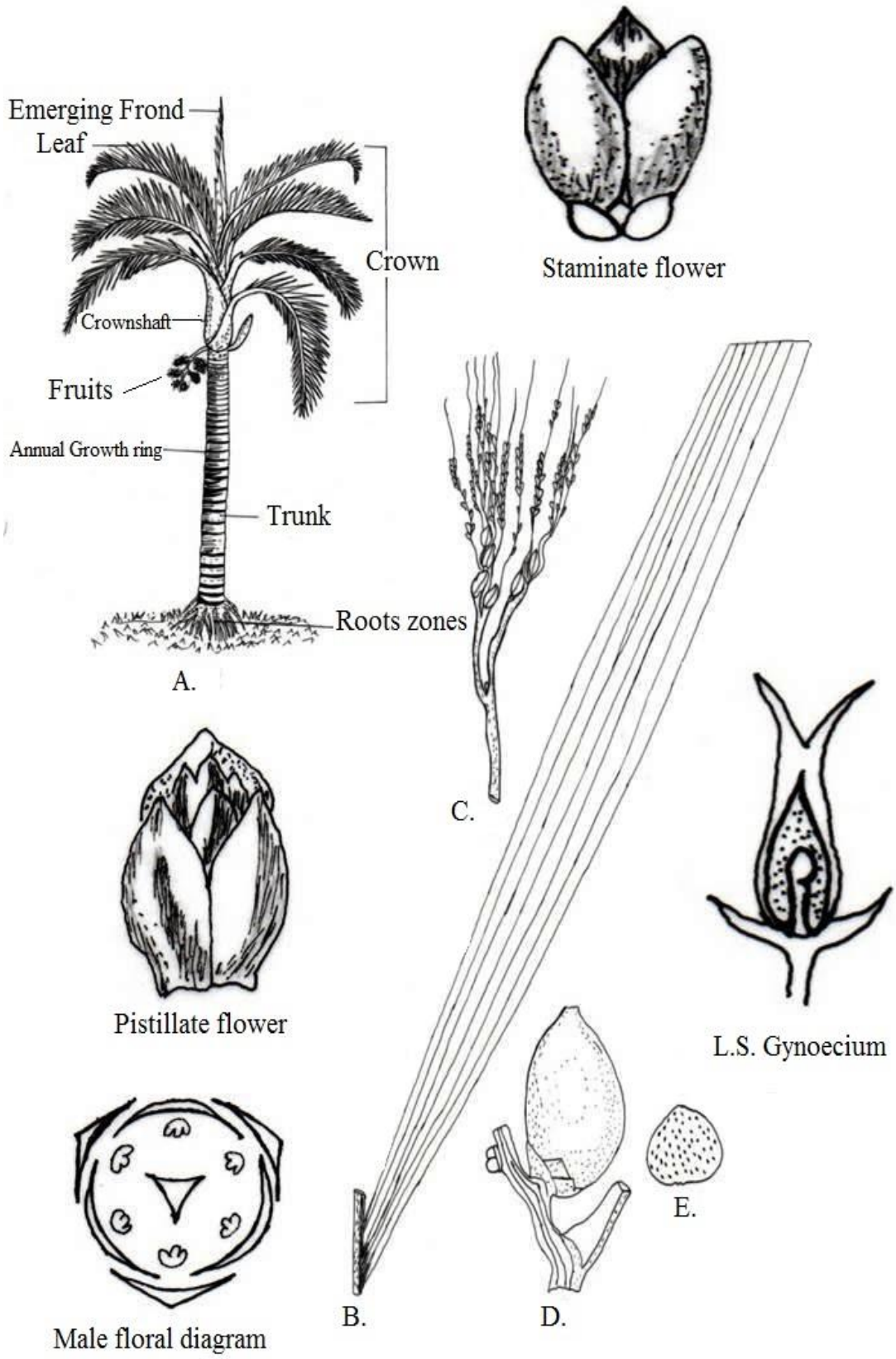

Fig. 47: A. *Areca catechu* L. **B.** Portion of leaf **C.** Young Inflorescence **D.** Mature fruit **E.** Mature seed

Areca triandra Roxb. *ex* Buch.-Ham., Mem.Wern. Nat. Hist. Soc. 5: 310. 1826; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 405. 1892; Prain, Beng. Pl. 2: 1086. 1906; Parkinson, Forest Fl. Anda. Isl. 264. 1923; Basu & Chakraverty, Manu. Cult. Palms in Ind., 127. 1994. *Areca laxa* Buch.- Ham., Mem. Wern. Nat. Hist. Soc. 5(2): 309.1826. *Ptychosperma polystachyum* Miq., Fl. Ned. Ind., Eerste bijv. 590. 1861. *Areca triandra* var. *bancana* Scheff., Natuurk. Tijdschr. Ned.-Indie 32: 165.1873. *Areca borneensis* Becc., Malesia 1: 22. 1877. Prain. Beng. Pl. 2: 1097.1903. *Areca humilis* Blanco *ex* H. Wendl., O.C.E.de Kerchove de Denterghem, Palmiers: 231. 1878. ***'Bon Gua, Triandra palm'*** [Fig. 48]

Cluster forming, dwarf to bushy palms; stems slender, erect to slightly bent, 4 m long, 2–4.5 cm in diameter near base. Leaves pinnate, arching, light green, 2–3 m long, leaflets or leaf segments sub opposite, alternate, linear ensiform, acuminate, broad at base, 0.2–1 m long, 3.5–5 cm wide, acuminate, prominently nerved on upper side, terminal leaflets broad, deeply partite, each lobe truncate with bidentate margins. Inflorescence infrafoliar, 35–40 cm long when unopened, prophyll pale green, leathery, bicarinate, caduceus, flower branches pale yellow to whitish, lemon scented, peduncle short, compressed, flower branches in one to three orders, ultimate flower branches (rachillae) filiform, male flowers in pairs, minute, numerous, creamy white in colour odorous at anthesis, highly caduceus, sepals 3, minute, ovate, unequal, petals 3, oblong, obtuse, valvate, stamens 3, filaments short, connate at base, female flowers larger than males, proximal, sepals 3, deep green, more or less circular in outline, imbricate, petals imbricate or rarely twisted, staminodes 6, conspicuous, ovary one loculed, one ovuled, stigma with unequal lobes. Fruits eliipsoid bullet shaped, 2.5–3 cm long, beak prominent, orange-red when ripe; seed with ruminate endosperm.

Flowering: February – June **Fruiting:** September – November

Status: Rare occurrence; near threatened (IUCN *ver. 2019-1*)

Distribution: India (West Bengal, Assam, Meghalaya, Mozoram), Bangladesh, Myanmar, China, Malaysia, Cambodia, Thailand; less common in Jalpaiguri district and Siliguri of West Bengal.

Ecology: This species grow luxuriantly in moist shady condition. Leaves get desiccated if exposed to strong sun.

Specimen examined: West Bengal, Jalpaiguri 22. 06. 2016 Mondal and Chowdhury, 1046 (Acc. No. 6503, NBU); West Bengal, Siliguri, North Bengal University Campus 06. 03. 2017 Mondal and Chowdhury, 1067 (Acc. No. 6504, NBU). *Other specimens:* Habdaypur, S. Andamans, 9.4.1892, Dr. King's collector, Acc. No. 72642 (MH); Junglebar, Portblair, 3.5.1964, Ellis & Ramamurty 19004 (MH); Assam, S. Coll. M. H. Acc. No. 52640 (MH); Wright myo, South Andamans, 13.1.1959, Thothathri 9064 (MH); Indonesia, 07.04.1965, K.V.Bavappa and C.A.R.S Vittal 40525 (ASSAM).

Uses: The tender shoot is edible and has been used as a fodder for buffaloes. Some local people use leaves for thatching and the stem as posts. Nuts are chewed like areca nut. This species is also grown as ornamental plant in the gardens. A versatile palm, that form dense clump of slender, pale green stems. The deep green pinnate leaves are very ornamental, tropical in its appearance and are easy to cultivate in any site around the garden where shade and water is available.

Fig. 48: *Areca triandra* Roxb. *ex* Buch.-Ham. **A.** Mature plant **B.** Herbarium specimen **C.** Fertile plant **D.** Wild habit **E & F.** Mature fruit **G.** Mature seeds **H.** section of seed with cotyledons

Genus: Pinanga Bl.

Pinanga Bl. Rumphia 2: 76. 1839; Becc. in Hook. *f*., Fl Brit. Ind. 6: 406. 1892; Basu & Chakraverty, Manu. Cult. Palms in Ind. 140. 1994; Sinha, Great Nicobar Isl. 464. 1999.

Small acualescent to erect, solitary or cluster forming, slender, pleonanthic, monoecious palms. Leaves pinnately ribbed or pinnate, without well developed crownshaft. Inflorescence infrafoliar, shortly pedunculate, prophyll elongate; peduncular bract absent, rachillae filiform to stout, flower clusters in triads, spiral, distichous or in 4 vertical rows, male flowers symmetric, obliquely 3 edged, sepals 3, petals 3; female flowers smaller than males. Fruit globose or ellipsoid to spindle shaped, seed globose, ellipsoid, endosperm deeply ruminate, homogeneous.

Distribution: *Pinanga* palms are typical undergrowth components of moist tropical forests in Asia (Native). Globally 120 species (Uhl and Dransfield, 1987) were recorded; six species found in India; in West Bengal 2 species were recorded.

Key to the Species

1a. Stem delicate, more or less acaulescent; inflorescence simple…….*P. gracilis*

2b. Stem erect; inflorescence subdigitately branched ……..*P. griffithii*

Pinanga gracilis Bl., Rumph. 2: 77. 1839; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 407. 1892; Noltie, Fl. Bhutan 3(1). 429. 1994. *Areca gracilis* Roxb., Fl. Ind. ed. 3: 619. 1832. *illeg*. *Seaforthia gracilis* (Bl.) Mart., Hist. Nat. Palm. 3: 185. 1838. *Nenga gracilis* (Bl.) Becc., Malesia 1: 25. 1877; Basu & Chakraverty, Manu. Cult. Palms in Ind. 42. 1994. ***'Himalayan Pinanga, Coulombe Palm'*** [Fig. 29E]

Cluster forming, slender stemmed, gregarious monoecious palms. Stem slender, reddish, 3.5–4.5 m long, 1–2 cm broad near middle, thickened upward. Leaves 1–2 m long, sparingly pinnate, petiole and leafsheath scurfy outside, leaflets broad at base, terminal ones bilobed, finely acuminate, prominently 3 nerved, 25–30 cm long or more, upper leaflets broader than middle leaflets, 14–16 cm long, 4–7 nerved, praemorsed at apices. Inflorescence with solitary basal prophyll, reflexed, simple, flower branches scarlet, 6–20 cm long, peduncle pubescent, male flowers in 3 rows, broad and flat, calyx minute, petals 3, cuspidately acuminate, 6mm × 4 mm; female flowers much smaller than males, spirally disposed, sepals and petals almost of same size and length. Fruiting branches pendulous, fruits ellipsoid to fusiform, scarlet or light, 8–10 mm long, about 6 mm broad at middle, tapering at stigmatic end.

