

PRELIMINARY REVISION OF SWIETENIOIDEAE (MELIACEAE) IN THAILAND



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ABSTRACT

Four genera, 9 species of the Subfamily Swietenioideae in Thailand are treated in this revision. They are 1. *Toona* : *T. ciliata* M. J. Roem., *T. microcarpa* (C.DC.) Harms, *T. sureni* (Bl.) Merr.; 2. *Swietenia* : *S. macrophylla* King, *S. mahogani* (L.) Jacq.; 3. *Chukrasia* : *C. tabularis* A. Juss.; 4. *Xylocarpus* : *X. granatum* Koenig, *X. moluccensis* (Lam.) M. J. Roem., *X. rumphii* (Kostel.) Mabb.

Identification keys to genera and species, as well as the distribution ranges and ecology of species, are provided. A brief historical review of the family is given.

INTRODUCTION

The Meliaceae is a family of mostly trees and shrubs, economically important chiefly for its high quality timbers, including the true mahoganies. It comprises of 50 to 51 genera with about 1,400 species, throughout the tropics and subtropics of both hemispheres and with feeble penetration into temperate zones. Its species occur, in a variety of habitats from rain forest to mangrove swamp and semidesert.

The family is divided into five subfamilies, of which three are small and restricted to Madagascar, while the other two, Melioideae and Swietenioideae, are pantropical and indigenous to Thailand as well.

The true mahoganies are Swietenioideae, particularly *Swietenia* in Americas and *Khaya* in Africa. All are highly prized for their excellent color and working properties. Important Meliaceae timbers besides these includes species of *Aglaiia*, *Azadirachta*, *Cedrela*, *Chukrasia*, *Dysoxylum*, *Guarea*, *Lovoa*, *Owenia*, *Soymida* and *Toona*.

Oils for soap-making have been extracted from the seeds of *Trichilia emetica*

in Uganda, and oil from the Malayan *Chisocheton macrophyllus* has been used as an illuminant. Insecticides have been derived from *Azadirachta* and *Melia* species. The flowers of *Aglaiia odorata* are used in the East in flavoring tea. The fruits of the Langsat (*Lansium domesticum*), and the Santol (*Sandoricum koetjape*) are popular in Thailand and Southeast Asia. Many genera are very ornamental and are increasingly seen in cultivation, particularly *Aglaiia*, *Chisocheton*, *Dysoxylum*, *Melia* and *Turraea*.

BRIEF HISTORICAL REVIEW

The Meliaceae was established by A.L. de Jussieu in 1789, when he brought sixteen genera together into a distinct family called Meliaceae in his *Genera Plantarum*.

Before then some plant taxonomists had described a number of taxa of Meliaceae. The *Herbarium Amboinense* (1741-7) by Rumphius contained descriptions and illustrations of species of six Meliaceae genera: *Camunium* (= *Aglaiia* Lour.), *Lansium*, *Sandoricu*, *Alliaria* (= *Dysoxylum* Bl.),

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Grantum (= *Xylocarpus* Koen.) and *Surenus* (= *Toona* M.J. Roem.). Although none of Rumphius' names were valid, two of them (*Lansium* and *Sandoricum*) were taken up by later authors. Linnaeus' first edition of *Species Plantarum* (1753) contained two representatives of the Meliaceae, *Melia azedarach* L. and *Azadirachta indica* A. Juss. (which Linnaeus named *Melia azadirachta*). During subsequent years, a number of well-known, Meliaceae genera were described by Linnaeus and others.

The Meliaceae received a circumscription similar to that accepted at the present time in the *Prodromus Systematis Naturalis* (1824) of A. P. de Candolle. Based on the number and structure of the seeds, A. P. de Candolle divided the family into three tribes: *Melieae*, *Trichilieae*, *Cedreleae*, finding the first taxonomic system of this family.

In 1830, Adrien de Jussieu made a more detailed account of the Meliaceae. His classification, based on a larger number of characters, was a definite improvement. But in circumscribing the family he returned wrongly to the practice of some earlier authors by excluding *Cedrela*, *Swietenia* and *Carapa* placing those in a separate family *Cedrelaceae*.

J.D. Hooker, in the *Genera Plantarum* of Bentham and Hooker (1862), followed A. de Candolle but differed from A. de Jussieu in uniting the *Cedrelaceae* and *Meliaceae*. Hooker included 37 genera in the Meliaceae, and arranged them in four tribes: *Melieae*, *Trichieae*, *Swietenieae*, *Cedreleae*. The majority of genera recognized by him are still accepted today.

After J. D. Hooker there were five comprehensive taxonomic systems of the Meliaceae published: Casimir de Candolle (1878), Harms (1896 and 1940), Kribs (1930) and T.D. Pennington & B.T. Styles (1975).

The classification of C. de Candolle (1978) was closely similar to that of J. D. Hooker. It retained four tribes of J. D. Hooker's but removed *Vavaea* from the

Melieae to the *Trichilieae*, *Carapa* from the *Trichilieae* to the *Swietenieae*, and placed newly described *Turraeanthus* to the *Melieae*.

