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THE SPECIES OF WALSURA AND PSEUDOCLAUSENA GENUS NOVUM (MELIACEAE)[1]

T.P. CLARK

Department of Plant Sciences, South Parks Road, Oxford OX1 3RB, U.K.

SUMMARY

The Indo-Malesian genus *Walsura* Roxb. is revised and the closely related new genus, *Pseudoclausena*, is segregated from it. *Walsura* consists of three sections of which one (*Ruswala*) is newly described, and thirteen species of which three (*W. dehiscens, W. pachycaulon* and *W. sarawakensis*) are newly described. One new combination is made (*W. trifoliolata* subsp. *acuminata*). The Malesian genus *Pseudoclausena* consists of one species (*P. chrysogyne*), formerly *Walsura chrysogyne*, and *W. velutina* is reduced to a new forma of it. A summary of the taxonomic history of the species is given. Notes on morphology (including micro-features of the leaf surface and pollen), wood, fruit and seed anatomy and chromosome and chemotaxonomic studies are included and seed dispersal systems are considered. Variation within the genera and speciation and biogeography are discussed. Notes on economic botany are given. All species are described and a key is presented.

INTRODUCTION

Since the last monographic treatment (De Candolle, 1878) of the species included in this revision something in excess of 95% of specimens currently available for study have been collected and 72% (i.e. 28 out of 39) specific names have been published within *Walsura*. Of these new species, many were published with little attempt at comparison with previously described ones, hence synonyms abound. Of the fourteen species recognised here, three are newly described, and (for this revision) five have been studied in the field and flowering material of one (*W. dehiscens* T. Clark) was collected for the first time. In the light of infraspecific variation demonstrated by material collected since De Candolle's revision, five of his twelve species have been or need to be reduced, and his key to the species is found to be largely based on inaccurately described characters (which in some cases could have been avoided by close examination of any specimen of the species concerned). All of this, together with the removal here of several species to a new closely related genus, necessitates a new monographic treatment, so that material may be correctly identified and the affinities and relationships of the species be understood more clearly.

The problem of generic delimitation in the *Trichilia* P. Browne (Africa & New World) – *Heynea* Roxb. ex Sims (Asia) – *Walsura* complex is an old chestnut in meliaceous taxonomy. *Heynea* has always been distinguished from *Walsura* princi-

[1] Part of a thesis successfully submitted for the degree of D.Phil. in the University of Oxford.

pally on the basis of fruit dehiscence, and using the same character Bentvelzen (1962) reduced *Heynea* to *Trichilia,* its species becoming *T. connaroides* (W. & A.) Bentvelzen and *T. sinensis* Bentvelzen. In this paper, for convenience, these species will be referred to as *Heynea* spec. The problems of generic delimitation in the Trichilieae have been investigated using an assortment of macro- and micro-morphological and anatomical features and this whole question (Clark, 1990) will be dealt with in a separate paper. It has been concluded however that *Walsura* and a new genus based on *W. chrysogyne* are quite distinct genera within the tribe (see below).

Where the term '*W. chrysogyne* et al.' is used below it refers collectively to the formerly recognised species *W. chrysogyne, W. brachybotrys, W. celebica, W. glabra, W. borneensis, W. hosei, W. palawanensis* and *W. velutina.* The term *Walsura* sensu stricto refers collectively to all other *Walsura* species.

TAXONOMIC HISTORY

William Roxburgh described the genus *Walsura* in Flora Indica (1832), having invalidly published the name in his Hortus Bengalensis (1814). In 1832, he included only two species (*W. piscidia* Roxb. and *W. robusta* Roxb.). The genus therefore appeared just too late for incorporation in Adrien de Jussieu's revision of the family and its species then known, published in toto in 1832. Jussieu did however publish (1830) a new species of *Heynea* (*H. trifoliolata*) and it was not until 1940 that its synonymy with *W. piscidia* was pointed out (by Harms). *Walsura robusta* was removed from the genus by Roemer (1846) to a new genus *Surwala,* but was reinstated in *Walsura* by Hiern (1875) where it has remained.

Walsura pinnata was described by Hasskarl from Java in 1855 and *W. gardneri* by Thwaites from Sri Lanka in 1858. *Clausena chrysogyne,* described by Miquel in the Rutaceae in 1861, was transferred to *Walsura* by Bakhuizen f. (1968) as the correct name for the wide-ranging and highly variable species *W. multijuga* King (1895). *Walsura trichostemon* was also described by Miquel (1868) and Kurz (1875) reduced Wallich's unpublished *W. villosa* into it, though De Candolle (1878) chose to keep these two species separate.

Then followed two important regional floristic accounts. Hiern in J.D. Hooker's Flora of British India (1875) keyed out and described eight species of *Walsura* (including *W. tubulata* from Sikkim as new) and Kurz in his Forest Flora of British Burma (1877) did the same for seven species, but also illegitimately reduced *Heynea* Roxb. ex Sims (one species) to the genus. *Walsura oxycarpa* Kurz, from the Andamans, was also first described in 1875. 1878 saw the publication of Casimir de Candolle's epic species revision of the Meliaceae in which he described and attempted to key out twelve species of *Walsura,* including one new species (*W. thwaitesii*). Harms (1896, 1940) gave a description of the genus but little or no information on individual species, and in the earlier work follows Kurz (1877) in including *Heynea* (at section status) but reinstated it as a distinct genus in 1940.

Since 1895, several species names have been published (see synonymies below), particularly based on material from Borneo, southeastern Indo-China and the Philippines. Only three are maintained in this revision, namely *W. bonii* Pellegrin (1910)

and *W. poilanei* Pellegrin (1944), both from Vietnam and *W. monophylla* Elmer ex Merrill (1954, published invalidly by Elmer in 1937) from the Philippines.

Pennington (1965) gives the fullest description of the genus (but not species) to date and includes observations of wood structure and pollen morphology. Pennington and Styles (1975) in the most recent generic monograph of the family have a slightly abbreviated version of Pennington's earlier work on *Walsura* and also briefly discuss its relationship with other members of the tribe.

MORPHOLOGICAL NOTES

Habit

All species in wet evergreen forest are predominantly sub-canopy trees, but in dry-zone evergreen forest in Sri Lanka, *W. trifoliolata* attains the same height as the other canopy trees (Holmes, 1956). *Walsura gardneri* of Sri Lanka is invariably a treelet to less than 3.5 m tall and its crown is more densely twiggy than in any other species. All species, with the notable exception of *W. pachycaulon,* have slender twigs. Leaves can be all along the shoot (e.g. *W. robusta*) or clustered around the shoot apex (e.g. *W. pinnata 'villamilii'*).

Exudate

All species seem to lack exudate of any sort in slash bark and wood. Most of the species have glands on the undersurface of the leaf, however. These have been observed in *W. tubulata* (cultivated under glass at Oxford) to exude small quantities of sweet colourless liquid and the glands producing it are, therefore, probably extra-floral nectaries. A colourless sweet sticky exudate has also been reported (*Pennington 7815,* Selangor) from the aril of *W. pinnata.*

Bark

Observations of bark morphology are sparse but seem to be of some taxonomic value. Most species have smoothish outer bark but that of *W. trifoliolata* is deeply fissured. Observations of some species are completely lacking.

Leaves

1) *Walsura* sensu stricto

The leaf is unifoliolate (*W. gardneri, W. monophylla* and occasionally in *W. pinnata 'cochinchinensis'*) or imparipinnate with lateral leaflet pairs opposite (never sub-opposite). The primary rachis is slightly swollen at the point of insertion of the petiolules, as is the petiolule immediately below the base of the lamina, and the leaflet here can often be slightly geniculate. The unifoliolate species have a second petiolule swelling either just below or continuous with the swelling at the lamina base. The largest leaves are found in *W. sarawakensis,* at up to 80 cm long. *Walsura trifoliolata* and *W. tubulata* have one-jugate leaves and most species of *Walsura* are two-jugate. Three-jugate leaves occur in *W. sarawakensis* and in *W. pinnata 'villamilii'* and the four- (and rarely five-)jugate state occurs in *W. pachycaulon* only. *Walsura trifoliolata* subsp. *trifoliolata* and *W. tubulata* grown from seed at the Oxford Botanic

Garden both produced undivided leaves in the early stages and the latter was still producing a small proportion of such leaves when five years old (and flowering).

All species have papillate epidermis on the abaxial surface of the leaflet lamina to some degree. This gives the surface a glaucous (in life) or matt (when dried) appearance. It should be noted that leaf epidermis is described as 'glaucous (in vivo)', this implies that it is matt (in sicco) also. Each epidermal cell concerned has one dome-like projection (complete with cuticular sculpturing) of the outer periclinal wall. Species differ in the extent to which the abaxial surface is covered, varying from only in the islets between the smallest veins (giving the surface a white dotted appearance) in *W. robusta* and (to a lesser extent) in *W. oxycarpa,* to all areas except the midrib and costae, as in *W. pachycaulon. Heynea* species also have a papillate abaxial epidermis.

Foliar trichomes range from the prostrate 2-armed trichomes of *W. trifoliolata* to prostrate simple trichomes (in e.g. *W. bonii*) to the erect simple trichomes of *W. poilanei.* All are unicellular. Stomatal subsidiary cell arrangement is actinocytic (sensu Wilkinson, 1979) and epicuticular wax (as found in *Owenia* species) is absent.

Venation patterns do not seem to be of great use taxonomically. However, costae frequency is a good character with some species and *W. pinnata 'villamilii'* is exceptional in having incomplete costae. These are 1/4–3/4 the length of normal costae and taper distally, but for most of their length are the same width and prominence as complete costae.

2) *Walsura chrysogyne* et al.

This group exhibits a wide range of leaf division, from one- to seven-jugate, with two-, three-, or four-jugate being the commonest states. The primary rachis and petiolule swellings typical of the other *Walsura* species are very slight or completely lacking in these species and, whilst most specimens have opposite leaflets, a small proportion have the slightly subopposite state. Venation patterns seem to provide no taxonomic characters.

The abaxial leaflet surface is non-papillate. The trichomes are erect, simple and multicellular and compound stellates (i.e. aggregations of simple hairs as opposed to the stellate trichomes proper found in some other genera of the Trichilieae) also occur (but very sparsely). Stomatal subsidiary cell arrangement is paracytic (sensu Wilkinson, 1979) and epicuticular wax is absent.

Inflorescence

In all species the inflorescence is a thyrse which may be very short and dense as in *W. brachybotrys* (= *W. chrysogyne*) and *W. dehiscens* (as short as 0.8 cm) or long and open as in *W. trichostemon* and *W. pachycaulon* (up to 30 cm in the latter). *Walsura trifoliolata* frequently has dense heads of flowers at the ends of the secondary rachides, a feature rare in other species. All species have a dense indumentum on the inflorescence, and in most this consists of minute simple trichomes only. In *W. trichostemon* the trichomes are so dense as to give the inflorescence a velutinous covering. Two-armed trichomes also occur (sparsely) in this species. In *W. trifoliolata, W. gardneri* and *W. oxycarpa* two-armed trichomes predominate on the peduncle and are replaced on all other parts by simple trichomes.

Flower

Most species seem to have hermaphrodite flowers only, but in *W. trifoliolata, W. pinnata* and *W. chrysogyne* et al. hermaphrodite or (on different trees) only male flowers occur. *Walsura robusta* seems to be dioecious but may also exhibit the hermaphrodite character.

Aestivation may vary considerably within a single specimen, from valvate to imbricate and, although much used in the past as a character in these species, is considered to be of little taxonomic value.

Walsura robusta is the only species with discrete filaments only, all other species having an androecium which is tubular below with discrete filaments above. The proportion of the total androecium length (excluding anthers) which is a tube provides a useful taxonomic character. The form of the apex of the filament is in most species bifid to some degree, but in *W. bonii* is truncate.

All species of *Walsura* have a shallow cylindrical disk above the ovary around the style base, but apart from *W. robusta* where it is pubescent, it is very constant and is of little taxonomic use. *Walsura chrysogyne* et al. lack a disk completely, however. All species have a dense covering of bristle-like trichomes on the ovary (being particularly dense in *W. chrysogyne*) but only in *W. tubulata* do they extend up the style. The stigma is normally capitate to conical, but in *W. dehiscens* a rather elaborate cone on top of a cap-like structure exists and in life the upper part is also covered by a layer of colourless gel-like substance, unknown elsewhere in the genus.

Pollen

Pollen morphology in these species is fairly uniform, as it is across the tribe and across the family (unlike similar-sized groups in e.g. Compositae). The grains are single, generally apolar and 4- (or 5-)zono-colporate (never syncolpate) and prolate-spheroidal to sub-prolate. *Walsura chrysogyne* et al. grains are 25.6–28.8 × 19.2–19.7 μm and those in other *Walsura* species are 30.0–53.6 × 24.0–41.6 μm, with *W. robusta* having the smallest grains and specimens of *W. pinnata* the largest. Micro-puncta may be well defined or poorly defined, which may provide a taxonomic character, but the form of the complex aperture is probably the best character, particularly the length and shape of the endoaperture and the form of its ends.

WOOD ANATOMY

The most detailed considerations of wood anatomy in these species are by Pennington (1965) and Datta & Samanta (1983), with a summary of Pennington's earlier work in Pennington & Styles (1975). The wood of *W. robusta* differs in some small features to that of *W. trifoliolata* and *W. tubulata,* and *W. chrysogyne* has a much larger vessel pore density (308/sq.mm) than these other three species (at 81–154/sq.mm). The paucity of data on individual species however severely limits the discussion of taxonomic worth of wood anatomical features.

Mehrotra (1989) has described a new species of *Walsura, W. deccanensis,* on the basis of wood anatomical characters of fossil material. He gives a detailed description of the wood structure of this fossil and compares it with wood samples of extant

species of *Walsura* (*W. robusta, W. piscidia* = *W. trifoliolata, W. villosa* = *W. trichostemon* and *W. glauca* = *W. pinnata*), *Heynea, Dysoxylum* Blume and *Lansium* Corr. Serr.

FRUIT STRUCTURE AND SEED DISPERSAL

The fruit of *Walsura robusta, W. trifoliolata* and *W. pinnata* is a berry consisting of a pericarp 0.3 to 2.3 mm thick. The outer, and much the thickest, layer is parenchymatous and the inner layer is sclerenchymatous. The inner layer can be further divided into an outer layer of sclereids and an inner layer of fibres. There are no sutures in the fruit wall. The seed, enclosed in a thick (0.2–1.7 mm) succulent aril-like structure, is connected to the pericarp via a septum which in two-seeded fruits divides the fruit cavity into two locules. *Walsura robusta* is odd in having prostrate trichomes (similar to those found on the leaf but a little longer) on the inner surface of the pericarp (i.e. of the fibrous layer), a feature unknown elsewhere in this genus or the family. The pericarp and septum structures of *W. dehiscens* are basically very similar to those of the above species except that there are longitudinal lines of weakness in the wall at the four wings and the septum runs between two of these, i.e. septicidally. Dehiscence can occur at either of the two pairs of sutures, but normally seems to happen (at least initially) at the two with the septum attached, causing the septum to split into two membranous hemi-septa. This dehiscence, if only weak, is unknown elsewhere in the genus.

The fruit of *W. chrysogyne, W. brachybotrys* and *W. velutina* differs considerably from that of the above species, externally in its asymmetric appearance and anatomically in completely lacking sclerenchyma tissue or well defined pericarp layers or a septum (or anything analogous to a septum). The leathery nature of the pericarp is due to very high levels of tannin in the cells (compared with low levels in the above species). No aril-like structure is present.

Cheek (1989) has made a detailed systematic study of seed anatomy in the family and examined the seeds of *W. pinnata, W. dehiscens* and *W. chrysogyne*. The latter he concluded to be significantly different from the others principally in that it lacked a fleshy aril and the normal meliaceous seed-coat stratification.

A fruiting tree of Species A, with a fruit very similar morphologically and anatomically to that of *W. pinnata,* has been observed in the field (Semengoh, Sarawak). The fruits were eaten whole and in large quantities by the Bornean Gibbon (*Hylobates muelleri*). Squirrels removed the pericarp and ate the aril (an operation involving great dexterity since the 'aril' is firmly attached to the rest of the seed), discarding the seeds which fell to the ground around the parent tree. The following day, all seeds on the ground were removed, however, presumably by rats. No other observations relating to possible dispersal systems in these species are known.

GERMINATION
(after Pennington & Styles, 1975)

Cryptocotylar, cataphylls minute, followed by spirally arranged simple entire eophylls. See Figure 3 for illustration of *W. trifoliolata* seedling.

CHROMOSOMES

Walsura trifoliolata is the only species studied cytologically. Its chromosome count is n = 14, 2n = 28 (Ghosh, 1961; Khosla & Styles, 1975; Datta & Samanta, 1977).

CHEMOTAXONOMY

Chatterjee & Kundu (1968) described a new pentacyclic alcohol, which they call Walsuranol, from *Walsura tubulata,* but they could not find limonoids in this species. Taylor (1984), however, reports the occurrence of various limonoids in the other Indian species, *W. trifoliolata.* Purushothaman et al. (1985) and Umadevi et al. (1988) have also made chemical studies of *W. trifoliolata.* No other species seems to have been investigated from a chemotaxonomic viewpoint.

VARIATION WITHIN THE GENERA

Walsura was first divided into sections by Hiern (1875) when he reduced Roemer's (1846) genus *Surwala* to *Walsura* as the monospecific section containing *W. robusta.* All other species were accommodated in sect. *Euwalsura.* Harms (1896) maintained these two sections and added a third (un-named) which included *W. trijuga* (Roxb.) Kurz (= *Heynea trijuga*). In 1940, when Harms reinstated the genus *Heynea,* he included this species there setting up another, third, section within *Walsura,* called *Neowalsura,* to accommodate *W. glabra* Merrill. However, this species is here (see below) moved to *Pseudoclausena.*

The section *Euwalsura* is here maintained, and its name amended slightly (to conform to the International Code) as section *Walsura,* and section *Surwala* is also maintained. A new section is described to accommodate *W. dehiscens* and is called *Ruswala.* Section *Ruswala* is characterised by the dehiscent fruit of its one species, and section *Surwala* by separate filaments and by trichomes on the inner surface of the pericarp. The ordering of the sections posed some problems, particularly with respect to *Ruswala.* Fruit anatomical evidence (see above) seems to suggest that section *Surwala* (i.e. *W. robusta*), may be nearer to *Heynea* than section *Walsura* is. Within section *Walsura* there is great diversity with, perhaps, those species centred on *W. pinnata* (see below) being the most different from *W. robusta.* The position of section *Ruswala* (*W. dehiscens*) depends largely on how the septicidal capsule character is treated. If it is regarded as a small evolutionary step from/to a loculicidal capsule then it is best placed on the *Heynea* side of section *Ruswala.* If, however, it is considered quite different, and probably the product/origin of a completely different evolutionary line, then it should probably be placed further away, possibly beyond section *Walsura.* It is this second juxtapositioning which is accepted here. This decision is supported by *W. dehiscens* having a stigma form unlike that found in any other species of *Walsura* or *Heynea.* Its very short staminal tube (c. 1/5 of the total length of the androecium) is nearer to the discrete filaments state of *W. robusta* than most species of the genus, but it could be pointed out that *W. gardneri* (in section *Walsura*) can have a tube as short as 1/8 the total length of the androecium.

Accepting this order (i.e. sect. *Surwala*–sect. *Walsura*–sect. *Ruswala*), an evolutionary ordering can then be speculated. If *Trichilia* is seen as the core genus of the tribe with *Heynea* as a modified version of an African *Trichilia* species, then the evolutionary trend could be seen to be: *Trichilia*–*Heynea*–*Walsura* (sect. I, *Surwala*–sect. II, *Walsura*–sect. III, *Ruswala*) with the septicidally dehiscent species *W. dehiscens* being a relatively recent innovation derived from the normal berry-bearing *Walsura* stock.

Section II, *Walsura*, accommodates the majority of the species and is here further divided informally into two species groups. Group 1 is defined by those species remaining when Group 2 is removed. Group 2 is centred on the highly variable and widely distributed species *W. pinnata* and is confined to the Malesian end of the distribution of the genus. Whilst the minor characters defining it are not sufficient to merit segregation as a separate section, it is considered useful to include the two groups in the current revision.

Group 2 is defined by the following characters, taken collectively: i) petiole adaxially flattened to shallowly canaliculate along its whole length (i.e. to first node); ii) leaf lamina abaxial surface glabrous or very sparsely pubescent; iii) all leaf veins clearly prominent (in sicco) on abaxial surface; iv) flower buds, just prior to opening, less than 4.6 mm long. *Walsura tubulata* from Darjeeling is most similar to the Group 2 species (but differs in flower size and in twig bark lenticellation) and, perhaps, provides the link between the two groups and, possibly, between the Indian/Sri Lankan species and the Malesian species.

Walsura chrysogyne et al. are considered so different from all other species of *Walsura* (see morphological and anatomical notes above and the key and diagnosis below) that they are removed to a new genus, *Pseudoclausena*.

