

TAXONOMIC REVISION OF THE SUBFAMILY STERCULIOIDEAE BEILSCHM. IN BANGLADESH

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Keywords: Sterculioideae; Systematics; Taxonomic treatment; Malvaceae; Bangladesh.

Abstract

The subfamily Sterculioideae Beilschm. of Malvaceae has been revised for Bangladesh which revealed 16 taxa belonging to five genera, such as *Firmiana* Marsili, *Heritiera* Ait., *Pterygota* Schott & Endl., *Scaphium* Schott & Endl. and *Sterculia* L. The genus *Sterculia* is unveiled with the highest number of taxa, whereas both *Pterygota* and *Scaphium* are represented with single taxon. Dichotomous bracketed keys to genera and species are constructed for easy identification. Each taxon is presented with an updated nomenclature, description of the taxa along with illustrations, specimens examined, phenology, notes on distribution and economical importance. In most cases, chromosome number has been provided.

Introduction

Understanding on the diversity and inter-relationships of plant life is based primarily upon the comparative data of revisionary studies (Stuessy, 1975). The process of undertaking a taxonomic revision is central to taxonomy. A revision involves restudy of a group to correct or improve its diagnosis, description or phylogeny. Taxonomic revision helps to update the system of classification as taxa are often subjected to phenotypic plasticity (Baur *et al.*, 2014). Sterculioideae Beilschm. is one of the nine subfamilies of Malvaceae representing 13 genera and around 430 species worldwide (Wilkie *et al.*, 2006; APG IV, 2016). These 13 genera have been distributed in four major clades (APG IV, 2016), such as (a) *Cola* clade incorporating *Cola* Schott & Endl., *Octolobus* Welw., *Pterygota* Schott & Endl., *Hildegardia* Schott & Endl., *Firmiana* Marsili, *Scaphium* Schott & Endl. and *Pterocymbium* R.Br.; (b) *Heritiera* clade incorporating the only genus *Heritiera* Ait.; (c) *Sterculia* clade including the single genus *Sterculia* L.; (d) *Brachychiton* clade incorporating *Brachychiton* Schott & Endl., *Acropogon* Schltr., *Argyrodendron* Klotzsch and *Franciscodendron* B. Hyland & Steenis (Wilkie, 2006). According to Bentham and Hooker (1883), all these 13 genera belong to the order Malvales of the series Thalamiflorae, subclass Polypetalae under the class Dicotyledonae of the Kingdom Phanerogamia. Schumann (1890) classified all these genera under the order Malvales of the subclass Archichlamydeae. Archichlamydeae was grouped along with another subclass Metachlamydeae under the class Dicotyledonae of the subdivision Angiospermae which was incorporated into the division Embryophyta. Later, Hutchinson (1959) placed them under the order Tiliales of the division Lignosae of the sub-phylum Dicotyledones and phylum Angiospermae. Subsequently, Cronquist (1981) grouped them under the order Malvales of the superorder Malvanae, and the subclass Dilleniidae of the class Magnoliopsida. The presence of sheath cells in Sterculioideae are unique within Malvaceae *sensu lato* (Chattaway, 1932, 1938).

Members of Sterculioideae has a pan-tropical distribution, being found in New Caledonia and other Pacific islands, Australasia, South, South-east and East Asia, Madagascar, tropical Africa, Central America, the Caribbean and tropical South America with most diversely disbursed in

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South-east Asia (Wilkie, 2006). This subfamily harbors a good number of economically and medicinally important species. *Heritiera fomes* Buch.-Ham is a dominant species of Sundarban Mangrove Forest that shows special ecologically adaptive features and medicinal properties (Mahmud *et al.*, 2014). Timbers obtained from *Heritiera fomes*, *Sterculia hamiltonii* (Kuntze) Adleb. are used for electric poles, posts and ridge plates (Alam, 2018). *Firmiana colorata* (Roxb.) R. Br., *Sterculia villosa* Roxb. and some other members are economically important for their use as avenue tree (Uddin *et al.*, 2021). *Pterygota alata* (Roxb.) R.Br., *Sterculia villosa*, and *Firmiana colorata* are profusely used in traditional medicine for their significant medicinal values (Al Muqarrabun *et al.*, 2015). Hooker (1874) reported seven species of Sterculioideae from the present territory of Bangladesh, and Prain (1903) documented five species from the current boundary of the country. Though several sporadic studies were carried out by different workers (Heinig, 1925; Raizada, 1941; Datta and Mitra, 1953; Sinclair, 1956; Ahmed *et al.*, 2009; Rahman *et al.*, 2012; Alam, 2018), however, taxonomic revision of the subfamily Sterculioideae has not been carried out in Bangladesh. Therefore, the current investigation aimed to revise the subfamily Sterculioideae in Bangladesh for the first time.

Materials and Methods

A total of 25 field trips were conducted for collecting plant specimens from various parts of Bangladesh, covering all the seasons. The collected plant specimens were critically studied and identified. Identifications were confirmed by consulting standard literatures (Hooker, 1874; Prain, 1903; Ahmed *et al.*, 2009; Wilkie and Ahmad, 2011; Rahman *et al.*, 2012; Alam, 2018). Specimens of Sterculioideae housed at Dhaka University Salar Khan Herbarium (DUSH), Bangladesh National Herbarium (DACB), Herbarium of Chittagong University (HCU) and Bangladesh Forest Research Institute Herbarium (BFRIH) were also studied and examined critically. Dichotomous bracketed keys to genera and species are constructed for ease of use. Nomenclature has been updated using standard recent Floras and authentic web-based data (<https://theplantlist.org>; <https://powo.science.kew.org>; <https://tropicos.org>; <https://gbif.org>; <https://www.ipni.org>). Each taxon is presented with detailed taxonomic description along with updated nomenclature, important synonyms, English and vernacular names, Flowering and fruiting period, Specimens examined, Chromosome number, Habitat, Distribution, Economic values and Illustrations (whenever possible). The taxa are arranged in an alphabetical order. Voucher specimens have been prepared following standard herbarium techniques (Hyland, 1972) and deposited at Dhaka University Salar Khan Herbarium (DUSH).

Results

Taxonomic Treatment

Sterculioideae is characterized by apetalous, exinvolucellate flowers with a fleshy, usually petaloid, gamosepalous calyx, absence of staminodes (estaminodes), monadelphous staminal column, androgynophore and apocarpous ovaries.

Sterculioideae is represented by 5 genera and 16 species in Bangladesh.

Key to genera of the subfamily Sterculioideae

- | | | |
|---|--|------------------|
| 1 | Leaves compound. | <i>Sterculia</i> |
| - | Leaves simple. | 2 |
| 2 | Fruits samara, 1-seeded, indehiscent; keels prominent. | <i>Heritiera</i> |
| - | Fruits follicles, 1 to many seeded, dehiscent; keels absent. | 3 |

- | | | |
|---|---|------------------|
| 3 | Fruits woody; seeds long winged. | <i>Pterygota</i> |
| - | Fruits membranous; seeds wingless. | 4 |
| 4 | Seeds 2-4, borne on margin of carpels; leaves palmately lobed. | <i>Firmiana</i> |
| - | Seeds solitary, not borne on margin of carpels; leaves not palmately lobed. | <i>Scaphium</i> |

FIRMIANA Marsili

In Saggi, Sci. Acad. Padova 1: 114, 116 (1786); Miquel, Fl. Ind. Bat. 1: 178 (1859); Benth. & Hook. f., Gen. Pl. 1: 218 (1862); K. Schumann in Engler & Prantl, Nat. Pflanzenfam. 3: 97 (1895); Hutch., Gen. Fl. Pl. 2: 519 (1967); *Erythropsis* Lind., Melet. Bot.: 33 (1832); Ridley, FMP 1: 277 (1922); *Sterculia* sect. *Firmiana* (Marsili) Mast. in Hook. f., Fl. Brit. Ind. 1: 359 (1874); King. J. As. Soc. Beng. 60: 60 (1891).

Trees or shrubs, deciduous. Leaves simple, palmately 3–5-lobed or entire. Inflorescence paniculate or rarely racemose, axillary or terminal. Flowers unisexual or polygamous, sometimes appearing before leaves. Calyx orange-red or golden, funnel-shaped or cylindrical, (4 or) 5-lobed or -partite, lobes short or divided nearly to base, reflexed. Petals absent. Male flowers with stamens 10–20, in capitate cluster at apex of androgynophore; anther 2-celled, anther cells curved; undeveloped pistil present. Female flowers with ovary 5-locular, ovoid or globose; styles basally connate; stigmas as many as carpels; ovules 2 to many per locule. Follicles stipitate, endocarp membranous, dehiscent long before maturity, foliaceous. Seeds 1 to many per follicle, globose, endosperm flat or plicate.

Key to species of *Firmiana*

- | | | |
|---|---|--------------------|
| 1 | Flowering when leafless; calyx lobes much shorter than tube. | <i>F. colorata</i> |
| - | Flowering with leaves present; calyx lobes much longer than tube. | <i>F. simplex</i> |

Firmiana colorata (Roxb.) R. Br. in Bennet & R. Br., Pl. Jav. Rar.: 235 (1844); Abedin and Ghafoor in Nasir & Ali (eds.), Fl. W. Pak. 99: 22 (1976); Malick in Sharma & Sanjappa, Fl. India 3: 420 (1993); Verdcourt in Dassanayake *et al.*, Rev. Handb. Fl. Ceyl. 9: 437 (1995); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 333 (2009). *Sterculia rubicunda* Wall., Numer. List [Wallich]: 1119 (1829); *Erythropsis roxburghiana* Schott & Endl., Melet. Bot.: 33 (1832); *Clompanus colorata* (Roxb.) Kuntze, Revis. Gen. Pl. 1: 78 (1891); *Stercuila colorata* Roxb., Pl. Corom. 1: 26, t. 25 (1795); Mast. in Hook. f., Fl. Brit. Ind. 1: 359 (1874); Prain, Beng. Pl. 1: 187 (1903); *Firmiana rubriflora* Kosterm., Reinwardtia 6: 293 (1962). **(Fig. 1).**

Vernacular names: Faisaudal, Budula, Ujal, Udal, Patagota, Deo Udal, Tey Udal (Chakma), Krasan-Baing (Marma), Silkamlambar, Sikalemak Gach (Tripura).

English name: The Coloured Sterculia.

A medium-sized, spreading, deciduous tree with a height of up to 15 m. Stem fluted, juvenile shoots covered with grayish stellate hairs. Branchlets sometimes grey-black at the time of desiccation. Bark smooth, very fibrous. Leaves 12–25 cm long and nearly as broad, crowded at the end of branchlets, palmately 3–5 lobed, lobes triangular, acuminate, leaves sometimes unlobed on adult trees, palmately 5–7 veined, glabrescent on adaxial and abaxial surfaces, base deeply cordate, petiolate, petioles 7–15 cm long. Flowers scarlet or orange-red, solitary or in clusters of 2–3 short panicles from the axils of fallen leaves, polygamous, the whole inflorescence densely covered with orange-red or dark brown stellate hairs. Sepals 5, calyx broadly tubular or funnel-shaped, slightly curved, toothed, abaxially densely stellate puberulent with orange hairs, adaxially densely stellate

puberulent, lobes ovate-triangular, ca. 4 mm, apex acute. Petals absent. Androgynophore present, 5-10 mm long, exserted, filamentous short, anthers 10, locules curved. Ovary superior, 5-locular, flask-shaped, glabrous; styles 5, free, short; stigma curved outward. Fruit a follicle, 8-11 x 3-5 cm, oblong with acute apex, follicle stalked, red or purple when mature, foliaceous, tongue-shaped, with apparent venation. Seeds 2, yellow, wrinkled or smooth, globose or ovoid, ca. 1 cm long, ca. 6 mm in diameter.

Flowering and fruiting: March-June.

Chromosome number: $2n = 40$ (Kumar and Subramaniam, 1986).

Ecology: The species occurs usually in mixed forests at high elevations and hilltops.

