

PANDANACEAE

露兜树科 lu dou shu ke

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Trees, shrubs, or woody lianas, terrestrial, evergreen, dioecious. Stems simple or often bifurcately branched, ringed with persistent annular leaf scars, often producing adventitious prop roots; aerial roots present or absent. Vegetative reproduction by suckers present or absent. Leaves simple, numerous, spirally arranged at apex of stems and branches, sessile, linear to lanceolate, leathery, often lustrous or glaucous, glabrous, keeled abaxially, parallel veined, with numerous horizontal secondary veins, base open-sheathed and amplexicaul, margin and midrib abaxially often spinulose, apex often long acuminate. Male inflorescences axillary and terminal, compound, bracteate, comprising several-branched racemes or panicles with crowded flowers on spicate ultimate branches; spathes often enlarged at apex, white or colored. Perianth absent. Male flowers sessile (pedicellate in *Sararanga* Hemsley), with pistillode sometimes present; stamens numerous, fasciculate, arising on rachises or spadix branches; filaments smooth (*Pandanus*) or papillose (*Freycinetia*), seemingly branched; anthers basifixed, 2-celled with 4 pollen sacs, dehiscing by longitudinal slits, connective often apiculate; pollen grains often spinulose. Female inflorescences terminal, solitary or in spikes, racemes, or capitula, short, bracteate, with crowded flowers, often pendulous in fruit. Female flowers with or without staminodes; pistils free or aggregated and appressed to adjacent pistils forming 1- to many-carpelled phalanges or clusters; ovary superior, 1- to several locular; ovules solitary to numerous, anatropous, placentation basal or parietal; style absent or very short; stigmas 1 or more, subsessile, glandular-papillose. Fruit a berry (*Freycinetia*) or drupe (*Pandanus*), when drupaceous a multiple structure (syncarp) composed of 2–20 woody, or basally fleshy or fibrous, cylindric to globose, connate, free or often crowded and clustered carpels, each cluster of carpels termed a “phalange,” with mesocarp fibrous and often pithy or hollow above, fibrous and fleshy below; endocarp membranous or evanescent. Seeds 1 to numerous, minute, often fusiform; testa membranous (*Pandanus*) or crustose (*Freycinetia*); endosperm oily and fleshy, or starchy; strophiole originating from raphe sometimes present; embryo basal, minute; germination often epigeal.

Three genera and ca. 800 species: Old World tropics, several species introduced as economic or ornamental plants; two genera and seven species (one endemic, one introduced) in China.

See Stone (Blumea 16: 361–372. 1968; in J.-F. Leroy, Fl. Cambodge, Laos & Vietnam 20: 3–48. 1983; Bot. J. Linn. Soc. 97: 33–48. 1988).

Zhou Lingyun & Zhong Xiongwen. 1992. Pandanaceae. In: Sun Xiangzhong, ed., Fl. Reipubl. Popularis Sin. 8: 12–23.

- 1a. Stems present, climbing by aerial roots, often also with long, pendulous aerial roots not utilized in climbing; prop roots absent; male spadices usually 2–5, rarely solitary, simple, sometimes fleshy; connective of stamen not apiculate; filaments papillose; ovary 1-locular; carpels many ovuled; fruit a berry 1. *Freycinetia*
1b. Stems present or absent; often with aerial roots or prop roots or both; male spadices solitary, branched, thin, leathery; connective of stamen apiculate; filaments smooth; ovary 1–12-locular; carpels always 1-ovuled; fruit a drupe divided into phalanges 2. *Pandanus*

1. FREYCINETIA Gaudichaud, Ann. Sci. Nat. (Paris) 3: 509. 1824.

藤露兜树属 teng lu dou shu shu

Scrambling or climbing shrubs, rarely herbs; aerial roots present. Leaves ± densely crowded, linear or lanceolate, basally with membranous, marcescent or caducous sheath margins. Inflorescences terminal or lateral, consisting of pedunculate simple spadices (usually 2–5), arranged in an umbel or short raceme and initially enclosed by several crowded, 3-seriate, green or colored, caducous spathes. Flowers unisexual, rarely bisexual; perianth absent. Stamens densely congested on rachis. Ovaries densely congested on rachis, usually surrounded by minute staminodes, 1-locular; ovules numerous, congested on 2 or more parietal placentae; stigmas 2 or more, separate or confluent. Fruit a berry, with or without a hardened apex. Seeds numerous.