The taxonomic division of the genera in this revision is therefore as follows:

WALSURA

Section I *Surwala* (M. Roemer) Hook. f.

1. *W. robusta* Roxb.

Section II *Walsura*

GROUP 1

2. *W. trifoliolata* (Adr. Juss.) Harms
   subsp. *trifoliolata*
   subsp. *acuminata* (Trimen) T. Clark, here invalid; no basionym
3. *W. tubulata* Hiern
4. *W. trichostemon* Miq.
5. *W. gardneri* Thw.
6. *W. bonii* Pellegrin
7. *W. oxycarpa* Kurz
8. *W. poilanei* Pellegrin

GROUP 2

9. *W. pinnata* Hassk.
   'pinnata'
   'cochinchinensis'
   'villamilii'
10. *W. pachycaulon* Mabb. ex T. Clark here invalid, for nom. nud.
11. *W. sarawakensis* T. Clark
12. *W. monophylla* Elmer ex Merr.

Section III *Ruswala* T. Clark

13. *W. dehiscens* T. Clark
    + three species (14, 15 & 16), incompletely known

PSEUDOCLAUSENA

17. *P. chrysogyne* (Miq.) T. Clark
    forma *chrysogyne*
    'chrysogyne'
    'multijuga'
    'brachybotrys'
    forma *velutina* (Ridley) T. Clark

GEOGRAPHICAL DISTRIBUTION AND SPECIATION

The species of *Walsura* (excl. *W. chrysogyne* et al.) occur in India (west to the Western Ghats and north to Darjeeling), Sri Lanka, the Andaman Islands, Burma, Thailand, Indo-China, Yunnan, Hainan, the Malay Peninsula, Sumatra, Java, Borneo, the northern and western Philippines (Luzon to Palawan), Sulawesi, Halmahera and western New Guinea (Manokwari). *Walsura chrysogyne* et al. occur in peninsular Thailand, the Malay Peninsula, southern Sumatra, Borneo, the southern Philippines (Samar, Leyte, Mindanao and Palawan), Sulawesi, Halmahera, Seram and western New Guinea. Distribution maps for most individual species are given below.

Walsura pinnata, at the Indo-China–Malesian end of the range, is a complex species (sensu Pennington & Styles, 1981), which may correspond to an ochlospecies (White, 1962). Such a species is highly variable and occupies a wide geographic range but is not divisible into subspecies. One population may contain two or more distinct morphological entities which do not intergrade, but the intermediates may (now) occur in another population far removed geographically. Closely related to *W. pinnata* are at least three other species, all distributed within its range and each of very small range (viz. *W. sarawakensis* and *W. pachycaulon* in Borneo, and *W. monophylla* on Palawan). If *W. chrysogyne* et al. are treated as one species (see below) then this is also a complex species and is limited to the Malesian region (Whitmore, 1984; equivalent to the 'Malaysian region' of Van Steenis, 1950), north to the isthmus of Kra and to Luzon in the Philippines and southeast to New Guinea.

By contrast, those species in the India to continental-Malesia end of the range are predominantly monotypic, taxonomically isolated species (sensu Pennington & Styles, 1981), each of which is separable from all other species by several diagnostic characters and is not divisible into subspecies, *W. dehiscens* being the only species from outside this range which falls within this category. *Walsura trifoliolata* is the only species within this range which could be described as a polytypic species, i.e. which on the basis of morphological characters, supplemented by geographical or ecological evidence, can be subdivided into two or more subspecies.

Walsura robusta seems to be of largely coastal occurrence whilst *W. trichostemon*, with a similar range, occurs much further inland as well. The velutinous indumentum of the latter may account for its tolerance of a more continental (i.e. seasonal) climate. The majority of specimens of the densely velutinous *P. chrysogyne* forma *velutina* are from localities above 300 m altitude, possibly for similar reasons. *Walsura gardneri* of Sri Lanka seems to be limited to hill country, although its shoots and leaves are glabrous, and the subspecies of *W. trifoliolata* generally occupy different climatic zones (see below), this being most pronounced in Sri Lanka. The distribution of *W. monophylla* in Palawan seems to be the only one which correlates with an edaphic factor, the trees being largely restricted to ultrabasic soils.

ECONOMIC BOTANY

Most of the widely occurring species seem to be used locally as a source of hard, durable timber[2] and *W. robusta* (in combination with other timbers) has been used in paper manufacture (Hossain & Siddique, 1970). The specific epithet of *W. piscidia* Roxb. (= *W. trifoliolata*) reflects the widespread practice in India of using the bark in fishing. The bark is stripped off the tree, broken up and thrown into the water whence a toxin coming from it kills the fish (which float to the surface and can be collected) but does not render the fish flesh inedible (Roxburgh, 1832: 388). Most species of *Walsura* are known to have a succulent aril which is sweet and edible but no evidence of its use as a human foodstuff can be found.

Biomass production in dry evergreen forest (in Thailand) dominated by *Hopea ferrea, Walsura trichostemon, Memecylon ovatum* and *Hydnocarpus ilicifolius* has been studied by Sabhasari (1971).

SYSTEMATIC TREATMENT

— Leaflet abaxial epidermis papillate, flower with well-defined disk; ovary 2-locular; fruit symmetrical; pericarp with sclerenchyma layer ..... **Walsura**
— Leaflet abaxial epidermis non-papillate; flower lacking disk; ovary 4- or 5-locular; fruit asymmetric; pericarp lacking sclerenchyma .. **Pseudoclausena**

2) The properties of the timber of *W. trifoliolata* are listed in Nazma et al. (1981: 221–222).

WALSURA[3]

Walsura Roxb. [Hort. Beng. (1814) 32, nom. nud.], Fl. Ind. 2 (1832) 386; C.DC. in DC., Monog. Phan. 1 (1878) 633; Harms in Engl. & Prantl, Nat. Pflanzenfam. III, 4 (1896) 302 and in ed. 2, 19b, 1 (1940) 118; Penn. & Styles, Blumea 22 (1975) 472. — Type species: *Walsura piscidia* Roxb. = *W. trifoliolata* (Adr. Juss.) Harms, effectively selected by Roemer (1846).

[*Monocyclis* Wall., Report E. I. Co. Bot. Gard. (1840) 26, nom. nud.; ex Voigt, Hort. Suburb. Calc. (1845) 135, nom. nud.]

Surwala Roem., Synops. Hesperides 1 (1846) 108. — Type species: *Surwaka robusta* (Roxb.) Roem. = *Walsura robusta* Roxb.

Napeodendron Ridley, J. Roy. As. Soc. Straits Branch 82 (1920) 179. — Type species: *Napeodendron altissimum* Ridley = *Walsura pinnata* Hassk.

Trees, unbranched low down or (if tree less than 4 m tall) densely twiggy at breast height, sympodial, leptocaul to pachycaul, buttressed or not, indumentum of simple and/or 2-armed trichomes; leaves usually all along leafy twigs, unifoliolate or imparipinnate with opposite leaflets, 1–4-jugate, to 80 cm long; rachis swollen slightly at the node(s); petiolule usually swollen slightly immediately beneath base of lamina and sometimes slightly geniculate; lamina apex acuminate to obtuse to retuse and base symmetric or slightly asymmetric, abaxial surface glaucous (in vivo) and glabrous to velutinous and sometimes with small glandular bodies (= black dots) on either side of and within 2 mm of the midrib; inflorescences axillary (cauliflory unknown), 0.8–30.0 cm long, each a thyrse with a very dense to open paniculate head, indumentum of simple and/or 2-armed trichomes; flower hermaphrodite or unisexual, just prior to opening ± cylindrical and up to 6 mm long, at maximum opening up to 9 mm diam., short pedicel widening almost imperceptibly into calyx; calyx much shorter than the petals, shallowly- to deeply-5-lobed, each lobe triangular with entire margins and acute apex; petals 5, free, valvate to imbricate, oblong to narrow-elliptic, apex acute to obtuse and sometimes hooded after opening; androecium of 10 discrete filaments each narrowly triangular or a tube summounted by 10 ligulate to narrowly triangular filaments, each filament with a truncate or short-bifid apex; anthers 10, deltoid, very short-beaked or not at all; disk annular, glabrous or pubescent; ovary very densely hairy with short erect trichomes or glabrous, 2-locular, each locule with 2 collateral ovules; style cylindrical to inversely conical; stigma capitate to short-cylindrical, may have two short lobes at apex; fruit a 1- or 2(–4?)-seeded berry or 1- or 2-seeded weakly dehiscent capsule, pericarp leathery with thin layer of sclerenchyma on inside, thin septum separating locules; seed more or less ellipsoidal, lacking endosperm, surrounded by transparent sweet fleshy aril.

Distribution – 16 species (including 3 incompletely known) in the Indo-Malesian region.

ARTIFICIAL KEY TO WALSURA SPECIES

(N.B. *W. yunnanensis* and *W. deccanensis* excluded)

1a. Leaf undivided 2
b. Leaf divided 4

3) From the Tamil name, 'Walsura', for *W. trifoliolata*.

2a. Peduncle of inflorescence with 2-armed trichomes; androecium tubular for less than 1/6 of length (Sri Lanka) ..... **5. W. gardneri**
b. Peduncle of inflorescence with simple trichomes only; androecium tubular for more than 1/3 of length 3
3a. Androecium tubular for 1/3–1/2 of its length; berry 8–11 mm diam. when mature (Philippines) ..... **12. W. monophylla**
b. Androecium tubular for 1/2–2/3 of its length; berry 12–24(–28) mm diam. when mature ..... **9. W. pinnata ('cochinchinensis')**
4a. Leaf 1-jugate 5
b. Leaf 2- or more-jugate 8
5a. Leaflets slightly asymmetric; filament apex truncate (Vietnam) .. **6. W. bonii**
b. Leaflets symmetric; filament apex shortly bifid 6
6a. Flower just prior to opening 5–6 mm long (Assam) ..... **3. W. tubulata**
b. Flower just prior to opening 2–4 mm long 7
7a. Leafy twigs puberulous (India & Sri Lanka) ..... **2. W. trifoliolata**
b. Leafy twigs glabrous ..... **9. W. pinnata**
8a. Leaves 2-jugate 9
b. Leaves 3–5-jugate 15
9a. Leaflet abaxial surface white-dotted (matt/glaucous in islets); androecium of discrete filaments ..... **1. W. robusta**
b. Leaflet abaxial surface not white-dotted (matt/glaucous uniformly); androecium tubular for part of its length 10
10a. Leaflet abaxial surface velutinous (Vietnam) ..... **8. W. poilanei**
b. Leaflet abaxial surface glabrous to subdensely pubescent 11
11a. Fruit 4-winged to rhomboid (in transverse section) and weakly dehiscent (Borneo) ..... **13. W. dehiscens**
b. Fruit globose and indehiscent 12
12a. Fruit slightly beaked 13
b. Fruit not beaked 14
13a. Inflorescence velutinous; berries minutely tomentose (Burma, N Thailand & Cambodia) ..... **4. W. trichostemon**
b. Inflorescence glabrous or puberulous; berries glabrous or puberulous (Andamans) ..... **7. W. oxycarpa**
14a. Petiole glabrous or extremely sparsely pubescent with prostrate simple trichomes; all veins prominent on abaxial surface of leaflet (in sicco) ... **9. W. pinnata**
b. Petiole densely puberulous with prostrate simple and 2-armed trichomes; only midrib and costae prominent on adaxial surface of leaflet (in sicco) (Borneo) **15. W. spec. A.**
15a. Leafy twigs 8–15 mm diam.; leaves 4- (or 5-)jugate (Borneo) **10. W. pachycaulon**
b. Leafy twigs 2.5–8.0 mm diam.; leaves 3-jugate 16
16a. Leaves 2- (or 3-)jugate; leaflet apex acute or acuminate for < 1.5 cm **9. W. pinnata**
b. Leaves 3-jugate only; leaflet apex acuminate for (2–)2.5–2 cm (Sarawak) **11. W. sarawakensis**

Section I. Surwala

Walsura sect. *Surwala* (Roem.) Hook. f. in Benth. & Hook. f., Gen. Pl. 1 (1862) 336. — *Surwala* Roem., Synops. Hesperides 1 (1846) 108. — Type species: *Walsura robusta* Roxb.

1. Walsura robusta Roxb. — Figs. 1, 2

Walsura robusta Roxb. [Hort. Beng. (1814) 32, nom. nud.], Fl. Ind. 2 (1832) 386; Wight & Arn., Prod. Fl. Pen. Ind. Or. 1 (1834) 120, excl. specim.; Roem., Synops. Hesperides 1 (1846) 108, excl. specim.; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 60; Hiern in Hook. f., Fl. Br. India 1 (1875) 565; Kurz, J. As. Soc. Beng. 44 (1875) 148; Prelim. Rep. Veg. Pegu App. B (1875) 37; For. Fl. Br. Burma 1 (1877) 223; C.DC. in DC., Monogr. Phan. 1 (1878) 638; King, J. As. Soc. Beng. 64 (1895) 85; Harms in Engl. & Prantl, Nat. Pflanzenfam. III, 4 (1896) 302 and in ed. 2, 19b, 1 (1940) 119; Prain, Bengal Pl. 1 (1903) 317 and ed. 2, 1 (1963) 221; Brandis, Ind. Trees (1906) 137; Lecomte, Fl. Gén. Indo-Chine (1911) 785; Lace, List Trees etc. Burma (1912) 26; Schmidt, Fl. Koh Chang (1916) 405; Craib, Fl. Siam. Enum. (1926) 262; Kanjilal et al., Fl. Assam 1 (1937) 241; Vidal, Bull. École Franç. Extrême-Orient. 49, 2 (1959) 607; Nir, Burmese Fl. Pl. 1 (1963) 173; Chun et al., Fl. Hainanica 3 (1974) 71; Suvatti, Fl. Thai. 2 (1978) 727; Balakrishnam, Fl. Jowai 1 (1981) 122; Deb, Fl. Tripura State 1 (1981) 453; Haridasan & Rao, For. Fl. Meghalaya 1 (1985) 214; Chen Ximu et al., J. Bot. Res. 4 (1986) 177. — Type: *Roxburgh s.n.*, India, Silhet (BM lecto, selected here; K syn).

[*Monocyclis robusta* Wall., Report E. I. Co. Bot. Gard. (1840) 26; ex Voigt, Hort. Suburb. Calc. (1845) 135, nom. nud.]

Surwala robusta (Roxb.) Roem., Synops. Hesperides 1 (1846) 108. — Type: as for *Walsura robusta*.

[*Scytalia glabra* Buch.-Ham. ex Wall., Cat. (1847) n. 8048E, nom. nud.]

Scutinanthe boerlagii Hochr., Pl. Bog. (1904) 64; Lam, Bull. Jard. Bot. Buitenzorg III, 12 (1932) 422; cf. Leenhouts, Fl. Males. I, 5 (1956) 249). — Type: *Hochreutiner 132*, Indonesia, Java, Bogor Botanic Garden, Tree No. III T 27 (BO holo; K, L, P iso).

Tree, to 25(–31) m tall, d.b.h. to 1.5 m; outer bark grey-brown, inner bark pink-red; leafy twigs 2.0–3.5 mm thick, glabrous to puberulous with simple trichomes, bark dark-brown to black and very densely lenticellate; leaves 14–18(–28) cm long, 2-jugate; petiole 2–4(–6) cm long, 0.5–1.8 mm thick, semiterete and flattened adaxially for entire length, glabrous to puberulous with simple trichomes, usually sparsely to densely lenticellate; petiolule ± terete (to slightly flattened adaxially), (of distal pair leaflet:) 0.4–1.0(–1.7) cm long and 0.5–1.0 mm thick; lamina (of distal pair leaflet:) 6.4–12.5(–15.5) × 2.8–4.0(–6.5) cm, (of terminal leaflet:) 6.5–10.5(–16.5) × 2.9–4.0(–7.0) cm, all leaflets (slightly obovate-)elliptic to ovate (basal leaflets usually slightly smaller and tending more to ovate), base acute to short-attenuate, apex acuminate, sub-coriaceous; adaxial surface with no veins prominent, abaxial surface with only midrib and costae prominent and glaucous (in vivo) only in islands between the smallest veins giving surface a whitish-dotted appearance, abaxial surface glabrous to extremely sparsely pubescent with simple trichomes (usually on the sides of the midrib); 5–7(–8) (distal pair leaflet) and 6–8 (terminal leaflet) costae on either side of the midrib; glands present or absent and occasionally conspicuous.

Inflorescences clustered around shoot apex in the axils of caducous undeveloped leaves or below in the axils of caducous undeveloped or (far less commonly) fully expanded leaves, 5–10(–18) cm long at anthesis, each an open thyrse, branched up to third order (excluding pedicels), first order branches up to (1.5–)3.0–5.0 cm

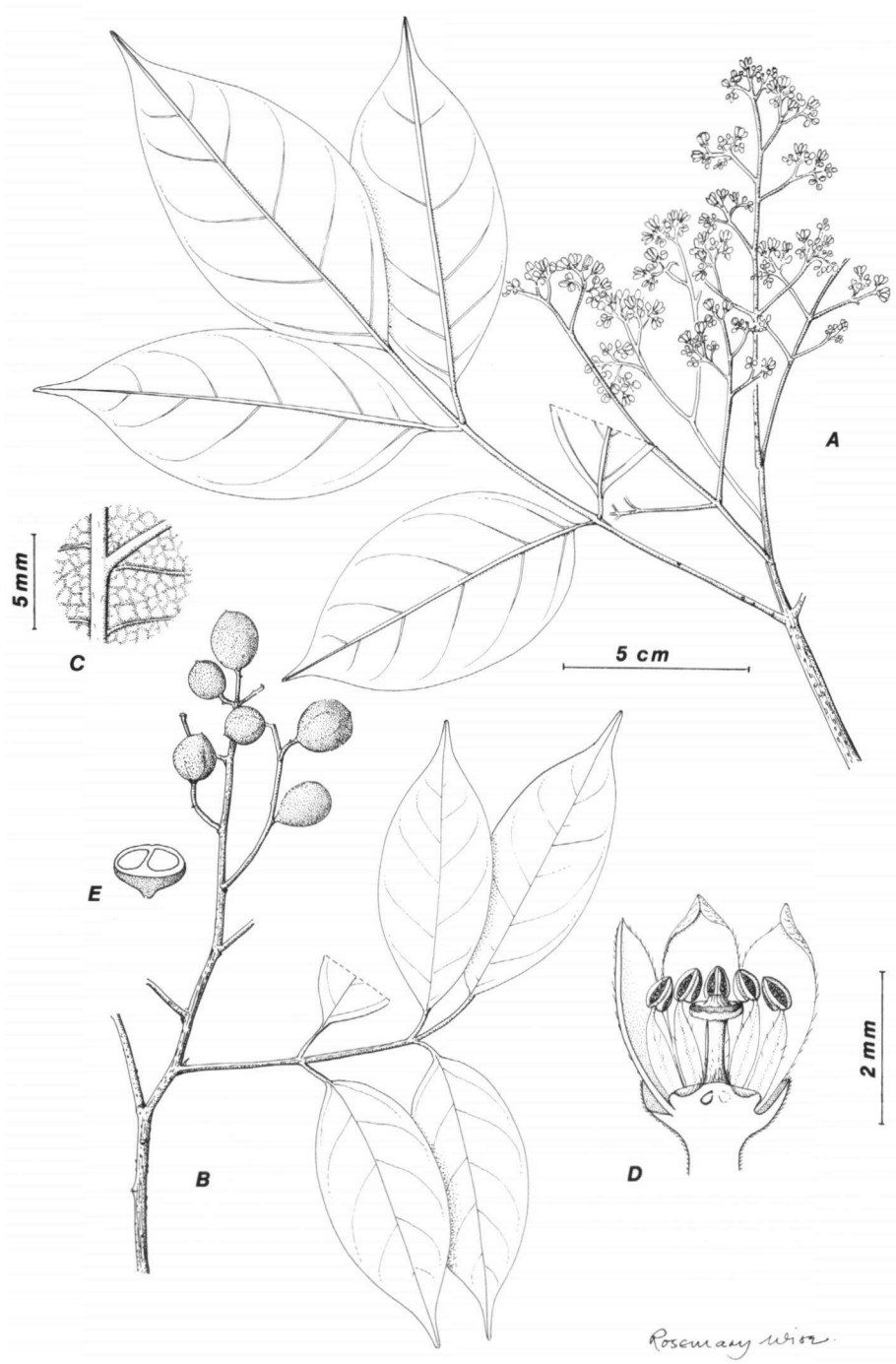

Fig. 1. *Walsura robusta* Roxb. A: habit; B: habit with infructescence; C: abaxial leaf surface detail (papillae islets); D: flower, LS; E: fruit, TS (A, C, D: *Parkinson 283*; B, E: *Bunchuai 1822 = BKF s.n.*).

long, primary rachis glabrous to densely puberulous with simple trichomes and usually dark-brown to black and densely lenticellate; flowers unisexual (and hermaphrodite?), scented, just prior to opening ± cylindrical to inversely conical, 2.7–4.0 mm long, 2.1–3.0 mm diam., at maximum opening 2.5–4.3 mm diam. with no size differences between the sexes; calyx 0.9–1.3 mm long, lobes 0.7–0.9 mm long; petals 2.5–3.4 mm long × 0.9–1.0 mm wide, valvate (to slightly imbricate), apex acute with upper c. 1/4 of petal incurved at c. 90° prior to maximum opening, puberulous inside and out; androecium of discrete filaments, each filament triangular and 1.2–1.3 mm long × 0.6–0.7 mm wide at the base with acute apex, glabrous to sparsely puberulous inside and out; anthers 0.46–0.50 mm long with a blunt end and no beak, sessile on filament apex, glabrous, the only difference between the sexes being that the female produces solely deformed (i.e. infertile) pollen; disk 0.2–0.4 mm high, minutely puberulous; style (in male flower:) 0.70–0.75 mm long, 0.27–0.33 mm diam., (in female flower:) 1.1–1.2 mm long, 0.4–0.7 mm diam., cylindrical to narrowly conical, glabrous except for ovary-type trichomes near the base; stigma capitate to short conical, 0.6–0.7 mm diam. at base, 0.2–0.5 mm high, with shallow depression at centre (in male) or slightly 2-lobed (in female), below (in male) or above (in female) the level of the anthers at anthesis; fruit a 1- or 2-seeded berry, globose, 1.1–1.9 cm diam., olive-green (in vivo) and brown (in sicco), puberulous, pericarp thin but coriaceous with very thin fibrous endocarp the inside of which (facing the seed) is densely pubescent with simple trichomes; seed ± globose or (in 2-seeded fruit) hemi-globose and 0.7–1.3 cm long, completely to almost completely enveloped in an aril, in vivo cream coloured and sweet to taste.