Representative specimens: **Bandarban**: Keokradong, Darjilingpara, 27 Mar 2019, Khandakar Kamrul Islam KKI 3582 (DACB). **Chittagong**: Raimalong hill, 6 Apr 1947, S.M. *et* Harley *s.n.* (DUSH); Dhurung, 23 Apr 1980, M.K. Alam *et* D.K. Das 3901 (BFRIH); Russian Hill, 17 Mar 1982, Nashu *et al.* 4243 (BFRIH); Chunati, 27 Mar 1998, M.A. Rahman *et al.* 2566 (HCU); Hathazari, Mithachara, 19 Mar 1999, M.A. Rahman 4717 (HCU); Chittagong University Botanical Garden, 9 Oct 2010, M.A. Rahman 7129 (HCU); Dudhpukuria-Dhopachori Wildlife Sanctuary, 13 Jun 2022, Sunzid 65 (DUSH). **Cox's Bazar**: Chakaria, Dulahazra, Bangabandhu Safari Park, 23 Jan 2017, Niyamul Kabir *et al.* NK 3207 (DACB). **Dhaka**: Sreepur, 20 Mar 1964, D.K. Das FRL348 (BFRIH). **Jamalpur**: Gandhigaon, Gajni forest, 5 May 1982, Mia *et al.* M. 695 (DACB). **Khagrachari**: Mong-Ro-Para, 10 Jan 1989, M.K. Alam EB 111 (BFRIH). **Mymensingh**: Barta, 12 Feb 1959, M.S. Khan K. 342 (DUSH). **Patuakhali**: Andhermanik River, 21 Apr 1960, Davidson *et al.* 129 (BFRIH). **Rangamati**: Pablakhali, 27 Apr 1965, D.K. Das *s.n.* (BFRIH). **Sylhet**: Satgaon forest, 8 Feb 1967, P. Bhattacharjee 155 (DUSH). **Tangail**: Madhupur, 29 Mar 1988, A.M. Huq 78 (DACB).

Global distribution: Bhutan, Bangladesh, Brazil, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand and Viet Nam.

Economic aspects: Fresh young seeds with an almond flavor are edible. In the Chittagong district of Bangladesh, the bark generates cordage that is used to tie animals and goats. The Chittagong Hill Tracts tribal people use the bark to manufacture bamboo basket straps called "Turung" which they wear on their foreheads. Ethnic people use this plant as a remedy to cholera for its promising anti-diarrheal activities. Besides that, some other diseases and disorders like hysteria, jaundice, urine infection, stomach ache, seminal emission, and spermaturia can be treated using this plant (Ashrafuzzaman and Sarwar, 2021).

Firmiana simplex (L.) W. Wight, Bull. Bur. Pl. Industr. U.S.D.A. 142: 67 (1909); Meyer, Chin. Pl. Names: 20 (1911); Merrill, Enum. Philip. Fl. Pl. 3: 56 (1922); Cheo, Crypt. China. 1: 141 (1931); Crossley, An Eva. Rec. Gen. Rec.: 23 (1977). *Hibiscus simplex* L., Sp. Pl. ed. 2: 977 (1763). *Sterculia urens* Roxb., Pl. Coromandel 1: 25, t. 24 (1795). *Cavallium urens* Schott & Endl., Melet.: 33 (1832); *Kavalama urens* (Roxb.) Raf., Sylva Tellur.: 72 (1838); *Clompanus urens* (Roxb.) Kuntze, Revis. Gen. Pl. 1: 78 (1891).

Vernacular name: Not known.

English name: Not known.

A soft wooded deciduous tree, up to 15 m tall. Bark white papery or greenish, smooth on the outer surface. Twigs glabrescent with distinct raised leaf scars and lenticels. Leaves crowded at the end of branchlets, palmately 3-5 lobed, coriaceous, hairy on lower surface, 12-20 x 10-20 cm, acuminate to cuspidate at the apex, deeply cordate at the base, usually 5-nerved from the base; petiolate; petioles very long, up to 20 cm; stipules narrowly lanceolate, caducous. Inflorescence

terminal, many flowered, 10-18 cm long, glandular, pubescent. Flowers small, yellow, pedicellate, pedicels ca. 4 mm long, sometimes equal to the length of calyx. Calyx 5-lobed, campanulate, lobes oblong or narrowly triangular, 4-8 x 3-5 mm, twisted outward, abaxially puberulent or yellowish, adaxially villous only basally, calyx tube as long as lobes. Male flowers with androgynophore as long as calyx, thicker in lower part, glabrous. Stamens 10; anthers sessile; staminodes present, 10. Female flowers with 5-6 ovary, ovoid in shape and hairy; style hairy; stigma 5-6 lobed, recurved. Fruit a follicle, 2-6, oblong, ellipsoid or kidney-shaped, 4-6 cm long and 1-2 cm broad when young, densely rusty, pubescent. Seeds 3-6, oblong to ellipsoid, sometimes globose, 7 mm in diameter, wrinkled, black.

Flowering and fruiting: October-February.

Chromosome number: $2n = 40$ (Raghavan and Arora, 1958).

Ecology: The species usually occurs in mixed deciduous forests.

Representative specimens: No specimen was available in any herbarium of Bangladesh.

Global distribution: Bangladesh, China, Cambodia, India, Japan, Sri Lanka, Taiwan, Thailand, United States of America and Viet Nam.



Fig. 1. *Firmiana colorata* (Roxb.) R. Br.: A. Habit (x 0.2); B. Fruits (x 0.2).

Economic aspects: The species has been widely employed in the pharmaceutical, health-care, food, cosmetics, waste management, paper-textile, composite fiber, and leather sectors. Because the gum exudate, this tree has a high market value, it is popularly referred to as the 'Karaya Gum' tree. Because of its natural availability, economic effectiveness, non-hazardous nature, quick recovery, and physicochemical qualities, karaya gum polymers are an excellent alternative to synthetic ones. Furthermore, tribal communities use the tree for its indigenous cures for oligospermia, leucorrhoea, constipation, body swelling, throat infection, wound healing, and other diseases. Also, the presence of diverse bioactive compounds has made this plant an excellent source to conduct research on Computer Aided Drug Designing (CADD) (Dhiman *et al.*, 2019).

HERITIERA Ait.

Hort. Kew. 3: 456 (1789); Miquel, Fl. Ind. Bat. 1: 179 (1859); Benth. & Hook. f., Gen. Pl. 1: 219 (1862); Mast. *in* Hook. f., Fl. Brit. Ind. 1: 362 (1874); King, J. As. Soc. Beng. 60: 79 (1891); Kostermans, Publ. Coun. Sci. Ind. 1: 3 (1959); Backer & Bakhuizen f., FJ 1: 415 (1964); Smythies, CST: 127 (1965); Cockburn, TS 1: 228 (1976); Turner, Gard. Bull. Sing. 47: 475 (1996); Phengkklai, Fl. Thailand 7 (3): 573 (2001); *Tarrietia* Blume, Bijdr. Fl. Ned. Ind.: 227 (1825).

Trees, usually with buttress. Leaves alternate, simple or palmately compound, abaxially usually scaly. Inflorescence cymose, paniculate, axillary, many-flowered, hairy or scaly. Flowers unisexual. Calyx campanulate or urceolate, 4–6-lobed. Petals absent. Male flowers with short androgynophore. Anthers 4–15, in 1 or 2 rings at apex of androgynophore, with pistillode. Female flowers with ovary with 3–5 coherent carpels, base with sterile anthers; ovules 1 per carpel. Style very short; stigma very small. Fruit woody or leathery, with keel-like prominence or wing, indehiscent. Seeds without endosperm.

Key to species of *Heritiera*

- | | | |
|---|--|-----------------------|
| 1 | Samara with a longitudinal ridge; leaves with faint secondary nerves and veins. | 2 |
| - | Samara winged or wing-like; leaves with prominent secondary nerves and veins. | 3 |
| 2 | Fruit body up to 2 x 1 cm; epicarp dull; pistil and stamens on a slender column with parallel sides. | <i>H. fomes</i> |
| - | Fruit body not less than 5 x 3 cm; epicarp shining; pistil and stamens on a based column, narrowly in the distal half. | <i>H. littoralis</i> |
| 3 | Leaves with 8-11 pairs of lateral nerves; anthers irregularly clumped on androgynophores. | <i>H. macrophylla</i> |
| - | Leaves with 4-5 pairs of lateral nerves; anthers in regular rings on androgynophores. | <i>H. papilio</i> |

Heritiera fomes Buch.-Ham. *in* Symes, Embassy Ava ed. 2, 3: 319, t. 28 (1800); Mast. *in* Hook. f., Fl. Brit. Ind. 1: 363 (1874); Balfour, Cycl. Ind. East. South. Asia 3: 885 (1885); Winkler, Botanis. Hilfs. Pflanz. : 139 (1912); Heinig, List Pl. Chitt. Coll. & HT.: 7 (1925); Sinclair, Bull. Bot. Soc. Beng. 9(2): 88 (1955); Malick in Sharma & Sanjappa (eds.), Fl. India 3: 428 (1993); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 336 (2009). *Heritiera minor* (Gaertn.) Roxb., Hort. Bengal.: 50 (1814); *Fometica punctata* Raf., Syl. Tellur. :75 (1838); *Amygdalus minor* (Roxb.) Kuntze, Revis. Gen. Pl. 1: 75 (1891). (Fig. 2).

Vernacular names: Sundari, Sunder.

English name: Sundri.

A medium-sized evergreen tree, 15-18 m tall, branchlets lepidote, bark grey. Leaves simple, alternate, 10-17 x 3-6 cm, elliptic-lanceolate, tapering to rounded at the base, acute or rounded and mucronate at the apex, glabrous above, adpressed scaly beneath, petioles up to 2 cm long. Flowers small, unisexual, in axillary panicles. Sepals 5 or rarely 4-6 toothed, stellate-hairy inside. Petals absent. Male flowers with 5-10 stamens, united in a column with a ring of 2-celled anthers at the apex. Female flowers with 4-6 carpels, almost free, styles short, stigmas 5 thick, ovule solitary in each carpel. Fruit a cluster of woody, indehiscent, keeled or winged ripe carpel. Seed solitary without vivipary but can float on the tidal water.



Fig. 2. *Heritiera fomes* Buch.-Ham.: A. Habit (x 0.4); B. Flower (x 1.5).

Flowering and fruiting: September-December.

Chromosome number: $2n = 38$ (Das *et al.*, 1995).

Ecology: Moderately saline zone, well-drained soil inundated by tidal water of low salinity. Although it is a mangrove species, it can tolerate the conditions of higher altitudes (Ahmed *et al.*, 2009).

Representative specimens: **Bagerhat:** Mongla, Hiron-point, 3 Feb 1987, A.M. Huq *et al.* M.K. Mia H. 8128 (DACB); **Barguna:** Patharhat, 20 Mar 1989, Huq *et al.* 9187 (DACB); Taltoli, Tangragiri, 15 Oct 2019, Dr. M Sultana DMS 3056 (DACB). **Cox's Bazar:** Chakaria, Palakata beat, 24 Apr 1966, D.K. Das FRL89 (BFRIH); Chokoria Sundarban, 27 Apr 2014, Shahrar Ahmed 50 (HCU); Chakaria, 27 Apr 2014, Md. Dulal Uddin 1 (HCU). **Dhaka:** Dhaka University Botanical Garden, 17 Aug 1953, Md. Shahjahan *s.n.* (DUSH); Dhaka University Botanical Garden, 30 Nov 2021, Sunzid 39 (DUSH). **Khulna:** Sarankhola range, 9 Mar 1963, D.K. Das FRL305 (BFRIH); Sundarbans, tidal forest, 20 Jun 1966 (DUSH), M. Ismail & M. Bhowmik 180 (DUSH); Bhadra, Sundarbans, 23 Mar 1970, M.S. Khan K. 1919 (DUSH); Sundarbans, Jongra, Chota basta beel area, 5 Nov 2001, S.N. Uddin *et al.* Dr. Floris Deodatus N. 1151 (DACB). **Satkhira:** Sundarban, Burigualini, 11 Dec 1989, Huq *et al.* H. 9368 (DACB); Sundarbans, Noxabaki, 20 Aug 2002, S.N. Uddin N. 1360 (DACB).