About 175 species: Sri Lanka to SE Asia, Australia, and Pacific islands; one species in China.

1. *Freycinetia formosana* Hemsley, Bull. Misc. Inform. Kew 1896: 166. 1896.

山露兜 shan lu dou

Freycinetia batanensis Martelli.

Lianas, scandent or scrambling. Stems procumbent or prostrate, to 10 m or longer. Branches with aerial roots, 0.5–5

cm wide, glabrous. Leaves elongate, linear-lanceolate, 10–60(–200) × 0.8–4 cm, leathery, base narrowed, margin sharply antrorsely spinulose toward tip and base, sometimes entire in upper part, with scattered spines along midvein abaxially, apex acuminate. Spadices 2–4, racemose, on stout peduncle ca. 5 cm; spathes yellow. Female peduncles 10–15 × 1.4–1.8 cm; spathes to 6 cm. Fruit syncarpous, globose, cylindric, or ovoid, 2.5–11 × 1.5–2 cm, composed of numerous dense drupes; drupes ovoid

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or irregularly angled with asymmetric edges, 0.5–1 × 0.4–1 cm. Seed cylindrical.

Thickets and cliffs near seashores. Taiwan [Japan (Ryukyu Islands), Philippines (Batan Island)].

Stone (Blumea 16: 369. 1968) observed that the Philippine taxon *Freycinetia batanensis* is a “mere” variety, “if not in fact synonym,” of *F. formosana*, and that *F. batanensis* differs from the Philippine

taxon *F. williamsii* Merrill in having a berry non-rostrate instead of rostrate. H. L. Li (Fl. Taiwan 5: 821. 1978) and other workers have recognized both *F. formosana* and *F. williamsii* as occurring in Taiwan, with *F. batanensis* included in the synonymy of *F. williamsii*, whereas we follow Stone in considering *F. batanensis* to be a synonym of *F. formosana*. According to Fl. Taiwan (loc. cit.) and FRPS (8: 13–14. 1992), *F. formosana* has leaves 60–90 × 2–3 cm and globose syncarps, whereas *F. williamsii* is smaller, with leaves 10–20 × 0.8–1.2 cm and with ovoid syncarps.

2. PANDANUS Parkinson, J. Voy. South Seas, 46. 1773.

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Trees, shrubs, or herbs, evergreen, dioecious. Stems simple or branched, erect or prostrate, often with stiltlike, verrucose prop roots and aerial roots, sometimes virtually absent, often suckering. Leaves simple, terminal, sessile, densely arranged in corkscrew spirals, 3- or 4-seriate, linear, often spinose-serrate on margin and on keeled midvein abaxially. Inflorescence of large, bracteate heads or spadices; perianth absent. Male inflorescence paniculate with spiciform branches subtended by secondary, usually colored, spathes, branches covered with numerous stamens; flowers not individually distinguishable. Female inflorescence of globose to cylindrical clusters or several-carpelled aggregates; flowers not individually distinguishable; carpels 1-ovuled; staminodes absent in female flower; placentation subbasal. Fruit a hard drupe, syncarpous, comprising an aggregation of individual connate, angled, fibrous phalanges; mesocarp sometimes hollow; exocarp fleshy; endocarp woody or bonelike; locules 1 or more; phalanges separating at maturity; stigma persistent, capitate. Seed solitary.

About 600 species: Old World tropics; six species (one endemic, one introduced) in China.

Pandanus utilis Bory, native to Madagascar and cultivated in China, unlike most other species, is both non-suckering and has reddish purple marginal spines (see FRPS 8: 23. 1992; Check List Hong Kong Pl. 297. 2002). *Pandanus boninensis* Warburg, native to Japan, is also cultivated in China (see FRPS 8: 23. 1992). *Pandanus utilis* and *P. boninensis* are cultivated at the Taiwan Forestry Research Institute, as is *P. pygmaeus* Thouars of the Mascarenes (pygmy plant ca. 40 cm).

1a. Herbs.

- 2a. Mature plants virtually sterile; leaf apex with 2 distinct lateral pleats and dense antrorse spines (prickles)
ca. 1 mm along pleats 1. *P. amaryllifolius*
- 2b. Mature plants fertile; leaf apex not laterally pleated and densely spinose.
- 3a. Leaves linear, 4–5 cm wide 2. *P. austrosinensis*
- 3b. Leaves narrowly linear, ca. 1.5 cm wide 3. *P. fibrosus*

1b. Trees or shrubs.

