

## NORTH EAST INDIAN SPECIES OF PANDANACEAE

A.N. MAHATA, A. MUKHERJEE \* AND M.S. MONDAL

*Botanical Survey of India, Calcutta*

### ABSTRACT

The Pandanaceae R. Br. is represented in North East India by 4 species of the only genus *PANDANUS* Parkinson among which *Pandanus unguifer* Hook.f. is endemic to this region and the Eastern Himalaya. This work provides informations about morphology, chromosome number, distribution and uses of the concerned taxa. *P. unguifer* Hook.f. and *P. furcatus* Roxb. have so far remained unrepresented in taxonomic literature on Meghalaya

### INTRODUCTION

The name Pandanaceae R. Br. is derived from the generic name *PANDANUS* Parkinson which is based on the Malayan name "Pandang". The family is represented in the world by 3 genera and about 875 species distributed specially in Old World tropics to New Zealand (Mabberley, 1997). Most members of this family constitute the maritime vegetation.

In India the taxon is represented by two genera viz. *PANDANUS* Parkinson and *FRECISETIA* Gaud., the latter being confined to the Andaman and Nicobar Islands. Major Indian species *PANDANUS* favours the coastal belt and marshy habitats. Few species are found in the plain land extending towards subtropical hilly region of North-east India.

The taxonomic position of the family is an interesting one. Botanists like Warburg (1900) and Rendle (1904) are of the opinion that Pandanales is the most primitive order of Angiosperms comprising of the families Pandanaceae, Typhaceae and Sparganiaceae. Even Lawrence (1951) and Core (1955) treated

this as the first order of monocot. But most of the present day taxonomists do not lend support to the inclusion of Typhaceae and Sparganiaceae with Pandanaceae in the same order. Hutchinson (1973) put Typhaceae and Sparganiaceae in Typhales near Arales and only Pandanaceae placed under Pandanales next to Palmae. Throne (1977, 1983, 1992) transferred Typhaceae and Sparganiaceae to Arales keeping Pandanaceae in Pandanales. Dahlgren (1980, 1983, 1985) shifted Typhales to Liliiflorae and Pandanales to Areciflorae. Takhtajan (1980, 1987) accommodated Pandanales and Typhales in his 7th super order Arecanae under subclass Arecidae. Cronquist (1981) put the monotypic order Pandanales in Arecidae before Arales and includes Typhales in Commelinidae.

A few attempts have been so far made to reveal its cytology (Ganguly, 1959; Mallick and Sharma, 1966; Cheah and Stone, 1971-73; Kumar and Subramaniam, 1985), palynology (Sharma, 1967) and chemotaxonomy (Gibbs, 1974).

The present work, a part of the project on

\*Department of Botany, University of Burdwan, W.B.  
Date of receipt : 28.11.97. Date of acceptance : 17.8.99.

'Revision of Indian Pandanaceae', is a pioneering attempt to prepare an exhaustive and updated taxonomic account of its members occurring in the north-west India as a positive contribution towards understanding of a taxon which has almost remained unattached at the national level.

#### MATERIALS AND METHODS

The work is based on field survey in Arunachal Pradesh, Meghalaya and Sikkim during 1996 and thorough scrutiny of literature and specimens preserved in the Central National Herbarium (CAL) and herbaria of Arunachal Pradesh Field Station, Itanagar; Eastern Circle, Shillong and Sikkim Himalayan Circle, Gangtok of Botanical Survey of India.

The diagnostic features and a key to the species have been presented. The taxa are arranged alphabetically with correct nomenclature, citation along with the information on chromosome number (wherever available), flowering and fruiting time and distribution.

#### KEY TO THE SPECIES

1. Plants above 3 m high ; fruits orange red ; drupes obconic :
  2. Plants 3-5 m ; leaves 80-100 × 5-8 cm ; male spike 6-9 cm long ; female inflorescences solitary, terminal unbranched spike ; drupe broadly obconic  
... 3. *P. odoratissimus*
  - 2a. Plants 3-12 m ; leaves 2-6 m × 5-9 cm ; male spike 9-15 cm long ; female spadices 1-9, forming a compound pendent spadix ; drupe cylindric obconic  
... 2. *P. furcatus*
- 1a. Plants up to 2 m high ; fruits red or yellow ; drupes oblong :
  3. Leaves 70-200 × 1.7-3 cm, male inflorescence not foetid ; stigma single ; fruits reddish  
... 1. *P. foetidus*
  - 3a. Leaves 60-90 × 3.5-6 cm ; male inflorescence not foetid ; stigma bifid ; fruits yellow  
... 4. *P. unguifer*