Global distribution: Bangladesh, India, Myanmar and Thailand.

Economic aspects: The plant is used by traditional health practitioners to treat diabetes, hepatic disorders, gastrointestinal disorders, goiter, and skin diseases. It has potent antioxidant, antinociceptive, antihyperglycemic, antibacterial, and anticancer properties. Important chemical ingredients such as saponins, alkaloids, glycosides, tannins, steroids, flavonoids, gums, phytosterols, and reducing sugars have been discovered through phytochemical investigations. Twigs are used in the treatment of oral infections and toothache. Hot decoction of bark is used to get relief from goiter and diabetes. Decoction of leaves and seeds have efficacy to treat various gastrointestinal disorders (Mahmud *et al.*, 2014).

Heritiera littoralis Dryand. in Ait., Hort. Kew. ed. 1, 3: 546 (1789); Mast. in Hook. f., Fl. Brit. Ind. 1: 363 (1874); Ridl., Fl. Mal. Pen. 1: 279 (1922); Craib, Fl. Siam. Enum. 1: 170 (1925); Kosterm., Reinwardtia 4: 490 (1959); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 337 (2009). ***Balanopteris minor*** Gaertn., Fruct. Sem. Pl. 2: 94 (1790); ***Balanopteris tothila*** Gaertn., Fruct. Sem. Pl. 2: 94 (1790); ***Sutherlandia littoralis*** (Aiton) J.F. Gmel., Syst. Nat. ed. 13: 1027 (1792); ***Samadera littoralis*** (Aiton) Oken, Allg. Naturgesch. 3(2): 1205 (1841); ***Systemon fischeri*** Regel, Ind. Semin. 1856: 38 (1856); ***Heritiera fischeri*** Regel & Rach, Ind. Semin. 1858: 45 (1859); ***Amygdalus littoralis*** (Aiton) Kuntze, Revis. Gen. Pl. 1: 75 (1891). **(Fig. 3).**

Vernacular names: Sundri, Aina.

English names: Looking Glass Tree, Looking Glass Mangrove.

Evergreen trees, up to 10-15 m tall; bark grayish-brown, sometimes pinkish-grey, vertically and superficially fissured, rough or smooth, inner bark brown-pink. Sapwood pale yellow. Young branchlets white scurfy scaly, mature branchlets lepidote. Stipules lanceolate, caducous; petiole 1-2 cm; leaf blade simple, alternate, oblong-lanceolate, elliptic, or ovate, 10-20 x 5-10 cm, leathery, abaxially densely silver-white scurfy scaly, adaxially glabrous or nearly so, base obtuse, apex acute or obtuse. Inflorescence paniculate, axillary, ca. 8 cm, densely stellate hairy or with scales. Flowers pale green to pinkish red. Calyx red-brown, campanulate, 4-6 mm, both surfaces stellate hairy, lobes triangular, ca. 2 mm. Male flowers with thin disc, papillate. Androgynophore short and glabrous. Anthers 4 or 5, in 1 ring. Female flowers with carpels 4 or 5; stigmas as many as

carpels, short and curved downward. Fruit nutlike, woody, drying yellow-brown, nearly ellipsoid, ca. 6 x 3.5 cm, keeled on back, glabrous. Seeds ovoid, ca. 2 cm.

Flowering and fruiting: May-December.



Fig. 3. *Heritiera littoralis* Dryand. - A habit sketch (x 0.4).

Chromosome number: $2n = 38$ (Das *et al.*, 1995).

Ecology: Inland zone of mangrove swamps.

Representative specimens: **Khulna:** *s. loc.*, 13 Sep 1949, P. Maheshwari *s.n.* (DUSH); **Dhaka:** Dhaka University Botanical Garden, 6 Jun 2022, Sunzid 83 (DUSH).

Global distribution: Australia, Bangladesh, Cambodia, China, East Africa, India, Indonesia, Madagascar, Malaysia, Myanmar, Philippines, Sri Lanka, Taiwan, Tanzania, Thailand, Tonga, Vanuatu and Viet Nam.

Economic aspects: The timber is used as a good source of fuel for its high heat-yielding efficiency. Wood is suitable for the production of wrapping, writing and printing papers. Tannins are present in the bark which can be used for toughening fishing nets. Seed extract is used as medicine in the treatment of dysentery and diarrhea (Ahmed *et al.*, 2009; Mitra *et al.*, 2021). The crude methanol extract of leaves possesses free radical scavenging, anti-hemolytic, cytotoxic and anti-bacterial activities (Karim *et al.*, 2020).

Heritiera macrophylla Wall. ex Kurz in J. Asiat. Soc. Beng. 42(2): 61 (1873); Kurz, Fl. Burm. 1: 141 (1877); Kanjilal *et al.*, Fl. Assam 1: 155 (1934); Kosterm., Reinwardtia 4: 502 (1959); Malick in Sharma & Sanjappa (eds.), Fl. India 3: 430 (1993). *Trochetia contracta* Wall., Numer List.: 1162 (1829); *Amygdalus macrophylla* (Wall.) Kuntze, Revis. Gen. Pl. 1: 75 (1891). (Fig. 4).

Vernacular name: Not known.

English name: Large leaf looking glass tree.

A medium-sized evergreen tree, with umbrella shaped crown, arborescent, up to 30 m in height. Leaves simple, petiolate, petioles cylindrical, pubescent, rusty brown when mature; lamina ovate-oblong or elliptic-oblong, apex acute, base obtuse to slightly cordate sometimes, margin entire mostly, sometimes undulate in dry condition, veined with pinnate parallel venation, veins prominent adaxially, texture subcoriaceous, adaxial surface sometimes rusty brown while abaxial surface silvery. Flowers are unisexual, 3-4 mm across, white-yellowish to pinkish-rose in colour, present in foot-long panicle like cymes, in leaf axils. Male flowers with 6-8 stamens; anthers irregularly clumped on androgynophore. Female flowers with 1 carpel. Fruit a samara, ellipsoid, with one apical fish-tail wing.

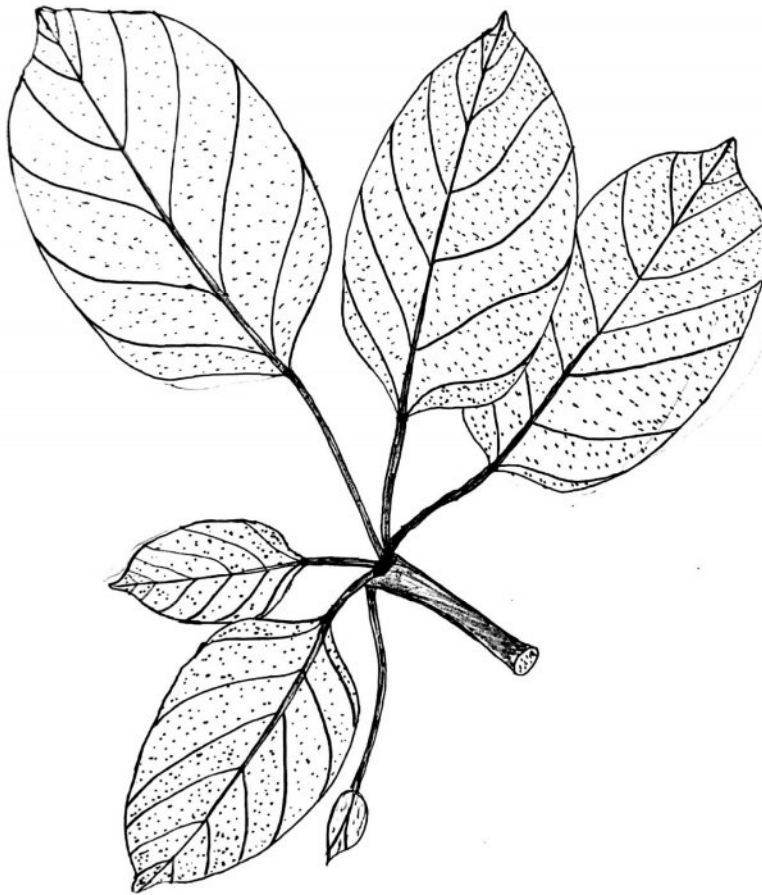


Fig. 4. *Heritiera macrophylla* Wall. ex Kurz.- A habit sketch (x 0.4).

Flowering and fruiting: November-February.

Chromosome number: $2n = 38$ (Das *et al.*, 1995).

Ecology: Inland zone of mangrove swamps.

Representative specimens: **Khulna:** *s. loc.*, 13 Sep 1949, P. Maheshwari *s.n.* (DUSH).

Global distribution: Bangladesh, Cambodia, China, India, Lao PDR, Myanmar, Thailand and Viet Nam.

Economic aspects: Mainly valued for its timber. The wood is hard with distinct annual rings and uniform medullary rays, joined by fine transverse lines. It takes a fine polish. It is used for posts and poles (Duncan, 2005).

Heritiera papilio Bedd., Fl. Sylhet: t. 218 (1872); Mast. in Hook. f., Fl. Brit. Ind. 1: 363 (1874); Balfour, Cycl. Ind. East. South. Asia 2: 39 (1885); Gamble, Fl. Pres. Mad. 1: 104 (1915); Mallick in Sharma & Sanjappa (eds.), Fl. India 3: 430 (1993); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 338 (2009); Uddin & Hassan, Vas. Fl. Chit. & Chit. Hill Tr. 2: 414 (2018). *Amygdalus papilio* (Bedd.) Kuntze, Revis. Gen. Pl. 1: 75 (1891); *Cattimarus hospitus* (L.) Kuntze, Revis. Gen. Pl. 1: 77 (1891); *Heritiera acuminata* All. *ex* Kurz in J. Bot. 12: 65, t. 141, f. 1, 1-3 (1874); Kanjilal *et al.*, Fl. Assam 1: 155 (1934).

Vernacular name: Sundari.

English name: Not known.

A small to medium-sized tree, 10-15 m in height, sometimes up to 30 m tall, arborescent. Young branches stellate-tomentose. Leaves simple, alternate, unifoliolate, 4-16 x 3-17 cm, lanceolate, oblanceolate or oblong to elliptic, base obtuse, obscurely acuminate at the apex, entire, texture coriaceous, petioles ca. 2 mm long, scaly. Flowers in axillary panicles, densely covered with stellate tomentose scales. Sepals 5, calyx campanulate. Petals absent. Male flowers with slender staminal column, anther thecae in a regular ring on an androgynophore. Female flowers with 5-6 sessile ovary, stellate scaly, sterile anther thecae present at the base of the ovary. Fruit a samara, 5-7 cm long, glabrous, 1-seeded.

Flowering and fruiting: April-December.

Ecology: Usually occurs in the hilly forests (Alam, 2018).

Representative specimen: No specimen was available in any herbarium of Bangladesh.

Global distribution: Bangladesh, India and Myanmar.

Economic aspects: Timber is hard which takes a fine polish and is used for temporary construction works for the manufacturing of poles, posts as well as agricultural implements (Ahmed *et al.*, 2009).

PTERYGOTA Schott & Endl.

Melet. Bot.: 32 (1832); Schumann in Engler & Prantl, Nat. Pflanzenfam. 3: 97 (1895); Kostermans, Reinwardtia 5: 415 (1961); Phengkklai, Fl. Thailand 7 (3): 615 (2001); Bayer & Kubitzki in Kubitzki & Bayer (eds.), Fam. Gen. Vasc. Pl. 5: 264 (2003); *Tetradia* R.Br. in Bennett, Pl. Jav. Rar.: 233 (1844); *Sterculia* L. sect. *Pterygota*, Benth. & Hook. f., *op. cit.* 218; Mast. in Hook. f., Fl. Brit. Ind. 1: 360 (1874); King, J. As. Soc. Beng. 60: 60 (1891).