Harm's first account of the Meliaceae (1896) was also similar to those of Hooker and C. de Candolle but contained some important differences. It divided the family into three subfamilies (*Cedreloideae*, *Swietenioideae* and *Melioideae*) and nine tribes, including 33 genera. Harms' second account (1940) did not alter the circumscription of the subfamilies, except to include those genera described since 1896 and to remove or change a few ranks. He also suggested that the three subfamilies should be treated as separate families.

Kribs (1930) examined the characteristics of the secondary xylem of 112 species from 36 genera of the Meliaceae, and then constructed a key to genera based on the characters of those, supplemented by facts from gross morphology. He suggested a new arrangement of genera, dividing the family into three subfamilies: *Swietenioideae*, *Lovioideae*, *Melioideae*, and reverted *Swietenioideae* should be ranked as a separate family.

T.D. Pennington & B.T. Styles studied comprehensively the systems mentioned above and new informations from morphology, anatomy, cytology and palynology, and presented a new classification of the Meliaceae in 1975. They divided the family into four subfamilies: *Melioideae*, *Quivisianthoideae*, *Capuronianthoideae*, *Swietenioideae*, comprised of twelve tribes and 51 genera (Table 1).

CLASSIFICATION AND DISTRIBUTION

Subfam. SWIETENIOIDEAE

Buds are nearly always protected by a cluster of scale-leaves. Leaves spirally arranged, monoecious. Loculi nearly always with biseriate ovules. Style - head discoid or very rarely capitate. Fruit a septifragal capsule, with a central columella; seed winged or with corky outer layers.