Flowering: June – September **Fruiting:** October – January

Status: Rare occurrence; Endangered (Renuka 2011)

Distribution: India (West Bengal, Assam, Meghalaya, Arunachal Pradesh, Manipur and Nagaland), Nepal, Bhutan, Bangladesh and Myanmar; it is common in moist tropical forests of terai, duars and Darjeeling (Mirik) and Kalimpong Himalaya (upto 1000m), Darjeeling.

Ecology: These species grows in damp evergreen forests and in the moist lower hill forests.

Specimen examined: West Bengal, Mirik 22.06.2017 Mondal and Chowdhury, 1047 (Acc. No. 10195, NBU). *Other specimen:* Darjeeling, November 1879, fr., Gamble 7463 (MH).

Uses: Fruits are used as a substitute of betel nut. The Hilly tribes of West Bengal, Arunachal pradesh and Assam consume both fresh and dried nuts as substitute of areca nut.

Pinanga griffithii Becc., Malesia. 3: 117. 1886; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 407. 1892; Basu & Chakraverty Manu. Cult. Palms in Ind. 143. 1994. [Fig. 49E]

Cluster forming palms, stem 1.5–2.5 m long, distinctly annulate, 1.5–2 cm in diameter with dark brown spots on the outer surface, internodes 5–7 cm long. Leaves 1.5m long, leaflets irregularly placed on the rachis, base broad, 3–7 nerved, upper leaflets opposite, sub opposite, broad based, 3–5 nerved, sub falcate, 3–5 bidentate, 30–40 cm long, terminal leaflets bilobed, 7–8 costulate. Inflorescence infrafoliar, 30–38 cm long, peduncle 3–5 cm long, branches 3–6 in number, 25–32 cm long. Flower clusters spirally disposed, in male flowers calyx shorter than corolla. Ripe fruits reddish, disposed in four vertical rows, each broadly ellipsoid, tapering at base, mammilate, 0.8–1.2 cm long, 6–8 mm broad at middle, pericarp thin; endosperm deeply ruminate, embryo basal.

Flowering: March–May **Fruiting:** June – October

Distribution: India (West Bengal, Assam, Arunachal Pradesh, Meghalaya, Manipur, Nagaland, Myanmar); occur in the moist forests of lower hill valleys along the water courses of Darjeeling and Kalimpong districts of West Bengal.

Status: Rare**;** Vulnerable (Renuka 2011)

Ecology: Mainly gorws in moist hilly forest and riverine area along with water course.

Specimen examined: West Bengal, Darjeeling 22.06.2017 Mondal and Chowdhury, 1048 (Acc. No. 32015, NBU).

Uses: Mostly used as ornamental and indoor plants.

Tribe: Cocoeae

Slender to robust, acaulescent to erect, sometimes climber palms. Crownshaft absent. Leaves pinnate, pinnately ribbed, reduplicate. Inflorescence interfolier, mostly unisexual or bisexual. Fruit generally with hard endocarp, with 3- distincrt pores; seed with very oily endosperm.

Genus: *Cocos* L.

Cocos L., Sp. Pl. 2: 1188. 1753. *Calappa* Steck, Diss de Sagu 9. 1757. *Coccus* Miller, The Gardener's Dictionary A bridged from the Folio Edition 4. 1754.

Slender to robust, acaulescent to erect palms. Crownshaft absent. Leaves pinnate, pinnately ribbed, reduplicate. Petiole short to long, adaxillay glabrous, abaxially with abundant, dot like scales and very small ramenta along the midrib, midrib prominantt adaxially, transverse veinlets evident. Inflorescence solitary, interfolier, branched to 1 order,pprotandrous; peduncle elliptic in cross section, robust, elongate, bearing scattered scales; prophyll tubular, 2 keeled laterally, opening apically, becoming fibrous, tomentose, persistant, mostly unisexual or bisexual. Staminate flowers asymmetrical, narrowly ovoid, moderate, sessile; sepals 3, distinct, rather unequal, imbricate, triangular, keeled, petals much longer than sepals, thick ratherleathery, distinct, valvate, irregularly boat shaped. Pistiollate flowers very large, globose in bud, becoming very broadly ovoid at anthesis; sepals 3, distinct, imbricate, rounded; petals similar to and somewhat longer than the sepals, lacking valvate apices, very leathery; staminoidal ring low, membranous, not lobed; gynocium trilocular at the very base, triovulate, broadly ovoid, obscurely 3 angled, extremely fibrous distally, stigma 3, very short, borne in a single depression, ovule anotropous, very small, laterally attached. Fruit generally with hard endocarp, with 3- distincrt pores; seed with very oily endosperm.

Distribution: A genus with one species widely distributed in the all over the world.

Cocos nucifera L., Sp. Pl. 2: 1188. 1753; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 482. 1892; Menon & Pandalai, Coconut Monogr. 1958; Dalzell & Gibson, Bombay Fl. 279: 1861; Prain., Beng. Pl. 2: 1095. 1903. Fischer in Gamble, Fl. Press. Madras 3: 1557. 1931; Basu & Chakravarty, Manu. Cult. Palms in Ind. 112. 1994; Noltie, Fl. Bhutan 3(1). 430. 1994. *Palma cocos* Mill., Dict. ed. 8: 2. 1768., *nom. illeg. Cocos indica* Royle, III. Bot. Himal. Mts. 395. 1840. *Cocos nana* Griff., Nor. Pl. Asiat. 3: 166. 1851. ***'Coconut palm, Nariel, Narikel'*** [Fig. 49B, D]

Solitary, pinnate leaved, monoecious palms. Stem erect, inclined, curved, irregularly ringed, 30 m long. Leaves pinnate, terminal crown, 5–7 m long, arching, drooping, leaf sheath heavy, semi woody, petiole grooved on upper side with smooth margins, leaflets oblong lanceolate, pleated, 1 m long, about 200 pair per leaf, midnerve prominent on upper side. Inflorescence infrafoliar, peduncular bracts 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 basal ring. Fruit large to 25–30 cm long, 1 seeded with bony endocarp with 3 pore 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 homogenous fluid.

Flowering and Fruiting: Throughout the the year.

Distribution: Pantropical; grows mostly near the seacoasts; cultivated as plantation crop for economic exploitation. It is is a common cultivated palm in Assam and Tripura; commonly cultivated in costal and plains of West Bengal.

Ecology: Coconuts germinate readily in warm temperature and quite fast in their growth. Usually found at sea level (150 m). The optimum mean annual temperature is estimated at 27°C with average diurnal variation of 5–7°C.

Status: Very Common; Least Consern. (Renuka 2011)

Specimen examined: West Bengal, South 24 parganas, Canning 09.2.2015 Mondal and Chowdhury, 1049 (Acc. No. 10186, NBU). *Other specimens:* Rajan Bag, Satpati palgav Range, Maharashtra, 14.1.1968, Billore 113550 (CAL); Quilon Dist., 18.7.1979, fl., Mohanan 63178 (CAL); Agarthala, 30.9.14, P. M. Debbarman 121 (CAL); BSI Compound, Poona, 17.11.1960, fl., John Cherian 68210 (CAL).

Uses: White endosperm is delicious and nutritious, and eaten raw as whole some food. The dry endocarp is also known as copra. Oils are extracted by pressing of copra. The

rough fibres extracted from the husk of the fruit has many local used apart from its commercial uses. The strong mid nerve from the leaflets are separated and the sticks are collectively used as brooms and for making baskets. Leaves are durable and used as thatch by the villegers.

Fig. 49: A. *Corypha taliera* Roxb. **B.** *Cocos nucifera* L. **C.** *Corypha umbraculifera* L. **D.** Inflorescence of *Cocos nucifera* L. **E.** *Pinanga griffithii* Becc. **F.** *Caryota urens* L.

Tribe: Caryoteae

Key to the Genus

1a. Leaves bi-pinnate, inflorescence always solitary in each node, flowers strictly bisexual; fruits mostly globose, 1–2 seeded; endosperm ruminate…….*Caryota*

1b. Leaves 1 pinnate, inflorescence not always solitary in each node, unisexual or bi sexual; fruits not globose, 1–3 seeded, endosperm homogeneous..…… 2

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

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

Genus: Arenga Labill**.**

Arenga Labill., Bull. Sci. Soc. Philom. Paris 2: 162.1800, *nom. cons*; *Saquerus* Steck, Dissertation Inaugualis medica de Sagu 15. 1775. *Didymosperma* H. A. Wendland & Drude *ex* J. D. Hooker, genera plantarum 3:917; Basu & Chakraverty, Manu. Cult. Palms in Ind. 96. 1994.

Solitary or cluster forming palm, tall or bushy, monoecious, monocarpic, hapaxanthic, rarely pleonanthic. Leaves pinnate, leaflets induplicate, terminal leaflets jointed, base auriculate or cuneate. Inflorescence terminal or axillary with inconspicuous prophyll and many sheathing fibrous penduncular 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, petals 3, velvate, stamens numerous, female flowers with 3 imbricate sepals, 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: About 20 species distributed from India to SE Asia, New Guinea and Australia; in India the genus represented 4 species and among the 4 species only 1 species found in West Bengal.

Arenga micrantha C. F. Wei, Acta Phytotax. Sinica 26: 404. 1988; Noltie, Fl. Bhutan 3(1): 413. 1994; Pie et al., Fl. China 23: 152. 2010.

Hapaxanthic, dioecious, dwarf, solitary palms. Stem 2.1 m long, 13 cm in diameter. Leaf sheath fibre blakish brown. Leaves 3m long, pinnate, leaf blade 85–175 × 55–65 cm, rachis triangular in section, brown scurfy, petiole 40–60 cm, upper surface slightly concave, lower side strongly convex, terminal leaflets 22–5 × 3–17 cm, flabellate. Flowering basipetally, female inflorescence pseudo-terminal and lateral, branched to 1-order, primary axis of the terminal inflorescence 95 cm, stout, branches 35 cm, stout flattened at base, bracteoles minute, flowers 8–10 mm diameter, sepals swollen, coriaceous, free broadly oblong, margins dark brown, 3.2 × 5.5 mm, pale yellowish, broadly rhombic, sub acute, fused in lower half, strongly concave, immature ovaries orange, weekly hexagonal on out line, depressed with weak radial ridges, stigmas 3, dark brown, locules 3, ovule 1–2, basal; male inflorescence with a narrow peduncle, panicle narrow, 85–105 cm, branches in 2–6 rows, flowers 4–5.5 mm, oblong, sepals 2 × 2.5–3 mm broadly rounded, free, petals yellowish, oblanceolate or obovate, coriaceous, slightly un equal, stamens 9–23, filaments short, slightly connate at base, anthers 2.7–3.2 mm, narrowly oblong, acute.