Distribution – Bangladesh, Burma, Andamans, Thailand, Laos, Vietnam, Peninsular Malaysia.

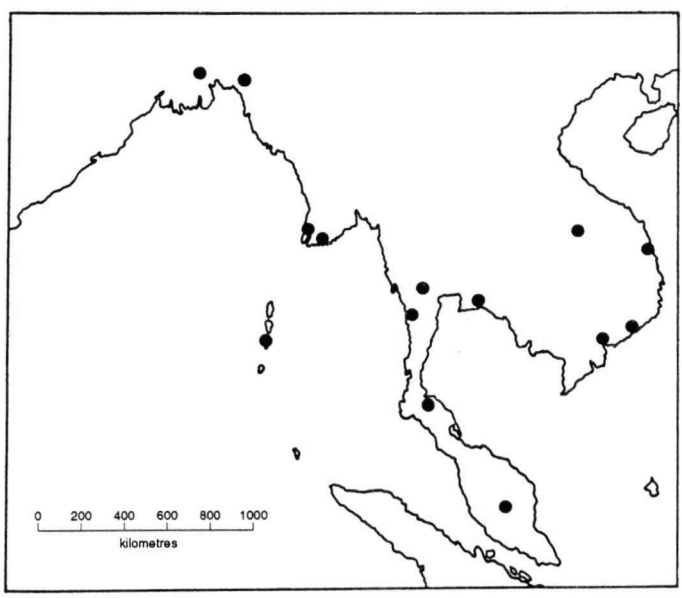

Fig. 2. Distribution of *Walsura robusta* Roxb.

Fig. 3. *Walsura trifoliolata* (Adr. Juss.) Harms subsp. *trifoliolata*. A: seedling; B: habit; C: flower, LS; D: androecium exterior; E: infructescence. — *W. trifoliolata* subsp. *acuminata* (Trimen) T. Clark. F: leaf (A: cult., Oxford; B–D: *Singhakumara 89*; E: *Singhakumara 304*; F: *Kostermans 25557*).

Vernacular names – In Silhet: upphing. Burmese: gyopho or gyobo. Thai: maki ai, lao.

Note – The only known collection of this species in Malaysia is *(T.C. Whitmore) FRI 20163*; Pahang, Taman Negara, Pahang Kuala (A, FRI incl. fruit in spirit, K, SAR). Seed harvested with this collection has given rise to a tree, c. 9 m tall in 1987, at FRIM (Kepong) and *FRI 27277* and *T. Clark 89* are from this tree.

Section II. Walsura

Walsura sect. *Walsura* Hook. f. in Benth. & Hook. f., Gen. Pl. 1 (1862) 336, 'sect. *Euwalsura*', emend.; Hiern in Hook. f., Fl. Br. India 1 (1875) 543 ('*Euwalsura*'). — Type species: *Walsura trifoliolata* (Adr. Juss.) Harms.

2. Walsura trifoliolata (Adr. Juss.) Harms — Figs. 3, 4

Walsura trifoliolata (Adr. Juss.) Harms in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 119, '*trifolia*', emend.; Saldanha & Nicolson, Fl. Hassan Dist. (1976) 396 ('*trifolia*'); Nair & Henry, Fl. Tamil Nadu (1982) 69 ('*trifolia*'); Matthew & Britto, Fl. Tamilnadu Carnatic 3, I (1983) 242 ('*trifoliata*'); Sharma et al., Fl. Karnatica (Anal.) (1984) 47 ('*trifoliata*'). — *Heynea trifoliolata* Adr. Juss. in Mirb. & Cass. apud Guill., Bull. Sci. Nat. Gol. 23 (1830) 239# ('238'); Linnaea 6, lit. (1831) 113; Mém. Mus. Hist. Nat. Paris 19 (1832) 235 ('*trifoliata*') & 274 ('*Haenea trifolia*')[4]; Panigrahi & Mishra, Ind. J. For. 11 (1988) 137 ('*trifoliata*'). — Type: *Sonnerat s.n.*, India (P holo; FHO photo).

[*Trichilia trifoliolata* Wall., Cat. (1847) n. 8093, nom. nud.; Hiern in Hook. f., Fl. Br. India 1 (1875) 564, nom in synon., non L. (1762) = *Trichilia trifolia* L.]

[*Trichilia coriacea* Wall., Cat. (1828) n. 1265, nom. nud.; Roem., Synops. Hesperides 1 (1846) 115, nom. in synon.]

Walsura piscidia Roxb. [Hort. Beng. (1814) 32, nom. nud.], Fl. Ind. 2 (1832) 387; Wight & Arn., Prod. Fl. Pen. Ind. Or. 1 (1834) 120; Roem., Synops. Hesperides 1 (1846) 108; Drury, Hndbk. Ind. Fl. 1 (1864) 165; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 60; Hiern in Hook. f., Fl. Br. India 1 (1875) 564; C.DC. in DC., Monogr. Phan. 1 (1878) 634; Lisboa, Gaz. Bombay Pres. 25 (1886) 44; Trimen, Fl. Ceylon 1 (1893) 250; Nairne, Fl. Pl. W. Ind. (1894) 55; Talbot, Trees etc. Bomb. Pres. (1894) 41 and in ed. 2 (1902) 78; Harms in Engl. & Prantl, Nat. Pflanzenfam. III, 4 (1896) 302 and in ed. 2, 19b, 1 (1940) 119; Dalgado, Fl. Goa (1898) 34; Cooke, Fl. Pres. Bomb. 1 (1903) 213; Brandis, Ind. Trees (1906) 136; Talbot, For. Fl. Bomb. Pres. & Sind 1 (1909) 241, incl. plate; Haines, For. Fl. Chota Nagur (1910) 253; Rao, Fl. Pl. Travancore (1914) 75; Haines, Bot. Bihar & Orissa 2 (1921) 178; Gamble, Man. Ind. Timb. (1922) 152; Fl. Pres. Madras 1 (1935) 183; Worthington, Ceylon Trees (1959) 123; Penn. & Styles, Blumea 22 (1975) 473. — Type: *Roxburgh s.n.*, India, 'Corrundel' [BM lecto, selected here, illus. Icon. Roxb. 3 (1969) t. 17].

Walsura piscidia var. *typica* Haines, Bot. Bihar & Orissa 2 (1921) 178, nom. superfl. pro var. *piscidia*.

[4] Although this paper (which is De Jussieu's monumental account of the family) is dated 1830, and was read at the Academy of Sciences on 25th January 1830, it was not published by November of that year when Guillemin (1830) gave a verbatim report of De Jussieu's classification and the diagnoses of his new genera and species. When De Jussieu's full account was published (1832?) this species was referred to by the specific epithets '*trifoliata*' and '*trifolia*' (one, perhaps, being a typographical error). In Guillemin's report, however, '*trifoliolata*' is used and this is accepted here as the first published (and technically accurate!) name for this species.

Walsura ternata Roxb., Fl. Ind. 2 (1832) 388. — *Walsura piscidia* var. *ternata* (Roxb.) Haines, Bot. Bihar & Orissa 2 (1921) 178. — *Heynia trifoliolata* var. *ternata* (Roxb.) Panigrahi & Mishra, Ind. J. For. 10, 2 (1988) 137 ('*trifoliata*'). — Type: *Roxburgh s.n.*, India, 'Corrundel' [BM lecto, selected here, illus. Icon. Roxb. 3 (1969) t. 18].

[*Xylocarpus ? antila* Buch.-Ham. in Wall., Cat. (1831/32) n. 4893, nom. nud; Wight & Arn., Prod. Fl. Pen. Ind. Or. 1 (1834) 20, nom. in synon.]

[*Walsura antila* Wight & Arn. ex Roem., Synops. Hesperides 1 (1846) 108, nom. in synon.]

Illigera obtusa Meissn. in A. DC., Prod. Syst. Nat. 15 (1864) 251; cf. Kubitzki, Bot. Jahrb. 89 (1969) 180. — Type: *Wight 394* (G-DC holo; K, L iso).

Tree, to 12 m tall, d.b.h. to 35 cm, occasionally buttressed to 50 cm; outer bark (smooth to) deeply fissured, light-grey-brown, brittle; inner bark orange-red, often showing through at fissures; leafy twigs 1.5–3.5 mm thick, sparsely to densely puberulous with simple and/or 2-armed trichomes, bark light to dark brown and usually lenticellate; leaves 9–18 cm long, 1-jugate; petiole 1.4–4.4 cm long, 0.75–1.0 mm thick, semiterete and flattened adaxially near base but ± terete for most of length, glabrous to puberulous with 2-armed trichomes; petiolule ± terete, (of lateral leaflets:) 2–10 mm long, 0.5–1.0 mm thick; lamina (of lateral leaflets:) 4.0–11.2 × 2.4–4.1 cm, (of terminal leaflet:) 5.0–12.8 × 2.5–4.5 cm, all leaflets slightly ovate to elliptic (to slightly obovate) with short attenuate base and retuse-obtuse to acuminate apex, sub-coriaceous, adaxial surface with no veins prominent (in vivo) or costae only slightly prominent (in sicco), abaxial surface glaucous (in vivo) except on most veins, with costae only slightly prominent (in vivo and in sicco) and sparsely pubescent with 2-armed trichomes; 7 (or 8) (lateral leaflets) and 7 or 8 (or 9) (terminal leaflet) costae on either side of midrib; glands sparse.

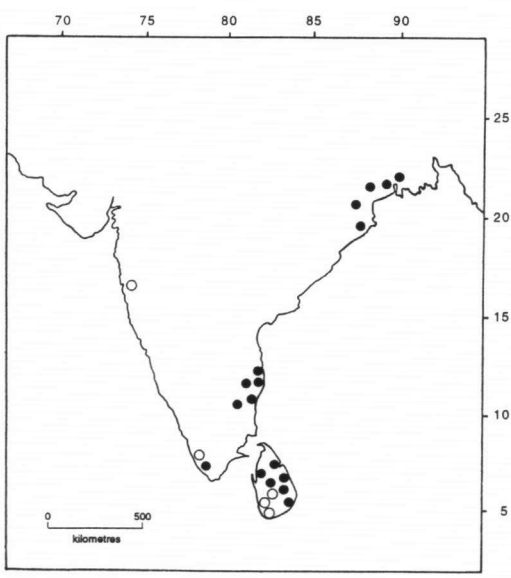

Fig. 4. Distribution of *Walsura trifoliolata* (Adr. Juss.) Harms subsp. *trifoliolata* (●) and subsp. *acuminata* (Trimen) T. Clark (○).

Inflorescences clustered around shoot apex in axils of caducous undeveloped leaves or solitary in axils of fully expanded leaves below, 2.8–10.5(–14.0) cm long at anthesis, each a compact to open thyrse, branched up to third order (excluding pedicels) of which the first order branches can be up to 5(–7) cm long, all parts puberulous with 2-armed trichomes predominating on the peduncle gradually replaced by simple trichomes on all other parts, peduncle occasionally lenticellate; flowers hermaphrodite or male only, just prior to opening ± cylindrical and 2–3 mm long, 1.8–2.0 mm diam., at maximum opening 3.2–4.3 mm diam.; calyx 0.9–1.0 mm long, lobes c. 0.8 mm long; petals 2.6–3.3 mm long × 0.8–0.9 mm wide, ± imbricate, apex acute to very slightly

acuminate; androecium cylindrical to cask-shaped[5], 1.5–2.0 mm long × 1.9–2.3 mm diam., tubular for 1/4–1/2(–2/3) of length, filaments equilong, the outside entirely glabrous or sparsely pubescent on filaments only (sometimes extending to below), the inside pubescent on the filaments and glabrous to very sparsely pubescent below, filament apex bifid with teeth c. 0.15 mm long; anthers 0.6–0.7 mm long, shortly-beaked, sparsely pubescent; disk 0.2–0.3 mm high; style 0.7–0.8 mm long, inversely conical, c. 0.2 mm diam. at base and c. 0.3 mm diam. at top, glabrous or very sparsely pubescent with erect trichomes; stigma ± conical (to capitate) c.0.9 mm diam. at base × c.0.6 mm high, shortly two-lobed at the top; fruit a 1- (or 2-)seeded berry, globose to obovoid to ellipsoid, 11–19 mm long, 8–18 mm diam., cream to light-brown (in vivo) and mid-brown (in sicco), surface smooth (in vivo) and minutely tomentose, pericarp thin but coriaceous with fibrous endocarp; seed ± globose, 7–9 mm diam. (subsp. *trifoliolata*), enveloped in a succulent sweet colourless to white (in vivo) aril.

Vernacular names – Singhalese: kiri-kon [also used of *Aglaia roxburghiana* Miq. = *A. elaeagnoidea* (A. Juss.) Benth.], molpetta; Tamil: chadavakku, chokala.

Note – Two subspecies are recognised, separated on the basis of two good morphological characters and (especially in Sri Lanka) by geographic (and climatic) differences (see Fig. 4).

a. subsp. **trifoliolata**

Leaflet apex retuse-obtuse to acute; mature fruit 11–14 mm long × 8–12 mm diameter.

Distribution – Sri Lanka (Intermediate- and Dry-zones) and southern & eastern India.

b. subsp. **acuminata** (Trimen) T. Clark, *comb. & stat. nov.*

Walsura piscidia var. *acuminata* Trimen, Fl. Ceylon 1 (1893) 250. — Type: *Thwaites C.P. 1162*, Sri Lanka (P-A holo; B†, BM, GH iso).
Walsura thwaitesii C.DC. in DC., Monogr. Phan. 1 (1878) 635. — Type: as above.

Leaflet apex acuminate; mature fruit 14–19 mm long, 10–18 mm diameter.

Distribution – Sri Lanka (Wet-zone) and the SW coast of India.

3. Walsura tubulata Hiern — Fig. 5

Walsura tubulata Hiern in Hook. f. , Fl. Br. India 1 (1875) 563; C.DC. in DC., Monogr. Phan. 1 (1878) 634; Harms in Engl. & Prantl, Nat. Pflanzenfam. III, 4 (1896) 302 and in ed. 2, 19b, 1 (1940) 119; Brandis, Ind. Trees (1906) 137; Cowan & Cowan, Trees N. Bengal. (1929) 31; Kanjilal et al., Fl. Assam 1, 2 (1937) 240; Biswas, Pl. Darjeeling & Sikkim 1 (1966) 229; Grierson & Long, Prov. Chklst. Trees & Shrubs Bhutan & Sikkim (1980) 29. — Type: *Griffith 1058*, Khasia Hills, Sikkim, India (K lecto, selected here; G-OC, GH iso).

5) Throughout this revision, 'cask-shaped' is taken to mean a symmetrical shape with convex sides and a circular cross section widest at the equator.

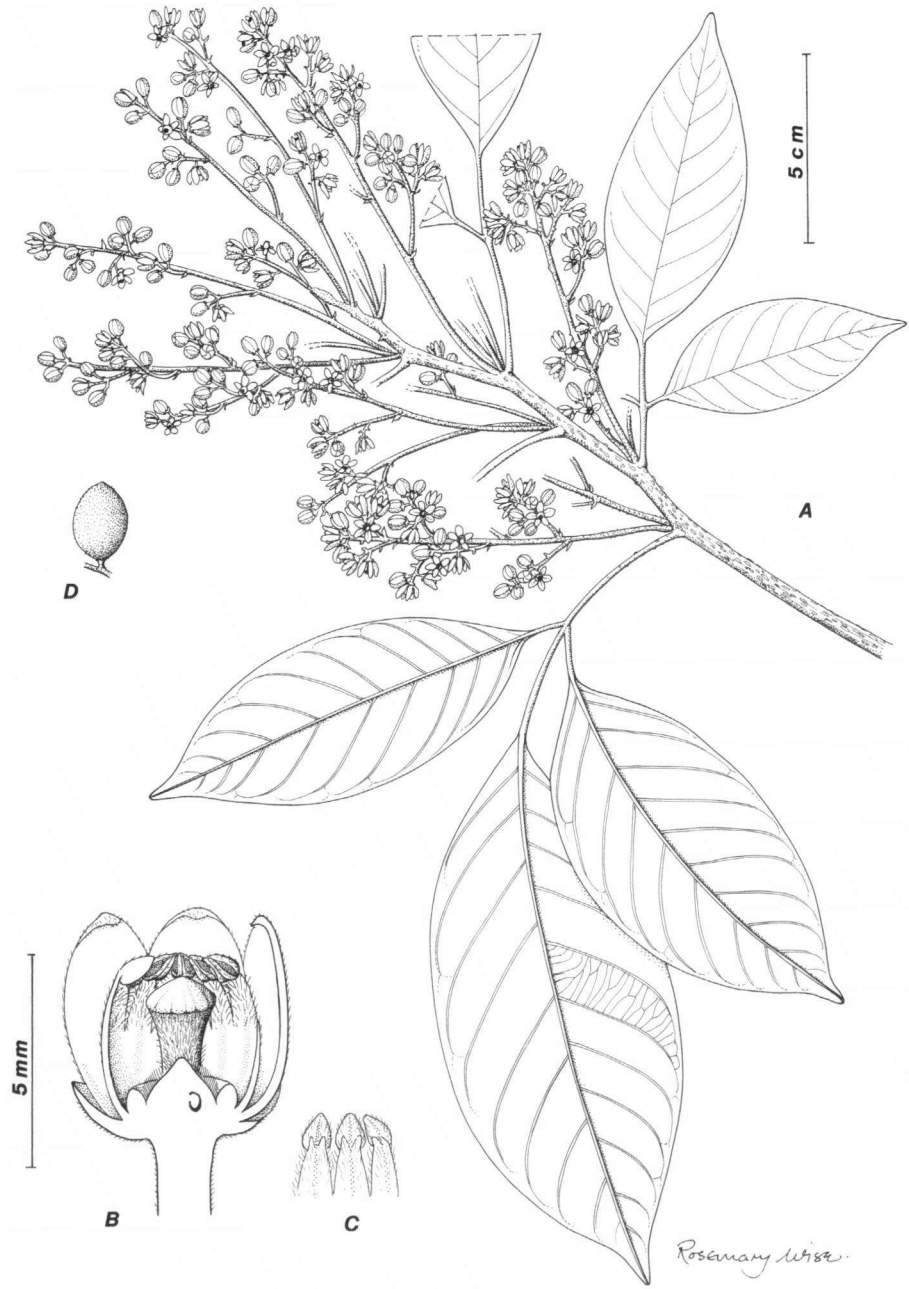

Fig. 5. *Walsura tubulata* Hiern. A: habit; B: flower, LS; C: filament apices seen from the exterior; D: fruit (A: *Griffith s.n.*, lecto; B, C: cult., Oxford = *T. Clark 93*; D: Univ. Michigan, Plants of Assam, *5567*).

Habit unrecorded: tree?; leafy twigs 3–6 mm diam., glabrous to puberulous with light-brown very densely lenticellate bark; leaves 19–34 cm long, 1-jugate, brown or olive-green when dried; petiole 2.5–6.0 cm long, 1.5–2.0 mm thick, semiterete and flattened adaxially, glabrous; petiolule terete to semiterete, (of lateral leaflets:) 0.6–1.8 cm long; lamina (of lateral leaflets:) 11.5–17.5 × 3.5–5.0 cm, (of terminal leaflets:) 9–19 × 3.5–7.0 cm, all leaflets elliptic to lanceolate and ovate to obovate, with shortly attenuate base and long-acuminate apex, chartaceous, adaxial surface with costae very slightly prominent and all other veins faint or indistinct (in vivo and in sicco), abaxial surface (other than midrib and costae) glaucous (in vivo) and glabrous with midrib and costae very sparsely pubescent (with simple trichomes) and all veins prominent (in sicco); 7–10 (lateral leaflet) and 9–11 (terminal leaflet) costae on either side of midrib; glands sparse.