1. ***Pandanus foetidus*** Roxb., Hort. Beng. 71. 1814, Fl. Ind. (ed. Carey) 3: 742. 1832 ; Kurz in Journ. Bot. 5 : 101. t. 62 f. 4-6. 1867; Hook.f. in Hooker f., Fl. Brit. India 6 : 483. 1893 ; Warb. in Engler, Pflanze. IV. 9 (Heft 3) : 80. 1900 ; Prain, Beng. Pl. 1101, 1903 (Repr. Edn. 2 : 828. 1963) ; Braindis, Ind. Trees 658. 1906 ; Heinig. Enum. 1381. 1907 ; Haines, Bot. Bihar Orissa, part V : 877. 1924; Howes in Kew. Bull. 76. 1946 ; Fischer in Gamble, Fl. Pres. Madras 1570. 1931 (Repr. Edn. 3 : 1095) ; Mitra, Fl. Pl. East. India 1:88. 1958 ; Anon. Wealth of India 7:217. 1966 ; Bennet, Fl. Howrah dist. 24. 1979 ; Balakrishnan, Fl. Jowai 2 : 558. 1983 ; Deb, Fl. Tripura State 2:441. 1993 ; Guha-Bakshi, Fl. Murshidabad Dist. 333. 1984 ; Kartikeyan et al., Fl. Ind. Enum. Monocot. 178. 1989. *Frisquetia macrocarpa* Gaud., Bot. Voy bonite t. 4, f. 2-8. 1843.

*Hind : Keur Kanta ; Beng. : Keya Kanta, Kotki Kanta.*

Perennial, much branched dense shrub forming impenetrable thicket, 1.5-2 m high often with no proper stem at maturity. Leaves tristichous, linear, 70-200 × 1.7-3 cm, acuminate, marginal spinules distant, strongly upcurved and along the keel recurved. Perianth none. Male spikes : ensheathed with yellowish white or light yellow spatheaceous bract, at young stage foetid ; male flowers : stamens numerous, free ; filaments very short, conical at base ; anthers linear, 6.35-8.45 mm long, generally waved with a proliniferous groove in each side. Female spikes : with very numerous flowers, foetid ; female flowers : carpel one, lower half angular and upper half tapering into a very sharp subulate point ; on the underside of which stigma linear, as furrowed elevations, glandular, pale coloured. Syncarp drooping, solitary, oblong, variable in size, 5-10 × 3-6 cm,

echinate with most acute spiny points (remnant of stigma) of the drupes, reddish when fully ripe, fibrous fleshy; drupes oblong 2-3 cm × 6-8 mm, angular, longitudinally fibrous, not very hard, quite smooth, with two compartments—one upper and one lower; upper larger with soft white pith; lower with solitary seed; medianly single but firmly and closely connected by a pulpy gluten, terminating in a persistent stigma forming a rather long sharp spine.

*Chromosome no.* : Not known.

*Fl. & Fr.* : June - January.

*Distrib.* : Peninsular to north-east India, Assam, Bihar, Meghalaya, Mizoram, Tamil Nadu, Tripura, West Bengal between 0-1000 m. Myanmar

*Specimens examined* : ASSAM : Thlea Syringam (K. & J. hills) 90 m, *Kanjilal* 6317; Jharia forest, *Deka* 1521; Sohbha to Dowki, 85 m, *Balakrishnan* 46189; Dowki, *Deka* (Acc. No. 30997); MEGHALAYA : Jaraine forest, Jowai, *Mahata* 22815-22820; MIZORAM : Kheitung, *Deb* 31222; WEST BENGAL : Indian Botanic Garden, *Prain* (Acc. No. 495240-41) (CAL); cultivated in Indian Botanic Garden (Acc. No. 5325, 5329-5330) (CAL); Lower Bengal, *Kurz* (Acc. No. 5326) (CAL).