Table 1. The Five Major Taxonomic Systems of The Meliaceae

A.P. de Candolle (1824)	J.D. Hooker (1862)	C. de Candolle (1878)	Harms (1940)	Pennington & Styles (1975)
Trib. 1 Melieae	Trib. 1 Melieae	Trib. 1 Melieae	Subfam. 1 Cedreloideae	Subfam. 1 Melioideae
<i>Geruma</i>	<i>Quivisia</i>	<i>Quivisia</i>	Trib. 1 Cedreleae	Trib. 1 Turraceae
<i>Humiria</i>	<i>Calodryum</i>	<i>Calodryum</i>	<i>Cedrela</i>	<i>Munronia</i>
<i>Turraea</i>	<i>Turraea</i>	<i>Turraea</i>	<i>Toona</i>	<i>Naregamia</i>
<i>Quivisia</i>	<i>Vavaea</i>	<i>Naregamia</i>	Trib. 2 Cedrelopsideae	<i>Turraea</i>
<i>Strigilia</i>	<i>Naregamia</i>	<i>Munronia</i>	<i>Cedrelopsis</i>	<i>Humbertioturraea</i>
<i>Sandoricum</i>	<i>Munronia</i>	<i>Melia</i>	Trib. 3 Ptaeroxyleae	<i>Calodecarya</i>
<i>Melia</i>	<i>Melia</i>	(incl. <i>Azadirachta</i>)	<i>Ptaeroxylon</i>	<i>Nymania</i>
Trib. 2 Trichilieae	(incl. <i>Azadirachta</i>)	<i>Mallea</i>	Subfam. 2 Swietenioideae	Trib. 2 Melieae
<i>Trichilia</i>	<i>Mallea</i>	<i>Turraeanthus</i>	<i>Khaya</i>	<i>Melia</i>
<i>Ekebergia</i>	Trib. 2 Trichilieae	Trib. 2 Trichilieae	<i>Soymida</i>	<i>Azadirachta</i>
<i>Guarea</i>	<i>Dysoxylum</i>	<i>Dysoxylum</i>	<i>Entandrophragma</i>	Trib. 3 Vavaceae
<i>Heynea</i>	<i>Chisocheton</i>	<i>Chisocheton</i>	<i>Chukrasia</i>	<i>Vavaea</i>
Trib. 3 Cedreleae	<i>Epicharis</i>	<i>Epicharis</i>	<i>Pseudocedrela</i>	Trib. 4 Trichilieae
<i>Cedrela</i>	<i>Cabrlea</i>	<i>Cabrlea</i>	<i>Schmardaea</i>	<i>Trichilia</i>
<i>Swietenia</i>	<i>Sandoricum</i>	<i>Sandoricum</i>	<i>Swietenia</i>	<i>Pseudobersama</i>
<i>Chloroxylon</i>	<i>Aglaia</i>	<i>Aglaia</i>	<i>Lovoa</i>	<i>Pterorhachis</i>
<i>Flindersia</i>	<i>Milnea</i>	<i>Milnea</i>	Subfam. 3 Melioideae	<i>Walsura</i>
<i>Carapa</i>	<i>Lansium</i>	<i>Lansium</i>	Trib. 1 Carapeae	<i>Lepidotrichilia</i>
	<i>Amoora</i>	<i>Amoora</i>	<i>Carapa</i>	<i>Malleastrum</i>
	<i>Synoum</i>	<i>Synoum</i>	<i>Xylocarpus</i>	<i>Ekebergia</i>
	<i>Guarea</i>	<i>Guarea</i>	Trib. 2 Turraceae	<i>Astrotrichilia</i>
	<i>Dasycoleum</i>	<i>Dasycoleum</i>	<i>Turraea</i>	<i>Owenia</i>
	<i>Ekebergia</i>	<i>Ekebergia</i>	<i>Naregamia</i>	<i>Cipadessa</i>
	<i>Walsura</i>	<i>Walsura</i>	<i>Nurmoria</i>	Trib. 5 Aglaieae
	<i>Heynea</i>	<i>Heynea</i>	<i>Munronia</i>	<i>Aglaia</i>
	<i>Beddomea</i>	<i>Beddomea</i>	<i>Cipadessa</i>	<i>Lansium</i>
	<i>Moschoxylon</i>	<i>Moschoxylon</i>	<i>Pterorhachis</i>	<i>Aphanamitis</i>
	<i>Odontandra</i>	<i>Odontandra</i>	<i>Nymania</i> (<i>Aitonia</i>)	<i>Reinwardtiodendron</i>
	<i>Trichilia</i>	<i>Trichilia</i>	Trib. 3 Vavaceae	<i>Sphaerosacme</i>
	<i>Owenia</i>	<i>Owenia</i>	<i>Vavaea</i>	Trib. 6 Guareeae
	<i>Carapa</i>	Trib. 3 Swietenieae	Trib. 4 Melieae	<i>Hekeldora</i>
	(incl. <i>Xylocarpus</i>)	<i>Carapa</i>	<i>Melia</i>	<i>Cabrlea</i>
	Trib. 3 Swietenieae	(incl. <i>Xylocarpus</i>)	<i>Azadirachta</i>	<i>Ruarea</i>
	<i>Swietenia</i>	<i>Swietenia</i>	Trib. 5 Trichilieae	<i>Turraeanthus</i>
	<i>Khaya</i>	<i>Khaya</i>	Subtrib. 1 Trichiliinae	<i>Guarea</i>
	<i>Soymida</i>	<i>Soymida</i>	<i>Trichilia</i>	<i>Chisocheton</i>
	<i>Chukrasia</i>	<i>Chukrasia</i>	<i>Heynea</i>	<i>Megaphyllaea</i>
	(<i>'Chickrassia'</i>)	(<i>'Chickrassia'</i>)	<i>Walsura</i>	<i>Synoum</i>
	<i>Elutheria</i>	<i>Elutheria</i>	<i>Ekebergia</i>	<i>Anthocarapa</i>
	Trib. 4 Cecreleae	Trib. 4 Cecreleae	<i>Owenia</i>	<i>Pseudocarapa</i>
	<i>Cedrela</i>	<i>Cedrela</i>	Subtrib. 2 Guareinae	<i>Dysoxylum</i>
	<i>Chloroxylon</i>	<i>Chloroxylon</i>	<i>Lansium</i>	Trib. 7 Sandoriceae
	<i>Flindersia</i>	<i>Flindersia</i>	<i>Reinwardtiodendron</i>	<i>Sandoricum</i>
			<i>Aphanamitis</i>	Subfam. 2
			<i>Amoora</i>	<i>Quivisianthoideae</i>
			<i>Guarea</i>	<i>Quivisanthe</i>
			<i>Urbanoguarea</i>	Subfam. 3
			<i>Leplaea</i>	<i>Capuronianthoideae</i>
			<i>Ruarea</i>	<i>Capuronianthus</i>

Table 1. (Cont.)

A.P. de Candolle (1824)	J.D. Hooker (1862)	C. de Candolle (1878)	Harms (1940)	Pennington & Styles (1975)
			<i>Synoum</i>	Subfam. 4
			<i>Pseudocarapa</i>	<i>Swietenioideae</i>
			<i>Aglaia</i>	Trib. 1 <i>Cedreleae</i>
			Subtrib. 3 <i>Chisochetoninae</i>	<i>Cedrela</i>
			<i>Turraeanthus</i>	<i>Toona</i>
			<i>Chisocheton</i>	Trib. 2 <i>Swietenieae</i>
			<i>Clemensia</i>	<i>Khaya</i>
			<i>Megaphyllaea</i>	<i>Neobeguea</i>
			Subtrib. 4 <i>Dysoxylinae</i>	<i>Soymida</i>
			<i>Didymocheton</i>	<i>Entandrophragma</i>
			<i>Cabralea</i>	<i>Chukrasia</i>
			<i>Dysoxylum</i>	<i>Pseudocedrela</i>
			<i>Anthocarapa</i>	<i>Schmardaea</i>
			<i>Epicharis</i>	<i>Swietenia</i>
			<i>Sandoricum</i>	<i>Lovoa</i>
				Trib. 3 <i>Xylocarpeae</i>
				<i>Carapa</i>
				<i>Xylocarpus</i>

Thirteen genera are found throughout the tropics and subtropics. Three are genera indigenous and one introduced to Thailand.