Inflorescences clustered around shoot apex in axils of caducous undeveloped and/or fully expanded leaves, and in groups of 1–4 in axils of fully expanded leaves below, 5–18 cm long at anthesis, paniculate, branched up to second order (excluding pedicels) of which the first order branches can be up to 6.5 cm long, all parts densely puberulous; flowers hermaphrodite, just prior to opening ± cylindrical and 5–6 mm long, 3–5 mm diam., at maximum opening 5–9 mm diam.; calyx 1.75–2.0 mm long, lobes 1.1–1.5 mm long; petals 4.5–5.8 mm long × 1.8–2.7 mm wide, valvate to imbricate, apex acute to obtuse and sometimes slightly recurved; androecium cylindrical to cask-shaped to flask-shaped, 3–4 mm long, 2.2–2.6 mm diam., tubular for c. 2/3 of length, filaments equi-long, the outside glabrous or sparsely pubescent just below the filaments, the inside pubescent on and just below the filaments, filament apex bifid with teeth 0.2–0.3 mm long; anthers almost sessile, 0.6–0.8 mm long, shortly beaked, glabrous or sparsely pubescent; disk 0.2–0.3 mm high; ovary with very dense covering of short erect trichomes, c. 2/3 below the level of the disk base; style 0.8–1.0 mm long, terete and c. 0.4 mm diam. or conical and c. 0.5 mm diam. at base and c. 0.8 mm diam. at top, sparsely pubescent with erect trichomes; stigma c. 1 mm diam., c. 0.5 mm high, capitate with depression at centre, just below level of anthers at anthesis; fruit a 1- (or 2-)seeded berry, globose to slightly obovate, 16–24 mm long, 14–18 mm diam., reddish-brown (in vivo) and mid-brown (in sicco), surface cerebriform and minutely velutinous, pericarp thin but coriaceous with very thin fibrous endocarp; seed globose to ellipsoidal and 12–13 mm long or (in 2-seeded fruit:) plano-ellipsoidal and 14–17 mm long, incompletely to completely enveloped in a thin aril.

Distribution – Darjeeling.

4. **Walsura trichostemon** Miq. — Figs. 6, 7

Walsura trichostemon Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 60; Kurz, J. As. Soc. Beng. 39 (1870) 72; Hiern in Hook. f., Fl. Br. India 1 (1875) 563, in nota; Kurz, J. As. Soc. Beng. 44 (1875) 148; C.DC. in DC., Monogr. Phan. 1 (1878) 637; Harms in Engl. & Prantl, Nat. Pflanzenfam. III, 4 (1896) 302 and in ed. 2, 19b, 1 (1940) 119; Lecomte, Fl. Gén. Indo-Chine 1 (1911) 790; Suvatti, Fl. Thai. 2 (1978) 728. — Type: *Teijsmann 5968*, Thailand (U holo; L iso).

[*Trichilia? villosa* Wall., Cat. (1828) n. 1264, nom. nud.; Wight & Arn., Prod. Fl. Pen. Ind. Or. 1 (1834) 120, nom. in synon.]

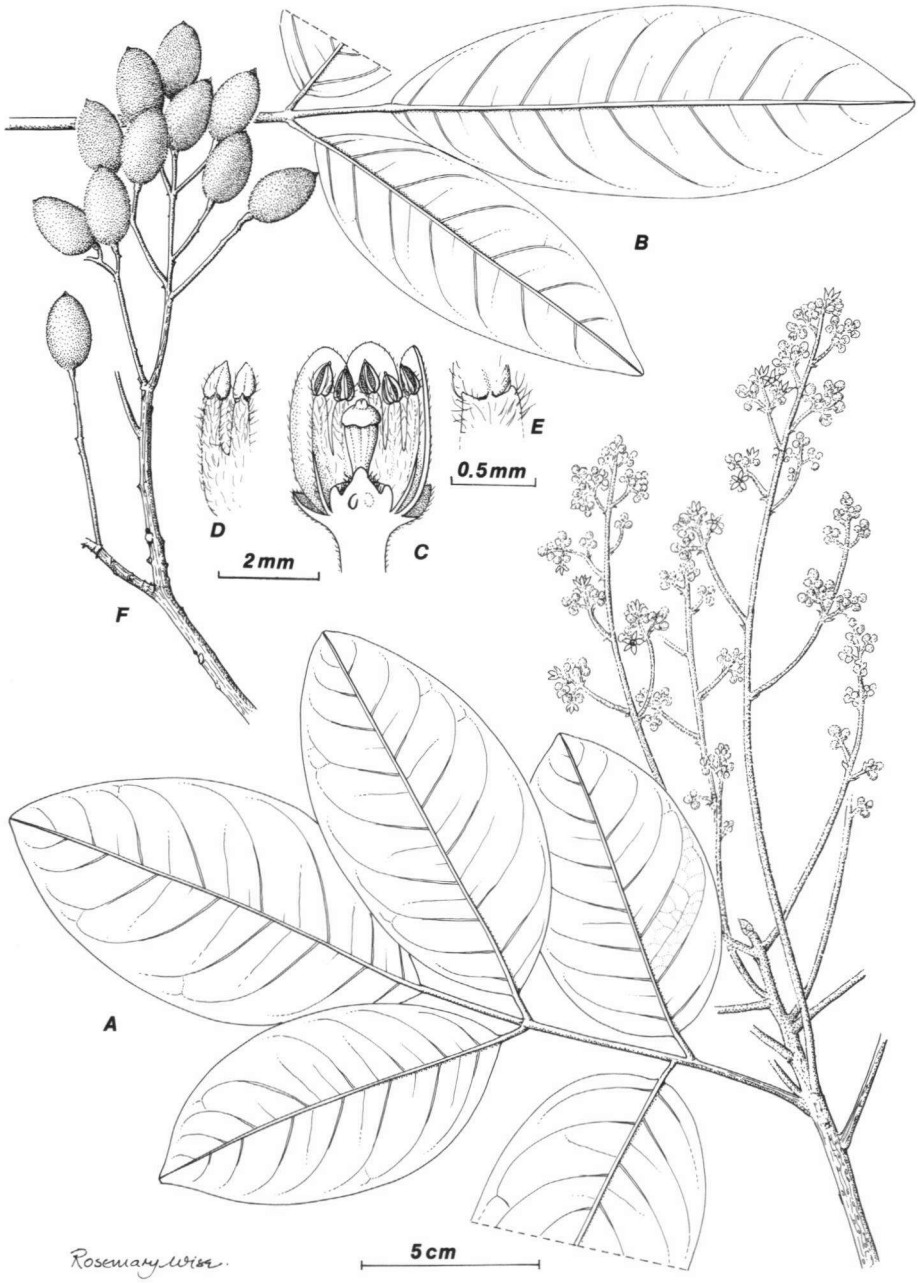

Fig. 6. *Walsura trichostemon* Miq. A: habit; B: leaf (part); C: flower, LS; D: androecium exterior; E: filament apices seen from exterior; F: infructescence (A–E: *Dickason 7046*; F: *Kerr 1841*).

Walsura villosa [Wall. ex Voigt, Hort. Sub. Calc. (1845) 135; Roem., Synops. Hesperides 1 (1846) 108; Mason, Fl. Burmanica (1851) 568; Wight & Arn. ex Kurz, J. As. Soc. Beng. 39 (1870) 72, nom. nud.] Hiern in Hook. f., Fl. Br. India 1 (1875) 564; Kurz, Prelim. Rep. Veg. Pegu App. B (1875) 37; For. Fl. Br. Burma 1 (1877) 223; C.DC. in DC., Monogr. Phan. 1 (1878) 636; Harms in Engl. & Prantl, Nat. Pflanzenfam. III, 4 (1896) 302 and in ed. 2, 19b, 1 (1940) 119; Brandis, Ind. Trees (1906) 136; Lecomte, Fl. Gén. Indo-Chine 1 (1911) 788; Lace, List Trees Burma (1912) 27; Nath, Bot. Surv. Sth. Shan States (1960) 105; Suvatti, Fl. Thai. 2 (1978) 728; nom. superfl. pro *W. trichostemon*, therefore, the same type.

Walsura villosa var.*cambodiana* Pierre, Fl. For. Coch. (1897) 21–25, t. 354. — Types: *Pierre 517*, Cambodia (L iso-syn; P iso) & *Pierre 4256*, Cambodia (L iso-syn; P syn).

Tree to 20(–24) m tall; bark not known; leafy twigs 3.5–5.0 mm diam., (sparsely to) densely puberulous with simple trichomes, bark light to mid brown and lenticellate; leaves 11–24 cm long, 2-jugate; petiole 3.5–6.0 cm long, 1–2 mm thick, ± terete or semiterete and flattened adaxially, sparsely to densely lenticellate and glabrous to densely puberulous with simple prostrate to semi-erect trichomes; petiolule ± terete, (of lateral pair leaflet:) 0.2–10.0 cm long, 0.8–1.3 mm thick, glabrous to sub-densely puberulous; lamina of distal pair leaflet 6–10(–14) × (2.2–)3.0–6.9 cm, the terminal leaflet slightly larger and the basal ones slightly smaller, oblong to elliptic to ovate (terminal leaflet tending more towards ovate than others) with very short attenuate base and retuse-obtuse to acute apex, sub-coriaceous, adaxial surface with all veins slightly prominent (in sicco), abaxial surface glaucous (in vivo) except on midrib and costae with costae prominent and all other veins slightly prominent (in sicco) and sparsely to densely pubescent on veins and sparsely pubescent on the inter-veinous lamina, trichomes simple prostrate and 2-armed, 7 or 8(–10) (lateral leaflets) and (7–)9 or 10 (terminal leaflets) costae on either side of midrib; glands absent or sparse.

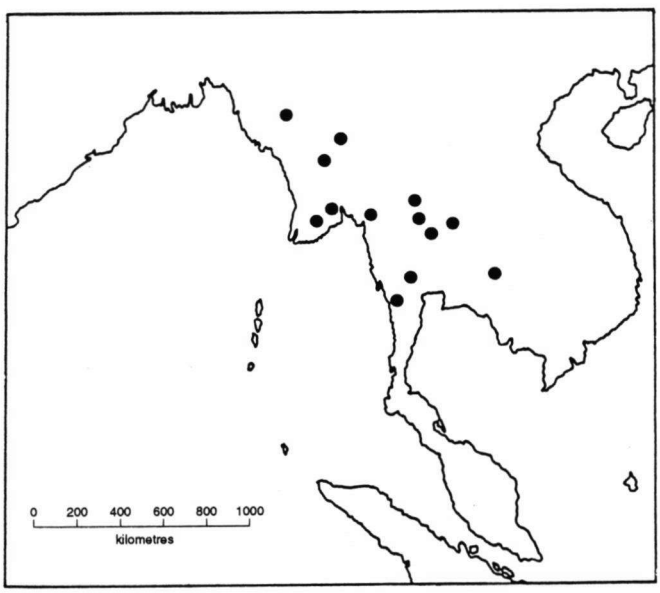

Fig. 7. Distribution of *Walsura trichostemon* Miq.

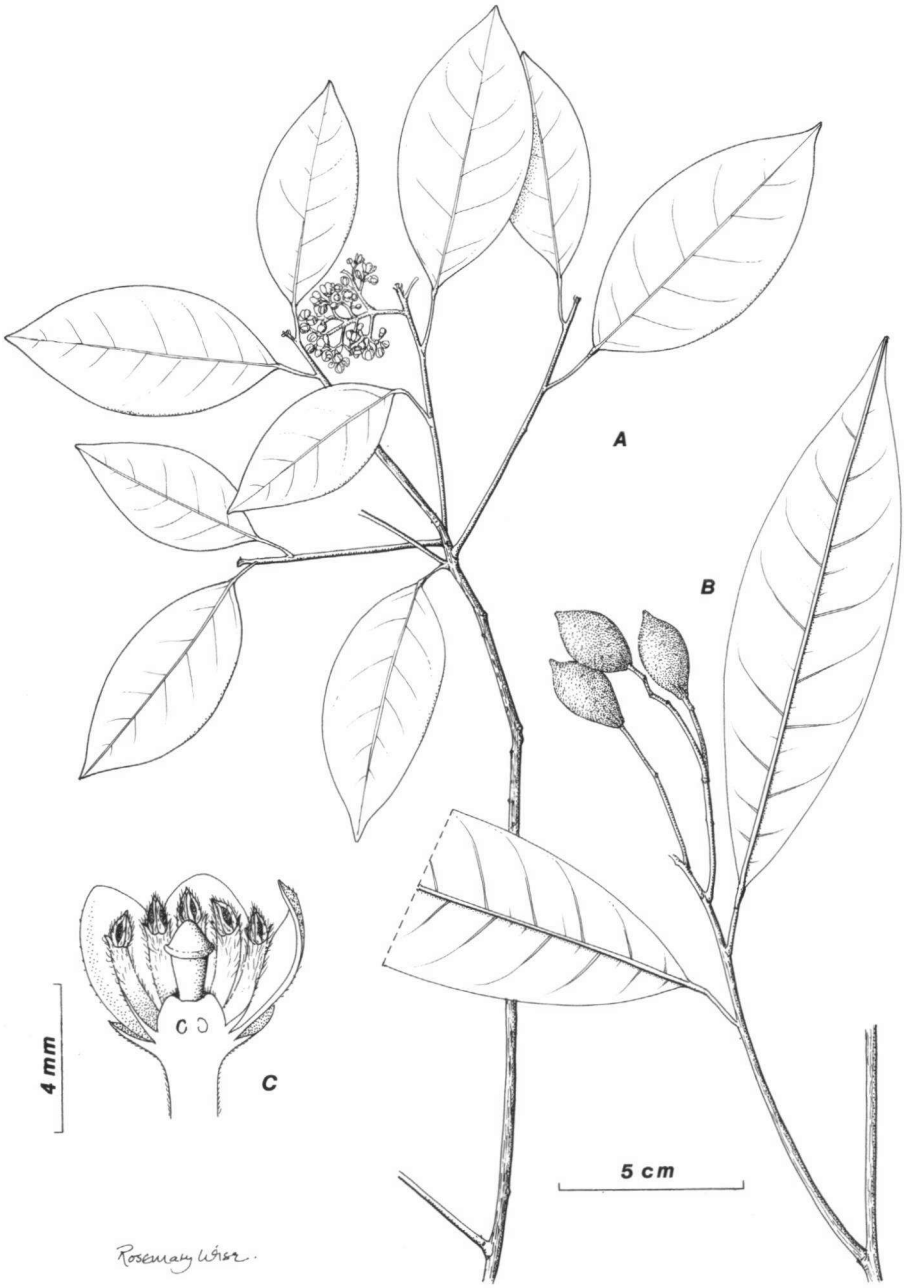

Fig. 8. *Walsura gardneri* Thw. A: habit; B: leafy twig with two inflorescences; C: flower, LS (A: *Thwaites C.P. 1163*; B, C: *T. Clark 90*).

Inflorescences densely clustered around shoot apex in axils of caducous undeveloped leaves or occasionally in axils of fully expanded leaves near the shoot apex or below, 5.5–17.0(–27.0) cm long at anthesis, each a compact to open thyrse, branched up to second (to third) order of which the first order branches can be up to 6.5 cm long, all parts velvety with simple (and few 2-armed) trichomes, peduncle and primary axis often lenticellate; flowers hermaphrodite, just prior to opening ± cylindrical and 3.5–5.0 mm long, 2.5–3.5 mm diam., at maximum opening 0.4–0.6 mm diam.; calyx 1.7–1.9 mm long, lobes c. 1 mm long; petals 3.4–4.0 mm long × c. 1 mm wide, ± imbricate, apex may be shortly acuminate, inside of petal may be sparsely puberulous; androecium cylindrical to slightly cask-shaped, 2.3–3.1 mm diam., tubular for 1/3–1/2 of length with alternate filaments slightly shorter, densely pubescent on filaments and glabrous to sparsely pubescent below with long straggly trichomes, all parts sometimes with white flecks (like tiny lenticels), lobe apex very shortly bifid (to almost truncate) with teeth up to 0.13 mm long; anthers 0.7–0.8 mm long with short downward-curving beak, sparsely hairy with long straggly trichomes; disk 0.3–0.4 mm high; style cylindrical or cylindrical widening in the upper 1/3–2/3, 0.7–1.4 mm long, c. 0.2 mm diam. at base, c. 0.6 mm diam. at top, glabrous or sparsely pubescent with erect trichomes in lower 1/3; stigma ± capitate with two short lobes at the top, 0.5–0.8 mm diam. near base 0.3–0.4 mm high; fruit a 1-seeded berry, ellipsoid to slightly ovoid with mammiform to very shortly acuminate apex, 2.2–2.5 cm long, 1.3–1.8 cm diam., light brown (in vivo and in sicco), minutely tomentose, pericarp thin but coriaceous with very thin fibrous endocarp; seed ± ellipsoid, enveloped in a thin aril.

Distribution – Burma, Thailand and Cambodia.

Vernacular name – Burmese: gyobo (as for *W. robusta*).

5. **Walsura gardneri** Thw. — Figs. 8, 9

Walsura gardneri Thw., Enum. Ceylon Pl. (1858) 61; Hiern in Hook. f., Fl. Br. India 1 (1875) 563; C.DC. in DC., Monogr. Phan. 1 (1878) 633; Trimen, Fl. Ceylon 1 (1893) 250; Harms in Engl. & Prantl, Nat. Pflanzenfam. III, 4 (1896) 302 and in ed. 2, 19b, 1 (1940) 119; Imp. For. Inst. Oxf., Descr. Chklst. Ceylon 4 (1939) 46. — Type: *Gardner s.n. in Thwaites C.P. 1163*, Sri Lanka, Kandy District, Hantane, Oct. 1845 (P-A holo; BM, G, K iso).

Small tree to 4 m tall; outer bark smooth, dark brown, flaking; inner bark red-brown; leafy twigs 2–3 mm thick, glabrous, bark mid to dark brown and lenticellate, leaves all along twig; leaves 10–14(–18) cm long, unifoliolate; petiole plus petiolule 0.8–2.0(–2.5) cm long × 0.5–1.0 mm thick, semiterete and flattened adaxially, glabrous; lamina 8.5–14.0 cm long × 3.8–6.4 cm wide, elliptic (to slightly ovate), base acute to very short attenuate and usually slightly asymmetric, apex (acute to) very short acuminate, sub-coriaceous, adaxial surface with no veins prominent (in vivo) or most veins slightly prominent (in sicco), abaxial surface with most of venation prominent (in vivo and in sicco) and glaucous (in vivo) except on midrib and costae and glabrous or extremely sparsely pubescent (on the midrib) with prostrate simple trichomes; 6 or 7 (or 8) costae on either side of the midrib; glands very small and sparse.

Inflorescences clustered around shoot apex in axils of caducous undeveloped leaves and never (?) below, 2.5–6.0 cm long at anthesis, each a compact thyrse

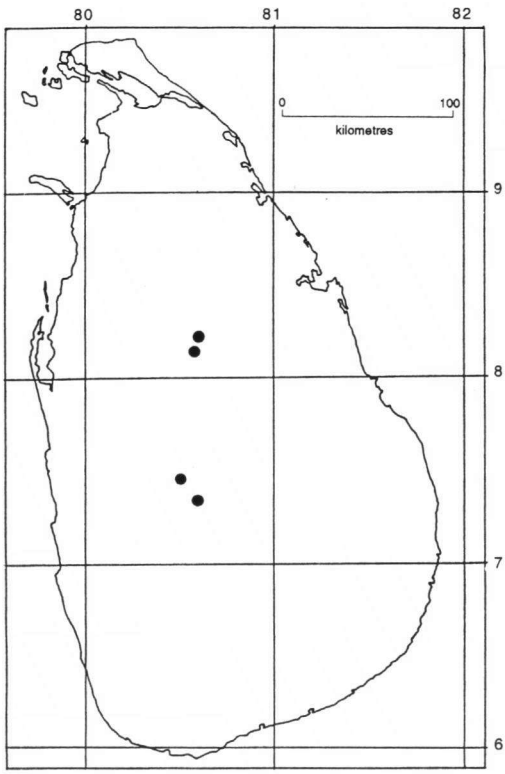

Fig. 9. Distribution of *Walsura gardneri* Thw.

branched up to second (to third) order (excluding pedicels), first order branches up to 2 cm long, all parts sparsely to densely pubescent with 2-armed trichomes predominating on the peduncle gradually replaced by simple trichomes on all other parts, peduncle sometimes sparsely lenticellate; flower hermaphrodite, not scented?, just prior to opening ± cylindrical and 2.4–2.7 mm long, 2.3–2.5 mm diam., at maximum opening 2.5–3.8 mm diam.; calyx 1.0–1.1 mm long, lobes 0.3–0.6 mm long; petals 2.8–2.9 mm long × 0.9–1.2 mm wide, imbricate, apex acute; androecium cylindrical to cask-shaped 1.0–1.8 mm long, 1.5–2.3 mm diam., tubular for 1/8–1/6 of length, alternate filaments slightly shorter, filaments pubescent with long trichomes inside and out and glabrous to sparsely pubescent below, filament apex bifid with erect teeth 0.1–0.2 mm long; anthers 0.5–0.7 mm long, shortly beaked, long hairy; disk 0.4–0.5 mm high, glabrous; style 0.3 (immature? at anthesis) to 0.6 mm long, cylindrical to narrowly obconical, 0.2–0.3 mm diam. at base and 0.3–0.4 mm diam. at top, glabrous; stigma capitate to broadly conical, 0.6–0.7 mm diam. at base, 0.4–0.5 mm high, very shortly 2-lobed at top; fruit a 1-seeded berry, ovoid to ellipsoid to slightly obovoid, 2.2–2.5 cm long, 1.2–1.5 cm diam., shortly beaked at apex for 1.5–2.5 mm, pale-green (in vivo) or brown (in sicco), surface rugose and densely but minutely puberulous with stiff simple trichomes, pericarp thick (1.0–1.5 mm) and coriaceous with thin fibrous endocarp; seed ± ellipsoid, 1.8–2.1 cm long, 1.1–1.8 cm diam., completely or almost completely enveloped in colourless sweet aril.