Flowering: June – August **Fruiting:** not seen

Status: Rare occurrence; Endangered (Renuka 2011)

Distribution : India, Bhutan and China; in india it is mainly found in West Bengal, Sikkin, Arunachal Pradesh; rare in temperate climate at Darjeeling hills (1400m) of West Bengal .

Ecology: This species is common in warm temperate broad leaved forest between 600 – 1450 m, composed of evergreen and deciduous forest.

Uses: Leaves are used as thatch and making of brooms.

Genus: Caryota L.

Caryota L., Sp. Pl. 2: 1189. 1753; Brandis, For. Ll. 550. 1874; Alexander, Fl. Pl. Ind. 357. 1894; Becc. in Hook. *f*., Fl. Brit. Ind. 6: 422. 1894; Brindis, Ind. Trees 654. 1906; Cowen, Fl. Trees Shrubs Ind. 104. 1969; Moore, Jr. in Gentes Herbarium 11 (2): 132. 1973.

Monoecious, monocarpic or hapaxanthic palms. Stems with more or less elongate, internodes, obscured a first by persistent fibrous leaf bases and sheaths, usually becoming bare, conspicuously ringed with narrow leaf scars, striate. Leaves twice pinnate, induplicate, with fishtail like terminal leaflets. Inflorescence terminal and axillary develop in besipetal sequence. Inflorescence bisexual, solitary, produced in abasipetal sequence, interfoliar and some times infrafolier, usually branched to 1 order or rarely spicate, usually pendulous; peduncle circular in cross section, densly scaly; prophyll tubular at first, soon splitting, 2 – keeled. Staminate flowers usually elongate, symmetrical; sepals 3, distinct, imbricate; petals 3, valvate, connate at the base. Pistillate flower globular; sepals 3, coriaceous, rounded, imbricate, connate at the base; petals 3, valvate, staminodes 1–6; ovary rounded or somewhat 3 – angled, trilocular with 1–2 locules. Fruit globose, 1–2 seeded; endosperm ruminate, embryo lateral.

Distribution: Genus consists of 13 species; distributed from India throughout SE Asia and the West Pacific to Vanuatu. In India 4 species occur; 3 species distributed from sea level to hill region of West Bengal.

Key to the species

1a. Stem cluster forming, not robust; leaf sheath mostly persistent; inflorescence not large, flowering branches 60 ……..……...*C. mitis*

1b. Stem solitary, robust, distinctly annulate, more or less clean, inflorescence large, flowering branches 130 …….....2

2a. Terminal leaflets deeply incised, margins sharply toothed ……..*C. urens*

2b. Terminal leaflets not deeply incised, margins dentate ……*C. obtusa*

Caryota obtusa Griff., Cal. J. Nat. Hist. 5: 480. 1845 & Palms of Brit. East Ind. 170. 1850; Becc. & Hooker *f*., Fl. Brit. Ind. 6: 422. 1893; Brandis, Ind. Trees 654. 1906; Basu & Chakraverty, Manu. Cult. Palms in Ind. 103. 1994. *Caryota rumphiana* var. *indica* Becc., Malesia 1: 75. 1877. *Caryota obtusidentata* Griff., Palms Brit. E. Ind. t. 236A, B. 1850. *Caryota gigas* Hahn *ex* Hodel, Palm J. 139: 51. 1998. ***'Giant Fishtail Palm, Fishtail Palm, Thai Mountain Fishtail Palm'***

Single stemmed, water loving, moderately fast growing, forest emergent with hepaxanthic or monocarpic, robust, palm where the mode of the growth dies after setting seed. Stem solitary, massive, erect with distinct longitudinal fissures, 14–22 m tall, base 70–90 cm in diameter, light brown, superficial roots form a bole. Leaves crowded near the apex, 7 m long, 3 m wide, petiole and sheath scurfy, villos, rachis subtrigonous, punctuate, terminal leaflets of primary rachis to 55 cm long, pinnules deep green, flabelliform or narrowly cuneiform, upper part of pinnules some times half rhombic, truncate, irregularly dentate, 18–38 × 5–16 cm. Inflorescence 4–5 m long, peduncle densely furfuraceous, 30 cm long, spathes 7 in number, 30 – 90 cm long, semi woody, scurfy, villosus out side, glabrous within, spikes 65–90, 1.5–2 m long, male flowers 15 × 6 mm, sepals 5 mm long, glabrous, margin fimbriate, petals 16 × 7 mm, purple with yellowish shade when fresh, stamens 40, anthers linear, slightly apiculate about 14 mmx ½ mm, orange yellow when fresh, female flowers 6.5 × 5 mm, sepals green, ciliated at margin, outer most sepal slightly bigger, petals triangular, obtuse, each 6 × 6 mm, overy ovoid, trigonous with 1–3 fertile locules, ovules anatropous, stigmas oblong, acute. Fruits 1.8–3 cm in diameter, greenish brown to dark red when ripe. Seed 1–3 cm in diameter, epicarp consists of compactly arranged cells and 2–3 rows of scelereids.

Flowering: January – March **Fruiting:** April – September; palm gives flowers once in its life time and produces several inflorescences in a basipetal order and the palm dies after the last inflorescence mature.

Status: Less common; Vulnerable (Renuka 2011)

Distribution: India, Myanmar, Sri Lanka and Malaysia; in West Bengal it is mainly found in tropical to temperate forests of Kurseong, Kalimpong and Darjeeling Himalaya (up to 1400 m).

Ecology: *Caryota obtusa g*rows in humid mountain slopes and in open woodland or glass-land in sun exposed, montane locations.

Specimen examined: West Bengal, Darjeeling, Sibkhola 08.01.2018. Mondal and Chowdhury, 1039 (Acc. No. 10214, NBU). *Other specimens:* Linto and Anand 24289 (KFRI); Mizoram, 09.08.2004, Sreekumar 24201 (KFRI); Simdhaara village, Assam 17.12.1957, fr., V. N. Naik, 5350 (BSI Shillong); K and G Hills, Assam, 15.12.1915,

leaf, fr., Upendranath Kanjilal, 6393 (BSI Shillong); Mousinram village, Meghalaya, 26.04.09, Linto 25021 (KFRI); Near Moosmai cave, Shillong, 28.4.09, Linto 25034 (KFRI).

Uses: Few tribal communities use the central soft part of the trunk as food.

Caryota mitis Lour., Fl. Cochin. 697. 1790; Mart., Hist. Nat. Palm. 3, 197. 1823-1853; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 423. 1850. *Caryota furfuraea* Bl. *ex* Mart., Hist. Nat. Palm. 3:195. 1838. Pl. 20. *Caryota propinqua* Bl. *ex* Mart., Hist. Nat. Palm. 3: 194. 1838. *Caryota javanica* Zipp. *ex*. Miq., Fl. Ned. Ind. 2: 41. 1856, *nom. illeg*. *Caryota griffithii* Becc., Nuovo Giorn. Bot. Ital. 3: 15. 1871. Brandis, Ind. Trees 654. 1906; Prain, Beng. Pl. 2: 1093.1903; Basu & Chakraverty, Manu. Cult. Palms in Ind. 102.1994. ***'Madi pathi'***

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

Flowering: January – March **Fruiting:** April – September; palm gives flowers once in its life time. Several inflorescences are produced in a basipetal order and the palm dies after the last inflorescence mature.

Status: Common; Vulnerable (Renuka 2011)

Distribution: India (West Bengal, Assam, Meghalaya, Arunachal Pradesh, Meghalaya, Andaman Island), Myanmer, China, Thailand and Malaysia; common in the tropical forests of Darjeeling and Kalimpong Hinalaya (upto 1300m) of West Bengal.

Ecology: Grows in lowland rain forests below 1300 m of Himalaya and widely planted as an ornamental.

Specimen examined: West Bengal, Darjeeling 22.06.2017 Mondal and Chowdhury, 1040 (Acc. No. 10214, NBU). *Other specimens:* Chidiyatapu, Andamans, 2.4.2001, Sreekumar and James 22614 (KFRI); South Andamans, 8.4.1988, fr., Renuka 4065 (KFRI); Rutland Islands, S. Andamans, 22.1.1982, Vasudeva Rao 8655 (CAL); Bagghola Forest, Orissa, 7.12.1962, Leaf, fr., G. V. S. Rao, 29977 (BSI Shillong); Lamia Bay, North Andaman, 15.10.2008, Linto and Manohara 25014 (KFRI);Mount Harriet, South Andamans, 12.9.2008, Linto 25004 (KFRI); Shadipur, Port Bliar, 22.10.2008, fr., Linto 25019 (KFRI); BSI Howrah, 18.02.2008, fl., fr., Linto 24290 (KFRI).

Uses: Cultivated in the gardens for beautification of landscape. Leaves are used as thatches and for making fancy items.

Caryota urens L., Sp. Pl. 2: 1189. 1753; Griff., Calcutta J. Nat. Hist. 5: 478. 1845 & Palms of Brit. East Ind. 169. 1850; Mart., Hist. Nat. Palm. 3, 193. Pl. 107, 108, 162. 1823-1853; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 422. 1892; Moore & Drands., Taxon 28: 70. 1979. Rheede, Hort. Malab. I: Pl. 11, 21. 1678; Prain., Beng. Pl. 2: 1093. 1903; Basu & Chakraverty Manu. Cult. Palms in Ind. 104. 1994; Noltie, Fl. Bhutan 3(1). 428. 1994. ***'Kath gua, Ana pana, Chunda pana'*** [Fig. 49F]

Solitary stemmed, erect, monocarpic palms. Stem light brown, rough, 18–20 m tall, 50–60 cm diameter near base, swollen at base. Leaves 6–10 per crown, gracefully arching when young, 15 m long, leaf base triangular, semi woody with strong fibrous out growth from margins, scurfy villous, margins converge into two elevated confluent line on adaxial side, petiole very strong, 7 cm broad near base, terminal pinna of primary rachis 25 × 9 cm, pinules cuneiform, obliquely truncate, upper part toothed. Inflorescence pendulus, 4 m long, peduncle very strong, incurved 80 cm long, 10 cm in diameter at middle, spathes 7, light grey, semi woody to leathery, closely imbricated on peduncle, 20–60 cm long, spikes 80, 2 m long, male flowers either in pairs or on two sides of three flowered clusters, calyx 3, imbricate, ciliate at margins, petals leathery, 10 × 6 mm, stamens 40, 3 mm long, anthers linear, acuminate, female flowers 5 × 5mm with scale like bracteole, sepals green, margins ciliate, triangular, light green obtuse, overy globose, subtrigonnal above, stigmas conical. Fruit 1 seeded reddish, pericarp thin, yellow; seed 1.2 cm in diameter, embryo dorsal.

Flowering: March – May **Fruiting**: June – August

Status: Common; Least concern (Renuka 2011)

Distribution: India (West Bengal, Assam, Meghalaya and Manipore) Mayanmar, Sri Lanka and Malaysia. These palm mainly commom in Sub Himalayan tracts in the ever green forest of Darjeeling and Kalimpong district.