Key to the genera

1. Stamens free; disc patelliform with petals adnate at base *1. Toona*
1. Stamens at least united at base into a tube
2. Seeds winged
3. Capsule large, more than 7 cm long; Staminal tube with appendages; introduced one *2. Swietenia*
3. Capsule small, less than 5 cm long; Staminal tube entire or with a crenulate margin; native one *3. Chukrasia*
2. Seeds wingless, with corky coat; mangrove and littoral *4. Xylocarpus*

1. TOONA

(Endl.) M.J. Roem., Fam. Nat. Syn. Monogr. Hesper. 1 : 131, 139. 1846; Harms, in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1) : 44 1940; Back & Bakh. f., Fl. Java 2 : 117. 1965; Penn. & Styles, Blumea 22 : 512, 1975; Mabb., Tree Fl. Malay. 4 : 256. 1989. *Cedrela* sect. *Toona* Endl., Gen. Pl. 2 : 1055. 1840. *Cedrela* L., p.p. in Ridley,

Fl. Malay. Penin 1 : 415. 1922 ; Symington, Malay. for. 4 : 119. 1935.

Deciduous or semi-evergreen trees, monoecious. Leaves paripinnate, leaflets entire, or dentate, glabrous or with simple hairs. Flowers 5 - merous, borne in much - branched thyrses; calyx free or (4) 5 - lobed; petals 5, united at base to disc; stamens 5, free, sometimes with 1 - 5 staminodes; ovary 5 - locular, each loculae with 6 - 10 ovules; style short, style - head discoid. Fruit a pendulous septifragal capsule, opening from the apex by 5 valves; seeds winged at one or both ends.

Approximately 6 species found in the Old World eastwards from India and southern China through Malaysia to Australia, three species found in Thailand.

Key to the species

1. Sepals free, 5 merous, imbricate
2. Capsules smaller than 2.5 cm long, subglabrous or lenticellate in conspicuous; valves thin, leathery *1. T. ciliata*
2. Capsules bigger than 2.5 cm long, lenticellate conspicuously; valves thick, woody *2. T. microcarpa*

1. Sepals united at base with 5 - lobed upwords;
lobes ovate semiorbicular, valvate 3. *T. sureni*

1. *Toona ciliata* M. J. Roem., Fam. Nat. Syn. Monogr. Hesper. 1 : 139. 1946; Hams in Engl. et Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1) : 45 f. 2. 1940; H. Li, in Fl. Yunnan 1 : 206. t. 48. f. 1 - 5, 1977; T. Smit., Thai Pl. Nam. 332. 1980; X.M. Chen, Journ. Wuhan Bot. Res. 4 (2) : 187. 1986. *Cedrela toona* Roxb. ex Rottl., Ges. Naturf. Fr. Neue Schr. 4 : 198. 1803; Hiern in Hook. f., Fl. Brit. Ind. 1 : 568. 1875; C. DC. in DC., Monogr. Phanerog. 1 : 745. 1878; Brandis, Ind. Trees, 145. 1906; Craib, Fl. Siam. En. 1 : 267. 1926. *C. mollis* Hand. - Mazz., in Sitzgsanz. AK. W.W. 57 : 266. 1920.

Thailand ____ Northern: *Chiang Mai*, *Phrae*, *Phitsanulok*; North-Eastern : *Phetchabun*; Eastern : *Nakhon Ratchasima*.

Distribution ____ China, India, Bengal and Burma.

Ecology ____ In mixed evergreen forest, frequently by streams; alt. 600-800 m. Flowering and fruiting in January- July.

Vernacular ____ Yom hom ยมหอม (General).

2. *Toona microcarpa* (C. DC.) Harms, in engl. et Prantl, Nat. Pflanzenfam. 3 (4) : 270. 1896; ed. 2, 19 b (1) : 46. 1940; H. Li, in Fl. Yunnan. 1 : 209. t. 48. f. 6 - 7. 1977; X. M. Chen, Journ. Wuhan. Bot. Res. 4 (2) : 188. 1986. *Cedrela microcarpa* C. DC., in DC., Monogr. Phanerog. 1 : 745. 1878; Brandis, Ind. Trees 146. 1906; Craib, Fl. Siam. En. 1 : 267. 1926.

Thailand ____ South- Western : *Kanchanaburi*; South-Eastern : *Chanthaburi*.

Distribution ____ India, Sikkim (type), Bengal, China to Burma and Cochin - China

Ecology ____ Scatted in evergreen forest. Flowering and fruiting in January-July.