- 4a. Plants not suckering; leaves often glaucous abaxially; phalanges 4–12-locular; persistent stigma simple, not bifurcate 5. *P. tectorius*
- 4b. Plants suckering; leaves not glaucous abaxially; phalanges 1–3(or 4)-locular; persistent stigma simple or bifurcate.
- 5a. Phalanges 2- or 3-locular; persistent stigma not bifurcate 4. *P. kaida*
- 5b. Phalanges usually 1-locular; persistent stigma bifurcate 6. *P. urophyllus*

1. Pandanus amaryllifolius Roxburgh, Fl. Ind., ed. 1832, 3: 743. 1832.

香露兜 xiang lu dou

Pandanus latifolius Hasskarl (1842), not Perrot (1825); *P. odoratus* Ridley.

Herbs evergreen. Stems branched; aerial roots present. Sucker shoots of small growth phase with stems slender, 1–1.6 m × 2–5 cm, decumbent and ascending; leaves 25–75 × 2–5 cm, somewhat glaucous abaxially, keeled abaxially but unarmed, margin entire except at apex, there with very few minute prickles less than 1 mm, apex with distinct twin lateral pleats; flowers unknown, probably never produced in small growth phase. Large growth phase with stems 2–4.5 m × ca. 15 cm, erect, not or only sparsely branched; leaves broadly linear, to 150–220 × 7–9 cm, glaucous abaxially, keeled abaxially and with twin lateral pleats with prickles same as in small growth

phase, apex acute; female inflorescence unknown; male inflorescence (evidently exceedingly rare) probably pendent, to 60 cm; spathes ca. 90 cm; spikes cylindrical, to 35 cm or more, upper ones much shorter, 9–10 × ca. 2 cm, of numerous crowded, flat staminal phalanges 1.5–2.5 mm wide; stamens mostly 3–6 per phalange; filaments 0.5–1.5 × 0.4–0.6 mm; anthers oblong, ca. 2.5 × 0.5 mm, apex bluntly convex, without or with a barely discernible apiculum.

Cultivated. Hainan (Danxian, Xinglong) [Indonesia; cultivated in Indonesia (West Papua), Malaysia, Philippines, Sri Lanka, Thailand, and Vietnam].

The small growth phase, “perpetuated by continual harvesting of its leaves” (Stone, Econ. Bot. 32: 287. 1978), is cultivated for the musky aromatic leaves used in cooking, e.g., for scented rice.

Warburg (in Engler, Pflanzenz. 3(IV. 9): 87. 1900) and Backer and Bakhuizen van den Brink (Fl. Java 3: 205. 1968) noted that this species is known only from sterile (vegetative) specimens. A male flowering

collection from a "large growth phase" in Ternate, North Moluku, Indonesia, was later described by Stone (loc. cit.: 287). The description denoting two growth phases is from Stone (loc. cit.: 287).

2. *Pandanus austrosinensis* T. L. Wu, Fl. Hainan. 4: 535. 1977.

露兜草 lu dou cao

Pandanus austrosinensis var. *longifolius* L. Y. Zhou & X. W. Zhong.

Herbs evergreen. Stems underground branched, with numerous adventitious roots, stems terrestrial unbranched. Leaves linear, to 5 m × ca. 5 cm, subleathery, margin with hamate spine, midrib raised abaxially, sparsely spinose, apex acuminate to triangular, with small serrate flagelliform tip. Male inflorescence of spikes to 10 cm; stamens mostly 6; filaments connate in a fascicle below, free above, ca. 3.2 mm, inserted into peduncles, umbraculate; anthers linear, ca. 3 mm, introrse, midrib with keel abaxially and densely spinulose. Carpels numerous, free at apex, adnate to nearby carpels at base. Ovary 1-locular; ovule 1; style short; stigma entire or furcate. Syncarp ellipsoid-globose or subglobose, 10–18 × 5–12 cm, consisting of 250–300 drupes; pericarp of mature fruits becoming fibrous; drupes obconic, ca. 3.3 × 1.2 cm, 5- to 6-ridged; persistent stigma spinose. Fl. Apr–May.

• Forests, streamsides, roadsides. Guangdong, Guangxi, SW Hainan (Jianfeng Ling).

3. *Pandanus fibrosus* Gagnepain ex Humbert, Notul. Syst. (Paris) 6: 177. 1938.

小露兜 xiao lu dou

Pandanus gressittii B. C. Stone.