Specimen examined: West Bengal, Darjeeling 28.11.2017. Mondal and Chowdhury, 1038 (Acc. No. 10177, NBU). *Other specimens:* Karadippara, Peechi, Thrissur, Kerela, 26.11.87, N. Sashidharan 4723 (KFRI); Bhavanipattanam, Orissa, 16.5.02, fl., Sreekumar and Dinesh 22683 (KFRI); Panamkutty, Idukki, 4.5.1984, fl., Mohanan 81781 (MH); Aickad. Adoor, Quilon, 15.11.1917, fl., Mohanan 68314 (MH); Forest area Bonacaud, Thiruvananthapuram, 20.10.1973, fl., Joseph 44517 (MH); Kallur, s. Kanara, 29.12.1938, Raju 6304 (MH); Silasagar Dt., assam, 13.11.1964, leaf fr., S.K Kataki 41569 (BSI Shillong); Boragharo, Orissa, 20.8.1931, fl., Narayanaswamy 5992 (MH); Thrissur, Kerela, 20.12.96, fl., Anto 6667 (KFRI); Maridinilli, Andhra, 29.5.01, Sreehumar and Dinesh 22699 (KFRI).

Uses: Fibre from the leaf sheath and petiole is used for manufacture of ropes and brushes. Pith of full grown palm just before commencement of flowering accumulates huge quantity of edible starch that is why this species is also known as Indian Sago Palm. Toddy is also prepared from the sap drawn from the cut end of the peduncle. Tribal people in the forest also extract and consume the cabbage cut out from the growing tip of the palm.

Genus: Wallichia Roxb**.**

Wallichia Roxb., Pl. Coromandel 3: 91. 1820; Kurz, Forest Fl. Burma 2: 531. 1877; Blatt., Palms Brit. Ind. 367. 1926; Basu & Chakraverty, Manu. Cult. Palms in Ind. 104. 1994.

Stem solitary or caespitose, covered mostly with sheath fibra. Leaves alternate or disticous, leaflets exauriculate. Inflorescence single, basipetal in emergence, pistillate inflorescence terminal, staminate inflorescences axillary, in male flower calyx copular or cylindrical, corolla much longer than calyx, lobes 3, stamens 3 – 6 or more, female flowers solitary, bracteates, calyx 3 lobed, imbricate, ovary functionally 3 loculed, 2 – 3 ovulate. Fruit 1 – 2 seeded; seed with endosperm ruminate.

Distribution: India, Bangladesh, Nepal, Burma, China and Malaysia. The genus represents 5 species in India mainly found in North East India; four species recorded West Bengal.

Key to the species

1a. Stem mostly solitary, arborescent; leaves distichous, leaflets elongated……..……*W. disticha*

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

2a. Leaflets oblong to linear oblong; margins wavy…….…...…….…*W. oblongifolia*

2b. Leaflets lobed or trapezoid, broadly cuneate at base …….……... *W. caryotoides*

Wallichia caryotoides Roxb., Pl. Coast Cor. 3: 91.1820; Griff., Cal. J. Nat Hist. 5: 485. 1845 & Palms Brit. E. Ind. 74. 1850; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 317. 1893. *Harina caryotoides* (Roxb.) Buch.-Ham., Mem. Wern. Nat. Hist. Soc. 5: 317. 1826. *Wrightea caryotoides* Roxb., Fl. Ind. ed. 3: 621.1832; Prain., Beng. Pl. 2: 1093. 1903. *Wallichia moorena* S. K. Basu, Taiwania 28: 146. 1983. Basu & Chakraverty Manu. Cult. Palms in Ind. 105. 1994. ***'Chilputta'*** [Fig. 50 &5 2 E,F,G]

Suckering, bushy, hapaxanthic palms. Stem low, very slender, covered with thick mat of leaf sheath fibre, leaves almost radical, pinnate, 2–2.5 m long, sheathing at base, leaf fibrous at margins, petiole slender, sub terete, rachis dorsally bifaced and ventrally convex, basal leaflets fascicled, 3 on each side, wedge shaped, narrowly cuneate, minutely dentate at apices, 27–30 cm long, 8–9 cm broad at middle, middle leaflets alternate, pendurae formly lobed, broadly cuneate, premorsed, mucronately dentate at margins, 35–40 cm long, 7–9 cm broad at middle, terminal leaflet deeply 3-lobed, acutely dentate, 28–30 cm long, staminate inflorescence axillary, 35–40 cm long, peduncle terete, 1.4–1.8 cm in diameter at middle, spathes many, alternate, papery, spikes filiform, numerous, 18–20 cm long, male flower solitary or paired, sessile 6 × 2 mm, calyx copular, margin sinuate, petals lanceolate, fleshy, slightly mucronate, stamens 6, filaments subulate, 2 mm long, connate to form a small column, anthers sagittate, lobes unequal; pistillate inflorescence 35–40 cm long, terminal, peduncle

terete, 1.5 cm diameter at base, spathes 2–3, alternate, 5–7 cm apart on peducle, papery, scurfy on outer side, spikes 12–14, alternate, 36–40 cm long, female flowers prominently 3 bracteate, lateral bracts very conspicuous, reniform, calyx broadly 3 lobed, petals broadly triangular, 4 × 3 mm, acute, ovary 3 loculed, stigma conical, slightly bifid. Fruit 2-seeded, obpyriform, 1.8 × 6 mm; seed planoconvex.

Flowering: February – March **Fruiting:** April – July. Flowering depends on the maturity of the palm. Once fully matured, the terminal inflorescence emerges out, mostly during warmer months. The axillary inflorescences subsequently develop during the ongoing life process.

Status: Rare occurrence; Near threatened (Renuka, 2011)

Distribution: Endemic to India **(**West Bengal, Assam, Meghalaya, Manipur, Tripura) and Mayanmar; found in moist evergreen forest of Mirik, Kalimpong and Darjeeling (300- 1000 m).

Ecology: Tropical lowland to mountain rain forest

Specimen examined: West Bengal, Darjeeling (Near Dudhia, Mirik) 28.11.2017. Mondal and Chowdhury, 1042 (Acc. No. 10176, NBU). *Other specimens:* Rheyanlie, Dibang valley, Arunachal Pradesh, 25.8.2000, fr., Bhaumik 3242 (BSI Shillong); Kheitum, Sushai Hills, Assam, 23.1.1963, Deb 31211(BSI Shillong).

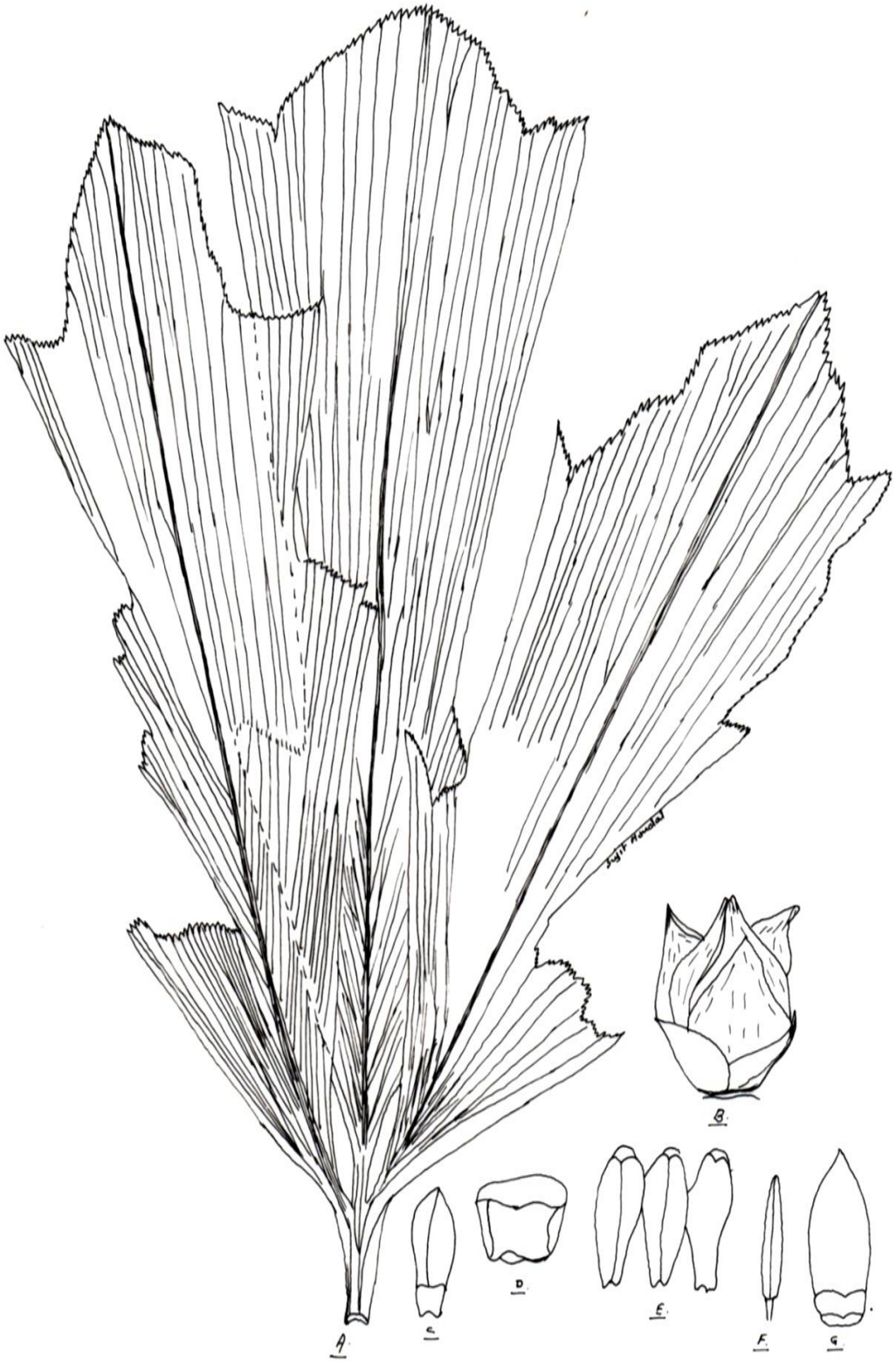

Fig. 50: *Wallichia caryotoides* Roxb. **A.** portion of leaf sheath **B.** female flower **C.** Male flower **D.** Calyx **E.** Petals **F.** Androcium **G.** Mature Fruit