3. *Toona sureni* (B1.) Merr., Int. Rumph. Herb. Amb. 305. 1917; Back. et Bakh. f., Fl. Java. 2 : 117. 1965; mabb., in Tree Fl. Malay. 4 : 258. 1989. *Swietenia*

sureni Blume, Cat. Gew. Buitenzorg. 72. 1823. *Cadrela febrifuga* Blume, Bijdr. 180. 1825; Ridley, Fl. Malay. Pen. 1 : 415. 1922. *C. Sureni* (B1.) Burkill, in Gard. Bull. Str. Settl. 5 : 120. 1930; Symington, Malay. For. 4 : 122. 1935. *Toona febrifuga* (B1) M.J. Roem., Fam Nat. Syn Monogr. Hesper. 1 : 139. 1846; Harms in Engl. et Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1) : 46. 1940; T. Smit., Thai Pl. Nam. 332. 1980.

Thailand ____ Penninsular : *Trang*.

Distribution ____ Tropical Asia from India and China to Papua New Guinea.

Ecology ____ Occurs at low elevation evergreen forest. Flowering and fruiting in January - August.

Vernacular ____ Surian สุหรียน (Peninsular).

These three species are very close, especially *T. Ciliata* and *T. sureni*. Sometimes it is not easy to distinguish them even though flowers and fruits are available. It deserves to be further studied about their classificatory positions of being separate species.

2. SWIETENIA

Jacq., Enum. Pl. Carib. 4. 1760; harms in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1) : 70. 1940; Corner, Ways. Trees Malay. 1 : 468. 1940; Back. & Bakh. f., Fl. Java 2 : 117. 1965; Penn. & Styles, Blumea 22 : 521. 1975. *Mahagoni* Adans., Fam. Pl. 2 : 343. 1763. *Roia* Scop., Introd. 226. 1777. *Suitenia* Stokes, Bot. Mat. Med. 2 : 479. 1812.

Deciduous trees. Leaves paripinnate; leaflets entire, glabrous. Flowers unisexual, borne in short, little - branched, axillary thyrses; calyx (4) 5 lobed, lobes imbricate; petals (4) 5, free, contorted and reflexed when open; staminal tube cup - shaped or urceolate, terminated by 8 - 10 appendages; anthers 8 - 10, apiculate, medifixed, alternating with the appendages; disk cupular - annular; ovary 5 - locular, each loculus with 12 - 16 ovules; style short, style - head discoid, with 5 -

stigmatic lobes. Fruit an erect, strongly woody capsule, opening by 5 valves from the base or base and apex simultaneously; seeds 9 - 16 per loculus, attached by the wing - end to the apex.

Three species in tropical America and the caribbean, two introduced to Thailand.

Key to the species

1. Leaflets more than 11 cm long; capsules longer than 13 cm; seeds (including wings) 7.5 - 9 cm long *1. S. macrophylla*
1. Leaflets less than 8 cm long; capsules shorter than 10 cm; seeds (including wings) 4.5 - 5.5 cm long *2. S. mahogani*

1. Swietenia macrophylla King, in Hook., Ic. pl., t. 1550. 1886; Craib in Fl. Siam. En. 1 : 266. 1926; Harms in Engl. et Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1) : 73. 1940; Corner, Wayside Trees Malay. 1 : 469. fig. 157, 2 : Pl. 142. 1940; Back. & Bakh. f., Fl. Java 2 : 118. 1965.

Thailand _____ locally cultivated as a roadside and ornamental tree in cities and towns.

Distribution _____ Honduras.

Vernacular _____ Mahokkaanee bai yai มะฮอกกาน้ำใหญ่ (Bangkok)

2. Swietenia mahogani (L.) Jacq., enum. Pl. Carib. 20. 1760; Linn., Sp. Pl. ed. 2, 271. 1762; Harms in Engl. et. Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1) : 71. f. 14. 1940; Corner, Wayside Trees Malay. 1 : 469. 1940; Back. & Bakh. f., Fl. Java 2 : 118. 1965.

_____ *Cedrela mahogani* Linn., Syst. ed. 10, 940. 1759. _____ *Swietenia mahogani* "L" DC., Prodr. 1 : 625. 1824.

Thailand _____ Occasionally cultivated in some gardens.

Distribution _____ Tropical America.

Vernacular _____ Mahokkaanee bai lek มะฮอกกาน้ำเล็ก (Bangkok)

3. CHUKRASIA

A Juss., in Mem. Mus. Hist. Nat. Paris 19 : 251. 1830; Harms in Engl. & Prantl, Nat.

Pflanzenfam. ed. 2, 19 b (1) : 65, fig. 45 s, T. 1940; Penn. & Styles, Blumea 22 : 519, fig. 18 c, d. 1975; Mabb., Tree Fl. Malay. 4 : 254. 1989. _____ *Plagiotaxis* Wall. ex Okuntze, Rev. Gen. Pl 1 : 110. 1891. _____ *Chickrassia* Wight & Arn. Prodr. Pl. Penins. Ind. Or. 1 : 122. 1834, Ridley, Fl. Malay. Penin. 1 : 415. 1922.