2. *Pandanus furcatus* Roxb., Hort. Beng. 71. 1814; Fl. Ind. (ed. Carey) 3 : 744; 1832; Hook.f. in Hook.f., Fl. Brit. India 6 : 484. 1893; Gamble, Trees, Shrubs and Climbers Darjeeling dist., Beng. (2nd Rev. Edn.) 87. 1896; Brandis, Ind. Trees 659. 1906; Fisher in Gamble, Fl. Pres. Madras 1570. 1931 (Repr. Edn. 3 : 1095. 1956); Burkill, Dictionary Econ. Product Malay Peninsula 2 : 1652. 1935; Mitra, Fl. Pl. East. India 1 : 89. 1958; Anon., Wealth of India 7 : 217. 1966; Stone in Dassanayeke and Fosberg, Rev. Handb. Fl. Karnataka Analysis 295. 1984; Kartikeyan *et al.*, Fl.

Ind. Enum. : Monocot. 178. 1989; Noltie, Fl. Bhutan 3(1) : 432. 1994.

*P. lias* Kurz in Tijdschr. Nederl. Ind. 27 : 218. 1864. *P. urophyllus* Hance in Jour. Bot. 13 : 68. 1875. *Rykia furcata* (Roxb.) De Vries in Kl. Akad. Vet. Verh. 203. 1854.

*Pandanus nepalensis* St. John *sensu* Ohashi, Fl. East. Himal. Report 3 : 165. 1975.

*Lep.* : Bor Kung; *Nep.* : Tarika; *Nish.* : Taku; *Sha.* : Pairumnang.

Perennial, strictly dioecious tree, 3-12 m high; main axis 15-30 cm diameter, dichotomously branched; aerial roots many, thick, arising from the lower part of the trunk. Leaves trifariously spiralled, ensiform, 2-6 × 5-9 cm, acuminate, margins and keel armed with sharp spinules; spinules of basal part of dorsal midrib retrorse, those at upper antrorse and at margin upcurved, keeled, drooping, dark green, clasping at base round the stem. Inflorescences terminal on normal shoots, pedunculate. Male spadices : many forming a compound spadix, 9-15 × 2-3 cm, spathe ensheathing each male spike *ca* 90 × 9 cm, with a spinulose 3-quetrous acumen at apex, golden yellow, not foetid; perianth none. Male flowers : many in close associations; stamens 3-5; filaments often connate into phalanges; anthers *ca* 5 cm long, 2-lobed, basifixed. Female spadix, 10-15 × 8-10 cm, spathe ensheathing each female spike (cephalium), oblong, abruptly acuminate; female spike : ellipsoid to oblong, composed of closely associated carpels; styles deeply forked. Syncarp usually solitary within a spathe, oblong, variable in size, 10-15 × 8-10 cm, orange red when fully ripe; drupe one-celled, 2-3 × 0.7-0.9 cm, cylindric obconic, with a convex crown; spine tip shining.

*Chromosome no.* : 2n = 60 (Mallick and Sharma, 1966).

*Fl. & Fr.* : May - February.

*Distrib.* : Eastern Himalaya ; Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Maharastra, Meghalaya, Manipur, Sikkim, Tripura, West Bengal between 0-2000 m. Bangladesh, Bhutan, Myanmar, Malayan Islands, Sri Lanka.

*Specimens examined* : ARUNACHAL PRADESH : Dreyi to Shoeling, 625-1200 m, Rao 10557 (CAL) ; Nilgning to Pangu, 481-762 m, Rao, 17669 (CAL) ; Tumbling to Kiak, 365-610 m, Rao 18001 (CAL) ; Petepool, Panigrahi 19673, 12539, 16794 (CAL) ; Naharlagaon, 530 m, Mahata 22804 (CAL) ; Gohpur road,  $\pm$  500 m, Mahata 22805 (CAL) ; MEGHALAYA : Nonghop, Joseph 45670 (CAL) ; Sharma 15819 MANIPUR : Chingmairung, 1000 m, Deb 125 (CAL) ; SIKKIM : Sikkim East district, Saramsa, 830 m, Hajra 621 ; Mazumdar and Dutta 229 (CAL) ; Rangpoh, 540 m, Mahata 22823, 22824 (CAL) ; Between Rongpoh and Singtam, 550 m, Mahata 22825 (CAL) ; WEST BENGAL : Tista Bridge, 152 m, Maheshwari 5020A, -B (CAL) ; Jalpaiguri, 39th Chote-Chinchula, 2000 m, Narayanaswami and Party 2821 (CAL) ; Jalpaiguri, Rajabghat, Khawa Depot road, Narayanaswami 2452 (CAL) ; Bengal and Borders : Dhamdhoom, 1000 m, Mukherjee 6155 (CAL).