Wallichia oblongifolia Griff., Cal. J. Nat. Hist. 5: 486, 1845. *Wallichia densiflora* Becc., Hook. *f*., Fl Brit. Ind. 6: 317. 1892. *Wallichia densiflora* Mart., Hist. Nat. Palm 3: (ed.2) 190. 1849; Noltie, Fl. Bhutan 3(1). 426. 1994. *Harina densiflora* (Mart.) Walp., Ann. Bot. Syst. 3: 1032. 1853. Prain, Beng. Pl. 2: 1094. 1903; Basu & Chakraverty, Manu. Cult. Palms in Ind. 105. 1994. ***'Chilputtal, Araru, Lemi, Ipathi'*** [Fig. 51, 52B,C,D]

Suckering, bushy, hapaxanthic palms. Stem low, slender covered with mat of leaf sheath and leaf sheath fibres. Leaves 1.5 – 2 m long, arching from base, basal leaflets oblong, in groups of 2 – 3 leaflets on each side of rachis, 10 – 20 cm long, 3 – 7 cm broad at middle, deep green upper, whitish below, middle leaflets linear oblong, 50 – 60 cm long, 6 – 8 cm broad at middle, midnerve on lower side light orange, terminal leaflets 4 nerved, 35 – 40 cm long, 18 – 20 cm broad, upper margins 3 lobed. Male inflorescence axillary, pendulous, 40 – 50 cm long, bracts peduncular, papery, imbricated, spathes smooth, deep scarlet inside, spikes filiform, in clusters, numerous, 15 – 17 cm long, attenueta, male flowers yellow, 1 – 2 mm long, calyx cylindrical, 4.5 × 1 mm, margins slightly dentate, petals spatuliform, 4.5 × 1.2 mm, stamens 6, filaments connate to form a short column, anthers 2 – 3 mm long; female inflorescence terminal, 45 – 50 cm long, erect, prophyll and peduncular spathes cylindrical at base, obtuse, outer spathe longer, carinate, tips sometimes pinnately foliar, female flowers spirally disposed, 2.5 × 3 mm, lateral bracts luneiform, calyx irregularly lobed, margins finely dentate, corolla shortly 3 lobed, shorter than pistil, stigmas minute. Fruit oblong, 2 seeded, crowded, 1.69 cm long, 9 mm broad at middle, perianth persistent, accrescent, green, stigmatic protuberance conspicuous; seed plano- convex, 12 × 4 mm.

Flowering: February – April **Fruiting:** May – August; once matured flowering starts with the emergence of terminal inflorescence followed by the axillary males in descending order. Flowering mostly occurs during summer.

Status: Rare occurrence; Threatened (Renuka 2011)

Distribution: India **(**West Bengal, Sikkim, Assam, Arunachal Pradesh, Manipur, Tripura, Nagaland), Nepal, Bhutan, Myanmar, Bangladesh and China; less common in tropical forests of lower hills (upto 1400m) of Darjeeling and Kalimpong district of West Bengal.

Ecology: Tropical humid forests and found dense and thickest in moist evergreen valleys of Himalaya (up to 1400 m).

Specimen examined: West Bengal, Darjeeling, Muktikhola. 28.11.2017. Mondal and Chowdhury, 1043 (Acc. No. 10213, NBU). *Other specimens:* Khasia & Jaintea Hills, Assam, 19.11.1969, Balakrishnan 50019 (BSI Shillong); Balaiba tilla, Nangpoh, Assam, 31.7.1964, Joseph 37480 (BSI Shillong); Near Moosmai cave, Cherrapunjee, 28.04.2009, Linto 25032(KFRI); Barapani, Shillong, 27.04.09. Linto 25031(KFRI); Namdapha, 16.12.1981, Joseph, 79182 (BSI Shillong); Mikir Hills, Assam, 15.7.1957, fr., Panigrahi 9371 (BSI Shillong); Dwaki, Near Chirapunjee, K & J Hills dist., Arunachal Pradesh, 25.11.1956, Pangrahi 4689 (BSI Shillong); Botanic Garden, Shillong, 25.7.1973, Deb 35744 (BSI Shillong).

Uses: Leaves are used as thatch and fodder for mountain animals. This species is also grown as ornamental.

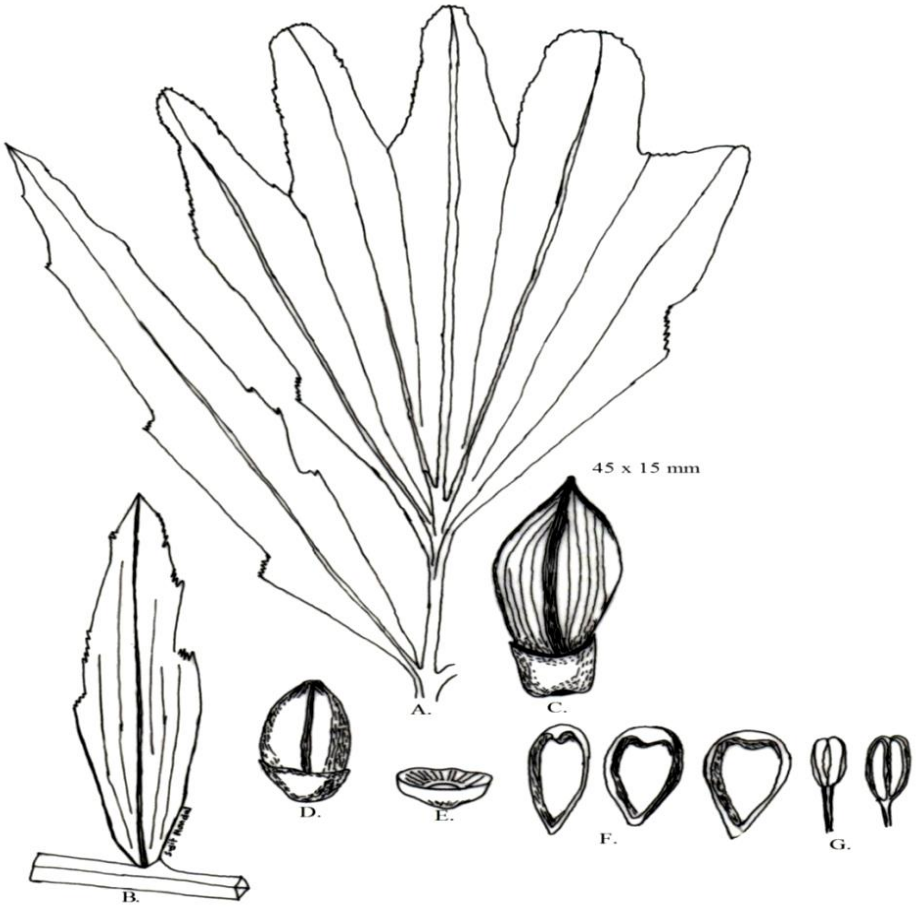

Fig. 51: *Wallichia oblongifolia* Griff. **A.** Section of leaf **B.** Single leaflet **C.** Mature flower **D.** Mature fruit **E.** Seed **F.** Petals **G.** Androecium

Wallichia disticha T. Anders., J. Linn. Soc. 11. 6. 1871; Becc. & Hook. *f*., Fl. Brit. Ind. 6: 419. 1892; Basu & Chakraverty, Manu. Cul. Palms in Ind. 106. 1994; Noltie, Fl. Bhutan 3(1). 427. 1994. *Didymosperma distichum* (T. Anders.) Hook. *f*., Rep. Progr. Condition Roy. Bot. Gard. Kew 1882: 61. 1884. *Wallichia kyomae* Kurz, Forest Fl. Burma 2: 533.1877. ***'Katong'*** [Fig. 52A]

Stem solitary or sometimes suckering hapaxanthic palms; stem erect, arborescent, 4 – 6 m long, and 25 – 32 cm diameter near base. Leaves ascending from the stem, distichously placed from lower portion of the stem, leaf sheath semi woody, margins extremely fibrous, scurfy with long black bristle on ventral side, petiole semi terete, 25 – 30 cm long, scuffy out side, grooved on lower side, rachis more or less triangular in cross section, ventrally grooved, lateral leaflets in groups, projected in different direction from rachis, each linear, notched on both margins near middle, terminal leaflets broadly 3 lobed, praemorsed, margins dentate. Male inflorescence axillary, 1 – 1.5 m long, spikes slender, 35 cm long, male flowers mostly in pairs, female flower rudimentary, stamens 6, 1.5 – 2 mm long; female inflorescence terminal, calyx obscurely 3 lobed, corolla 3 partite, almost cover the pistil, stigmas mamillate, 2 fid. Fruit oblong, reddish brown when ripe, 2 – 3 cm long, 1.5 cm broad at middle.

Flowering: May – July **Fruiting:** August – October; palm gives flowers once in its lifetime. Several inflorescences are produced in a basipetal order and the palm dies after the last inflorescence mature.

Distribution: India (West Bengal, Sikkim and Arunachal Pradesh), China, Myanmar, and Bangladesh. In West Bengal it is mainly found in Darjeeling and kalimpong district.

Status: Rare occurrence; Threatened (Renuka 2011)

Ecology: Lowland to montane rain forests, especially in rocky places on steep slopes, often in disturbed areas; below 1200 m.

Specimen examined: West Bengal, Darjeeling, Kurseong, 26.04.2016. Mondal and Chowdhury, 1041 (Acc. No. 10216, NBU). *Other specimen:* Nusa to Wami, Tirap, Arunachal Pradesh, 2.9.1958, Panigrahi 15078 (BSI Shillong).

Uses: Highly valuable palm, it may supply principal food, when cultivation of paddy or other cereal crops are destroyed by the natural calamities like flood or earth quakes. The bark of the *Wallichia disticha* is peeled, crushed and converted in to dry powder.

Fig. 52: A. *Wallichia disticha* T. Anders., **B.** *Wallichia oblongifolia* Griff. **C** Mature fruits *W. oblngifolia* Griff. **D.** Herbarium specimen of *W. oblngifolia* Griff. **E & F.** Herbarium specimens *Wallicha caryotoides* Roxb. **G.** Inflorescence *W caryotoides* Roxb. © *Dr. S.K.Basu (G).*

4.5. Discussion:

Present dissertation is the outcome of of extensive field work in various altitudinal wide ranges of habitats and explored the entire indigenous species of palms and canes flora of West Bengal. A total of 49 indigenous species (Table 9) representing subfamilies of Coryphoideae, Calamoideae, Nypoideae and Arecoideae have been recorded. Subfamily Coryphoideae represents 13 species of 6 genera, Calamoideae represents 23 species of 4 genera, Arecoideae represents 12 species of 6 genera and Nypoideae represents only one species of *Nypa* from the boundary of West Bengal (Table 11). Among the recorded 49 indigenous species, Calamoideae shows highest number of species (44%) followed by Coryphoideae 28%, Arecoideae 26% and Nypoideae 2% (Fig. 53), similarly Arecodeae represents 41% genera, Coryphoideae 31% genera, Calamoideae 18% genera and Nypoideae 6% (Fig. 54).