Distribution – Sri Lanka.

6. **Walsura bonii** Pellegrin — Fig. 10

Walsura bonii Pellegrin in Lecomte, Not. Syst. (1910) 277. — Type: *Bon 5217*, Vietnam, Tonkin, Phu-dien (P holo; FHO photo).

Habit unrecorded: tree?; leafy twigs 1.7–3.0 mm diam., glabrous with dark-brown, lenticellate bark; leaves 11.5–19.5 cm long, 1-jugate, brown when dried; petiole about

1 mm diam., semiterete and flattened adaxially, glabrous; rachis 0.5–0.8 mm diam., terete to semiterete, glabrous; petiolule ± terete, (of lateral leaflets:) 0.4–0.9 cm long, slightly swollen at point immediately below base of lamina; lamina of lateral leaflets 5.5–7.6 × 2.4–3.9 cm, lamina of terminal leaflet 9.5–12.8 × 4.6–5.6 cm, all leaflets elliptic and slightly asymmetric with short-attenuate base and long-acuminate apex, chartaceous, adaxial surface with costae prominent and all other veins slightly prominent (in sicco), abaxial surface (other than midrib and veins) matt (in sicco) and glabrous, midrib very sparsely pubescent with prostrate trichomes and all veins prominent (in sicco), all leaflets with 8–10 costae on either side of the midrib; glands c. 0.18 mm diam., sparse, on the abaxial surface of the leaflet, seen as black dots within 1 mm of the midrib.

Inflorescences clustered around shoot apex in axils of undeveloped (not caducous) leaves and/or in groups of 1–4 arising from axils of expanded leaves near the shoot apex, 7.5–12.0 cm long at anthesis, a thyrse, branched up to second order (excluding pedicels) of which the first order branches can be up to 3.8 cm, all parts densely puberulous; flowers hermaphrodite, just prior to opening ± cylindrical and 2.3–3.5 mm long, 1.5–2.0 mm diam., at maximum opening 0.4–0.6 mm diam.; calyx 0.8–1.0 mm long, pubescent on outside only; petals 4.0–4.3 mm long × 1.2–1.5 mm wide, valvate or very slightly imbricate, apex shortly acuminate and (when mature) recurved; androecium cylindrical, 2.1–2.5 mm long, 1.4–1.8 mm diam., tubular for 1/2(–3/4) of length with alternate filaments slightly shorter, pubescent on outside along whole length and inside on lobes only, lobe apex truncate with stalk to anther c. 0.07 mm long; anthers 0.6–0.8 mm long, shortly beaked, glabrous; disk annular, 0.2–0.3 mm high, wall ± terete and c. 0.16 mm diam. in TS, glabrous and smooth; ovary with dense covering of short erect trichomes, c. 3/4 of ovary below the level of the disk; style 0.7–0.8 mm long, c. 0.2 mm diam. at base, c. 0.3 mm diam. just below stigma, terete, striate; stigma c. 0.5 mm diam., c. 0.2 mm high, capitate with shallow depression at centre; fruit unknown.

Distribution – Vietnam (only known from the type-collection).

7. **Walsura oxycarpa** Kurz

Walsura oxycarpa Kurz, J. As. Soc. Beng. 44 (1875) 200; For. Fl. Br. Burma 1 (1877) 224; C.DC. in DC., Monogr. Phan. 1 (1878) 637. — Type: *Kurz s.n.*, South Andaman. (CAL holo; K iso).
Walsura candollei King, J. As. Soc. Beng. 64 (1895) 84; Parkinson, For. Fl. Andaman Is. (1923) 122; syn. nov. — Type: *Kurz s.n.*, Andaman Islands (CAL holo; G iso).

Small tree; leafy twigs 3–6 mm thick, dark-brown, lenticellate, glabrous to pubescent with prostrate trichomes; leaves 18–29 cm long, 2-jugate, brown when dried; petiole 3.5–7.0 cm long, 1.0–1.5 mm thick, semiterete and slightly flattened adaxially, glabrous to sparsely pubescent with short simple and 2-armed trichomes, usually lenticellate; petiolule ± terete, (of lateral leaflets:) (0.4–)0.8–1.0 cm long and 0.5–1.0 mm thick, glabrous to very sparsely pubescent; lamina (of distal lateral:) 10–14 × 3.2–4.4 cm, (of terminal:) 10–16.5 × 3.1–5.5 cm, (basal:) 8–13 × 3.4–4.7 cm, all leaflets narrowly ovate (to narrowly elliptic) with short attenuate (and occasionally slightly asymmetric) base and short acuminate apex, sub-coriaceous, adaxial surface with no veins prominent (in sicco), abaxial surface with most of venation prominent

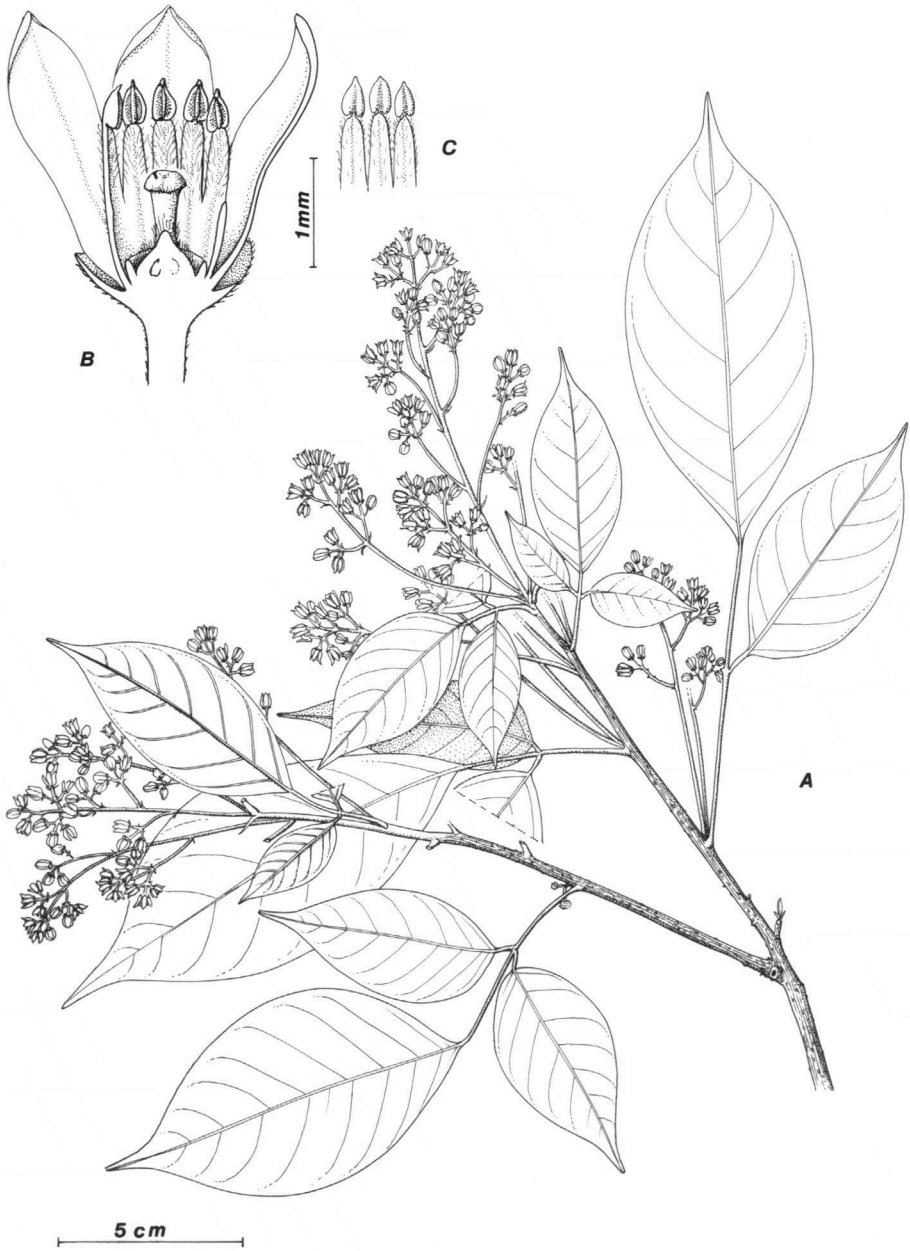

Fig. 10. *Walsura bonii* Pellegrin. A: habit; B: flower, LS; C: filament apices seen from exterior (A–C: *Bon 5217*).

(in sicco) and matt (in sicco) usually only in islets between smallest veins and extremely sparsely puberulous with minute prostrate simple trichomes; glands present but very small.

Inflorescences clustered around shoot apex in axils of caducous undeveloped or fully expanded leaves, 4.5–16.0 cm long at anthesis, each an open thyrse branched up to third order (excluding pedicels), first order branches up to 3 cm long, primary rachis minutely pubescent with 2-armed trichomes for most of length, replaced by simple trichomes distally, branches and all other parts densely puberulous with simple trichomes; flowers hermaphrodite, just prior to opening ± cylindrical and 2.9–3.3 mm long, 2.4–2.6 mm diam., at maximum opening 3.0–4.5 mm diam., calyx 0.9–1.3 mm long, lobes 0.7–0.9 mm long; petals 3.1–3.2 mm long × 1.2–1.6 mm wide, imbricate, outside densely pubescent and inside sparsely to sub-densely pubescent, apex acute to short-acuminate; androecium ± cylindrical, 1.8–1.9 mm long, 1.7–1.9 mm diam., tubular for 1/4–1/3 of length with alternate filaments usually slightly shorter, filaments densely hairy inside and out with long straggly trichomes but tubular part glabrous, filament apex very shortly bifid; anthers 0.7–0.9 mm long, shortly beaked, sparsely to sub-densely hairy with long straggly trichomes; disk c. 0.2 mm high; style obconical, 0.3–0.8 mm long, 0.2–0.3 mm diam. at the base and 0.2–0.7 mm diam. just below the stigma, glabrous; stigma capitate to broadly conical with two lobes on top, 0.2–0.3 mm long (excl. lobes), 0.6–1.0 mm diam., lobes up to 0.18(–0.20) mm long; fruit a one-seeded berry, ovoid and beaked, 1.8–2.3 cm long (excl. beak), 1.2–1.7 cm diam., beak 2–3 mm long, minutely puberulous, pericarp coriaceous with a fibrous endocarp; seed ovoid, 1.3–1.6 cm long.

Distribution – Andaman Islands.

Note – Kurz described *Walsura oxycarpa* from fruiting material only. C. de Candolle received from Kurz also some fragments of *W. candollei* which he considered as a new species. King received flowering material of the same species through the Calcutta Botanic Gardens and described it as *W. candollei*. Comparison of isotypes revealed that the two are doubtless synonymous.

8. **Walsura poilanei** Pellegrin

Walsura poilanei Pellegrin, Bull. Soc. Bot. France 91 (1944) 177. — Type: *Poilane 1186*, Vietnam, Quang-Tri Prov., Mai-lanh, 23-iii-1920 (P lecto, selected here & syn. X 3; FHO photo).

Tree 18 m tall, bole 15 m, girth 0.8 m; outer bark grey-brown; inner bark pink; leafy twigs 4–7 mm diam., glabrous or puberulous with simple trichomes, bark mid-brown and lenticellate; leaves 21–34 cm long, 2-jugate; petiole 4–7 cm long × 2.0–3.5 mm thick, semiterete and flattened adaxially, sparsely pubescent; petiolule (of distal pair leaflet:) 0.7–1.1 cm long × 1.0–1.5 mm thick, sparsely puberulous with simple trichomes; lamina (of distal pair leaflet:) 12.0–17.5 × 6.5–8.4 cm and elliptic, (terminal:) 12–18 × 4.5–7.5 cm and (ovate to) broadly elliptic (to obovate), (basal:) 9.5–12.0 × 4.5–5.8 cm and ovate to broadly elliptic, all leaflets with a truncate (to short-acute) and usually slightly asymmetric base and very short-acuminate apex, sub-coriaceous, adaxial surface with all veins very slightly prominent (in sicco), abaxial surface with all veins prominent (in sicco) and matt and velutinous with simple erect trichomes;

12 or 13 (distal pair and terminal leaflets) or 10 or 11 (basals) costae on either side of the midrib; glands present but very small.

Inflorescences clustered around shoot apex in axils of caducous undeveloped leaves or fully expanded leaves in groups of 1–3, 10–23 cm long at anthesis, each an open thyrse, branched up to third order (excluding pedicels), first order branches up to 7 cm long, all parts tomentose with prostrate to semi-erect simple trichomes; flowers hermaphrodite, just prior to opening cylindrical and 2.5–3.0 mm long, 2.2–2.5 mm diam., at maximum opening 2.8–3.3 mm diam.; calyx 1.2–1.7 mm long, lobes 0.8–1.2 mm long; petals 2.9–3.1 mm long, 1.3–1.5 mm wide, imbricate, apex acute, inside glabrous; androecium ± cylindrical, 1.5–1.8 mm long × 1.5–2.1 mm diam., tubular for 1/3–1/2 of length, filaments sub-densely pubescent with straggly hairs inside and out, tubular part glabrous or sparsely and straggly pubescent inside and out, filaments all the same length, filament apex very shortly bifid with teeth c. 0.5 mm long; anthers 0.6–0.7 mm long, apex very shortly acuminate, glabrous except for a tuft of minute simple trichomes at the apex; disk c. 0.2 mm high; style obconical, 0.5–0.6 mm long, 0.2–0.4 mm diam. at the base and 0.3–0.4 mm diam. at the top, glabrous to sub-densely pubescent in the lower 1/4 with ovary-type trichomes; stigma capitate and slightly lobed on top, 0.4–0.5 mm high (excl. lobes), 0.5–1.0 mm diam. at base; fruits unknown.

Distribution – Vietnam (known only from the type-collection).

9. **Walsura pinnata** Hassk. — Figs. 11, 12

Walsura pinnata Hassk., Retzia 1 (1855) 147; Miq., Fl. Ned. Ind. (1859) 542; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 60; C.DC. in DC., Monogr. Phan. 1 (1878) 639; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 186; Koord., Exk. Fl. Java 2 (1912) 447; Backer & Bakh. f., Fl. Java 2 (1965) 129; Mabberley, Tree Fl. Malaya 4 (1989) 254. — Type: *Koorders 971*, Indonesia, Java, Bogor Botanic Garden, Tree No. III b 20; 26 June 1892 (BO neo, designated here).

Walsura hypoleuca Kurz, J. As. Soc. Beng. 42 (1872) 296; Hiern in Hook. f., Fl. Br. India 1 (1875) 564; Kurz, Veg. Pegu (1875) 37; For. Fl. Br. Burma 1 (1877) 224; syn. nov. —Type: *Kurz s.n.*, South Andaman, Port Mowat (K lecto, selected here).

Walsura neurodes Hiern in Hook. f., Fl. Br. India 1 (1875) 564; C.DC. in DC., Monogr. Phan. 1 (1878) 636; King, J. As. Soc. Beng. 64 (1895) 84; Ridley, Fl. Mal. Pen. 1 (1922) 412; Wyatt-Smith & Kochummen, Mal. For. Rec. (1979) 17. — Type: *Maingay 344*, Malay Peninsula, Malacca (K holo; L).

Heynea cochinchinensis Baillon, Adansonia 11 (1879) 265. — *Walsura cochinchinensis* (Baillon) Harms in Engl. & Prantl, Nat. Pflanzenfam. III, 4 (1896) 302 and in ed. 2, 19b, 1 (1940) 119; Pierre, Fl. For. Coch. (1897) 21–25, t. 354; Pellegrin in Lecomte, Not. Syst. (1910) 227; Pham-Hoang-Ho, Fl. S. Vietnam (1960) 244; syn. nov. — Type: *Lefèvre 106*, Vietnam, Ho Chi Min City, Bien-hoa (P holo; L iso).

Walsura elata Pierre, Fl. For. Coch. (1897) 21, t. 355; syn. nov. — Type: *Pierre 4219*, Vietnam (P holo; BM, G, K iso).

Walsura aherniana Perk., Fragm. Fl. Philipp. (1904) 34; Merr., Enum. Philipp. Fl. Pl. 2 (1923) 379; syn. nov. — Type: *Ahern 264*, Philippines, Luzon, Camarines (B holo †; K, NY iso).

Walsura villamilii Merr., Philipp. J. Sci. 9, Bot. (1914) 308; Univ. Calif. Publ. Bot. 15 (1929) 132; syn. nov. — Type: *FB 13764*, Philippines, Mindanao, Zamboanga Dist., Margosatubig (PNH holo †; BM iso).

Napeodendron altissimum Ridley, J. Roy. As. Soc. Straits Branch. 82 (1920) 179; Symington, Bull. Misc. Info. Kew (1937) 319. — Type: *Ridley s.n.*, Malaysia, Selangor (K holo).

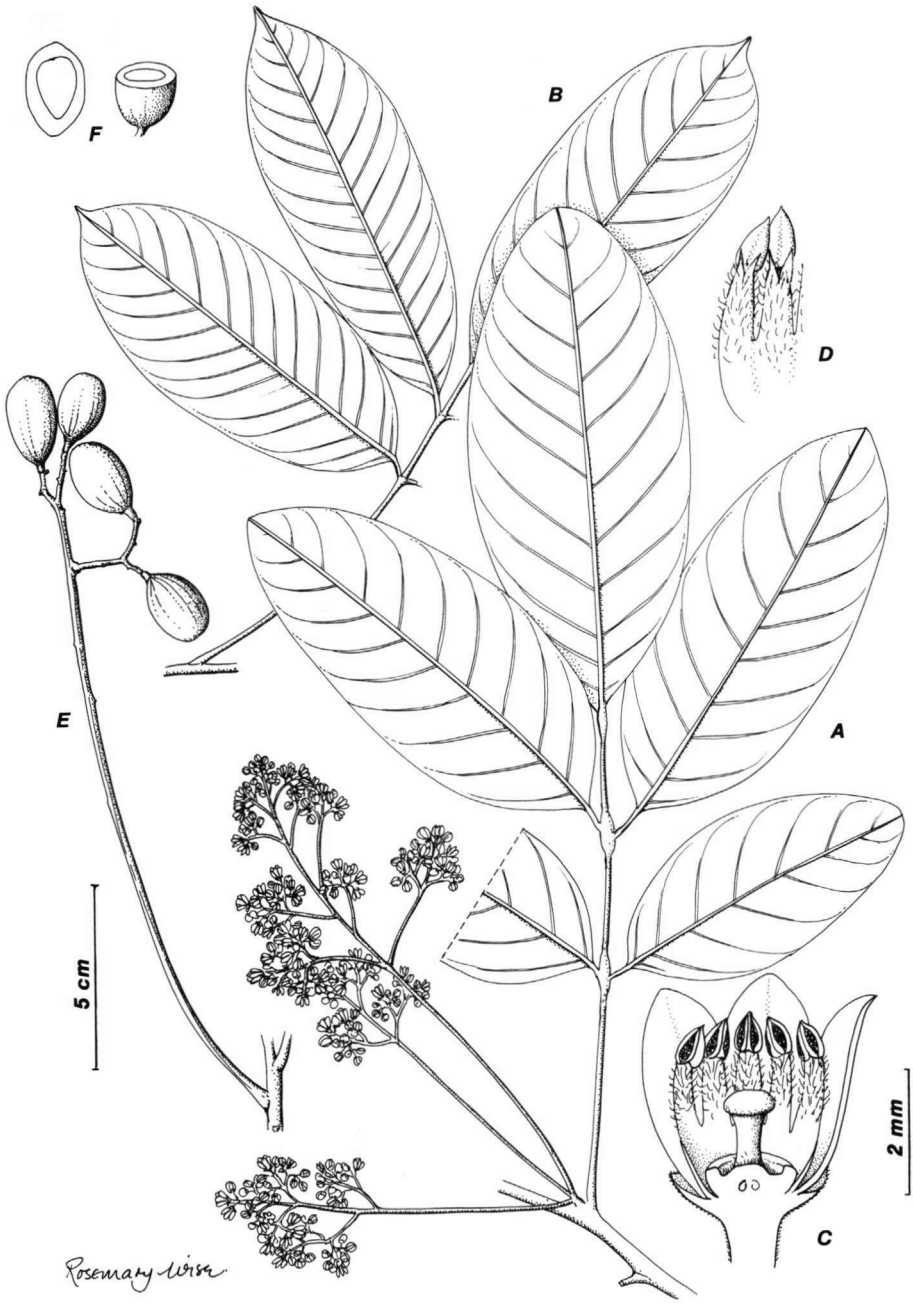

Fig. 11. *Walsura pinnata* Hassk. *'pinnata'*. A: habit; C: flower, LS; D: androecium (part) exterior; E: infructescence; F: berry, TS & LS. — *W. pinnata 'villamilii'*. B: leaf (part) (A, C, D: *Garrett 1237*; E: *KL 1640*; F: *Pennington 7815*; B: *SAN 61654*).