Trees. Leaves cordate, usually entire, but lobed when very young. Inflorescence axillary, racemose or paniculate. Flowers unisexual. Calyx campanulate, 5-lobed to base, lobes reflexed at apex. Petals absent. Male flowers with cylindrical androgynophore, enclosed by calyx. Filaments clustered into 5 groups, staminodes usually present; anthers sessile. Female flowers with very

short androgynophore and 5 undeveloped staminodes. Carpels almost free; ovules many per carpel; stigma swollen, radiate. Follicle woody, subglobose, with long stipe and many seeds. Seeds with long and wide apical wing.

Pterygota alata (Roxb.) R. Br. in Benn., Pl. Jav. Rar. : 234 (1834); Heinig, List Pl. Chitt. Coll. & HT.: 7 (1925); Kochumenn in Whitmore, Tr. Fl. Malaya 2: 371 (1973); Abedin & Ghafoor in Nasir & Ali (eds.), Fl. W. Pak. 99: 23 (1976); Malick in Sharma & Sanjappa (eds.), Fl. India 3: 455 (1993); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 343 (2009). *Erythropsis roxburghii* Schott & Endl., Melet. Bot.: 33 (1832); *Sterculia teynii* Bedd., Fl. Sylv.: t. 230 (1872); *Clompanus alata* (Roxb.) Kuntze, Revis. Gen. Pl. 1: 78 (1891); *Sterculia alata* Roxb., Pl. Corom. 3: 84, t. 287 (1819); Fl. Ind. ed. Carey 3: 152 (1832); Mast. in Hook. f., Fl. Brit. Ind. 1: 360 (1874); Kurz, Fl. Burm. 1: 134 (1877); Prain, Beng. Pl. 1: 274 (1903). (Fig. 5).

Vernacular names: Buddha Narikel, Kashmiri Badam, Narikeli, Pagla Gach, Tula, Kufala (Chakma), Lakha (Marma).

English name: Buddha Coconut Tree.

Large tree, arborescent, deciduous, up to 50 m in height, crown narrow, conical, branches horizontal, branchlets pubescent at first with golden yellow hairs. Bark greyish-brown to grey with horizontal wrinkles and shallow vertical fissures. Buttress root present. Leaves simple, alternate, usually clustered at the end of branchlets, stipulate, stipules subulate, caducous, petiolate, petiole cylindrical, glabrous, 50-150 x 2-2.5 mm, leaf blade cordate or broadly ovate, 10-23 x 8.5-19 cm, sometimes deeply cordate at the base, lobes absent, coriaceous, glabrous both adaxially and abaxially, margin entire to nearly entire, apex acute or obtuse, palmately reticulate veins present, veins 5-7, veinlets numerous, prominent on both surfaces. Inflorescence axillary, paniculate, shorter than petiole. Flowers brownish yellow, ebracteate, unisexual, male flowers or bisexual but functionally female flowers in rusty-tomentose racemes. Calyx campanulate, densely stellate, adaxially subglabrous red abaxially, 5-6 lobed, linear-lanceolate, free upwards, connected at the base, 16 x 4 mm each with 1.5 mm thickness. Petals absent. Male flowers with androgynophore, cone shaped, inserted, half as long as calyx, 6 mm long, bearing 4-6 groups of 4 anthers each. Female or bisexual flowers with 5 carpels, inserted ovary 2-3 mm long, globose and puberulent; style short, extrorse, recurved; stigmas rounded. Fruit is woody follicle, large, compressed globose, ca. 12 cm in diameter, puberulent outside, adaxially cork-like. Seeds many, ca. 40 per follicle, oblong, compressed in 2 rows with long and wide wing.

Flowering and fruiting: December-May.

Chromosome number: $2n = 40$ (Kumar and Subramaniam, 1986).

Ecology: Highland and open sunny dryland. The species is also found to be planted along the roadsides as avenue tree (Alam, 2018).

Representative specimens: **Bandarban:** Ruma, 28 Feb 1988, M.K. Alam *et* M. Mohiuddin 6007 (BFRIH). **Bogra:** Dosmail, RDA campus, 18 Nov 2020, Zinia Nasrin ZN 03 (DACB). **Dhaka:** Ramna, 1 Feb 1947, S.K. Sen *s.n.* (DUSH); Azimpur, Army Recruiting Office, 1 Nov 1963, A.F. Muhammad 34 (DUSH); Dhaka University Campus, TSC, 10 Sep 1982, A.M. Huq 5688 (DACB); Dhaka University Campus, TSC, 17 Oct 2021, Sunzid 33 (DUSH); Bangladesh National Botanical Garden, 6 Jun 2022, Sunzid 80 (DUSH).

Global distribution: Bangladesh, Bhutan, China, Cuba, India, Malaysia, Myanmar, Pakistan, Philippines, Thailand, United States of America and Viet Nam.

Economic aspects: Timber is white and has great potential for pulping because of long fibers. Extract of leaves have been used to demonstrate antioxidant activities. Therefore, the

phytochemicals can be used to design potential drugs for biogerontological research. Seeds are medicinally significant, edible and are often eaten after roasting. Seeds possess narcotic properties and often used as a substitute for opium (Agarwal and Jain, 2017). Crude ethanol extract of leaves is reported to have excellent *in-vivo* and *in-vitro* antioxidant effects (Jahan *et al.*, 2014). The leaf extracts contain active compounds showing *in-vitro* antibacterial activity against multidrug resistant and biofilm forming strains of *Staphylococcus* spp. (Panda *et al.*, 2020).

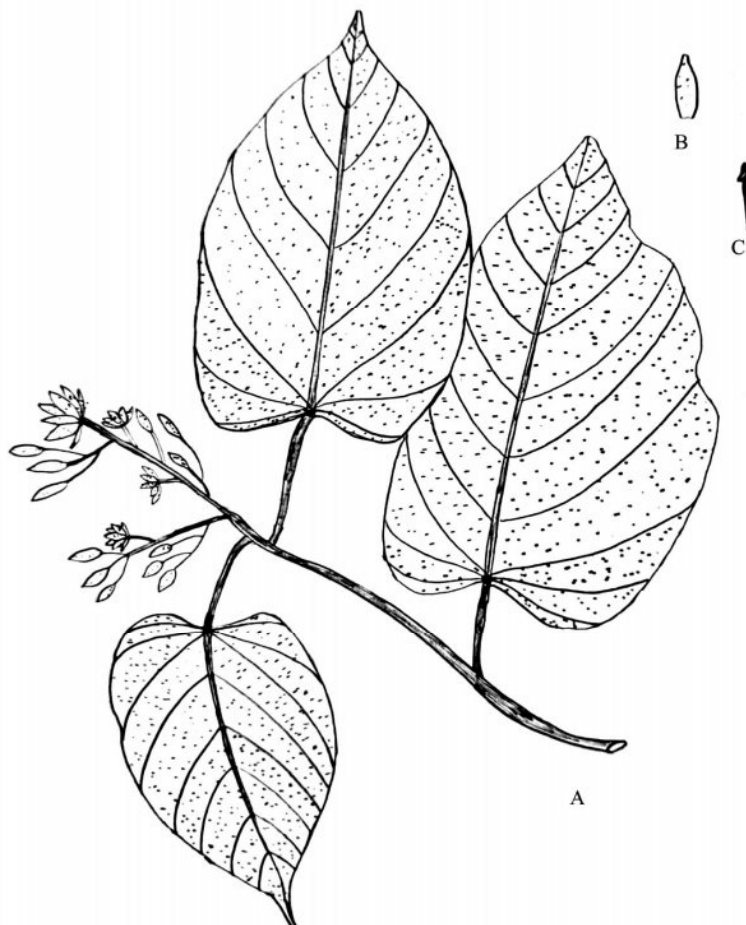


Fig. 5. *Pterygota alata* (Roxb.) R. Br.: A. Habit (x 0.3); B. Sepal (x 0.5); C. Stamen (x 1.5).

SCAPHIUM Schott & Endl.

Melet. Bot.: 33 (1832); Kostermans, J. Sci. Res. Indonesia 2: 3 (1953); Phengkklai, Fl. Thailand 7 (3): 624 (2001); Bayer & Kubitzki in Kubitzki & Bayer (eds.) Fam. Gen. Vasc. Pl. 5: 265 (2003); Cheek in Heywood *et al.*, Flow. Pl. Fam. World: 311 (2007); Wilkie, Edin. J. Bot. 66 (2): 283 (2009); *Caryophyllum* Miq., Fl. Ind. Bat. Suppl. 1: 401 (1861); *Sterculia* L. sect. *Scaphium* Benth. & Hook. f., Gen. Pl. 1: 218 (1862); Mast. in Hook. f., Fl. Brit. Ind. 1: 361 (1874); King, J. As. Soc. Beng. 60: 60 (1891).

Trees. Leaves simple, spirally arranged, entire, stipules caducous. Flowers unisexual, small pale green, axillary or terminal panicles. Calyx 4-6 lobed, united at the base, glabrous inside. Corolla absent. Stamens 8 to 10 in male flowers, on a globose head at the terminal part of a thin staminal column. Female flowers 5 carpels, free, styles free, stigmas simple, pointed. Fruit a large follicle, boat-shaped, membranous. Seeds wingless, solitary.

Scaphium scaphigerum (Wall. ex G. Don) G. Planch, Hist. Nat. Drogues Simples ed. 6, 3: 646 (1869); Baillon, Hist. des Pl. 4: 110 (1867); Kurz, Fl. Burm. 1: 140 (1877); Balfour *et al.*, Ann. Bot. 19: 356 (1905); Kosterm., J. Sci. Res. Indo. 2(1): 3 (1953); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 344 (2009). *Scaphium wallichii* Schott & Endl., Melet. Bot.: 33 (1832); *Sterculia scaphigera* Wall. Cat. No. 1130 (1828); Mast. in Hook. f., Fl. Brit. Ind. 1: 361 (1874); *Clompanus scaphigera* (Wall. ex G. Don.) Kuntze, Revis. Gen. Pl. 1: 78 (1891). **(Fig. 6).**

Vernacular names: Shaogan, Shampan, Pogan, Sukan, Shagan.

English name: Water Malva Nut.

A deciduous tree, up to 35 m tall. Buttresses often present, 1–2 m tall. Inner bark reddish, fibrous, 10–15 mm thick. Outer bark grey-green to brown, cracked to flaking. Sapwood white. Terminal branches pale brown to brown, striate to smooth, lenticels absent, glabrous. Petiole pale brown, 2–12 cm long, 2–4 mm wide, smooth to striate, glabrous or occasionally stellate hairy, both ends darker. Stipules caducous or persistent only at apex of stalk, rounded to triangular, 2–4 mm long, glabrous or with very minute simple hairs on both surfaces. Leaf lamina sub-leathery to leathery, occasionally papery, ovate, elliptic or elliptic-oblong, symmetric to asymmetric, base rounded to acute (occasionally truncate or slightly cordate), apex acute, 1.3–2.3 times as long as wide, 8–34 cm long, 6–17 cm at widest point, upper surface glabrous, occasionally with gland dots, drying pale brown-tan, shiny, lower surface glabrous, occasionally with gland dots, drying pale brown-tan, dull; midrib raised on both surfaces; basal veins 1–2 pairs. Tertiary veins flat on both surfaces, slightly paler than lamina below, inconspicuous above. Inflorescences 5–12 cm long, densely stellate hairy. Bracts caducous. Flower buds drying brown, ovoid, slightly elongated towards apex, sparsely to densely stellate hairy, lobe margin densely stellate hairy, more or less distinct. Pedicel absent to 2 mm long, 0.5–1 mm wide, densely stellate hairy. Flowers 5–8 mm long, yellow with purple base, when fresh, drying brown, 5-lobed, lobes 2/3 the length of the calyx, calyx outer surface sparsely stellate hairy, inner surface glabrous (including base), androgynophore 5–8 mm long, protruding, recurved at apex, sparsely simple hairy, sometimes with stellate hairs with long branches on upper half, glabrous on lower half, anthers ca. 10–12, glabrous or sparsely simple hairy, carpels rudimentary and sparsely hairy in male flower, fully developed and densely stellate hairy in female flower, 3–5, free or nearly so; style absent to 0.2 mm long in male flower, 1–1.5 mm long in female flower; stigmas glabrous, as many as carpels, superficially fused. Fruit with 2–5 follicles per flower, follicles papery, 9–26 cm long, inner surface sparsely stellate hairy, shiny, outer surface sparsely to densely stellate hairy (especially dense along venation), dull, follicle stalk to 7–25 mm long. Seeds 1 per follicle, spherical to elliptic, glabrous, seed oriented away from follicle.