Herbs evergreen, or small shrubs. Stems branched. Leaves narrowly linear, to 62 × ca. 1.5 cm, margin and midrib abaxially spinose. Male inflorescences spicate, branched, 2–5 cm; spathes 3.5–14 × 0.6–2 cm, margin above middle spinulose or not; stamens 10–16, in filament bundles ca. 7 mm, free filaments at apex of filament bundles ca. 2 mm; anthers cylindrical, ca. 10 × 7 mm, small cusp of apex connective ca. 1.2 mm. Female inflorescences capitate, cylindrical, ca. 3 × 1.2 cm; spathes 10–24 × 1–4 cm, margin sparsely spinose or not; carpel 1, 1-locular; ovule 1, subbasal; stigma unbranched, ligulate, abaxially smooth, adaxially coarse. Syncarp ellipsoid or globose, ca. 6 × 3 cm, consisting of numerous drupes; drupes obconic, free after ripening, ca. 1.2 × 0.2–0.3 cm; persistent stigma spiny, simple. Fl. Apr–May.

Streamsides in forests, riversides. Hainan, Taiwan [Vietnam].

Stone (Fl. Cambodge, Laos & Vietnam 20: 40. 1983) considered *Pandanus gressittii* to be a synonym of *P. fibrosus*.

4. *Pandanus kaida* Kurz, J. Roy. Asiat. Soc. Bengal 38: 148. 1869.

勒古子 le gu zi

Pandanus forceps Martelli.

Shrubs or small trees. Stems branched, 1–3 m tall; aerial roots absent. Leaves linear, ca. 1(–4) m × 3–5 cm, margin and midvein spiny, apex acuminate, with long flagelliform tip. Male inflorescences consisting of several spikes, each spike ca. 10 cm; spathes in lower part ca. 45 × 4.5 cm; stamens usually 10, few male flowers with more than 20 stamens; filaments adnate beneath, ca. 7 mm, umbraculate, free filaments ca. 1 mm; anthers narrowly ellipsoid, ca. 3 × 0.7 mm, apex with small cusp ca. 0.5 mm. Female inflorescences capitate, paniculate, ca. 4 × 1.7 cm; spathes numerous, 14–20 × 2–3 cm; carpels 2 or 3 connate in a bundle, 2- or 3-locular; ovule 1 per locule; stigma short, with 2 serrate branches. Syncarp ellipsoid, consisting of ca. 150 phalanges; phalanges obconic, ca. 3 × 1.7 cm, projected part 5-angled above; persistent stigmas 2, branched, serrulate. Fl. May–Jun.

Seasides, stream banks, sunny low-lying areas, forests. Guangdong, Hainan [Vietnam].

Stone (Fl. Cambodge, Laos & Vietnam 20: 40. 1983) considered *Pandanus forceps* to be a synonym of *P. kaida*. Stone (Ceylon J. Sci., Biol. Sci. 11(2): 119. 1975) noted that *P. kaida* currently is known only in cultivation. The plants sometimes are used for hedges or living fences, and the young shoots are edible.

5. *Pandanus tectorius* Parkinson, J. Voy. South Seas, 46. 1773.

露兜树 lu dou shu

Pandanus fascicularis Lamarck; *P. odoratissimus* Linnaeus f. var. *sinensis* (Warburg) Kanehira; *P. remotus* H. St. John; *P. sinensis* (Warburg) Martelli; *P. tectorius* var. *sinensis* Warburg.

Trees or shrubs, 3–10 m. Stems erect or ascending, many branched, non-suckering; prop roots present or absent; numerous aerial roots often present. Leaves green, often glaucous abaxially, linear-ensiform, to 180 × 10 cm, spinose-serrate on margin and midvein abaxially, apex abruptly long acuminate. Male inflorescence to 60 cm, pedunculate, paniculately compound with ultimate spiciform branches; spathes 13–18, white, narrowly lanceolate, 10–60 × 1.5–4 cm, serrate on margin and midvein; spikes pendulous, 8–20 mm; stamens 10(–25), racemously fasciculate; filaments connate below, 1–3 mm; anthers linear, ca. 3 × 0.6 mm, connective mucronate. Female inflorescence capitate, solitary, globose to ovoid-ellipsoid, 10–25 cm; spathes numerous, white, 15–30 × 1.4–2.5 cm, margin serrate; ovule 1 per locule. Syncarp pendulous, globose or cylindrical, to 17 × 15 cm; phalanges 40–80 per aggregate-head, each phalange comprising 4–12 fused obconic carpels connate below and free above, fragrant, yellow to orange to yellowish brown from base to apex, 4–10 × 1–6.5 cm; carpel apices distinct, flattened or angled, tuberculate; persistent stigma subsessile, slightly protruded. Fl. Jan–May, fr. Oct.