Walsura angulata Craib, Bull. Misc. Info. Kew (1926) 344; Fl. Siam. Enum. 1 (1926) 261; Suvatti, Fl. Thai. 2 (1978) 727; syn. nov. — Type: *Kerr 6793,* Thailand, Srirachi, Nawng Kaw (K holo; BM iso).

Walsura glauca C. Fischer, Bull. Misc. Info. Kew (1927) 87; syn. nov. — Type: *Parkinson 1686,* Burma, Sth. Tenasserim (K holo).

Walsura grandifolia Ridley, Bull. Misc. Info. Kew (1930) 370; syn. nov. — Type: *Haviland 1635,* Borneo, near Kuching (K holo; SAR iso).

Tree, height to 18(–37) m, girth to 0.76(–1.22) m, bole to 11(–24) m; outer bark smooth and thin, light-grey-brown, often with lenticels, falling in parts showing pink-brown inner bark; sapwood very pink to pale-brown to pink-yellow, with slight aroma similar to that of the fruits; leafy twigs slender, 2.5–8.0 mm diam., glabrous with grey-brown usually lenticellate bark; leaves (9, if leaf undivided, to) 14–70 cm long, undivided to 2- (or 3-)jugate; petiole 2.5–11.0 cm long, 1–4 mm thick, semiterete and flattened adaxially, glabrous or extremely sparsely pubescent, occasionally lenticellate near the base; petiolule semiterete and flattened adaxially, (of lateral leaflets:) 0.4–1.4 cm long and 0.5–1.5 mm thick, geniculate just below base of lamina; lamina (of distal pair leaflet:) 2.1–11.5 × 5.5–25.0 cm, the basal leaflets usually conspicuously smaller and the terminal a little larger, all narrowly oblanceolate, elliptic or oblong, with cuneate or cuneate-attenuate base and acute to shortly (< 1.5 cm) acuminate apex, sub-coriaceous, adaxial surface with most of veins slightly prominent (in sicco and in vivo), abaxial surface (other than midrib and costae) glaucous (in vivo) and glabrous or very sparsely pubescent on midrib and costae only with most (in sicco) or only to second order (in vivo) veins prominent, (of distal pair leaflet) 7–12(–20) costae on either side of midrib or (in '*villamilii*') with incomplete costae also (see above); glands usually present.

Inflorescences clustered around shoot apex in axils of caducous undeveloped leaves and/or rarely solitary in axils of expanded leaves near the shoot apex, (4–)8–35 cm long at anthesis, an open thyrse, branched up to third order (excluding pedicels), first order branches up to 10 cm long, all parts densely puberulous, rachis occasionally lenticellate; pedicel 0.5–2.0 mm long; flowers hermaphrodite or male only, just prior to opening ± cylindrical and 2–4 mm long, 2.0–2.8 mm diam., at maximum opening 3.5–5.0 mm diam.; calyx 1.2–1.9 mm long, lobes 0.7–1.7 mm long, densely puberulous on outside only; petals 3.0–3.8(–4.0) mm long × 1.5–1.8(–1.9) mm wide, imbricate, apex sometimes slightly hooded when mature; androecium cylindrical or slightly ampuliform, (1.7–)2.0–4.3 mm long, (1.5–)2.0–2.5 mm diam., tubular for (1/4–)1/2(–2/3) of length with alternate filaments slightly shorter or all to same length, outside glabrous or very sparsely pubescent on tubular part and sparsely to densely pubescent on filaments, inside glabrous on tubular part and densely pubescent on filaments, filament apex bifid with teeth c. 0.2 mm long, stalk to anther 0.2–0.3 mm long originating just below base of teeth; anther 0.6–0.8 mm long, occasionally shortly beaked, glabrous or (in '*villamilii*') puberulous; disk 0.2–0.3 (–0.4) mm high; ovary densely hairy or very rarely glabrous (see below); style cylindrical to narrowly conical, 0.6–0.7(–1.1) mm long, 0.3–0.4 mm diam. at base and 0.3–0.6 mm diam. at top, glabrous; stigma c. 0.4 mm long, 0.7–1.0 mm diam., capitate, just below the level of the anthers at anthesis; fruit a 1- (or 2-)seeded berry, globose (to ovoid), 1.2–2.4 (rarely 2.8) cm long, 1.2–2.4 cm diam., pale-green

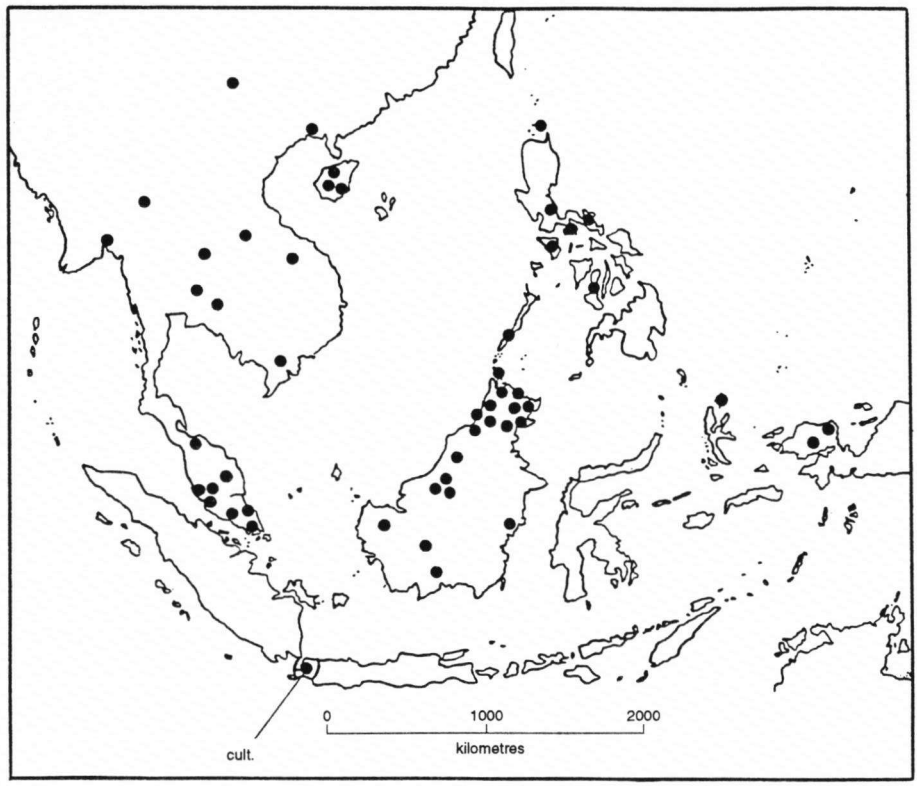

Fig. 12. Distribution of *Walsura pinnata* Hassk.

(or red: *Fung 20154*) (in vivo) or brown (in sicco), sparsely and minutely puberulous, pericarp thin but coriaceous with very thin fibrous endocarp; seed ± ellipsoid and 1.3–2.3 mm long, 0.9–1.3 mm diam. or (in 2-seeded fruit:) hemi-ellipsoid and up to 2.1 cm long, enveloped in a fleshy white or colourless sweet tasting aril which sometimes exudes a clear sticky liquid.

Distribution – Burma, Thailand, Yunnan, Hainan, Cambodia, Vietnam, Malay Peninsula, Java (cult.: Bogor), Borneo, Philippines (Palawan to Luzon), Halmahera, extreme western Irian Jaya.

Notes – *Walsura pinnata* has the largest range of all the species of *Walsura* or *Pseudoclausena* and is highly variable, mainly in leaf and leaflet size but also, to a lesser extent, in leaflet number. The type specimens of *W. pinnata, W. neurodes* and *W. aherniana* are clearly the same species described from different geographical/political areas (viz. Indonesia, Malaysia and the Philippines respectively). Pierre (1897) seems to distinguish *W. elata* by its large (25–28 mm long, 20 mm diam.) berries and (26–31 cm long) leaves. Both of these characters can be accommodated within the morphological range of *W. pinnata* and even though the size of the fruit is at the upper end of the range for this complex, there are many intermediates. The an-

gular (in transverse section) petiole with which Craib (1926) segregates *W. angulata* in fact occurs throughout this complex and particularly in specimens from Borneo, where much material of the complex has been collected since 1926. Leaf and leaflet size is of little use as a character in this complex, so *W. grandifolia* must also be reduced. Kurz's *W. hypoleuca* from Burma (at the north-western limit of the range of the complex) is defined by its very short staminal tube (as a proportion of the total length of the androecium) but Kurz specimens at Kew (including the lectotype, selected here) have androecia tubular for 1/4 or more of their length, which is fairly common within this complex. The only significant character which *W. glauca,* also from Burma, seems to possess is a glabrous ovary. This is unique within the genus but in all other features it seems to fit very well into the *W. pinnata* complex. Given the variation known to occur in floral pubescence throughout the genus, this single character is considered insufficient to support a distinct species. Ridley's monotypic genus *Napeodendron* seems to be distinctive only in that it has floral parts in 4s & 8s. Since the species was based on one specimen only, and since in all other respects it is typical of *W. pinnata,* Symington's reduction is maintained.

Walsura cochinchinensis and *W. villamilii* are defined by their degree of leaf division, being 1–3-foliolate and 7-foliolate respectively. In all other respects, *W. cochinchinensis* is identical with *W. pinnata.* Its range (NE Thailand to Vietnam) falls well within the range of 5-foliolate *W. pinnata* but 3-foliolate specimens do rarely occur elsewhere (in Luzon and Borneo).

Walsura villamilii from Sabah and W Mindanao is additionally supported by a few minor characters, particularly the presence of incomplete costae (see above) and the degree to which the androecium is tubular (see below), but most of these characters (including leaflet number) occur elsewhere within the range of *W. pinnata.* In view of this, although *W. villamilii* and *W. cochinchinensis* can be seen as largely distinct morphological entities within the species, the presence of many intermediates dictates their reduction. It may be useful, however, with this proviso, to maintain an informal recognition of these entities, as Mabberley (1979) did within *Chisocheton lasiocarpus* (Miq.) Valeton, also in the Meliaceae.

KEY TO ENTITIES

1a. 9-foliolate, with incomplete costae and androecium tubular for 1/4–1/2. Borneo (Sabah) and W Mindanao ..... **'villamilii'**
b. 1–7-foliolate, without incomplete costae and androecium tubular for 1/2(–2/3) 2
2a. 1–3-foliolate. N Thailand to Vietnam and Hainan ..... **'cochinchinensis'**
b. 5–7-foliolate ..... **'pinnata'**

10. Walsura pachycaulon Mabb. ex T. Clark, *spec. nov.* — Figs. 13, 14

Arbor; rami frondosi pachycaules, (0.6–)0.8–1.5 cm in diametro; folia imparipinnata, 4- (5-)juga; petiolus ad insertiones petiolulorum tumidus, semiteres, parte adaxiali applanata vel leviter canaliculata; petiolulus leviter tumidus admodum infra basin laminae, plus minusve teres; foliolorum lamina anguste oblanceolata vel elliptico-oblonga cum apex brevis acuminatus, pagina abaxialis in vivo glauca, in sicco opaca, nervi laterales (primi ordinis) 9–13(–19) in utroque latere; inflorescentiae

Fig. 13. *Walsura pachycaulon* Mabb. ex T. Clark. A: leaf (part); B: inflorescence; C: flower, LS; D: fruits (A: *SAN 68486*; B, C: *SAN 53580*, holo; D: *Kostermans 4421*).

circum apicem surculi in axillis foliorum immaturorum caducorum congestae, 16–30 cm longae sub anthesi, unaquaeque thyrsus laxus; flores hermaphroditi; calyx parce 5-lobus; petala 5, libra, imbricata, oblonga, apice plus minusve acuta; androecium cylindrica vel leviter ampulliformis, c. 1/4 eius longitudinis tubularis, filamenta 10, partim pubescens, apex filamenti bifidus, cum dentibus brevibus; stylus anguste et inverse conatus, glaber; stigma ad instar cylindri brevis cum apice leviter tholiformi; discus glaber; ovarium glabrum, biloculare, unusquisque loculus cum 2 ovulis collateralibus; fructus baccatus, monospermus, globosum vel ovoidus, pericarpium coriaceum, puberulus; semen anguste ellipsoideum, ab arillo gelineo circumcinatim?. — Typus: *(W. Meijer) SAN 53580,* Malaysia, Sabah, Sandakan Dist., Mile 3 Lungmanis Virgin Jungle Res., NT. 73, Oct. 1965 (L holo; SAN iso, incl. flowers in spirit).

Tree to 29 m tall, girth to 90 cm; outer bark 0.6–3.8 cm thick and dark-grey-brown to blackish; inner bark pink; leafy twigs pachycaul, (0.6–)0.8–1.5 cm diam., sparsely to densely lenticellate, glabrous; leaves 38–60 cm long, 4- (or 5-)jugate; petiole 10–22 cm long and 3–7 mm thick, semiterete with flat to shallowly canaliculate adaxial surface, sparsely lenticellate and glabrous; petiolule 0.5–2.3 cm long and 0.8–2.0 mm thick, ± terete; lamina (of distal pair leaflet:) 3.5–6.5 × 13.0–19.5 cm and basals slightly smaller and terminal slightly larger, all leaflets narrowly oblanceolate or elliptic or oblong, apex acuminate, base cuneate to cuneate-attenuate, sub-coriaceous, both surfaces with all veins slightly to conspicuously prominent (in sicco), abaxial surface glabrous to very sparsely pubescent with very short simple trichomes; 9–14 (distal pair leaflets), 10–19 (terminals) and 9–13 (basals) costae on either side of the midrib; glands absent or very sparse and very small.

Inflorescences clustered around shoot apex in axils of caducous undeveloped leaves, 16–45 cm long at anthesis, each an open thyrse branched to third order (excl. pedicels) with first order branches up to 15 cm long, pedicels 1.0–2.5 mm long, all parts densely puberulous; flowers hermaphrodite, just prior to opening ± cylindrical and 2.6–3.2 mm long, 2.5–3.0 mm diam., at maximal opening c. 5.2 mm diam.; calyx c. 1.32 mm long, lobes c. 0.5 mm long; petals c. 4.2 mm long × c. 2.2 mm wide, imbricate; androecium cylindrical to narrow-ampuliform, 2.1–2.4 mm long, 2.2–2.9 mm diam., tubular for c. 1/4 of length, tubular part glabrous on both surfaces, filaments glabrous on outside and pubescent on inside, filament apex bifid with teeth c. 0.1 mm long; anthers c. 0.6 mm long and very short beaked, glabrous except for a short tuft of trichomes from the apex; disk c. 0.7 mm high, glabrous; style 1.0–1.5 mm long, 0.4–0.5 mm diam. (base) and 0.6–0.7 mm diam. (top), narrow-

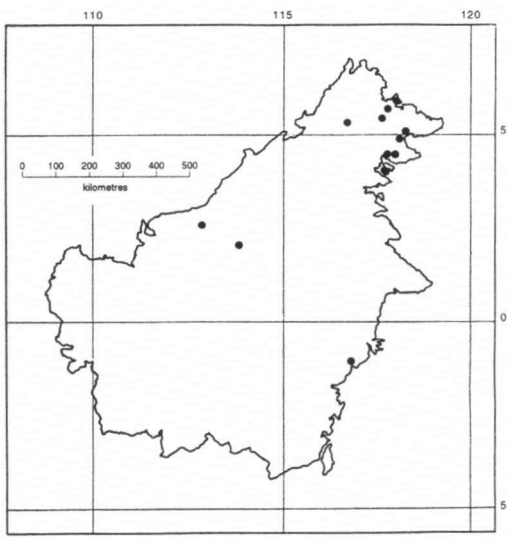

Fig. 14. Distribution of *Walsura pachycaulon* Mabb. ex T. Clark.

ly obconical, glabrous; stigma c. 0.4 mm high, c. 0.9 mm diam., cylindrical with low-domed top; fruit a 1-seeded globose (to ovoidal) berry, 1.8–4.2 cm diam., brown when mature (in vivo), sparsely puberulous, pericarp to 5 mm thick and coriaceous; seed narrowly ellipsoid, to 2.8 cm long, 1.6 cm diam., incompletely (?) surrounded by sweet tasting jelly-like aril.

Distribution – Borneo: Sabah & 4th Div. Sarawak.

Note – This species is most closely related to *Walsura pinnata* and is a member of Group 2, see comments under 'Variation within the genera' above. It is distinguished from all other members of the genus by its pachycaul leafy shoots and large (i.e. 9 or 11) leaflet number. In addition to these characters, it differs from the other members of Group 2 in its very short staminal tube which is only c. 1/4 of the total length of the androecium.

11. **Walsura sarawakensis** T. Clark, *spec. nov.* — Figs. 15, 16

Arbor; folia imparipinnata, 3-juga; petiolus ad insertiones petiolulorum tumidus, semiteres, parte adaxiali applanata; petiolulus leviter tumidus admodum infra basin laminae, plus minusve teres vel leviter applanatus in parte adaxiali, lamina elliptica vel late lanceolata, apex longe [(2–)2.5–5 cm] acuminatus, pagina abaxialis in vivo glauca, in sicco opaca, nervi laterales (primi ordinis) 14–18 in utroque latere; inflorescentiae circum apicem surculi in axillis foliorum interdum caducorum immaturorum congestae; flores hermaphroditi; calyx non profunde lobatus; petala 5, libera, imbricata, oblonga vel elliptica, cum apice acuto; androecium cylindricum, 1/2–2/3 eius longitudinis tubularis, filamenta 10, partim sparse pubescens, apex lobi bifidus, cum dentibus brevibus; antherae puberulus; stylus cylindricus, glaber; stigma capitatum; discus glaber; ovarium trichomatibus brevibus erectis dense, 2-loculare, unusquisque loculus cum 2 ovulis collateralibus; fructus baccatus, cum 1–3 seminibus, ellipsoideus, pericarpium coriaceum, glabrum; semen ellipsoideum, ab arillo viscido albo circumcinctum. — Typus: *Purseglove 5204,* Malaysia, Sarawak, 4th Div., Bt Mayeng (SING holo; L iso).

Tree to 6 m tall; leafy twigs 6–8 mm thick, glabrous with light brown sparsely lenticellate bark; leaves 52–80 cm long, 3-jugate; petiole 15–21 cm long, 0.2–0.4 cm thick, semiterete and flattened adaxially, glabrous to very sparsely puberulous with very short erect trichomes, sparsely lenticellate; petiolule 5–18 mm long, 1.0–1.5 mm thick, ± terete or slightly flattened adaxially; lamina (of distal pair leaflet:) 24–30 × 5–8 cm, (of terminal leaflet:) 28–41 × 5.8–10.0 cm, all leaflets lanceolate with short attenuate base and apex acuminate for (2–)2.5–5 cm long, sub-coriaceous, all veins prominent on both surfaces, abaxial surface matt on intervenous lamina and over most of smallest veins and very sparsely pubescent with simple trichomes; 14–17 (distal pair leaflet) and 17 or 18 (terminal leaflet) costae on either side of the midrib; glands conspicuous.