Deciduous trees. Leaves paripinnate; leaflets entire, asymmetric; leaves of young trees mostly bipinnate with lobed leaflets. Indumentum of simple hair. Flowers large, unisexual; thyrses axillary, usually shorter than the leaves; calyx lobed; petals 4 or 5, free, contorted and reflexed when open. Staminal tube cylindrical, narrowing towards the apex entire or with a crenulate margin; anthers attached to the margin, disk small; ovary flask - shaped, 3-5-locular, each loculus with numerous ovules; style slender, style - head capitate with 3 - 5 stigmatic ridges. Fruit a woody, ovoid or ellipsoid capsule, opening by 3 - 5 valves from the apex; seeds with terminal wings, 60 - 100 per loculus, arranged laterally in tiers in the valve.

A single species found in India eastwards to southern China and western Malaysia, also occurring in Thailand.

1. Chukrasia tabularis A. juss., in Mem. Mus. Hist. Nat. Paris 19 : 251. 1830; Hiern in Hook. f., Fl. Brit. Ind. 1 : 568. 1875, "Chickrassia"; Pellegr. in Lec., Fl. Gen. I. - C. 1 (7) : 780. 1911; Ridl., Fl. Malay. Pen. 1 : 415. 1922, "Chickrassia"; Craib in Fl. Siam. En. 1 : 266. 1926; Harms in Engl. et Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1) : 66. 1940; How et T. Chen, in Acta Phytotax. sin. 4 (1) : 32. 1955; H. Li, in Fl. Yunnan 1 : 211. t. 49. f. 1 - 4. 1977; X. M. Chen, in J. Wuhan Bot. Res. 4 (2) : 189. 1986; Mabb., Tree Fl. Malay, 4 : 256. fig. 10. 1989. _____ *Swietenia chickrassia* Roxb. Hort. Beng. 33. 1814.

1 a. var. tabularis cf. the above mentioned citations.

Thailand _____ Northern : *Chiang Mai*, *Phrae*; North-Eastern : *Phetchabun*; Central : *Saraburi*; South - Eastern : *Prachin Buri*, *Chanthaburi*.

Ecology _____ In mixed deciduous forest, frequently by streams; alt. 250 - 700 m. Flowering and fruiting in April - October.

Vernacular _____ Fak daap ผักดาบ, Chanthaburi; Waa- raa-yong วาไรยง (Khmer - Prachin Buri); Siat kaa เสียดกา, (Prachin Buri)

1 b. var *velutina* (M.J.Roem) King, in Journ. As.Soc.Beng. 64 (2) : 88. 1895, "Chickrassia"; Harms in Engl. et Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1) : 66. 1940; How et T. Chen, in Acta Phytotax. Sin. 4 (1) : 32. 1955; H. Li, in Fl. Yunnan 1 : 213. 1977; X. M. Chen, in J. Wuhan Bot. Res. 4 (2) : 189. 1986. _____ *Plagiotaxis velutina* Well., Cat. n. 1270. 1829, nom. nud. _____ *Chickrassia velutina* M.J. Roem., Synops. monogr. 1 : 135. 1846. _____ *Chukrassia velutina* Wight et Arn., Prodr. 1 : 123. 1834; Kurz, for. Fl. Burma 1 : 227. 1877; C.DC. in DC., Monogr. Phanerog. 1 : 727. 1878; Pierre, Fl. For. Cochinch. t. 357. 1885; Craib, in Fl. siam. En. 1 : 266. 1926; T. Smitinand, Thai Pl. Names 39. 1980.

Thailand _____ Northern : *Mae Hong Son*, *Chiang Mai*, *Lamphun*, *Lampang*, *Phrae*; North - Eastern : *Loei*, *Khon Kaen*; Eastern : *Nakhon Ratchasima*; Central : *Saraburi*; Peninsular : *Surat Thani*.

Distribution _____ Scattered in dry evergreen forest; alt. 300 - 700 m. Flowering and fruiting between July and October.

Vernacular _____ Ring baang รังข้าง, Ree รี (Karen - Mae Hong Son); Khoyong ไคย่อง (Karen -Chiang Mai) ; Yom khao ยมขาว (Northern); Yom hin ยมหิน, Ma fueang chaang มะเฟืองช้าง, Sadao chaang สะเดาช้าง, Sadao สะเดาหิน (Central); Chaa ka dao ช้างเคเดา (Peninsular)

The distinction between these two varieties, var *tabularis* and var. *velutina*, as two extreme cases, is obvious _____ for the former it is its glabrous twigs, raches and both surfaces of leaflets except there are sometimes a few clusters of hairs at the axillae of nerves on the back of leaflets, and

for the latter there are dense fine pubescences on its young twigs, raches and the back of leaflets. But of a great number of specimens we have studied, there are some intermediates the density of indumentum has a gradual change.