Table 9: Genus and species of Indigenous Palms in West Bengal according to sub–family

Sub Family	Genus	Species
Coryphoideae	6	14
Calamoideae	4	23
Nypoideae	1	1
Arecoideae	6	12
Total		**49**

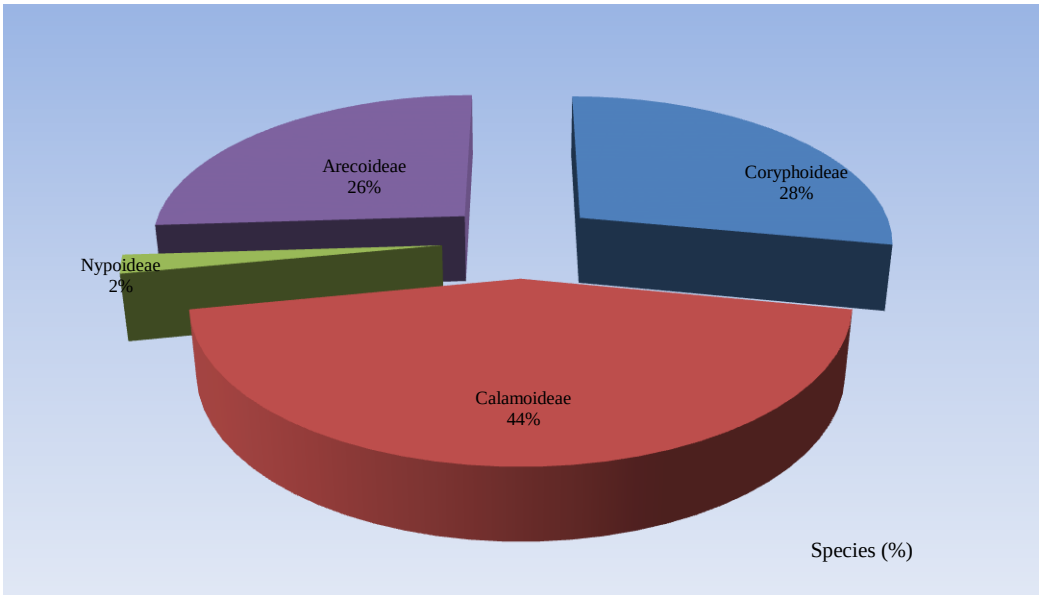

Fig. 53: Percentage of the genus according to the sub family

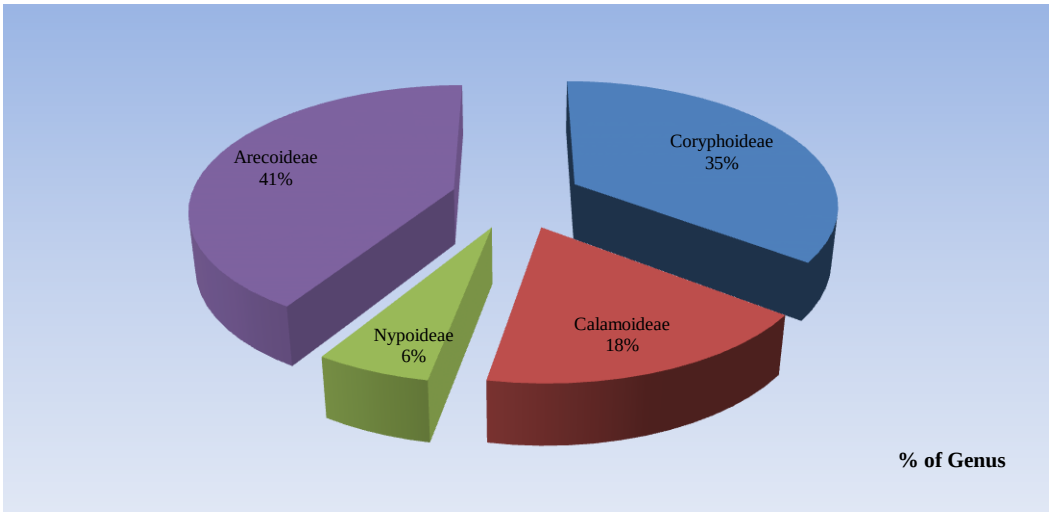

Fig. 54: Percentage of the species according to the sub family

Table 10: District wise distribution of *Calamus* and *phoenix* in West Bengal

District	***Phoenix* sp.**	***Calamus* sp.**
Alipurduar	2	6
Bankura	2	2
Paschim Bardhaman	2	1
Purba Bardhaman	2	1
Birbhum	2	0
Cooch Behar	2	4
Darjeeling	4	11
Uttar Dinajpur	1	1
Dakshin Dinajpur	1	1
Hooghly	2	0
Howrah	3	0
Jalpaiguri	1	8
Jhargram	3	1
Kolkata	2	0
Kalimpong	4	7
Malda	1	1
Paschim Medinipur	2	1
Purba Medinipur	2	1
Murshidabad	3	0
Nadia	3	0
North 24 Parganas	3	0
South 24 Parganas	3	0
Purulia	3	0

Rattans are quite interesting species due to their peculiar armatures and economic uses. Among the recorded rattans, *Calamus* is the largest genus (Fig. 55 & Table 10) that represents 17 species in West Bengal and out of that 17 species were reported in the forests of terai, duars and Himalaya of Darjeeling and Kalimpong districts. Only *Calamus tenuis* is growing at road side bushes or found growing in fragmented reserve forest near water bodies of Gangetic plains. *Plectocoemia* represents three species that were mostly growing in high altitude temperate forests of Darjeeling and Kalimpong. *Daemonorops* genus represents two species growing in tropical forests of terai and duars of Northern Bengal. From the entire West Bengal a total of 26 species of palms were recorded from various habitats like high and low altitudes of Himalaya, Terai, Duars, plains of Bengal, Western Plateau and estuarine mangroves and a district wise species distribution is given in table 13. *Phoenix* is the major genera representing five species in West Bengal (Fig. 56 & Table 10). *Phoenix rupicola* is strictly restricted in lower hills of Darjeeling and Kalimpong districts. *Phoenix acualis* is a stemless palm that grows mainly in dry lands, plateau and hills of West Bengal and is also available in lower hills of Darjeeling and Kalimpong districts of Nothern Bengal. *Phoenix dactylifera* and *P. sylvestris* are common in Bengal plains. *Phoenix paludosa* and *Nypa fruticans* are the only palm species that strictly grows in tidal forests of estuarine mangroves of Sunderban Biosphere reserve of West Bengal. The most interesting genus *Wallichia* and *Caryota* are poorly distributed in Darjeeling and Kalimpong district of North Bengal at an altitude of 1200 m. The majority of palms are shade loving, so few species like *Borassus flabellifer*, *Cocos nucifera Livistona jenkinsiana* grows in the regions of fully exposed to sunlight. The beautiful fan-leaved palm like *Licuala peltata* has a restricted distribution in shady moist hilly slopes near Teesta River of Darjeeling Himalaya (upto 1830 m). Another robust beautiful palm genus *Pinanga* is common in moist tropical forests of Terai, Duars and Himalaya of Darjeeling and Kalimpong district upto 1000 m of altitude.

Table 11: Genus and number of species of Indigenous Palms in West Bengal according to sub–family and tribe

Sub Family	Tribe	Genus	Species
Coryphoideae	Corypheae	*Licuala*	1
		Livistona	1
		Trachycarpus	2
		Corypha	3
		Phoenix	5
	Borasseae	*Borassus*	1
Calamoideae	Calameae	*Calamus* (Ecirrate)	12
		Calamus (Cirrate)	5
		Daemonorops	2
		Plectocomia	3
		Salacca	1
Nypoideae	-	*Nypa*	1
Arecoideae	Caryoteae	*Arenga*	1
		Caryota	3
		Wallichia	3
	Areceae	*Areca*	2
		Pinanga	2
	Cocoeae	*Cocos*	1
Total			**49**

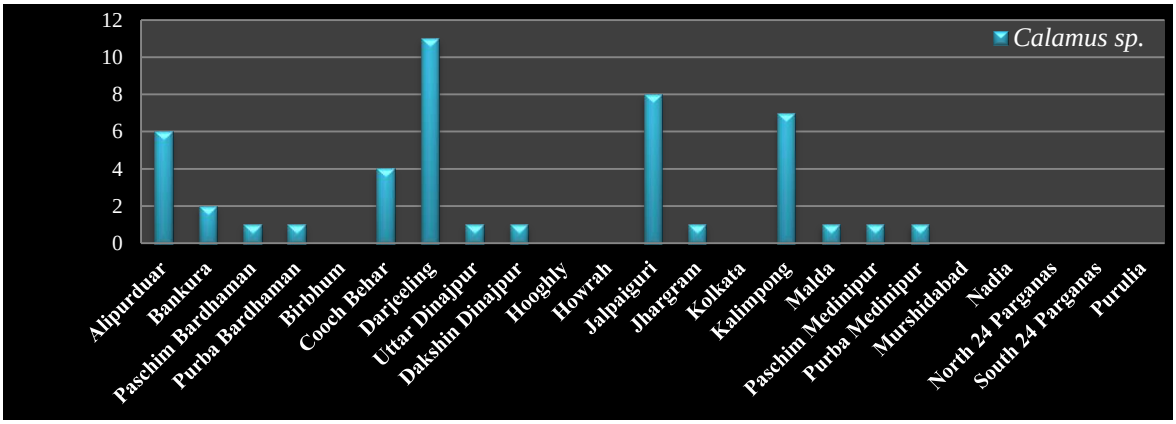

Fig. 55: District wise distribution of *Calamus sp.* in West Bengal

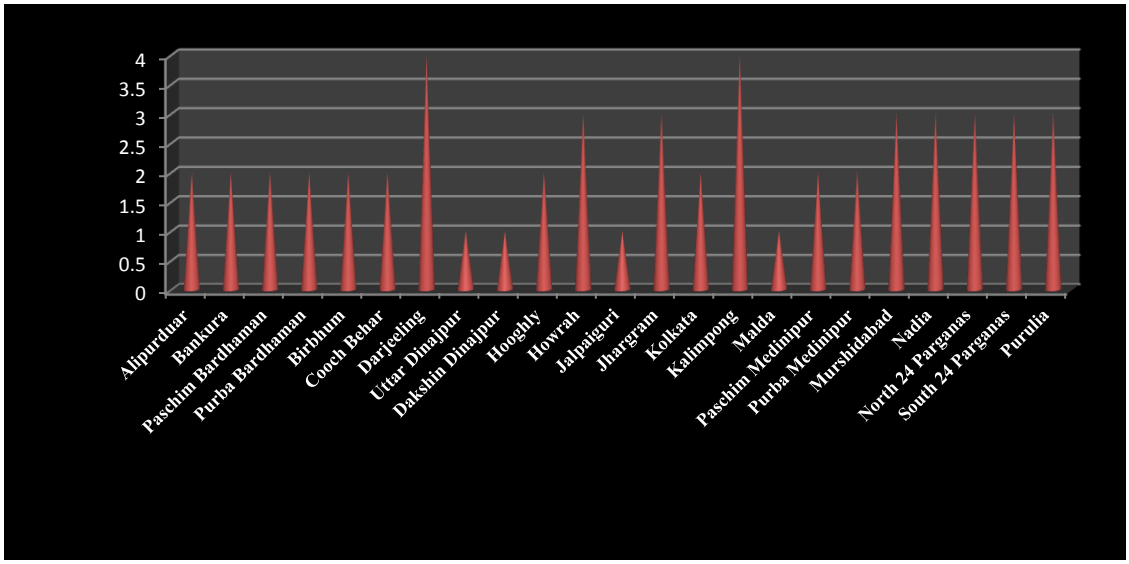

Fig. 56: District wise distribution of *Phoenix sp*. in West Bengal

In India 43 endemic palms and rattans were distributed in three major geographical regions namely Peninsular India, N and NE India and Andaman and Nicobar Islands. Out of recorded endemic palms, 22 species are found in Eastern Himalaya, 14 species in N and NE India and 7 species from West Bengal namely like *Calamus leptospadix, Calamus numbariensis, Calamus pseudoerectus, Daemonorops teraiensis, Pinanga gracilis, Phoenix rupicola, Plectocomia himalayana.*