Flowering and fruiting: February-May.

Chromosome number: Not known.

Ecology: Near limestone deposits, there are evergreen forests.

Representative specimens: **Bandarban:** Kapru Para VCF, 25 May 2017, Syedul Alam *et* Rahman 27893 (BFRIH).

Global distribution: Bangladesh, Cambodia, China, Lao PDR, Malaysia, Myanmar, Thailand and Viet Nam.

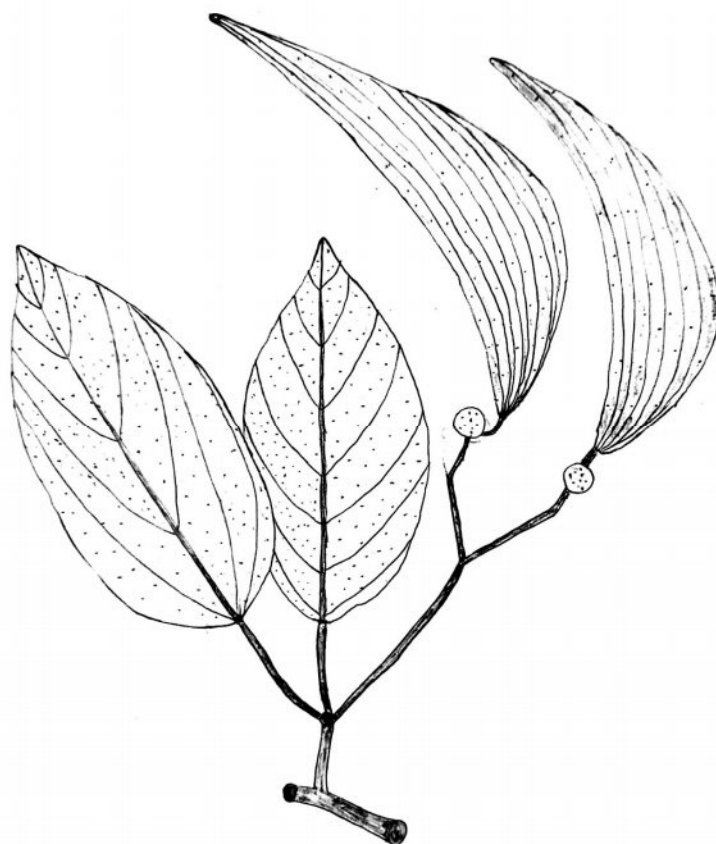


Fig. 6. *Scaphium scaphigerum* (Wall. ex G. Don) G. Planch. - A habit sketch (x 0.3).

Economic aspects: In China, the fruit is used to treat dysentery. The fruit is macerated in water in Cambodia, Thailand, and Malaysia, resulting in a massive increase in the volume of the outer shell or pericarp, generating a big gelatinous mass. Sweetened jelly is served as a delicacy. It also aids in the treatment of diarrhea and dysentery (Ahmed *et al.*, 2009). Studies on biological activities reveals that fruit gel powder of *Scaphium scaphigerum* exhibit glucose absorption inhibitory effect and antioxidant activity. The quality-controlled fruit gel powder controls the body weight (Phlicharoenphon *et al.*, 2017).

STERCULIA L.

Sp. Pl.: 1007 (1753); Miquel, Fl. Ind. Bat. 1: 172 (1859); Benth. & Hook. f., Gen. Pl. 1: 217 (1862); Mast. in Hook. f., Fl. Brit. Ind. 1: 354 (1874); King, J. As. Soc. Beng. 60: 59 (1891); Schumann in Engler & Prantl, Nat. Pflanzenfam. 3: 96 (1895); Ridley, FMP 1: 267 (1922); Bull. Misc. Inform. Kew 6: 221 (1938); Prain, Beng. Pl. 1 (Reprint): 186 (1963); Backer & Bakhuizen f., FJ. 1: 411 (1964); Phengkklai, Fl. Thailand 7 (3): 623 (2001); Bayer & Kubitzki in Kubitzki & Bayer (eds.), Fam. Gen. Vasc. Pl. 5: 263 (2003); Cheek in Heywood *et al.*, Flow. Pl. Fam. World: 311 (2007).

Trees or shrubs. Leaves simple, entire or palmately lobed, rarely palmately compound, margin entire or dentate. Inflorescence usually axillary, paniculate, rarely racemose. Flowers unisexual. Calyx 5-lobed or 5-partite. Petals absent. Male flowers with anthers clustered at top of androgynophore, enclosing undeveloped carpels. Female flowers with very short androgynophore, staminodes at top of androgynophore in whorl around base of carpels. Carpels 5; ovules 2 to many per carpel; styles connate at base; stigmas as many as carpels, free. Fruit a group of follicles, usually leathery, less often woody, dehiscent when mature. Seeds 1 to many per follicle, usually with endosperm.

Key to species of *Sterculia* L.

- | | | |
|---|--|--|
| 1 | Leaves palmately lobed or digitate. | 2 |
| - | Leaves not lobed. | 4 |
| 2 | Leaves digitate. | 3 |
| - | Leaves palmately lobed. | <i>S. villosa</i> |
| 3 | Leaflets whitish pubescent beneath; calyx lobes inflexed; staminal column 2 mm long. | <i>S. versicolor</i> |
| - | Leaflets glabrous beneath when mature; calyx lobes inflexed; staminal column 10 mm long. | <i>S. foetida</i> |
| 4 | Calyx lobes broadly ovate, spreading. | 5 |
| - | Calyx lobes linear or linear-lanceolate, connivent at the top. | 6 |
| 5 | Leaves glabrous above, rusty-tomentose beneath, cordate or subcordate at base. | <i>S. guttata</i> |
| - | Leaves glabrous on both surfaces, more or less rounded at base. | <i>S. lanceifolia</i> |
| 6 | Fruits lanceolate; staminal column 4-5 mm long. | <i>S. lanceolata</i> var.
<i>coccinea</i> |
| - | Fruits ovate; staminal column less than 4 mm. | 7 |
| 7 | Leaves glabrous or glabrescent on both surfaces; calyx urceolate; style glabrous. | <i>S. parviflora</i> |
| - | Leaves densely stellate hairy on both surface; calyx campanulate; style hairy. | <i>S. balanghas.</i> |

Sterculia balanghas L., Sp. Pl.: 1007 (1753); Wight, Illus. Ind. Bot. 1: 30 (1840); Mast. in Hook. f., Fl. Brit. Ind. 1: 358 (1874); Pickering, Chron. Hist. Pl. : 333 (1879); Gamble, Fl. Pres. Mad. 1: 106 (1915); Merrill, Enum. Phill. Pl. 3: 53 (1922); Craib, Fl. Siam. Enum. 1: 169 (1925); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 345 (2009). *Sterculia citrifolia* Salisb., Prodr. Stirp. Chap. Allerton: 387 (1796); *Balanghas telabo* Raf., Sylva Tellur.: 72 (1838); *Sterculia mollis* Wall. ex R. Br., Pterocym.: 231 (1844); *Sterculia ensifolia* Mast. in Hook. f., Fl. Brit. Ind. 1: 358 (1874); *Sterculia balanghas* L. var. *angustifolia* (Roxb.) Mast. in Hook. f., Fl. Brit. Ind. 1: 358 (1874); *Sterculia angustifolia* Roxb., Fl. Ind. 3: 148 (1832); Kurz, Fl. Burm. 1: 138 (1877); Ridl., Fl. Mal. Pen. 1: 274 (1922); Craib, Fl. Siam. Enum. 1: 165 (1925); Raizada, Ind. For. 67: 245 (1941).

Vernacular name: Balan Udal.

English name: Panama tree.

A medium-sized tree, young parts rusty tomentose, bark greyish-brown, smooth. Leaves simple, 10-30 x 5-13 cm, oblong-ovate, rounded at the base, apex blunt or acute, densely stellate

hairy on both surfaces, petioles 3-5 cm long, swollen at both ends, pubescent. Flowers small, yellow or greenish-purple, fragrant, on stellate hairy panicles, slightly drooping from ends of branches. Calyx campanulate, 5-lobed, 7-10 mm long, pubescent outside, hairy inside. Petals absent. Male flowers with 10 stamens, staminal column ca. 2 mm long, with a group of 2-loculed anthers at the tip, anthers sessile, staminodes 10. Female flowers with 5 carpels, free, hairy with 4-8 ovules; styles cohering, densely hairy; stigmas recurved, 5-lobed. Fruit a follicle, 4-5, oblong, woody, almost sessile, curved with dark brown tomentose surfaces. Seeds 3-6, oblong-ovoid, black, shining.

Flowering and fruiting: January-May.

Chromosome number: Not known.

Ecology: Swampy areas and hilly forests. Also occurs in the deciduous forests.

Representative specimen: No specimen was available in any herbarium of Bangladesh.

Global distribution: Bangladesh, Cambodia, India, Lao PDR, Malay Peninsula, Myanmar, Nepal, Sri Lanka and Thailand.

Economic aspects: The plant has ornamental value. Seeds are edible and often consumed after roasting. The seeds are nearly palatable as chestnuts. Fiber is obtained from the bark which is used in Sri Lanka to build cottages. The wood is soft. Fruit of the species is considered to have cooling and laxative effects (Ahmed *et al.*, 2009).

Sterculia foetida L., Sp. Pl.: 1008 (1753); Roxb., Fl. Ind. ed. Carey 3: 154 (1832); Mast. in Hook. f., Fl. Brit. Ind. 1: 354 (1874); Kurz, Fl. Burm. 1: 135 (1877); Prain, Beng. Pl. 1: 187 (1903); Ridl., Fl. Mal. Pen. 1: 268 (1922); Craib, Fl. Siam. Enum. 1: 166 (1925); Abedin and Ghafoor in Nasir & Ali (eds.), Fl. W. Pak. 99: 16 (1976); Malick in Sharma & Sanjappa (eds.), Fl. India 3: 459 (1993); Verdcourt in Dassanayake *et al.*, Rev. Handb. Fl. Ceyl. 9: 431 (1995); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 346 (2009). *Sterculia polyphylla* R. Br., Pterocymb.: 227 (1844); *Sterculia mexicana* var. *guianensis* Sagot, Ann. Sci. Nat. Bot. Ser. 6, 11: 153 (1881); *Clompanus foetida* (L.) Kuntze, Revis. Gen. Pl. 1: 77 (1891). **(Fig. 7).**

Vernacular names: Jangli Badam, Jukigli Badam, Jangal Badam, Udal Badam.

English names: Wild Almond, Poon Tree.