3. *Pandanus odoratissimus* Linn.f. Suppl. Pl. 64. 1978 ; St. John in Taxon 12 : 201. 1963 ; Stone in Gard. Bull. Singapore 22 : 236. 1976 and in Dassanayake & Fosberg, Rev. Handb. Fl. Ceylon 3 : 311. 1981 ; Mathew, Fl. Tamil Nadu Carnatic 2 : 1680. 1983 ; Kartikeyan *et al.*, Fl. Ind. Enum. : Monocot. 178. 1989

*P. tectorius* auct. pl. non Solan ex Parkinson, J. Voy. H.M.S. End. 46. 1773.

*Keura odorifera* Forssk., Fl. Aegypt-Arab. 172. 1775.

*Pandanus odorifera* Forssk., O. Ktze, Rev. Gen. Pl. 2 : 737. 1918 (*nomen dubium*).

*P. fascicularis* Lam. Encycl. 1 : 372. 1783.

*Hind* : Kewoda ; *Beng.* : Keya, Keori, Ketuki ; *Khasi* : Tiew Lasubon.

Perennial, bushy shrub or small tree, ca 3-5 m, high ; branching di-or trichotomous or spreading irregularly. Leaves tristichious, spirally arranged, linear, ensiform, acuminate 80-100  $\times$  5-8 cm, coriaceous, with stout white prickles having brown tip ; prickless on margins pointing forward and those on dorsal midrib forward and backward, slightly curved ; clasping at base around stem. Perianth none. Male inflorescence : composed of 8-10 spike ; bracts white or cream coloured ; sweet scented. Male spikes : cylindric, 6-9 cm long, shortly stalked bearing numerous racemose phalanges ; stamens one to numerous ; filament short, free or connate ; anthers 2-celled, linear, briefly apiculate, white ; pollens spinulose, white. Female inflorescence : terminal, unbranched, with solitary spike (cephalium), with three rows of floral leaves, imbricate, present at equal distances, white, persistent at base of the young fruit ; cephalium receptacle with many phalanges ; each phalynx with few to many phalanges ; each phalynx with few to many carpels. Syncarpium ovoid, 14-30 cm long, 12-20 cm across (weighing 1.5-3.8 kg.), green or rich orange in colour ; phalanges penta- or hexagonal, those from cephalium base (peduncular end) always curved, shorten and with more carpels than those of lateral and apical parts of cephalium ; young phalanges greenish-white, later yellow, finally orange-reddish to vermilion ; mature phalanges free from each other but tightly crowded, eventually falling off from cephalium receptacle, leaving a penta- or hexagonal scar.

*Chromosome no.* :  $2n = 60$  (Ganguly, 1959 ; Mallick and Sharma, 1966 ; Cheah and



Fig. 1 : Mature fruit of *Pandanus odoratissimus* Linn. f. from Mausynram, Meghalaya.

Stone, 1971-73).

*Fl. & Fr.* : March to December,

*Distrib.* : Andaman and Nicobar Islands, Bihar, Goa, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Sikkim, Tamil Nadu, Tripura, West Bengal, upto 1500 m. China, Java, Malay Island, Mauritius, Myanmar, Polynesia.

*Specimens examined* : MAGHALAYA : Khasia hills, Barapani Experimental Garden (in

cultivation), Mahata 22806-22809 (CAL); on way to Cheerapunjee, Mahata 22810-22813 (CAL); Cheerapunjee, Mahata 22814 (CAL); Mausynram, Mahata 22821-22822 (CAL); SIKKIM : Rongpoh, 540 m (in cultivation) Mahata 22824 (CAL); TRIPURA : Muhuri, Deb 2160 (CAL); Agartala, 166-266 m, Debbarman 521 (CAL); WEST BENGAL : Indian Botanic Garden (Acc. No. 5328, 5331) (CAL); Indian Botanic Garden, St. John 26394 (CAL). (Fig. 1-3).



Fig. 3 : A natural plant community of *Pandanus odoratissimus* Linn. f. in Cheerapunjee, Meghalaya showing a male inflorescence.

4. *Pandanus unguifer* Hook.f. in Bot. Mag. t. 6347. 1878 ; Noltie, Fl. Bhutan 3(1) : 433. 1994.