Palms are one of the least protected group of flowering plants with many species being severely threatened and becoming rare in the wild habitats day by day in very faster manner. Habit destruction, over exploitation and unscientific harvesting methods for the past few decades, resulted a drastic depletion of the palm resources in West Bengal. Present study has explored various wild habitats but not any singifiantly large population of any palm and cane species from study areas have been reported. Due to the favourable habitat and climate, maximum number of recorded palm and cane species were concentrated in North Bengal Terai, Duars and lower and upper hills of Darjeeling and Kalimpong districts. Very few species were found in plains of Middle, Sourthern and Western part of Bengal. Species of Arecaceae are almost distributed throughout the West Bengal and districtwise species dispersion is elaborated in table 12 and Fig 57. Percentage of genus and species distribution is quite interesting and it it is found that northern most districts were share maximum percentage (Fig. 58 & 59).

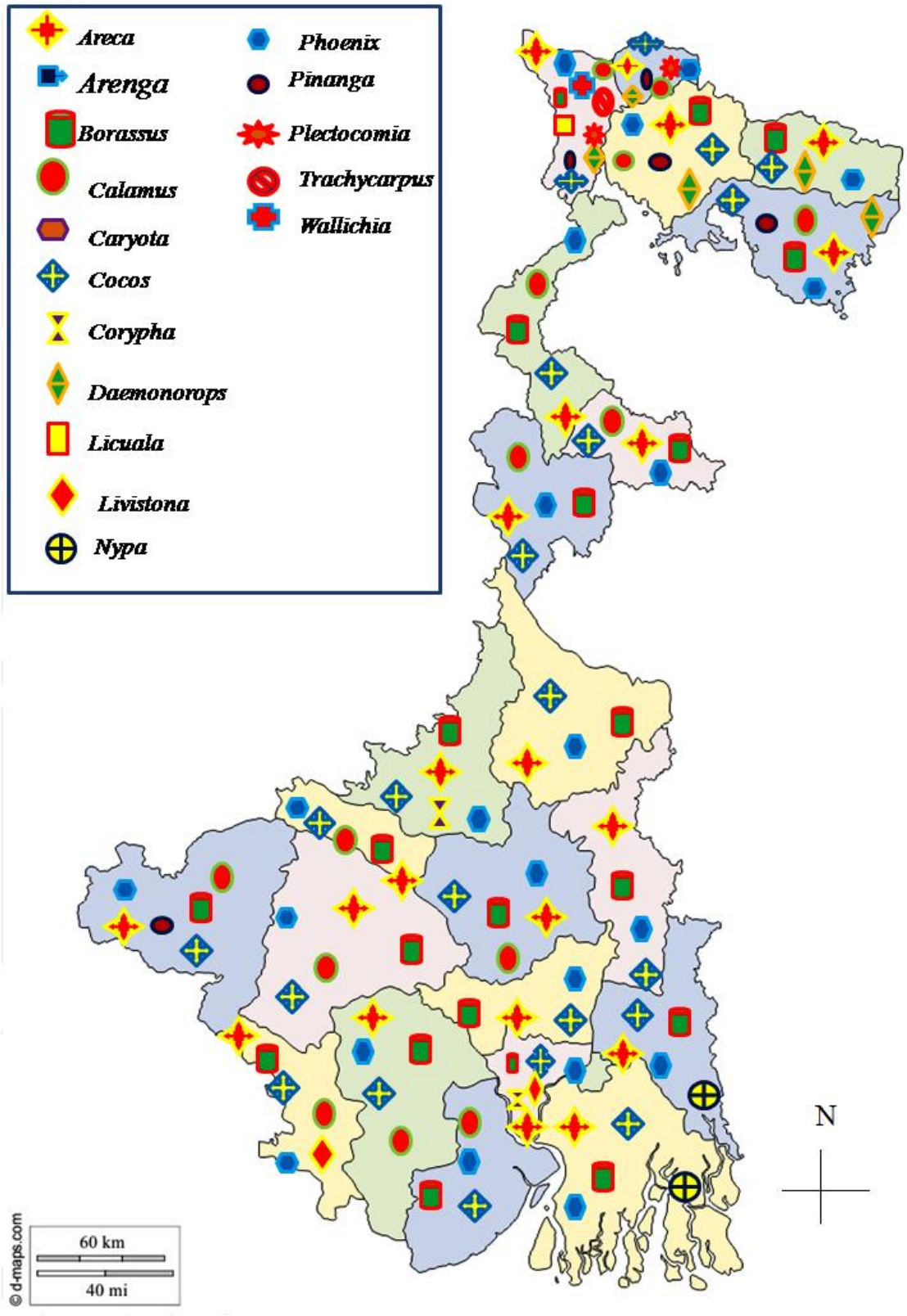

Fig. 57: District wise palms distribution in West Bengal

Table 12: District wise palms distribution

DISTRICT	AREA	MAP	GENUS	SPECIES
Alipurduar	3,383 km^2 (1,306 sq mi)		*Phoenix, Areca, Borassus, Cocos, Calamus, Daemonorops*	*Areca catechu, Borassus flabellifer, Cocos nucifera, Phoenix acaulis, P. sylvestris, Calamus acanthospathus, C. tenuis, C. guruba, C. latifolius, C. inermis, C longisetus, C viminalis, Daemonorops jenkinsiana,*
Bankura	6,882 km^2 (2,657 sq mi)		*Phoenix, Areca, Borassus, Cocos, Calamus*	*Areca catechu, Borassus flabellifer, Cocos nucifera, Phoenix acaulis, P. sylvestris, Calamus tenuis, C. leptospadis*
Paschim Bardhaman	1,603.17 km^2 (618.99 sq mi)		*Phoenix, Areca, Borassus, Cocos, Calamus*	*Areca catechu, Borassus flabellifer, Cocos nucifera, Phoenix acaulis, P. sylvestris, Calamus tenuis*
Purba Bardhaman	5,432.69 km^2 (2,097.57 sq mi)		*Phoenix, Areca, Borassus, Cocos, Calamus*	*Areca catechu, Borassus flabellifer, Cocos nucifera, Phoenix acaulis, P. sylvestris, Calamus tenuis*
Birbhum	4,545 km^2 (1,755 sq mi)		*Phoenix, Areca, Borassus, Cocos, Corypha*	*Areca catechu, Borassus flabellifer, Cocos nucifera, Phoenix acaulis, P. sylvestris, Corypha taliera, C. utan*
Cooch Behar	3,387 km^2 (1,308 sq mi)		*Phoenix, Areca, Borassus, Cocos, Calamus, Daemonorops*	*Areca catechu, Areca triandra, Phoenix acaulis, P. sylvestris, Borassus flabellifer, Cocos nucifera, Calamus erectus, C. acanthospathus, C. longisetus, C. inermis*

Darjeeling	2,092.5 km^2 (807.9 sq mi)		*Phoenix, Areca, Borassus, Cocos, Calamus, Daemonorops, Plectocomia, Trachycarpus, Licuala, Pinanga, Wallichia*	*Areca catechu, Areca triandra, Phoenix acaulis, P. sylvestris, P. rupicola, P. lourerii, Borassus flabellifer, Cocos nucifera, Calamus erectus, C. acanthospathus, C. arborescence, C. viminalis, C. tenuis, C. leptospadix, C. pseudoerectus, C. latifolius, C. numbariensis, C. floribundus, C. kinghianus, C. khasianus, C. flagellum, Daemonorops jenkinsiana, D. teraiensis, Plectocomia himalayana, P. bractealis, Pinanga gracilis, P. griffithii*
Uttar Dinajpur	3,140 km^2 (1,210 sq mi)		*Phoenix, Areca, Borassus, Cocos, Calamus*	*Areca catechu, Phoenix acaulis, P. sylvestris, Calmus tenuis, Cocos nucifera, Borassus flabellifer*
Dakshin Dinajpur	2,219 km^2 (857 sq mi)		*Phoenix, Areca, Borassus, Cocos, Calamus*	*Areca catechu, Phoenix acaulis, P. sylvestris, Calmus tenuis, Cocos nucifera, Borassus flabellifer*
Hooghly	3,149 km^2 (1,216 sq mi)		*Phoenix, Areca, Borassus, Cocos*	*Areca catechu, Phoenix sylvestris, P. dactylifera, Cocos nucifera, Borassus flabellifer*
Howrah	1,467 km^2 (566 sq mi)		*Phoenix, Areca, Borassus, Cocos, Corypha, Livistona*	*Areca catechu, Phoenix sylvestris, P. dactylifera, P. acaulis, Cocos nucifera, Borassus flabellifer, Corypha taliera, C. utan, C. macropoda*
Jalpaiguri	2,844 km^2 (1,098 sq mi)		*Phoenix, Areca, Borassus, Cocos, Calamus, Daemonorops, Pinanga,*	*Areca catechu, Areca triandra, Phoenix sylvestris, Cocos nucifera, Borassus flabellifer, Calamus erectus, C. flagellum, C. floribundas, C. gracilis, C. inermis, C. tenuis, C. leptospadix, C. guruba, Pinanga gracilis, Daemonorops jenkinsiana*

Nadia	3,927 km^2 (1,516 sq mi)		*Phoenix, Areca, Areca catechu, Phoenix Borassus, Cocos sylvestris, P. dactylifera, P. rupicola, Cocos nucifera, Borassus flabellifer*
North 24 Parganas	4,094 km^2 (1,581 sq mi)		*Phoenix, Areca, Areca catechu, Phoenix Borassus, Cocos, sylvestris, P. dactylifera, P. Nypa paludosa, Cocos nucifera, Borassus flabellifer, Nypa fruticans*
South 24 Parganas	9,960 km^2 (3,850 sq mi)		*Phoenix, Areca, Areca catechu, Phoenix Borassus, Cocos, sylvestris, P. dactylifera, P. Nypa paludosa, Cocos nucifera, Borassus flabellifer, Nypa fruticans*
Purulia	6,259 km^2 (2,417 sq mi)		*Phoenix, Areca, Areca catechu, Phoenix Pinanga, Borassus, Cocos, sylvestris, P. dactylifera, P. acaulis, Cocos nucifera, Borassus flabellifer*