Medium to large tree, arborescent, deciduous, upto 40 m tall. Branches verticillate and spreading. Bark grey to brown, lenticellate; inner bark brown to reddish brown fibrous. Sapwood white to cream. Twigs glabrous, swollen towards apex, 2.5 cm in diameter, leaf scars prominent, young shoots hairy. Leaves digitately compound, palmately 5-10 foliate, crowded at the end of thick branchlets. Stipules present, caducous, subulate, margin pubescent, glabrous adaxially, puberulent abaxially, 8 x 3 mm. Petiole 6 cm long, finely pubescent or puberulent. Leaflets elliptic-lanceolate, coriaceous, entire, veins pinnately parallel, 7.5-14.0 x 2.0-4.5 cm, apex acute to acuminate, base acute to cuneate, glabrous beneath when mature. Inflorescence terminal, subterminal or axillary panicles. Flowers unisexual and bisexual, greenish yellow becoming red, smell unpleasant; pedunculate, peduncle 5.5 to 8.5 cm long, pedicellate, pedicel 6 mm long; calyx campanulate, deeply divided into 5-6 lobes, adnate at the base, linear-oblong to lanceolate, subacute, stellate-hairy, 10 x 4 mm. Petals absent. Male flowers with 14-15 stamens, staminal column ca. 10 mm long, capitate, hairy at the base, 10-15 anthers grouped into a head, staminodes 14. Female flowers inserted, ovary globose, densely villous, 5 loculed, each locule with 12-20 ovules; styles cohering; stigmas very small, 5-lobed or flattened, glabrous. Fruit is follicle curved, arranged in a cluster, boat-shaped, woody, short beaked, smooth outside, fibrous inside, 10-15 seeded, red when mature. Seeds ca. 20 in each follicle, ellipsoid, 2.5 cm long, 1.3 cm diameter, purple-black.

Flowering and fruiting: November-April.

Chromosome number: $2n = 40$ (Kumar and Subramaniam, 1986).

Ecology: Usually grows in the hot, tropical lowlands and moderate highlands. Also found in the areas with or without a clear dry season. The species prefers a deep, fertile, moist but well-drained soil in a sunny, sheltered position.



Fig. 7. *Sterculia foetida* L.: A. Habit (x 0.2); B. Flower (x 1.2); C. Fruit (x 0.2).

Representative specimens: **Bandarban:** Betchara Para, 13 Jun 1983, M.K. Alam 4606 (BFRIH). **Chittagong:** Hamzarbagh, 13 Mar 1985, Mujib *et al.* 5345 (BFRIH); Hathazari, Fatehpur, Mithachara, 1 Mar 2017, Iqbal Mahmud IQ 606 (DACB). **Cox's Bazar:** Kutubida, 27 Dec 1983, Huq *et al.* H. 6653 (DACB); Bhomarighona, 24 Apr 2017, Ehsanul Huq EH 91 (DACB); Maheshkhali, Dineshpur, 2 May 2017, Niyamul Kabir *et al.* NK 3644 (DACB); Chakaria, Fasiakhali, 10 May 2017, Niyamul Kabir *et al.* NK 3912 (DACB); Himchari, *s. dies.*, M.A. Rahman 390 (HCU). **Dhaka:** *s. loc.*, 15 Sep 1949, S.K. Sen *s.n.* (DUSH); Azimpur Maternity Hospital, 12 Aug 1964, A.F. Muhammad 180 (DUSH); Suhrawardi Udyan, 30 Oct 2021, Sunzid 29 (DUSH). **Munshiganj:** Bikrompur, 20 Sep 1996, Nazrul Huq *s.n.* (DACB).

Global distribution: Bangladesh, Cambodia, China, India, Indonesia, Malaysia, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand, Viet Nam, Eastern Africa and North Australia.

Economic aspects: The leaves and seeds of the species possess anti-inflammatory and anti-nociceptive activities. The seeds are fit for human consumption, representing a good source of fats (30%–36%) and proteins (11.4%). The leaves and bark are often used as diaphoretic, diuretic, and aperient agents and have been applied to the treatment of rheumatism, obesity, gonorrhoea, edema, and skin disease. The plant serves as a repository of phytoconstituents, including alkaloids, flavonoids, terpenoids, phenols, and steroids. Therefore, these phytochemicals can serve as useful compounds in the searching of new small drug like potential molecules in the Computer Aided Drug Designing endeavors (CADD). The ethanolic seed extracts have been reported to show antioxidant and anticancer activities (Alam *et al.*, 2021). The sweet yellowish cotyledons are eaten after the black seed coat is removed. They are effective for rheumatism relief and are used as a laxative, diuretic, anti-epileptic, purgative and insect repellent. Seed oil is useful for lighting and painting, as well as treating itches and other skin disorders (Ashrafuzzaman and Sarwar, 2021).

Sterculia guttata Roxb., Fl. Ind. ed. Carey 3: 148 (1832); Mast. in Hook. f., Fl. Brit. Ind. 1: 355 (1874); Balfour, Cycl. Ind. East. South. Asia 3: 737 (1885); Nairne, Fl. Pl. W. Ind.: 34 (1894); Brandis, Ind. Trees : 82 (1921); Craib, Fl. Siam. Enum. 1: 166 (1925); Malick in Sharma & Sanjappa (eds.), Fl. India 3: 462 (1993); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 347 (2009). *Astrodendrum malabaricum* Dennst., Schlusssel Hort. Malab.: 30 (1818); *Clompanus malabarica* Kuntze, Revis. Gen. Pl. 1: 77 (1891).

Vernacular names: Raiphall, Bansal.

English name: Not known.

A large evergreen tree, young parts rusty stellate tomentose, bark dark green, warty, cracked outside, blaze white, mottled with brown. Leaves simple, ovate, rounded, or slightly cordate at the base, acute or abruptly shortly acuminate at the apex, entire, under surface and petioles tomentose, petioles 2-7 cm long, stipules ensiform, caducous. Flowers white and pale yellow, in terminal, rusty, tomentose, racemiform panicles, pedicels 2-3 mm long, hairy, with an offensive smell. Calyx campanulate, deeply 5-partite, lobes narrowly lanceolate, rusty tomentose outside, glandular and with scattered long hairs inside. Petals absent. Male flowers with 10-12 stamens, staminal column 6-8 mm long, slender, curved, anthers 10-15, sessile, very small, staminodes 10. Female flowers with 5 carpels, free, ovary surmounting the ring of anthers, globose, woolly; styles curved; stigmas 5-lobed. Fruit a follicle, red when ripe, coriaceous, compressed, tomentose outside, smooth and reddish inside, with 3-5 seeds in each follicle. Seeds black and large.

Flowering and fruiting: April-August.

Ecology: The species occurs along the margins of evergreen forests, and in semi-evergreen forests. Very rare in moist, low-lying areas.

Representative specimens: **Bandarban:** Keokradong, Darjiling Para, 26 Mar 2019, Khandakar Kamrul Islam KKI 3584 (DACB). **Chittagong:** Hazarikhil, 30 Mar 1976, D.K. Das *s.n.* (BFRIH). **Sylhet:** Lawachara, 17 Mar 1984, M.K. Alam 4975 (BFRIH).

Global distribution: Bangladesh, India, Myanmar, Sri Lanka, Thailand and Viet Nam.

Economic aspects: One kind of coarse rug is manufactured by beating and washing the inner bark in the Malabar Coast. Seeds are eaten after roasting. Seeds contain important bioactive compounds that might be used in the development of effective insecticides as shown *in-vitro* tests to control larvae of mosquitos (Katade *et al.*, 2006).

Sterculia lanceolata var. *coccinea* (Jack) Phengklai, Thai. Forest. Bull. Bot. 23: 99 (1995); Rehder *et* Sargent, Bard. Bibl. 2: 538 (1911); Craib, Contrib. Fl. Siam. 1: 24 (1912); Merrill, Bibl. Enum. Born. Pl.: 379 (1921). *Sterculia coccinea* Roxb. [Hort. Beng. : 50 (1814) *nom. nud.*], Fl. Ind. ed. Carey 3: 151 (1832) *non* Jack (1822); Mast. in Hook. f., Fl. Brit. Ind. 1: 359 (1874). *Clompanus hamiltonii* O. Kuntze, Rev. Gen. Pl. 1: 77 (1891). *Sterculia hamiltonii* (Kuntze) Adelb., C.A. Backer, Bekn. Fl. Java 4b (107): 23 (1944). *Sterculia indica* Men., J. Ann. Arb. 33: 245 (1952). (Fig. 8).

Vernacular name: Toni Udal.

English name: Not known.

Small tree, up to 15 m tall, ca. 30 cm in diameter. Arborescent, buttress absent. Bark grey, smooth; inner bark fibrous. Sapwood white. Twigs grey to pale brown, glabrous but apical parts sometimes with sparse stellate hairs, slender, 0.2-0.7 cm diameter. Stipules caducous, linear, up to 0.7 cm long, creamy. Leaves alternate or spirally arranged, simple, lamina papery, broadly elliptic, ovate to slightly obovate-oblong, 7-17 x 3-7 cm, base acute to rounded, symmetric to slightly asymmetric, with 3-5 basal veins, apex often distinctly caudate with slender acumen to 2 cm long, occasionally acuminate; upper surface glabrous, drying brown, lower surface with sparse stellate hairs or glabrous; lateral veins 5-7 pairs, raised on both surfaces, arching to form intramarginal vein; petioles slender, very pale brown to yellow, glabrous, 1-7 cm long, swollen and darkened at both ends. Inflorescences sub-terminal or axillary racemes, often branched, up to 12 cm long, with sparse stellate hairs, each branch 3-flowered. Flowers unisexual, pale white to green-yellow, calyx tubular to urceolate, 2-15 mm long, 2-4 mm in diameter, outer surface with sparse stellate hairs, inner surface glabrous, 5-lobed, lobes narrowly oblong, 2-3 mm long, with dense simple hairs along margin, joined or not at apex, androgynophore 1-2 mm long, erect, glabrous. Male flowers with 10 anthers present at the globose head. Female flowers with ca. 1 mm long androgynophore; styles coherent, with sparse stellate hairs; stigmas obovate with sparse stellate hairs. Fruit a cluster of 1-5 orange-red leathery follicles; follicles up to 10 cm long, 1.5-3 cm wide, outer surface with dense minute stellate hairs, inner surface glabrous. Seeds 3-5 in each follicle, ellipsoid, 0.9-1.6 cm long, 0.6-1.2 cm in diameter, black in color.

Flowering and fruiting: April-September.

Ecology: Hill slopes along streams.

Representative specimens: **Bandarban:** Ruma, Thanapara, 10 May 2018, Khandakar Kamrul Islam KKI 2791 (DACB); Ruma, Bogalake, 26 Mar 2019, Khandakar Kamrul Islam KKI 3510 (DACB). **Chittagong:** Badolchari, 25 Jan 1997, M.A. Rahmand *et* Aditi Khisa 665B (HCU); Himchari, Barachara, 29 Jun 1997, M.A. Rahman *et al.* 1422 (HCU); Dhopachori, 2 Sep 1999, M.A. Rahman *et al.* 5530 (HCU); Hazarikhil Wildlife Sanctuary, 19 Aug 2014, S.N. Uddin N. 5469 (DACB). **Cox's Bazar:** Ruma, Eid Ghor, 20 Mar 2018, Niyamul Kabir *et* Mehedi Hassan NK 7218 (DACB). **Khagrachari:** Dighinala, Kowser *et al.* KH 6689 (DACB). **Maulvibazar:** Madhabkunda, 25 Jun 2001, S.N. Uddin N. 1086 (DACB); Lawachara National Park, 17 Aug 2009, S.N. Uddin N. 3896 (DACB); Kamalganj, Adampur, 20 Sep 2011, S.N. Uddin N. 4745 (DACB). **Rangamati:** Kutukchari, Chegaiyachari, 16 Jun 1998, S.B. Uddin *et al.* 3125 (HCU); Bilaichari, Farua, 23 Jul 2009, S.N. Uddin N. 3802 (DACB). **Sylhet:** Golapganj, 3 Mar 1976, Atiqur Rahman 60 (DACB); Jainta-Sarighat, 3 Oct 1983, Huq *et al.* H. 5337 (BFRIH); Jaintapur, 19 Oct 1986, A.M. Huq *et* M.K. Mia H. 7839 (DACB).

Global distribution: Bangladesh, Bhutan, India, Lao PDR, Malaysia, Myanmar, Nepal, Thailand and Viet Nam.

Economic aspects: Wood is hard, strong. Usually used for construction works especially for the production of poles, posts and ridge plates. Fruits are edible and enriched with nutrients,

usually consumed after cooking. Seeds are also edible and are eaten fried or roasted (Ahmed *et al.*, 2009; Alam, 2018).