4. XYLOCARPUS

Koenig, Naturforscher (Halle) 20 : 2. 1784; Ridley, Kew Bull. 1938 : 288. 1938; Harms in engl. & Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1: 81, t. 19.1940; Back. & Bakh. f., Fl. Java 2 : 118. 1965; Penn. & Styles, Blumea 22 : 525. Fig. 16 g, h. 1975; Mabb., Tree Fl. Malay. 4 : 258. 1989. _____ *Carapa* sensu Lam., Encycl. Meth. 1 : 621. 1785; Aubl., P.P. in Ridley, Fl. Malay Pen. 1 : 414. 1922; Corner, Wayside Trees Malay. 1 : 458. 1940. _____ *Monosoma* Griff., Notul. 4 : 502. 1854. *Granatum* Rumph. ex O. Kuntze, Rev. Gen. 1 : 110. P.P. 1891.

Semi - evergreen trees. Leaves paripinnate with leaflets (1) 2 or 3 (4) pairs, entire, glabrous. Flowers unisexual, but with well developed vestiges of the opposite sex present, borne in short axillary thurses; calyx 4 - lobed to about the middle; petals 4, free; staminal tube with 8 included anthers and 8 appendages; disk large, red, cushion - shaped; ovary 4 - locular, each loculus with 3 or 4 (- 6) ovules; style short, style - head discoid. Fruit a large pendulous subspherical septifragal capsule, tardily dehiscing by 4 valves; seeds 5 - 20, large, pyramidal or tetrahedral, testa corky, inlaid with fibres.

Three species found in mangrove, swamps or coastal scrub of the Old World, all in Thailand.

Key to the species

1. Trees of mangroves or other muddy substrates; leaflets obovate - oval - oblong, apices obtuse to rounded.
2. Buttresses snake - like, without pneumatophores; bark smooth, scaling. Leaflets usually rounded at apex, withering orange - red. Fruit globose, 10 - 20 cm diam.

1. *X. granatum*

2. Buttresses not snake-like, pneumatophores present; bark strongly fissured. Leaflets usually acute at apex, withering bright yellow. Fruit broadly ellipsoid, 8 - 15 cm diam.

2. *X. moluccensis*

1. Trees of rocky coasts; leaflets ovate - broadly ovate - cordate, apices

3. *X. rumphii*

1. *Xylocarpus granatum* Koenig, in Naturf. 20 : 2. 1784; Harms in Engl. et Prantl, Nat. Pflanzenfam. ed. 2, 19 b (1) : 84. t. 19. f. A. - C. 1940; How et T. Chen in Acta Phytotax. Sin. 4 (1) : 30 : 1955; Back. & Bakh. f., fl. Java 2 : 118. 1965; X. M. Chen in Journ. Wuhan Bot. Res. 4 (2) : 191. 1986; Mabb., Malay. For. 45 (3) : 450. 1982, et. Tree Fl. Malay. 4 : 260. Fig. 12 B. 1989.

Carapa obovata Bl., Bijdr. 1 : 179. 1825; C. DC., in DC. Monogr. Phanerog. 1 : 718. 1878; Watson, Malay. For. Rec. 6 : 70, 73 - 74, 124. 1928. *C. moluccensis* sensu Ridley, Fl. Malay. Pen. 1 : 414. 1922, non Lam. *C. granatum* (Koenig) Alston, in Burkill Dict. 452. 1935; Corner, Wayside Tree Malay. 1 : 458. 1940. *Xylocarpus obovatus* A. Juss., in Mem. Mus. hist. Nat. Paris 19 : 244. 1830; Craib, in Fl. Siam. En. 1 : 265. 1926. *X. minor* ridley, in Kew Bull. 1938 : 289. 1938

Thailand _____ Southern-eastern : Rayong, Chanthaburi, Peninsular : Chumphon, Ranong, Phangnga.

Distribution _____ Old World Tropics from East Africa to Tonga.

Ecology _____ Common in mangrove forest. Flowering and fruiting in March - November.

Vernacular _____ Kra buon Khaao กระบูนขาว, Ta buon กระบูน, Ta buon khaao กระบูนขาว, (South-Eastern, Peninsular)

2. *Xylocarpus moluccensis* (Lam.) M.J. Roem., Syn. hesperides 1 : 124. 1846; Craib, in Fl. Siam. En. 1 : 264. 1926; Back. et Bakh. f., fl. Java 2 : 118. 1965; Mabb., Malay. For. 45 (3) : 450. 1982, et in Tree Fl. Malay. 4 : 260. Fig. 12 C. 1989. *Carapa moluccensis* Lam., Encycl. Meth. 1 : 625. 1785; Hiern in

Hook. f., Fl. Brit. Ind. 1 : 567. 1875; Watson, Malay. 1 : 459, 1940, pro jaj. parte. _____

C. obovata sensu Ridley, Fl. Malay. Pen. 1 : 414. 1922, non Blume. _____

Xylocarpus mekongensis Pierre, Fl. For. Cochinch. t. 359 B. 1897.