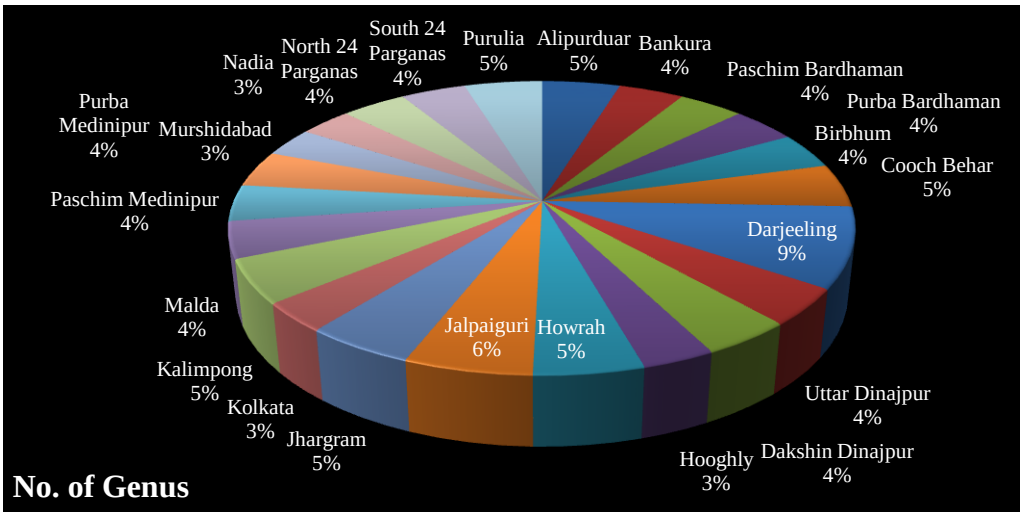

Fig. 58: Graphical representation (in %) of palms genus in each district of West Bengal

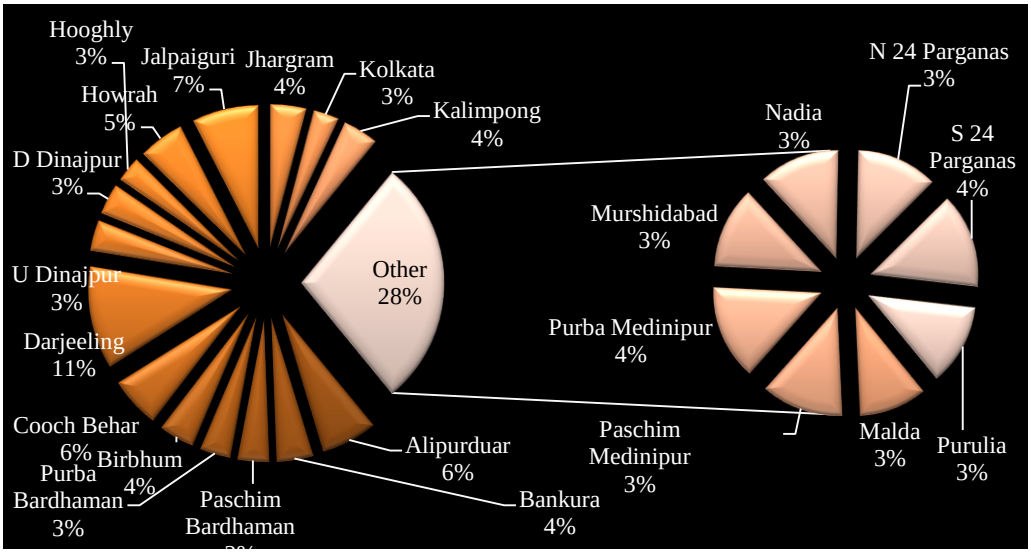

Fig. 59: Graphical representation of palms species (in %) in each district of West Bengal

Due to drastic habitat loss and climate change, most of the species of palm and canes were under huge threats. IUCN recognized various such species being recorded under different threatened caterory in their portal. *Calamus numbariensis* is only species which is critically endangered (CR) and is reported from Kalimpong and Darjeeling district. Four species namely *Areca triandra, Phoenix acaulis, Phoenix paludosa* and *Phoenix rupicola* are categorized under near threatened (NT) category and another 4 species namely *Nypa fruticans, Areca catechu, Corypha utan* and *Calamus tenuis* are categorized under least concern (Table 13). The status of different palms and canes were assessed by Renuka (2011) based on the population sizes in various locality and it was found that *Licuala peltata* is only species which is critically endangered (CR) reported from Darjeeling district and five species namely *Arenga micrantha, Calamus flafelllum, Calamus floribundus, Plectocomia himalayana, Pinanga gracilis* considered as endangered (E) taxa. Two threatened species *Wallichia oblongifolia* and *Wallichia disticha* are common in Kalimpong and Darjeeling district, other seven species of *Wallichia caryotoides Livistona jenkinsiana, Trachycarpus martianus, Calamus gracilis, Calamus guruba, Calamus khasianus* and *Daemonorops jenkinsiana* are under near threatened (NT) categories which are distributed in Terai Duras and Darjeeling Himalayas and five species of *Caryota obtusa, Calamus erectus, Calamus leptospadix, Plectocomia assamica,* and *Pinanga griffithii* are also recognized as vulnerable (V). Seven least concern species are *Caryota urens, Borassus flabellifer, Phoenix loueirii,*

Phoenix sylvestris, Calamus longisetus, Calamus viminalis, and Cocos nucifera are quite common in West Bengal (IUCN Standards and Petitions Subcommittee 2014).

Table 13: Indegenous species found in West Bengal [Abbreviation used: E= Endangered; NE= Near Threatened; LC= Least Conserned; R=Rare; T= Threatened; V= Vulnerable]

Sl. No.	Taxa	Common Name	Status	Source
1.	*Areca catechu*	Supari,	LC	IUCN ver 3.1
2.	*Areca triandra*	Jungli Supari	LC	IUCN 2019-1
3.	*Arenga micrantha*	X	E	Renuka, 2011
4.	*Borassus flabellifer*	Tal	NT	Renuka, 2011
5.	*Calamus acanthospathus*	Motta bet	AB	X
6.	*Calamus arborescens*	Bethgara	V	Basu, 2013
7.	*Calamus erectus*	Kara beth	V	Renuka, 2011
8.	*Calamus flagellum*	Pulti bet, Rabi bet	E	Renuka, 2011
9.	*Calamus floribundus*	X	E	Renuka, 2011
10.	*Calamus gracilis*	X	NT	Renuka, 2011
11.	*Calamus guruba*	Sundi bet	NT	Renuka, 2011
12.	*Calamus inermis*	X	V	Renuka, 2011
13.	*Calamus latifolius*	Korak bet	R	X
14.	*Calamus leptospadix*	Ranibet, Mugri bet	V	Renuka, 2011
15.	*Calamus longisetus*	Udombet,Onti bet	LC	Renuka, 2011
16.	*Calamus nambariensis*	Kiri beth	CE	IUCN ver 3.1
17.	*Calamus pseudoerectus*	Otla bet, betgara	EN	Mondal et. al 2019
18.	*Calamus tenuis.*	Jatibet, Pani bet	LC	IUCN ver 3.1
19.	*Calamus viminalis*	Bagibet, Jungli bet	LV	Renuka, 2011
20.	*Calamus khasianus*	X	NT	Renuka, 2011
21.	*Calamus kingianus*	X	V	X
22.	*Caryota mitis*	Madi pathi	V	Renuka, 2011
23.	*Caryota obtusa*	Bhure palm	V	Renuka, 2011
24.	*Caryota urens*	Ana pana	LC	Renuka, 2011
25.	*Cocos nucifera*	Narikel	LC	Renuka, 2011
26.	*Corypha umbraculifera*	Talipalm	R	IUCN 2019.1
27.	*Corypha taliera*	Suicidal Palm	R	IUCN ver 2.3
28.	*Corypha utan*	X	NE	IUCN ver 3.1

29.	*Daemonorops jenkinsianus*	Karah	NT	Renuka, 2011
30.	*Daemonorops teraiensis*	Kanra bet	EN	Mondal & Chowdhury 2019
31.	*Licuala peltata*	Jumai or Mathi.	CE	Renuka, 2011
32.	*Livistona jenkinsiana*	Toko tree	NT	Renuka, 2011
33.	*Nypa fruticans*	Golpata	NT	IUCN ver 3.1
34.	*Phoenix acaulis*	Narkuli khejur	NT	IUCN ver 3.1
35.	*phoenix loureirii*	Kunth	LC	Renuka, 2011
36.	*Phoenix paludosa*	Hental	LC	IUCN ver 3.1
37.	*Phoenix rupicola*	X	NT	IUCN ver 2.3
38.	*Phoenix sylvestris*	Khejur	LC	Renuka, 2011
39.	*Pinanga gracilis*	Kantha kamuku	E	Renuka, 2011
40.	*Pinanga griffithi*	X	V	Renuka, 2011
41.	*Plectocomia assamica*	X	V	Renuka, 2011
42.	*Plectocomia bractealis*	X	V	X
43.	*Plectocomia himalayana*	X	E	Renuka, 2011
44.	*Salacca sacunda*	X	NE	X
45.	*Trachycarpus fortunei*	Fan palm	R	Basu, 2013
46.	*Trachycarpus martianus*	Fan palm	NT	Renuka, 2011
47.	*Wallichia caryotoides*	Jaru patti	NT	Renuka, 2011
48.	*Wallichia oblongifolia*	X	T	Renuka, 2011
49.	*Wallichia disticha*	Tika palm	R	Renuka, 2011

After the floristic survey since 2013–2018 two new taxa *Calamus pseudoerectus* and *Daemonorops teraiensis* were discovered and also recognized as endemic and endangered species for Eastern Himalayan regions of West Bengal.

Eastern Himalaya and Sub-Himalayan tarai-duars of West Bengal houses several green patches of *in-situ* conservatories that are quite rich in flora and fauna diversity. During this dissertation few interesting specimens were collected in various times and from that collection two new taxa were discoved for the science. One species is *Calamus pseudoerectus* Sujit Mondal, S. K. Basu & M. Chowdhury and one species is *Daemonorops teraiensis* Sujit Mondal and M. Chowdhury were described here as new species. In addition, four species *i.e., Areca triandra* Roxb. *ex* Buch.-Ham., *Calamus nambariensis* Becc., *C. longisetus* Griff., *Salacca secunda* Griff., and *Plectocomia bractealis* Becc. were first time recorded from the boundary West Bengal.