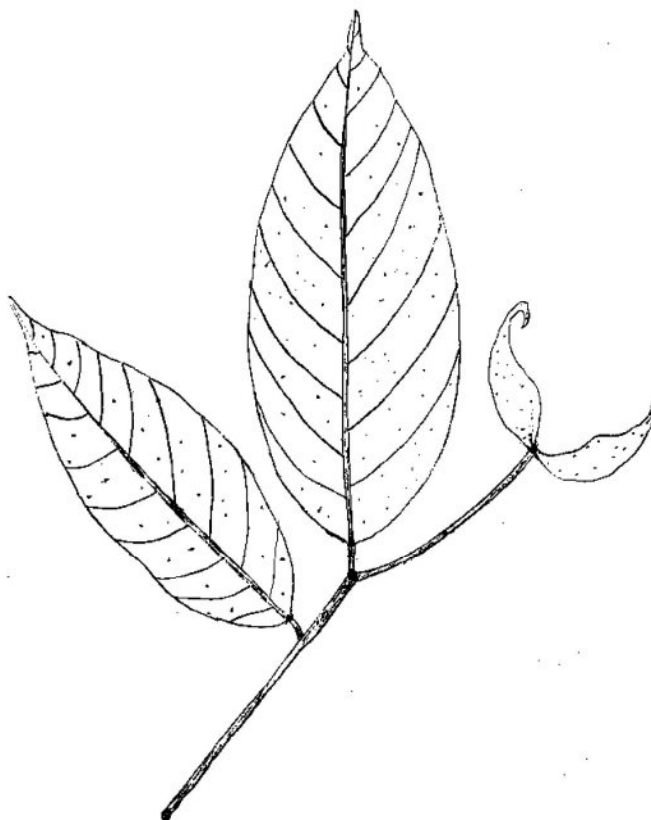


Fig. 8. *Sterculia lanceolata* var. *coccinea* (Jack) Phengklai - A habit sketch (x 0.3).

Sterculia parviflora Roxb. *ex* G. Don., Gen. Hist. 1: 516 (1831); Roxb., Fl. Ind. ed. Carey 3: 147 (1832); Mast. in Hook. f., Fl. Brit. Ind. 1: 356 (1874); Ridl., Fl. Mal. Pen. 1: 271 (1922); Malick in Sharma & Sanjappa (eds.), Fl. India 3: 468 (1993); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 348 (2009). *Sterculia maingayi* Mast. in Hook. f., Fl. Brit. Ind. 1: 359 (1874); *Sterculia holttumii* Ridl., Kew Bull. 1926: 471 (1926).

Vernacular name: Parvi Udal.

English name: Not known.

Arborescent, up to 35 m in height, ca. 100 cm in diameter. Buttress plank-like up to 1 m tall. Bark grey-orange to brown, smooth with occasional small scales and lenticels; inner bark red-brown, 1 cm thick, fibrous. Sapwood white. Twigs 0.3-0.6 cm in diameter, slightly swollen at the apex, glabrous but sometimes stellate hairs on the very young parts, leaf scars conspicuous. Stipules caducous. Leaves alternate, simple, lamina papery to leathery, ovate, elliptic to elliptic-oblong, 8-20 x 4-10 cm, base slightly cordate to truncate, basal veins 1-2 pairs, apex acute or very shortly acuminate; upper surface glabrous, lower surface with sparse, very minute, round, peltate scales; lateral veins excluding basal ones, 5-7 or 12 pairs, straight or arching, sunken above,

prominent beneath; intercostal veins ladder-like, sunken above, often prominent beneath, petioles 1.5-8 cm long, glabrous. Inflorescences sub-terminal or axillary panicles, much branched, erect, 9-20 cm long, with dense stellate hairs or scurfy; bracts caducous. Flowers unisexual, pale yellow becoming reddish pink; calyx tube urceolate, 3-5 mm long, outer surface with dense stellate hairs, inner surface glabrous, lobes 5, lanceolate, 3-4 mm long, inner surface with sparse hairs, converging and joined at apex. Male flowers with slender androgynophore, 0.5-0.25 mm long, glabrous; anthers 10, forming a globose head at the apex of androgynophore. Female flowers with 0.5-1 mm long androgynophore, base of carpels surrounded by 10 sterile anthers, carpels 5, glabrous or with sparse hairs; styles coherent, slender, ca. 0.5 mm long, glabrous or with a few hairs; stigmas 5, ovate, curved. Fruit a cluster of up to 5 orange-red leathery follicles; follicles oblong, 6-9 cm long, 2-3 cm wide, with dense minute stellate hairs. Seeds 2 or more in each follicle, ellipsoid, 1.2-2 cm long, 0.8-1.5 cm in diameter, black.

Flowering and fruiting: February-July.

Ecology: Lowland and mixed deciduous forests. Found in a variety of substrates including basalt and calcareous shale.

Representative specimen: No specimen was available in any herbarium of Bangladesh.

Global distribution: Bangladesh, Cambodia, India, Malaysia, Myanmar, Thailand and Viet Nam.

Economic aspects: The white colored wood is used for indoor construction and plywood. Good quality fibers can be obtained from the bark of the species. The tree also has ornamental value as it is sometimes planted in the garden as well as in the roadside avenue (Alam 2018).

Sterculia lanceifolia Roxb., Fl. Ind. (eds) 3: 150-151 (1832); Laudon *et* Spottiswoode, Gard. Mag. Reg. 4: 450 (1826); Kurz, Asiatic Soc. Beng., Journ. Asiat. Soc. 45(2): 120 (1876); Western Australia Museum, Rec. Wes. Aust. Mus. 23: 115 (2006). *Sterculia ovalifolia* Wall., Numer. List: 1132 (1829); *Sterculia lanceifolia* G. Don., Sylhet 1: 517 (1831); *Southwellia roxburghiana* Spach, Hist. Nat. Veg. 14: 402 (1847); *Clompanus roxburghii* (Wall.) Kuntze, Revis. Gen. Pl. 1: 78 (1891). **(Fig. 9).**

Vernacular name: Ushli.

English name: Not known.

Trees or shrubs. Bark grayish. Branchlets puberulent. Stipules subulate, minutely hairy, caducous. Leaves petiolate. Petioles 2.5-3.5 cm, both ends pulvinate. Lamina lanceolate, linear-lanceolate or oblong-lanceolate, 10-23 x 2.5-7.5 cm, minutely pilose, becoming glabrous, lateral veins 9-10 on each side of midrib, slightly connected near margin, base rounded or obtuse, apex obtusely acuminate. Inflorescence racemose, or rarely paniculate, axillary, 5-7 cm, much shorter than leaves, few flowered, stellate pilose. Pedicel slender, 5-8 mm. Calyx red, campanulate, divided nearly to base, ca. 7 mm, abaxially sparsely puberulent, lobes oblong-lanceolate, ca. 5mm, much longer than calyx tube, spreading outward. Male flowers with curved androgynophore, surface glabrous. Female flowers with globose ovary, densely puberulent. Follicle oblong or oblong-lanceolate, ca. 7 cm in length, seeds 4-8, abaxially densely red hirsute, apex beaked. Seeds black, ovoid.

Flowering and fruiting: February-August.

Ecology: The species is commonly found in the hilly forests.

Representative specimens: **Maulvibazar:** Kamalganj, 7 Mar 2011, S.N. Uddin N4472 (DACB).

Global distribution: Bangladesh, China, India, Lao PDR, Malaysia, Myanmar, Nepal, Thailand and Viet Nam.

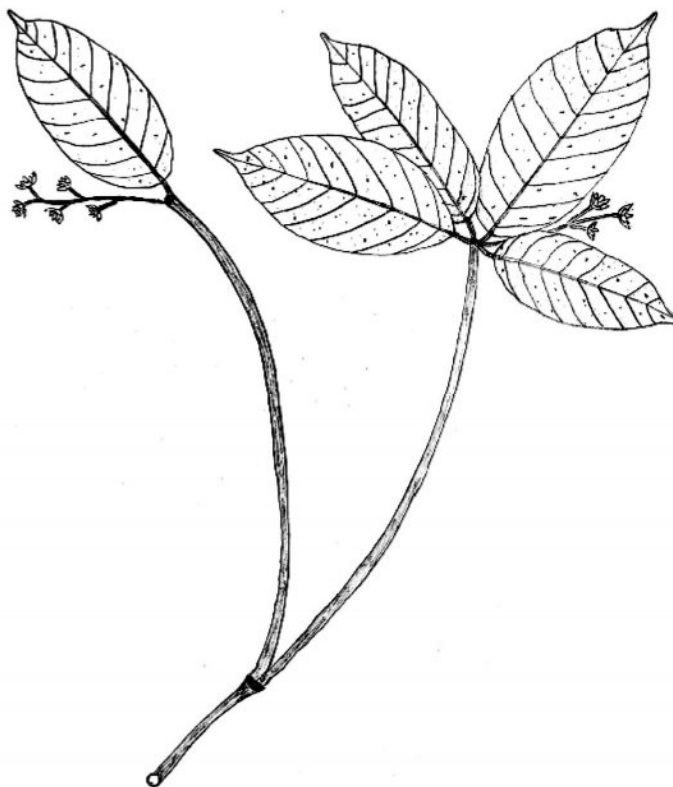


Fig. 9. *Sterculia lanceifolia* Roxb. - A habit sketch (x 0.3)

Economic aspects: Timber serves as the source of fuel. It can also be used for different construction purpose and infrastructure development. Seeds are edible, often used in the form of condiments for seasoning of foods (Uphof, 1959).

Sterculia versicolor Wall., Pl. Asiat. Rar. 1: 48, t. 59 (1830); Mast. in Hook. f., Fl. Brit. Ind. 1: 355 (1874); Kurz, Fl. Burm. 1: 135 (1877); Just, Botanis. Jahres. 6(2): 966 (1878); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 349 (2009); Uddin & Hassan, Vas. Fl. Chit. & Chit. Hill Tr. 2: 427 (2018). *Southwellia versicolor* (Wall.) Wight, Ill. Ind. Bot. 1: 77 (1838); *Clompanus versicolor* Kuntze, Revis. Gen. Pl. 1: 78 (1891). **(Fig. 10).**

Vernacular name: Ranga Udal.

English name: Not known.

Large tree with spreading crown, 24-27 m tall, trunk straight, stout, bark grey, branchlets with prominent scars of fallen leaves. Leaves peltate, digitately 5-7 foliate, elliptic-lanceolate, 18.5-28.9 x 4-16 cm, tapering at the base, acute or shortly acuminate at the apex, subcoriaceous, glabrous above, puberulous or glabrescent beneath, petioles 8-15 cm long. Flowers fragrant, orange-yellow or pale-yellow, many, in erect panicles crowded at the ends of branchlets, pedicels short. Calyx campanulate, hairy, ca. 1 cm long, lobes oblong, inflexed. Male flowers with ca. 2 mm long staminal column, curved, filaments short, anthers 2-loculed. Female flowers with 5-

lobed ovary, hairy with sterile anthers at the base; styles ca. 2 mm long, villous, curved with radiating sub-peltate stigmas. Fruit a follicle, slightly compressed, coriaceous. Seeds 7-15 mm long, oblong.



Fig. 10. *Sterculia versicolor* Wall. - A habit sketch (x 0.5).

Flowering and fruiting: March-July.

Ecology: The species occurs in the hill forests.

Representative specimens: **Chittagong:** Maheshkhali, 7 Mar 1978, M.S. Khan *et al.* K. 4895 (DACB).

Global distribution: Bangladesh, India and Myanmar.

Economic aspects: Mainly valued for timber. Timber can serve as a useful source of fuel wood for its high heat yielding capacity. Seeds are edible, often eaten after roasting. Fiber obtained from bark is used to make ropes and cordage (Ahmed *et al.*, 2009; Alam, 2018).