Thailand _____ South-eastern : Chanthaburi, Trat, Peninsular : Surat Thani, Trang.

Distribution _____ Indomalaysia to N. Australia.

Ecology _____ Common in muddy seacoasts and tidal rivers. Flowering and fruiting in May - September.

Vernacular _____ Ta ban ตะบัน, Tabun dom ตะบันดำ (Sout-Eastern, Peninsular).

3. *Xylocarpus rumphii* (Kostel.) Mabb., Malay. For. 45 (3) : 450. 1982, et in Tree Fl. Malay. 4 : 260. Fig. 12 A. 1980.

Carapa rumphii Kostel., in Allg. Med. Pharm. Flora 5 : 1988. 1836. _____

C. moluccensis Lam., sensu Corner, Wayside Trees Malay. 1 : 458. 1940, pro min. parte.

Thailand _____ South-Eastern : Chon Buri, Rayong; Peninsular : Ranong, Krabi.

Distribution _____ Old World Tropics from East Africa to Tonga.

Ecology _____ Scattered along rocky seashores and headlands. Flowering and fruiting in almost all seasons.

ACKNOWLEDGEMENTS

We are cordially grateful to the Director, Dr. Thawatchai Santisuk, and the staff members of The Forest Herbarium, Bangkok, Thailand, in kindly giving the access to the reference, collections and other facilities during our study.

Our kindest regards are due to Dr. Chamlong Phengkhai, of The Forest Herbarium, Royal Forest Department, and Dr. Utis Kutintara, the Head of Department of Forest Biology, Kasetsart University, for the encouragement, valuable advice given to the authors and for reading through the manuscript, to Dr. Suchitra Changtragoon, of the Biotechnology and Biochemistry Section, Central Forest Research Laboratory and Training Centre, Royal Forest

Department, for translating some German references for us, to Dr. Somkid Siripatanadilok and other staff members of the Department of Forest Biology, Kasetsart University, for their lavish help.

I, the first author, also wish to tender my humble gratitude to Mr. Kachorn Tingthana-thikul for his lavish support of my scholarship during my stay in Thailand, and to the Faculty of Forestry, Kasetsart University for kindly accepting me as a visiting scholar.

APPENDIX

NUMBERS OF TAXA

1. *Chukrasia tabularis* A. Juss.
1a. var *tabularis*
2. *Swietenia macrophylla* Kind
3. *S. mahogani* (L.) Jacq.
4. *Toona ciliata* M.J. Roem.
5. *T. microcarpa* (C.DC.) Harms
6. *T. sureni* (Bl.) Merr.
7. *Xylocarpus granatum* Koenig
8. *X. moluccensis* (Lam.) M.J. Roem.
9. *X. rumphii* (Kostel.) Mabb.

INDEX TO COLLECTORS' NUMBERS

The first number of each pair is the collector's number, the second refers to the number of the species.

BKF. 633 : 4; 641 : 1b; 1057 : 4; 2680 : 1b;
12522 : 9; 13469 : 7; 096272 : 9; 096274 : 8.
Boonnab C. 310 : 6; s.n. (BKF 51471) : 8
Burma P. 16 : 1b
Charaem 18 : 2
Charan 50 : 2
Dee 60 : 1a; 229 : 1b; 1140 : 5

Din 186 : 1b
Geesink R. and T. Santisuk 5314 : 7
Iwatsuki K. T - 27778 : 8
Iwatsuki K. and T. Santisuk s. n. (BKF 71501) :
8; s.n. (BKF 71507) : 8
Khid 378 : 1b
Larsen K. *et al.* 2198 : 1a; 32493 : 0
Luan 5 : 1b
Maxwell J.F. 87 - 892 : 1b; 88 - 1078 : 1b; 89 -
413 : 4; 89 - 604 : 5
Native s.n. : 7
Niyomdham C. 1954 : 9
Phengkai C. 1981 : 9
Phengkai C. *et al.* 3104 : 5; 3812 :
Pipat s.n. (BKF 82534) : 7
Promdet C. 23 : 8
Rollet s.n. (BKF 71031) : 7
Sangkachand B. 1564 : 6
Santisuk T. 694 : 7; s.n. (BKF 082483) : 8; s.n.
(BKF 085533) : 4; s.n. (BKF 085540) : 4; s.n.
(BKF 085570) : 1a; s.n. (BKF 96467) : 3.
Singyadam K. 23 : 1b
Smarn 65 : 7
Smitinand T. 2284 : 9; 3159 : 5; 4820 : 1b;
11552 : 4; s.n. (BKF 94766) : 9
Smitinand T. *et al.* 7569 : 1b
Soradaeh 387 : 4
TDBS 11193 : 4; 12233 : 9; 12316 : 7; 12345 : 9
Vanpruk L. 14 : 8; 205 : 1a; 220 : 4
Vathnasuvakul C. s.n. : 8
Yasothorn C. 38 : 6