Inflorescences clustered around shoot apex in axils of (sometimes) caducous undeveloped leaves, 7.5–8.0 cm long at anthesis, a compact thyrse branched up to second order (excluding pedicels) of which the first order branches can be up to 1.3 cm long, all parts densely puberulous and primary rachis sparsely lenticellate; flowers hermaphrodite, just prior to opening cupiform and c. 2.6 mm long, c. 2.1 mm diam., at maximum opening c. 2.8 mm diam.; calyx c. 1.1 mm long, lobes c. 0.8 mm long; petals 3.2–3.5 mm long × 1.7–1.8 mm wide, imbricate; androecium cylindrical, c. 2.0 mm long, c. 1.6 mm diam., tubular for 1/2–3/4 of length, alternate

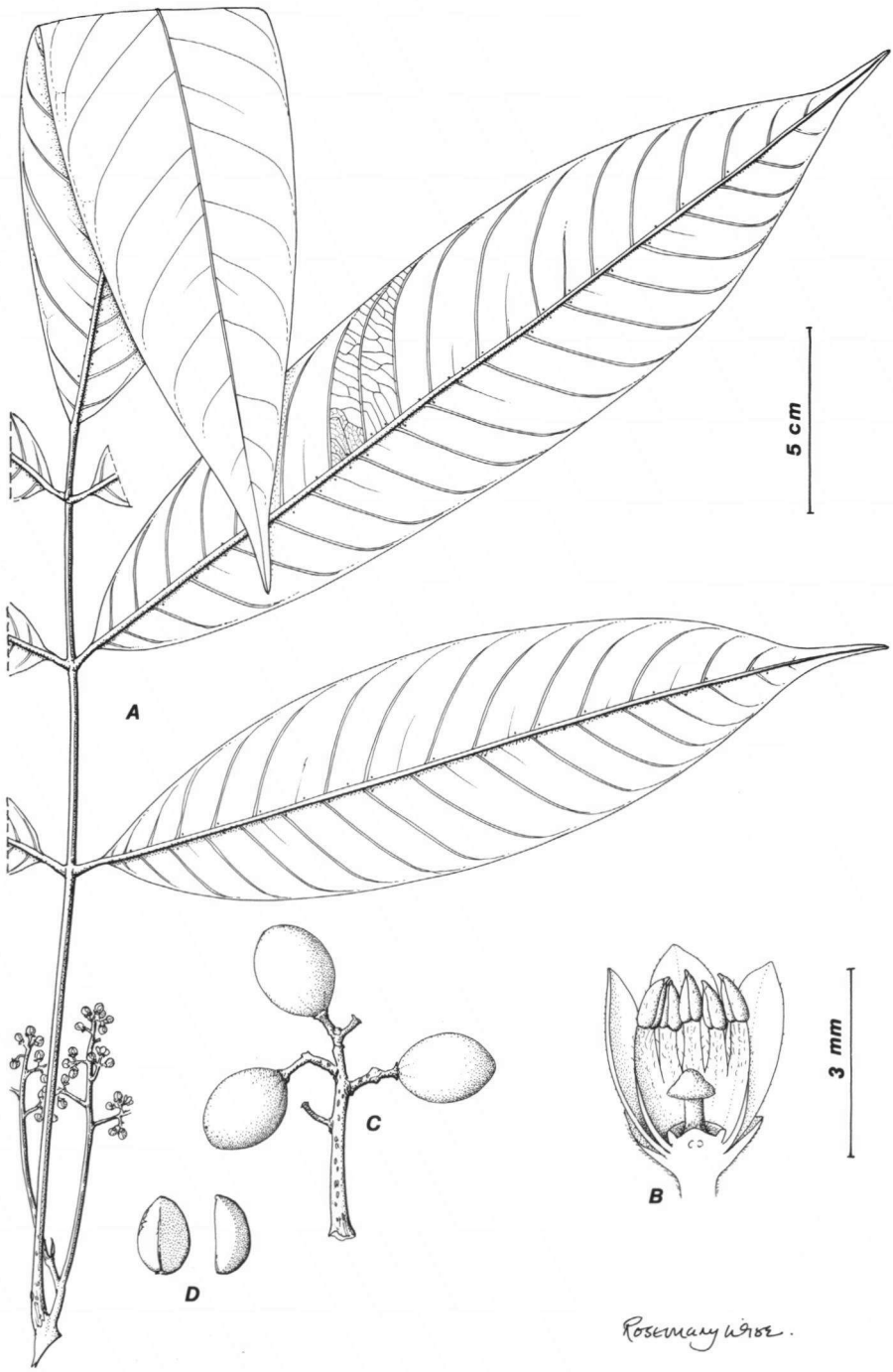

Fig. 15. *Walsura sarawakensis* T. Clark. A: habit; B: flower, LS; C: fruits; D: seeds (A, B: *Purseglove B5204*; C, D: *Purseglove B5143*).

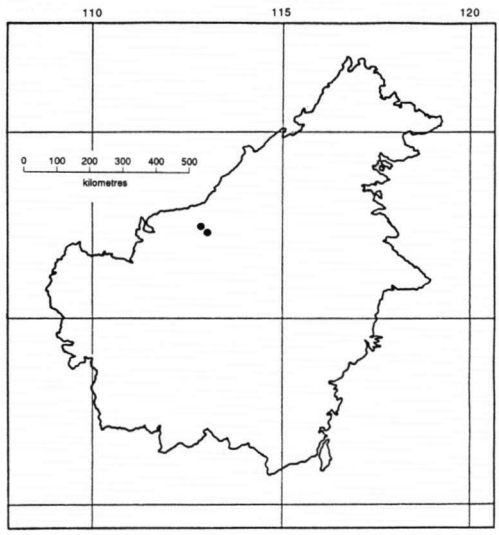

Fig. 16. Distribution of *Walsura sarawakensis* T. Clark.

filaments very slightly shorter, filaments (inside and out) sparsely pubescent and tubular part glabrous to very sparsely pubescent, filament apex bifid with erect teeth c. 0.3 mm long; anthers c. 0.8 mm long, apex acute to very shortly beaked, very sparsely and minutely puberulous; disk c. 0.3 mm high; style cylindrical, c. 0.5 mm long, c. 0.4 mm diam., glabrous; stigma capitate, c. 0.7 mm high, c. 1.1 mm diam. at base; fruit a 1–3-seeded berry, ellipsoid, 2.0–3.0 × 1.7–2.5 cm, green to purplish-brown (in vivo) and brown (in sicco), glabrous, pericarp coriaceous; seed ellipsoid, 1.8–2.3 × c. 1.4 cm, (in vivo) enveloped by a sticky white aril.

Distribution – Known only from five collections from a small area in Sarawak, north of Kapit (viz.: *P5143* from Sana on Sungai Tau; *P5204* from Bukit Mayeng in the Tau Range; *P5219* from Bukit Mersing in the Tau Range; *SAR 5279* from 'upper' Batang Rajang; Sarawak 'native collector' / *California Botanic Garden 5279* from 'Upper Rajang').

Note – This species is most closely related to *Walsura pinnata* and is a member of Group 2; see comments under 'Variation within the genera' above. It differs from the members of the genus outside Group 2 in having a 7-foliolate leaf and from all members within Group 2 by its long acuminate leaflet apex. It is also the only species of the genus known to produce up to 3-seeded fruits.

12. **Walsura monophylla** Elmer ex Merr. — Fig. 17

Walsura monophylla [Elmer, Leafl. Philipp. Bot. 9 (1937) 3391, descr. angl., ex] Merr., J. Arnold Arbor. 35 (1954) 138, descr. lat. — Type: *Elmer 12903,* Philippines, Palawan, Brook's Point, March, 1911 (PNH† holo; G, NY iso).

Tree, to 10 m tall, d.b.h. 10 cm when tree 3 m tall; leafy twigs 2.0–4.5 mm thick, glabrous and frequently lenticellate, bark rough and dark brown; leaves 8–20(–27) cm long, undivided; petiole plus petiolule 0.8–1.8(–2.8) cm long, 0.8–1.8 mm thick, semiterete and flattened adaxially, glabrous; lamina (8–)12–17(–25) cm long × (3.5–)4.5–5.5(–8.8) cm wide, lanceolate to elliptic to slightly obovate with very short attenuate base and acute to very short acuminate apex, sub-coriaceous to coriaceous, all veins prominent on both surfaces, abaxial surface glaucous (in vivo) on intervenous areas and over smallest veins and glabrous to very sparsely pubescent with short simple trichomes, (8–)10–12(–15) costae on either side of the midrib; glands conspicuous.

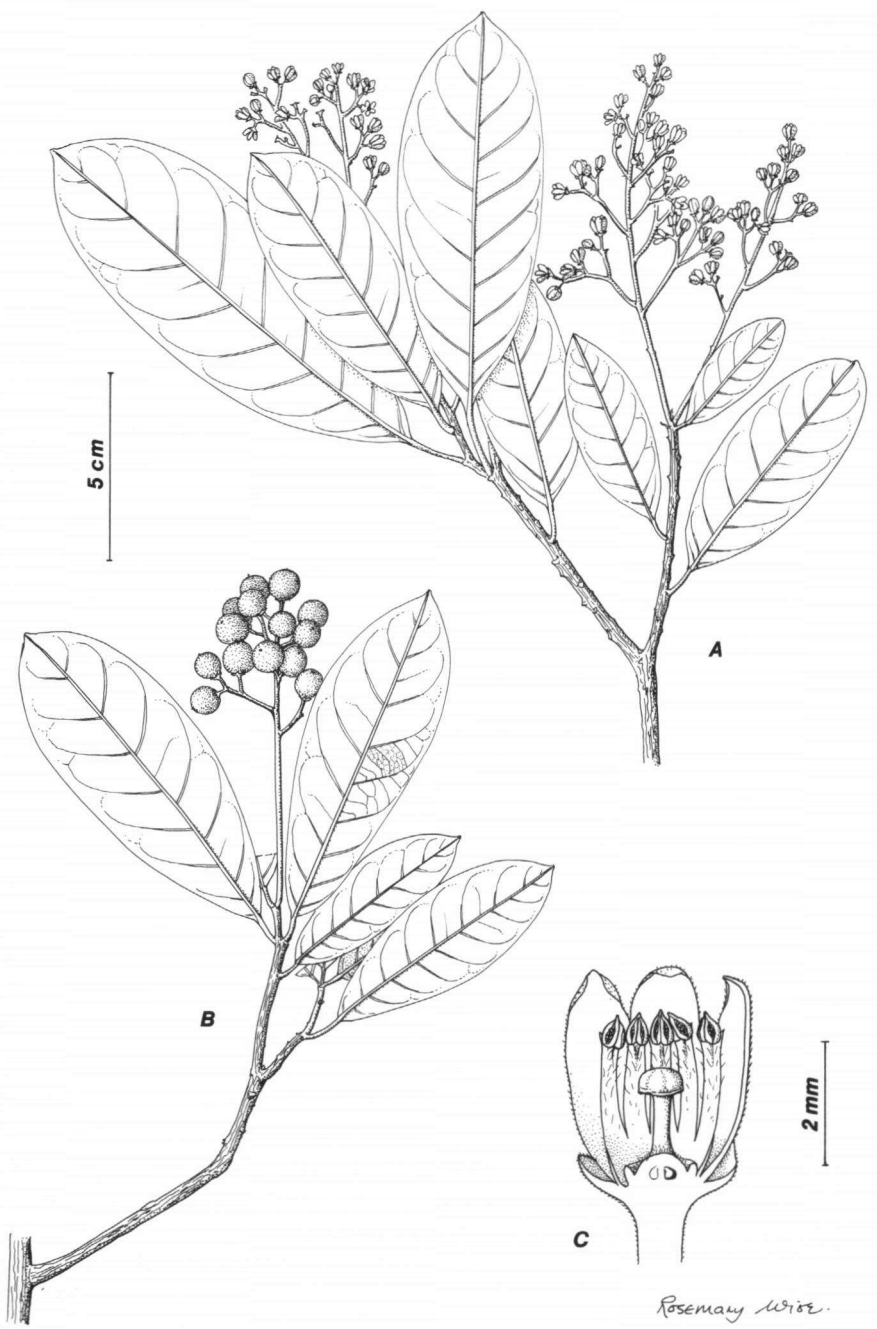

Fig. 17. *Walsura monophylla* Elmer ex Merr. A: habit; B: habit with infructescence; C: flower, LS (A, C: *PNH 252 Edaño*; B: *SMHI 1607*).

Inflorescences clustered around shoot apex in axils of caducous undeveloped leaves or solitary or in pairs in axils of fully expanded leaves below, 6–9 cm long at anthesis, each a ± compact thyrse branched up to second order (excl. pedicels), first order branches up to 3 cm long, all parts sparsely pubescent with short simple trichomes; flowers hermaphrodite, just prior to opening cylindrical to cupiform and 3.5–4.5 mm long, 2–3 mm diam., at maximum opening 4.0–7.5 mm diam.; calyx 1.5–1.7 mm long, lobes 0.8–1.2 mm long; petals 4.0–4.5 mm long × 1.8–2.0 mm wide, slightly imbricate to valvate, apex acute and often slightly hooded; androecium cylindrical to conical, 2.1–3.0 mm long, 2.1–2.3 mm diam. near base, tubular for 1/3–1/2 of length, alternate filaments slightly shorter, filaments (inside and out) pubescent and tubular part glabrous to very sparsely pubescent, edges of lobes often slightly recurved, lobe apex bifid with erect teeth 0.2–0.4 mm long; anthers 0.8–0.9 mm long, very shortly beaked, glabrous; disk c. 0.4 mm high; ovary very densely pubescent with short, simple, rigid trichomes; style 1.0–1.2 mm long, narrowly and obconical, c. 0.3 mm diam. at the base and c. 0.5 mm diam. at top, glabrous; stigma capitate with flattened or trapezoidal top, not lobed but with a shallow depression at the centre, c. 0.5 mm high, 0.9 mm diam. at base; fruit a 1- or 2-seeded berry, globose, 0.8–1.1 cm diam., pale-green to cream (in vivo) or olive-green to mid-brown (in sicco), sparsely puberulous, pericarp very thin and sub-coriaceous, surface rugose but almost smooth; seed ± spherical or ± hemi-spherical and c. 8 mm long, enveloped in a thin aril?

Distribution – Palawan.

Note – This species seems most closely allied to *Walsura pinnata* but differs in its small thin-walled fruits (showing greater resemblance to *W. trifoliolata*) and short inflorescence. Also, whilst all specimens of *W. monophylla* have unifoliolate leaves, in *W. pinnata* they occur only rarely (in some specimens of '*cochinchinensis*'). It is an understory tree, often of stunted forest, and usually found on ultra-basic rocks. It is a hyperaccumulator of nickel and has a very specialised Ni detoxification system (Baker, pers. comm., 1991).

Section III. Ruswala T. Clark, *sect. nov.*

Inflorescentiae brevissimae, 1.0–1.7 cm longae sub anthesi, densae; androecium tubulare, c. 4/5 eius longitudinis lobatum; fructus longitudinaliter quadrialatus (immaturus), rhomboidalis (in sectione transversali) ad subglobosus, septicidalis, leniter dehiscens in duabus valvis. — Typus: *Walsura dehiscens* T. Clark.

13. Walsura dehiscens T. Clark, *spec. nov.* — Figs. 18, 19

Arbor, rami frondosi leptocaules, 1.5–3.5 mm diametro; folia imparipinnata, bijuga; rhachis leviter tumidus ad insertionem petiolulorum et admodum infra basin laminae, teres, excepta pars proprie basalis adaxialiter leviter applanata; petiolulus teres; lamina (foliolorum terminalium et lateralium) elliptica (ad obovata), (foliolorum basalium) ovato-elliptica; pagina abaxalis cum nervatura leviter prominente (in vivo et in sicco), in vivo glauca, in sicco opaca (costa media et nervi laterales primi ordinis excepti); corpora parva glandulosa in utroque latere costae mediae et nervorum lateralium primae ordinis; inflorescentiae in axillis foliorum immaturorum vel plene expansorum prope apicem surculi vel infra orientes, sub anthesi 1.0–1.7 cm longae, omnes thyrsi arcte compacti; flores hermaphroditi; calyx 5-lobus; petela 5, libera, imbricata, anguste elliptica vel oblonga, apice acuta;

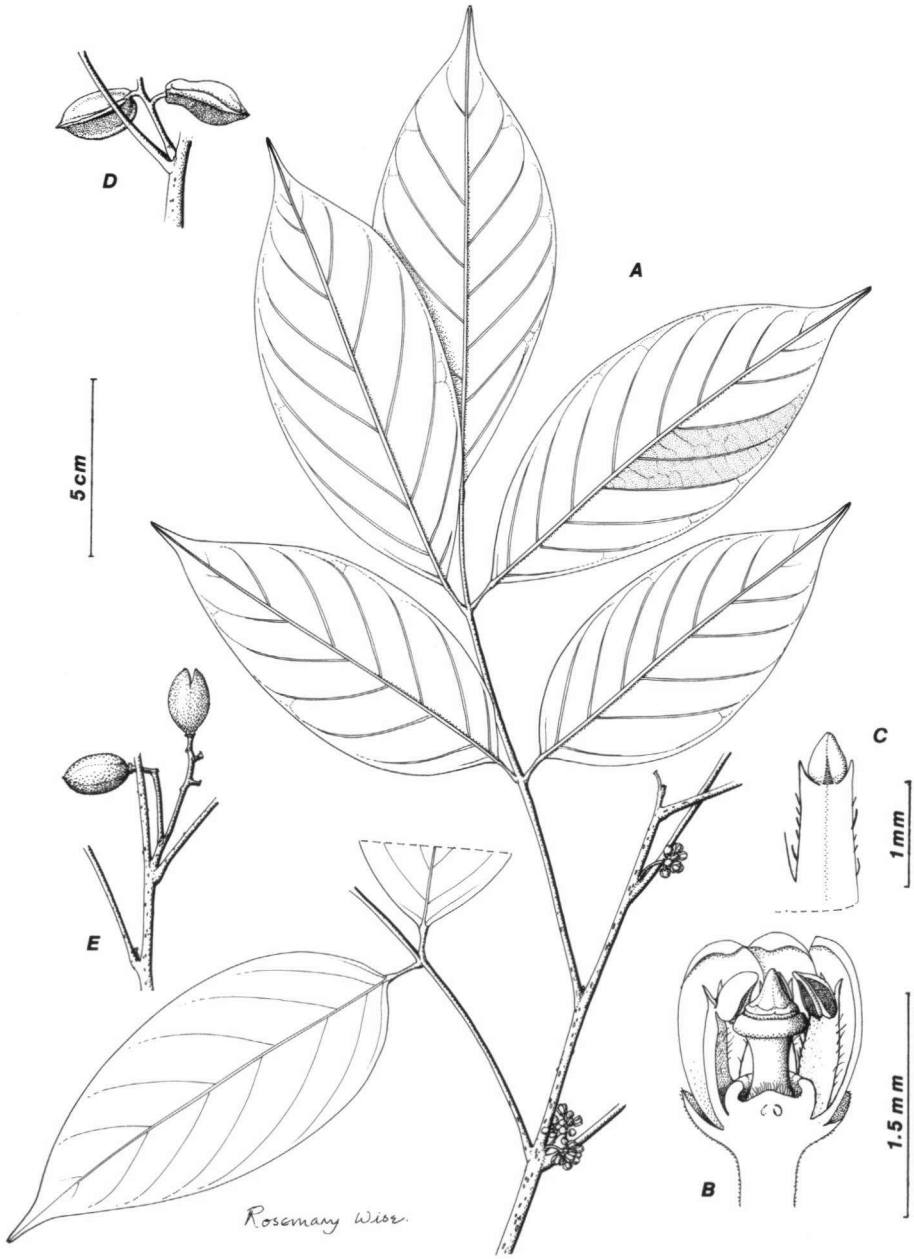

Fig. 18. *Walsura dehiscens* T. Clark. A: habit; B: flower, LS; C: androecium (part) exterior; D: immature (winged) fruits; E: mature fruits, one just beginning to dehisce (all *T. Clark 78*).

androecium cylindricus vel leviter cupiformis, c. 1/5 eius longitudinis tubularis, filamenta 10, tantum margines filamenta pubescentes, apex filamenti bifidus cum dentibus brevibus; antherae 10, glabrae; stylus anguste et inverse conicus, stigma capitatum, apice cum 2 lobis brevibus; discus glaber; ovarium trichomatibus brevibus rigidis dense obtectum, biloculare, unusquisque loculus cum 2 ovulis collateralibus; fructus cum 1 (2) semine (-ibus), longitudinaliter quadrialatus (immaturus), rhomboidalis (in sectione transversali), subglobulosus, septicidalis, leniter dehiscens in duabus valvis, pericarpium coriaceum; semen plus minusve ellipsoideum. — Typus: *T. Clark 78,* Malaysia, Sarawak, 1st Div., Sabal; July 1987 (L holo; FHO, SAR iso).