Sterculia villosa Roxb., Fl. Ind. ed. Carey 3: 153 (1832); Mast. in Hook. f., Fl. Brit. Ind. 1: 355 (1874); Prain, Beng. Pl. 1: 187 (1903); Heinig, List Pl. Chitt. Coll. & HT.: 7 (1925); Sinclair, Bull. Bot. Soc. Beng. 9(2): 88 (1955); Malick in Sharma & Sanjappa (eds.), Fl. India 3: 472 (1993); Ahmed *et al.* (ed.), Encycl. Fl. Fauna Bangladesh 10: 350 (2009). *Sterculia armata* Mast. in Hook. f., Fl. Brit. Ind. 1: 357 (1874); *Clompanus armata* (Mast.) Kuntze, Revis. Gen. Pl. 1: 78 (1891);

Clompanus villosa (Roxb. ex Sm.) Kuntze, Revis. Gen. Pl. 1: 78 (1891); *Sterculia ornata* Wall. ex Kurz in J. Asiat. Soc. Beng. 42 (2): 228 (1873); Kurz, Fl. Burm. 1: 136 (1877); Brandis, Ind. Trees: 81 (1921); Craib, Fl. Siam. Enum. 1: 168 (1925); *Sterculia lantsangensis* Hu, Bull. Fan Mem. Inst. Biol. Bot. 8 (1): 42 (1937). **(Fig. 11).**

Vernacular names: Udal, Chandul, Sambeing (Marma), Frit (Marma), Crukhaoya Bang (Marma), Lambuk (Tripura), Sibotoigo kalai (Tripura), Ya Sing (Murong).

English name: Elephant Rope Tree.

Small to medium-sized tree, arborescent, deciduous, 10-15 m tall, bark grey-white, ca. 2.5 cm thick. Branchlets robust with heart shaped leaf scars of fallen leaves, brown stellate pubescent to tomentose when young. Leaves simple, crowded at the end of branchlets when young; stipulate, stipules lanceolate, ca. 10 mm long, petiolate, petiole cylindrical, 15-40 cm long, minutely tomentose, leaf blade deeply cordate at the base sometimes, entire, coriaceous, minutely pubescent, apex caudate, abaxially densely yellow-brown stellate tomentose, adaxially sparsely pubescent, 30-40 x 30-45 cm, palmately 3-7 lobed, each lobe again 3 lobed, central lobe broadly ovate, veins 5, palmately reticulate. Inflorescence subterminal on branchlets, paniculate, densely ferruginous stellate tomentose. Flowers bisexual, incomplete, irregular, ebracteate, pinkish-yellow in crowded drooping panicles from the end of the thick shoots, male and female flowers intermixed, pedunculate, peduncle 3-18 cm long, pedicellate, pedicel 5 mm long. Calyx broadly campanulate, pinkish inside, 5 lobed, lobes ovate, abaxially pubescent, adaxially glabrous, 7 x 4 mm. Petals absent. Male flowers with 10 stamens, staminal column 2-3 mm long, recurved, glabrous, anthers 10, sessile, staminodes 10. Female flowers with 5 carpels, ovary globose, strigose, 5 loculed, many-ovuled; style inserted, recurved, hairy; stigmas flattened or with 5 lobes, extrorse. Fruit is follicle, 3-5 cm in diameter, oblong to ellipsoid, apex shortly beaked, sessile, leathery, rusty pubescent, many seeded, red when ripe. Seeds 3-5, oblong, smooth, black.

Flowering and fruiting: February-May.

Chromosome number: $2n = 40$ (Kumar and Subramaniam, 1986).

Ecology: Hill slopes in mixed deciduous forests.

Representative specimens: **Bandarban:** Roangchari, 16 Jun 2001, M. Rahman 8703 (BFRIH). **Chittagong:** Pablakhali-Saratali, 30 Apr 1977, Huq et Rahman H. 3275 (DACB); *s. loc.*, 3 May 1977, A.M. Huq 3354 (DACB); Chunati Wildlife Sanctuary, 8 May 1994, A.M. Huq et M.K. Mia 10372 (DACB); Mirsori, Mohamaya lake, 21 Feb 2018, Moniruzzaman et al. MAK 7737 (DACB); Fatikchari, Hazarikhil, 18 Apr 2018, Moniruzzaman et Kowser MK 8275 (DACB). **Cumilla:** Cumilla University Campus, 29 Aug 2016, Tajul et al. TOK 197 (DACB). **Dhaka:** 25 Mar 1964, D.K. Das FKH 365 (BFRIH); Savar, 5 Jun 1978, Soejarto et M. Rahman 4974 (DACB); Dhamrai, 29 Jan 1982, A.M. Huq 5519 (DACB); Dhaka University Botanical Garden, 19 Aug 2021, Sunzid 3 (DUSH). **Khagrachari:** Panchuri, 5 Sep 2016, Kowser et al. KH 392 (DACB). **Mymensingh:** Jamalpur, Gajni forest, 7 May 1982, Mia et al. M. 817 (DACB); Bangladesh Agricultural University Botanical Garden, 2 Jan 2022, Sunzid 50 (DUSH). **Rangpur:** Rangpur Sadar, 15 Apr 1994, M. Mohiuddin 1107 (BFRIH). **Sherpur:** Jhenaighati, Gazni, 9 Feb 1985, Khan et al. K. 7041 (DACB). **Tangail:** Pargacha, 14 Jun 1989, M.K. Mia 211 (DACB).

Global distribution: Bangladesh, Cambodia, China, India, Lao PDR, Myanmar, Nepal, Pakistan and Thailand.

Economic aspects: Ropes, cordage, and bags are made from a coarse fiber produced from the inner bark. The tree produces a transparent gum that is utilized in medicinal preparation. Baked or roasted seeds are popular. The Chittagong Hill Tracts tribal people use the bark to build straps for their long bamboo basket, known as "Turung" which they wear on their heads (Ahmed et al., 2009). Traditionally the plant is used as an agent in diuretic, cooling and aphrodisiac purposes.

The plant is also utilized by Indians as traditional remedy for inflammation. Sherbet, prepared from the petiole of the plant along with water and sugar is given in urinary problems and rheumatism. The bark and the petiole are used as a remedy in seminal weakness. White exudates of the tree are used for throat infection. Root infusion is taken as food adjunct while the whole plant extract is useful for skin diseases. The plant also has anthelmintic, antidiabetic, antimicrobial, membrane stabilization and antithrombotic activity. Some chemical constituents like flavonoids, chrysoeriol, diosmetin-7-O- β -D-glucoside and hrysoeriol-7-O- β -D-glucoside have been isolated from the species. These important phytochemicals can be used for computer aided drug discovery against suitable target using molecular docking, ADMET (absorption, distribution, metabolism, excretion and toxicity) and molecular dynamics simulation approaches (Hossain *et al.*, 2013).

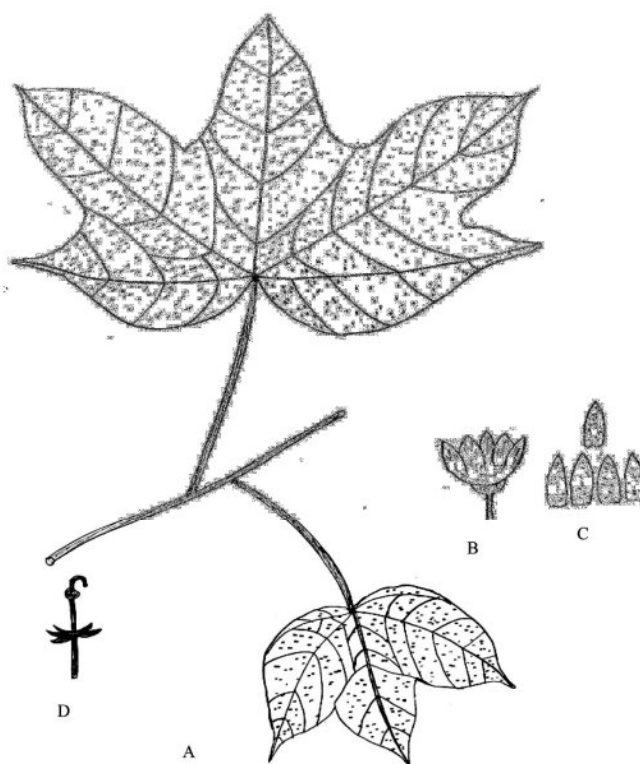


Fig. 11. *Sterculia villosa* Roxb.: A. Habit (x 0.3); B. Flower (x 1.7); C. Calyx (x 1.3); D. L.S. of flower (x 1.0).

Discussion

Taxonomic revisions are required to keep track of potential changes and implications, as every new species discovered has an impact on the currently accepted system of classification (Stuessy, 1975). Phenotypic plasticity further necessitates the need of taxonomic revision as it is responsible for the expression of different types of phenotypes from the same genotype depending on the environmental effect (DeWitt *et al.*, 1998). The present revisionary studies in the subfamily Sterculioideae with 16 taxa is the first on its nature in Bangladesh. Sterculioideae in Bangladesh

incorporates a good number of economically and medicinally important taxa (Alam, 2018). Several attempts have been made worldwide to shed light on the current state of the member taxa of Sterculioideae. Taylor (1989) revised neotropical taxa of *Sterculia* L. which solved the controversy regarding the sexuality of the two floral types. The genus *Brachychiton* was previously included under *Sterculia* and its generic status was ambiguous. Later, Guymer (1988) resolved it into a distinct genus using characteristic features of follicles, seed coats and embryo. The problem of species delimitation in the genus *Scaphium* was solved by Wilkie (2009) with recognition of eight species which was four in the previous revision conducted by Kostermans (1953).

Several floristic studies have reported the occurrence of the member taxa of Sterculioideae throughout the country but no detailed revisionary studies have been carried out so far. The present investigation revealed five genera of Sterculioideae in Bangladesh such as *Firmiana*, *Heritiera*, *Pterygota*, *Scaphium* and *Sterculia* with two, four, one, one and eight taxa, respectively. Among the taxa studied, four taxa belonging to three genera could not be examined because of inavailability of these species and no specimens belonging to these species were deposited in any herbaria of the country. These four taxa were *Firmiana simplex*, *Heritiera papilio*, *Sterculia balanghas* and *Sterculia parviflora*. *Firmiana simplex* was reported as *Sterculia urens* Roxb. by Mia *et al.* (2011) based on the specimen examined by Hooker & Thomson in 1850, where no specific location was mentioned. Ahmed *et al.* (2009) stated the occurrence of *Heritiera papilio* from the forests of Sylhet district. *Sterculia balanghas* was reported by Raizada (1941) from the Chittagong Hill Tracts. Hooker (1874) reported *Sterculia parviflora* from the territory which at present falls under Sylhet region.

Based on the field observations, herbarium specimens and relevant literature (Ahmed *et al.*, 2009; IUCN, 2012; Mia *et al.*, 2011; Rahman *et al.*, 2012; Alam, 2018; Ashrafuzzaman and Sarwar, 2021) the status of the taxa of the subfamily Sterculioideae has been determined. Among the studied taxa, *Sterculia villosa* and *S. lanceifolia* var. *coccinea* (= *Sterculia hamiltonii*) were found as common and considered as Least Concern (LC). *Firmiana colorata*, *Sterculia foetida*, *Pterygota alata*, *Heritiera fomes*, *H. littoralis* and *H. macrophylla* are rarely found in nature and going to be Near Threatened (NT). *Scaphium scaphigerum* was found as Vulnerable (VU), while *Firmiana simplex*, *Sterculia guttata* and *Sterculia versicolor* were found to be Endangered (EN). In the recent past, Ara *et al.* (2013) reported *Sterculia versicolor* as Endangered in Bangladesh that was supported by the present study. As a continuation of the current revision, we aim to apply the techniques of molecular systematics including DNA barcoding and phylogenetic analyses which would further strengthen the systematic position of the taxa of Sterculioideae in Bangladesh.

Acknowledgements

The authors gratefully acknowledge the financial support from the Ministry of Science and Technology for conducting this study. Thanks are due to the authorities of the DACB, DUSH, HCU and BFRIH for providing facilities to examine specimens and to consult their libraries.

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