Seashores, sandy beaches. Fujian, Guangdong, Guangxi, Guizhou, Hainan, Taiwan, Yunnan [SE Asia, tropical Australia, Pacific islands (Polynesia)].

Pandanus tectorius sometimes is used as a living fence, and the leaves are used for weaving.

According to FRPS (8: 20. 1992), *Pandanus tectorius* var. *sinensis* (a variety not accepted in this treatment on the authority of Stone, Fl.

Cambodge, Laos & Vietnam 20: 24. 1983) occurs on seaside beaches in Guangdong, Guangxi, Hainan, and Taiwan and differs from the typical variety in having leaves narrower, attenuate into a long flagelliform apex, to 15 cm; ovary (4 or)5- or 6(or 7)-locular; and syncarp smaller, globose, ca. 8 × 8 cm, consisting of 50–60 phalanges, each phalange ca. 2.5 × 2 cm. Stone (loc. cit.) considered *P. tectorius* var. *sinensis*, with phalanges ca. 3.5 × 4 cm, to be a synonym of *P. odoratissimus*, with phalanges 3–8 × 2.5–4.5 cm. The correct name of this taxon has long been controversial (see Martelli, “*Pandanus odoratissimus*” o “*Pandanus tectorius*”? Nuovo Giorn. Bot. Ital., n.s. 36: 329–337. 1929). Stone (Bot. J. Linn. Soc. 97: 36–38. 1988) reinstated *P. tectorius*, reversing his former acceptance of *P. odoratissimus* (Fl. Cambodge, Laos & Vietnam 20: 23. 1983). The type specimen of *P. remotus*, a name synonymized by Stone (loc. cit.: 24), is from Hong Kong (Shek O).

Stone (Bot. J. Linn. Soc. 97: 46–47. 1988) noted that there are “variegated-leaf mutants of *P. tectorius*, known in horticulture variously as *P. sanderi* and *P. veitchii* ... (which can back-mutate to all green leaf forms).” The mutant (cultivar) *P. sanderi* Masters is cultivated as an ornamental in Hong Kong (see Check List Hong Kong Pl. 297. 2002). Its leaves have yellow or golden longitudinal marginal stripes. *Pandanus veitchii* Masters & T. Moore is cultivated at the Taiwan Forestry Research Institute. Its leaves have white or silvery marginal stripes.

6. *Pandanus urophyllus* Hance, J. Bot. 13: 68. 1875.

分叉露兜 fen cha lu dou

Trees, 7–13 m tall. Stems simple or branched at apex;

aerial roots present. Leaves clustered at apex of stem; blade linear, 1–4.2 m × 2–11 cm, leathery, abaxially sparsely spinose along midrib, margin densely serrate with incurved spines, apex incurved, flagelliform and triangular caudate. Male inflorescences consisting of several spikes; spikes golden yellow, terete, 10–15 cm; spathes ca. 1 m × 10 cm; male flowers numerous; stamens 3–14 per bundle, aggregated at apex of stalked filaments; anthers linear, ca. 5 mm, apex of connective with long, curved, aristiform cusp. Female inflorescence pendulous on peduncle, capitate, to 80 × 3 cm, with ca. 15 spathes; female flowers with 1 carpel, rarely 2; stigma bifurcate and curved. Fruit solitary or in racemes, reddish brown or orange-red, cylindrical to ellipsoid, to 23 × 12 cm; drupes connate, obconic-pyramidal; exocarp fleshy, sweet; styles bony, spiny, projected part of apex pyramidal, 1- or 2-locular; persistent stigma 2- or 3-furcate. Fl. Aug.

Riversides, streamsides in forests, also cultivated as hedges and living fences. Guangdong, Guangxi, Xizang, Yunnan [India (Sikkim), Vietnam].

In FRPS (8: 15. 1992), *Pandanus urophyllus* was treated as a synonym of *P. furcatus* Roxburgh. We follow Stone (Fl. Cambodge, Laos & Vietnam 20: 34–35. 1983) in maintaining *P. urophyllus* as a distinct species.

The leaves are used to make raincoats. The roots are used medicinally (FRPS 8: 15. 1992), but details are lacking.