*P. minor* Buch.-Ham. in Wall. Cat. 8592. 1828 (*nom. nud.*) ; Solms in Linnaea 42 : 18. 1878 ; Hook.f. in Hook.f. Fl. Brit. India 6 : 485. 1893.

*P. monodon* Balf. f. in Journ. Linn. Soc. Bot. 27 : 53. 1878. *Barrotia manodon* Gaud. Bot. Voy. Bonite t. 13.f. 15-24. 1843.

Perennial dioecious shrub forming a clump, ca 2 m high ; stems slender decumbent. Leaves lirate, 60-90 × 3.5-6 cm, more abruptly acuminate at apex, gradually narrowed towards base, teeth longer (ca 5 mm) on upper edge, more curved irregularly and widely spaced (over 2 cm apart near base). Inflorescences terminal on normal shoots, pedunculate terminal spike, ca 17 × 6 cm, ensheathed by spatheaceous bract, the lowest one 18 × 7 cm ; anthers 1.5-2 mm. Female inflorescences : terminal, single,



Fig. 2 : *Pandanus unguifer* Hook.f. : distribution restricted in N.E. India. Material deposited in BSI, Arunachal Field Station Herbarium.

ensheathed by floral leaves, the lowest one  $18 \times 5$  cm ; cephalium  $6-14 \times 5-9$  cm, yellow when ripe, brown when dry. Drupe oblong  $2-2.5$  cm  $\times$   $7-12$  mm, free apical part covered by a penta or hexagonal cap ; style persistent, simple, concave ; stigma spiny, bifid.

*Chromosome no.*: Not known.

*Fl. & Fr.* : November - March.

*Distrib.* : Eastern Himalaya, Arunachal Pradesh, Assam, Meghalaya, Tripura, Sikkim, West Bengal between 150-1550 m. Bhutan.

*Specimens examined* : ARUNACHAL

PRADESH : *Pramanik* 6433 ; Itanagar, 500 m (in cultivation), *Mahata* 22802 (CAL); ASSAM : Along railway line, Panigrahi 27828 (CAL) ; MEGHALAYA : Bhalukmara hills, *Kanjilal* 4682 ; Jowai, *Deka* 5035 (CAL) ; TRIPURA : Agartala, 166-266 m, *Debbarmann* 341 (CAL). (Fig.2).

#### DISCUSSION

The present work brings into light the 4 species of *Pandanus* from North east India. Although they occur mostly in the tropical regime but have a trend to establish in

subtropical regions, particularly so in case of *P. furcatus* and *P. unguifer*. Both *P. furcatus* and *P. odoratissimus* have a wide range of distribution spreading from Indian territory to Malesia through the eastern Himalaya, North-eastern hills and Myanmar. It was amazing to find the warmth-loving *P. odoratissimus* in the subtropical wet habit of Cheerapunjee and Mawsynram, the regions receiving the highest rainfall in the world. The distribution of *P. furcatus* is also very interesting. Although it is basically a resident of the eastern Himalaya and north-eastern Himalayan part it has representatives in Maharashtra, the Andaman and Nicobar Islands and in Sri Lanka. *P. foetidus* occurs almost in all warm parts of Peninsular India but also takes an interest to establish in north-eastern hilly region. *P. unguifer* deserves special mention since it remains confined only to the eastern Himalaya where they are often cultivated. *P. furcatus* and *P. unguifer* have so far remained unrepresented in taxonomic literature on Meghalaya (Balakrishnan, 1983). The chromosome number of *P. furcatus* and *P. odoratissimus* reflects a close affinity,  $2n$  being 60 in each case.

PANDANUS is of considerable economic importance (Anon, 1966). Fruits of *P. furcatus* are eaten in Sikkim (Rai & Rai, 1994) and leaves are woven into mats in Arunachal Pradesh. Fibers are obtained from leaves of *P. odoratissimus* and *P. foetidus* which are used for nets and cordage in Tripura (Deb, 1983.) Since *P. odoratissimus* has commercial use in the production of *Kewda attar*, *Kewda water* and *Kewda oil*, Northeast India can prove its worth as a potential source of this plant wealth. A sustainable utilization and simultaneous conservation is essential.

#### ACKNOWLEDGEMENTS

The authors are grateful to the Director, Botanical Survey of India and the Officers-in-

charge of Arunachal Field Station, Eastern Circle and Sikkim Himalayan Circle for affording herbarium, library and working facilities.

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