Tree to 9(–13) m tall, girth to 25(–40) cm; outer bark smooth and grey; inner bark pale yellow; leafy twigs 1.5–3.5 mm thick, dark-brown to black-brown and densely lenticellate, glabrous to puberulous with occasional simple trichomes; leaves 25–30 (–35) cm long, 2-jugate; petiole 4.5–9.5 cm long, 1.5–2.0(–2.5) mm thick, ± terete and slightly flattened adaxially near the very base, sub-densely lenticellate, very sparsely puberulous; petiolule ± terete, (of distal pair leaflet:) 0.7–1.4(–2.4) cm long and 0.6–1.2 mm thick; lamina (of distal pair leaflet:) (9–)11–16(–19) × 4–6(–8) cm, (terminal leaflet:) 11–15(–19) × 5–8 cm, (basal leaflet:) 8–16 × 4–6(–8) cm, lateral and terminal leaflets elliptic (to obovate), basal leaflets ovate to elliptic, chartaceous to sub-coriaceous, adaxial surface with all veins slightly or not at all prominent (in vivo & in sicco), abaxial surface with most veins slightly prominent (in vivo & in sicco) and surface glaucous (in vivo) except for on midrib and costae and (usually) intercostae, abaxial surface very sparsely to densely pubescent (to sub-tomentose) with ± erect simple trichomes; 7–9 (lateral and terminal leaflets) and 6–8 (basal leaflets) costae on either side of the midrib; glands conspicuous and dense and usually extending along either side of the costae also.

Inflorescences in axils of undeveloped or fully expanded leaves near the shoot apex or lower down, 1.0–1.7 cm long at anthesis each a tightly compact thyrse, branched to first- (to second-)order, first-order branches up to 4 mm long, peduncle sparsely lenticellate and all parts densely puberulous with simple trichomes; flower hermaphrodite, not scented, just prior to opening cylindrical and 1.5–1.6 mm long, 1.2–1.3 mm diam.; calyx 1.0–1.4 mm long, lobes c. 0.6 mm long; petals 2.2–2.5 mm long × 1.0–1.8 mm wide, glabrous on inside; androecium cylindrical to slightly cask-shaped, c. 1.5 mm long, tubular for c. 1/5 of length, filament edges only pubescent, filament apex bifid with teeth c. 0.2 mm long; anthers 0.4–0.5 mm long and very short beaked; disk c. 0.4 mm high; style narrowly obconical, c. 0.5 mm long, c. 0.3 mm diam. at base and c. 0.5

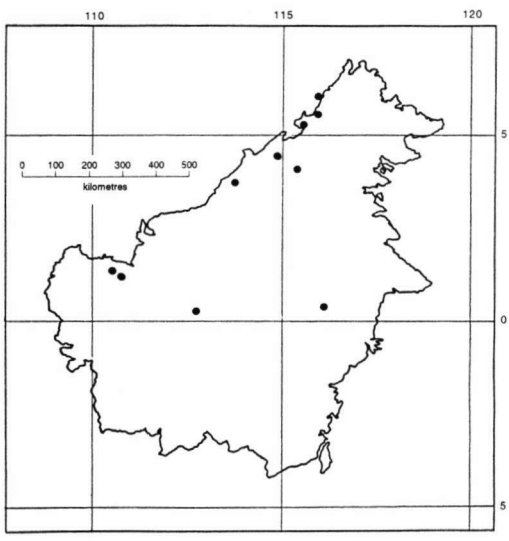

Fig. 19. Distribution of *Walsura dehiscens* T. Clark.

mm diam. just below stigma; stigma capitate with two lobes on top, c. 0.4 mm diam. long (excl. lobes), c. 0.9 mm diam. at base, lobes c. 0.2 mm high; fruit a 1(–2)-seeded septicidally dehiscent capsule, longitudinally 4-winged (immature) to rhomboidal (in transverse section) to almost globose, 1.7–2.5 cm long, 0.6–0.9 cm diam., green or glaucous (in vivo) and brown (in sicco), puberulous with simple trichomes, pericarp 0.7–1.0 mm thick generally but up to 1.3 mm thick at the four edges, fibrous endocarp 0.13–0.18 mm thick, septum c. 0.18 mm thick between the two locules connected to pericarp at two opposite suture lines, fruit weakly dehiscent into two (or 4?) valves commencing at the distal end, the septum splitting into two membranes at dehiscence.

Distribution – Borneo (1st & 4th Divisions, Sarawak; Beaufort and Kota Kinabalu areas, Sabah; Longbleh area, East Kalimantan).

INSUFFICIENTLY KNOWN SPECIES

14. Walsura spec. A

Tree to 35 m tall, d.b.h. to 0.75 m, buttressed to 1.2 m; bark smooth to flaky, reddish; leafy twigs 2.5–4.0 mm diam., glabrous, bark light-brown to whitish, lenticellate; leaves 13–24 cm long, 2-jugate; petiole 2.5–5.0 cm long, 1.5–2.0 mm thick, ± terete and slightly flattened adaxially near the base, densely puberulous with prostrate simple and 2-armed trichomes; petiolule ± terete, (of distal lateral:) 0.7–1.2 cm long, 0.7–1.0 mm thick; lamina (of distal lateral:) 8–12 × 3.5–5.0 cm, (of terminal leaflet:) 8–14 × 4.0–5.5 cm, (of basal leaflet:) 7.5–11.5 × 3.5–4.0 cm, all leaflets elliptic with acute base and very short acuminate apex, sub-coriaceous, adaxial surface with no veins prominent, abaxial surface with midrib and costae only prominent and very sparsely pubescent with prostrate simple and 2-armed trichomes; 7–9 (distal lateral), 9–10 (terminal) and 7–8 (basal) costae on either side of the midrib; glands present; flowers unknown; fruit a 1- or 2-seeded berry, (globose to) ellipsoid, 2.2–2.6 cm long, 1.5–1.8 cm diam., olive-green (in vivo) and brown (in sicco), puberulous with prostrate simple and 2-armed trichomes, pericarp coriaceous with a very thin fibrous endocarp; seed 1.0–1.5 cm long, completely enveloped in a fleshy sweet-tasting aril.

Distribution – Sarawak (1st & 4th Divisions).

Note – This species superficially resembles *Walsura pinnata*, and in fruit anatomy (except for the 2-armed trichomes) is very similar, but the degree of vein prominence on the undersurface of the leaflet (especially after drying) is very different.

15. Walsura yunnanensis C.Y.Wu

Walsura yunnanensis C.Y. Wu, Flora Yunnanica 1 (1977) 226 (& drawing). — Type: *Y. H. Li 2927*, Yunnan (KUN holo).

The author comments that this species is allied to *Walsura tubulata* but the description gives it a 5-foliolate leaf and its other features do not seem to be particularly compatible with this suggestion.

16. Walsura deccanensis Mehrotra

Walsura deccanensis Mehrotra, Rev. Palaeobot. & Palynol. 58 (1989) 205–213. — Type: *Lucknow Museum fossil 35939*, India, Madhya Pradesh, Mandla Dist., Ghughua near Shahpura (Deccan Intertrappean beds: Early Tertiary); (Birbal Sahni Institute of Palaeobotany, Lucknow, holo).

Described from fossil material only. See under 'Wood anatomy' above.

PSEUDOCLAUSENA T. Clark, *genus novum*

[*Melospermum* Scort. ex King, J. As. Soc. Beng. 64 (1895) 83, nom. in synon.]
Walsura sect. *Neowalsura* Harms in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 119. — Type species: *Walsura glabra* Merr. = *Pseudoclausena chrysogyne* (Miq.) T. Clark.

Arbores; folia imparipinnata, (1–)2–4(–7)-juga; lamina foliolorum integra, epidermide in pagina abaxiali tantum simplici, trichomata foliaria multicellularia, glandulae absentes; inflorescentia axillaris, thyrsus valde compactus vel plus minusve laxus, cum indumento trichomatum tantum simplicium; flos aut hermaphroditicus aut masculinus; calyx profunde 5-lobus, petala 5, libera, imbricata, anguste elliptica vel oblonga, apicae acuminata; androecium plus minusve cylindricus, ad 1/4–1/2 eius longitudinis tubularis, filamenta 10, unusquique filamenta linearis pro maiore parte eius longitudinus et cum apice breviter bifido; antherae 10, praeter apicem cum caespite brevi trichomatum glabrae; stylus glaber vel in parte inferiore sparse pubescens; stigma capitatum, apice cum 2 lobis brevibus; discus nullus; ovarium trichomatibus brevibus rigidus densissime obtectum, aspectu aureo, 4- vel 5-loculare, loculis uniovulatis; fructus baccatus, cum 1 vel 2 seminibus, plus minusve globosus, brevissime rostellatus, leviter asymmetricus, coriaceous sed sclerenchymate omnio destitute semen plus minusve ellipsoideum. — Typus: *Clausena chrysogyne* Miq. = *Pseudoclausena chrysogyne* (Miq.) T. Clark.

Leaf abaxial surface epidermis non papillate; flower lacking a disk; ovary 4- or 5-locular; fruit with short beak, slightly asymmetric and completely lacking sclerenchyma.

Note – The generic name *Pseudoclausena* is given since the type species was originally placed in the genus *Clausena* Burm. f. (Rutaceae) by Miquel. Similarly, *Pseudobersama mossambicensis* (Sim) Verdcourt, also a monotypic genus of the Trichilieae, was originally placed in the genus *Bersama* (Melianthaceae).

17. Pseudoclausena chrysogyne (Miq.) T. Clark, *comb. nov.* — Figs. 20, 21

Clausena chrysogyne[6] Miq., Fl. Ind. Bat. Suppl. (1861) 502. — *Walsura chrysogyne* (Miq.) Bakh. f., Blumea 16 (1968) 359; Mabberley, Tree Flora Malaya 4 (1989) 254 & tab. — Type: *Teijsmann HB 3805*, Indonesia, Sumatra, Palembang (L holo; U iso).
Cipadessa borneensis Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 6; cf. Steenis & Bakh. f., Bot. Jahrb. 86 (1967) 399. — Type: *Korthals 115*, Borneo (Kalimantan?) (L holo).
Walsura multijuga King, J. As. Soc. Beng. 64 (1895) 83; Ridley, Fl. Mal. Pen. 1 (1922) 412. — Type: *King's Coll. 10622*, Malaysia, Perak (CAL holo; K, L iso).
[*Melospermum rubro-stamineum* Scort. ex King, J. As. Soc. Beng. 64 (1895) 83, nom. in synon.]
[*Walsura quadrilocularis* Valet., Ic. Bogor 2 (1906) 156, nom. nud.; Dakkus, Bull. Jard. Bot. Buitenzorg Suppl. (1930) 295 and ed. 2, p. 237 & ed. 3, p. 244; Bakh. f., Blumea 16 (1968) 359 ('*W. quadrangularis*'). nom. in synon.]

6) Greek, chryso = gold, gyne = woman, referring to the golden colour of the ovary, due to its covering of short, stiff, golden trichomes.

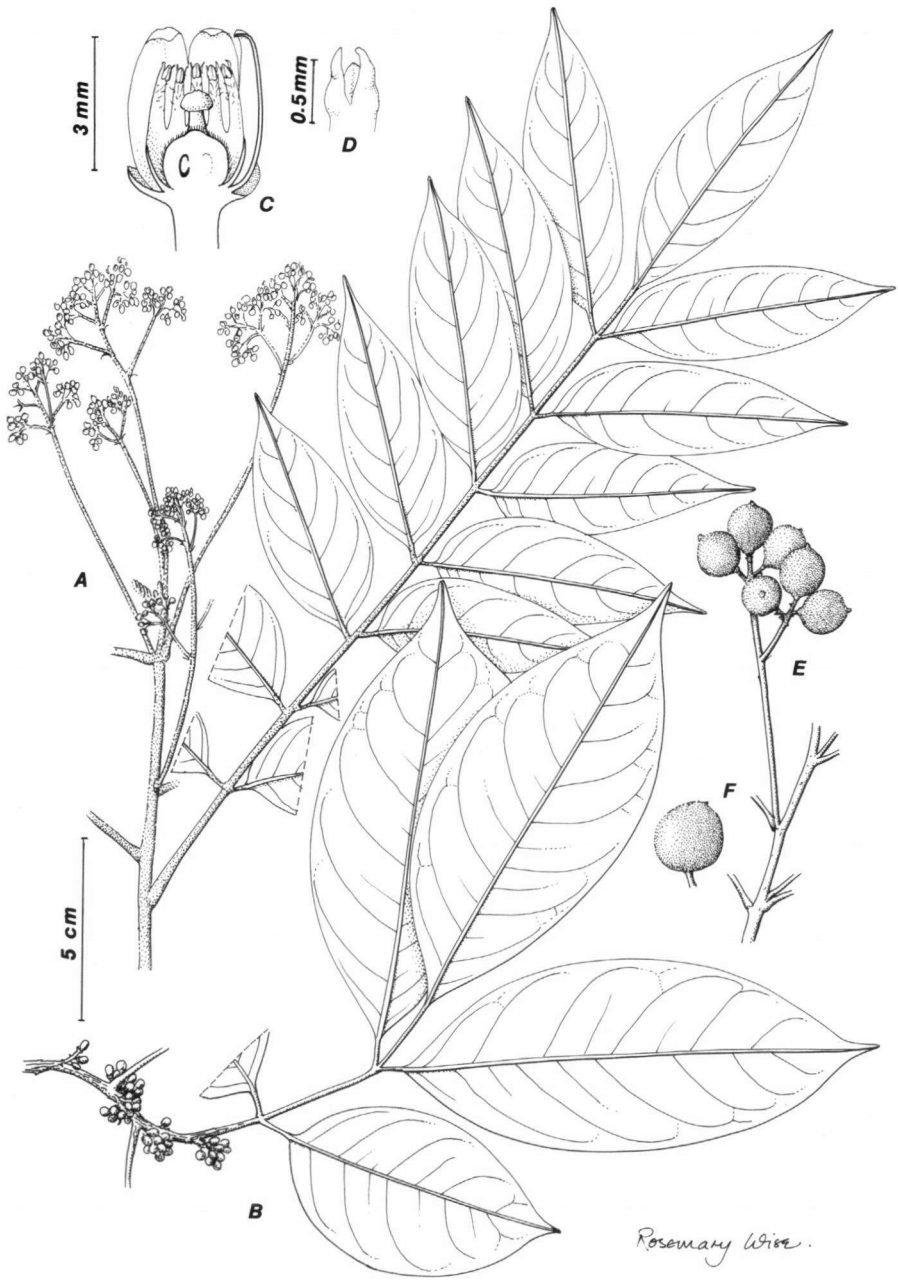

Fig. 20. *Pseudoclausena chrysogyne* (Miq.) T. Clark *'chrysogyne'*. A: habit; C: flower, LS; D: filament apex seen from exterior; E: infructescence; F: berry (mature). — *P. chrysogyne 'brachybotrys'*. B: habit (A: *Pennington 7983*; C, D: *SAN 81144*; E, F: *SMHI 20*; B: *Wenzel 295*).

Walsura brachybotrys Merr., Philipp. J. Sci. 8, Bot. (1913) 378; syn. nov. — Type: *Wenzel 295*, Philippines, Leyte, Dagami, 3 July 1913 (PNH† holo; E, GH, NY iso).

Walsura celebica C.DC., Meded. 's Rijks Herb. Leiden 22 (1914) 10; syn. nov. — Type: *Elbert 3188*, Celebes, Penango, 24 Sept 1909 (L holo).

Walsura glabra Merr., Philipp. J. Sci. 13 (1918) 76; syn. nov. — Type: *'Native collector', BS 2438*, Malaysia, Sarawak, Feb.–June 1914 (PNH holo†; A phot.).

Walsura borneensis Merr., Univ. Cal. Publ. Bot. 15 (1929) 213; Bakh. f., Blumea 16 (1968) 359. — Type: *Elmer 20167*, Malaysia, Sabah, Sandakan. Oct.–Dec. 1921 (PNH holo; A, BM, G, K, NY, P, SING, Z iso).

Walsura hosei Ridley, Bull. Misc. Info. Kew (1930) 371; syn. nov. — Type: *Hose 394*, Malaysia, Sarawak, Baram, Dec. 1894 (K holo; L iso).

[*Walsura palawanensis* Elmer, Leafl. Philipp. Bot. 9 (1937) 3393, nom. non rite publ. (descr. angl.)]

Tree to 25 m tall, bole to 15 m tall, d.b.h. to 60 cm; outer bark smooth and c. 2 mm thick, unfissured and pale-brown to greyish-brown; inner bark 3–4 mm thick and red-brown; sapwood whitish with red or pink tinge; leafy twigs 1.1–3.5 mm thick, glabrous or puberulous or velvety, trichomes simple, bark mid brown to very light brown or greyish and sometimes sparsely lenticellate; leaves 18–42 cm long, (3–)5–9(–15)-foliolate, brown (to olive green) when dried; petiole 2.5–8.5 cm long and 0.8–2.1 mm thick, terete or semiterete, slightly flattened adaxially, glabrous or puberulous or velvety, trichomes simple; petiolule ± terete, (of distal lateral leaflet:) 1.5–10.0 mm long × 0.4–0.9 mm thick, glabrous or puberulous or velvety; lamina (of distal lateral leaflet:) (5.3–)7.2–14.0(–18.5) × 2.3–5.0(–6.5) cm, (of terminal leaflet:) (6.4–)7.2–16.5(–19.5) × 2.4–5.0(–6.8) cm, (of basal leaflet:) 4.0–12.5 × 1.9–5.5 cm, lateral leaflets on any one leaf of similar areas and basal leaflets usually 1/4–1/2 of this area, ovate to elliptic (to lanceolate), the basal leaflets tending to be narrower, base attenuate and slightly asymmetric, apex shortly acuminate, sub-coriaceous, adaxial surface with no veins or only midrib prominent (in sicco), abaxial surface with only midrib and costae prominent (in sicco) and not glaucous (i.e. epidermis is non-papillate) and glabrous to tomentose with simple decumbent to erect trichomes; 6–9(–15) (distal pair leaflet) or 7–10(–15) (terminal leaflet) or 6–9(–14) (basal leaflet) costae on either side of the midrib; glands absent.

Inflorescences clustered around shoot apex or below in axils of fully expanded or expanding leaves, 1–6(–10) cm long at anthesis, each a very compact to open thyrse, branched up to second (to third) order (excl. pedicels) of which the first order branches are up to (0.7–)7.5 cm long, primary rachis and all branches lacking lenticels and glabrous to tomentose with simple trichomes; flowers hermaphrodite (with little pollen) or (on different plant) male only (with much pollen), just prior to opening cylindrical to cask-shaped, 3.0–3.6 mm long, 1.4–2.6 mm diam., at maximum opening 2.9–6.0 mm diam.; calyx 1.5–1.8 mm long, deeply 5-lobed, each lobe 0.8–1.2 mm long with a blunt apex; petals 5, free and imbricate, 2.8–4.8 mm long × 1.5–1.8 mm wide, narrow-elliptic to oblong, apex acute; androecium ± cylindrical, 1.5–3.3 mm long, 0.9–1.8 mm diam., tubular for 1/4–1/2 of length, each filament linear or slightly narrowed towards the apex, filament apex bifid with erect to spreading teeth 0.4–0.5 mm long; anthers 0.4–0.5 mm long, glabrous or with a short tuft of trichomes from the apex; disk absent; ovary very densely pubescent with short stiff trichomes, appearing golden or extremely rarely (see below) glabrous, 4- or 5-locular, each locule with one ovule; style ± cylindrical, 0.4–0.6 mm long, 0.2–0.3

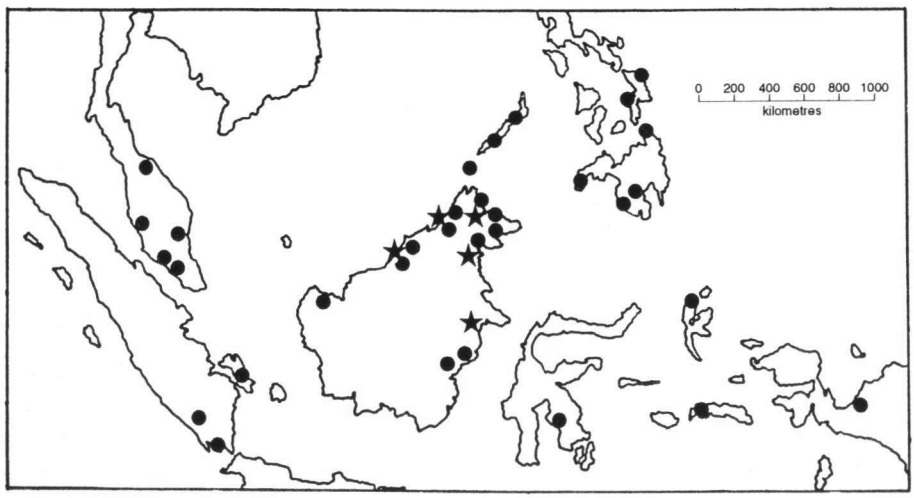

Fig. 21. Distribution of *Pseudoclausena chrysogyne* (Miq.) T. Clark forma *chrysogyne* (●) and forma *velutina* (Ridley) T. Clark (★).

mm diam., glabrous to sparsely pubescent in the lower half; stigma ± capitate and shortly two-lobed on top, (excl. lobes:) 0.5–0.6 mm diam. at base, 0.3–0.5 mm high, below the level of the anthers at maturity; fruit a 1- or 2-seeded berry, ± globose, 1.3–1.8 cm diam. with a short beak,3–5 mm long, positioned asymmetrically on the fruit, pericarp coriaceous but lacking sclerenchyma, parenchyma with high levels of tannins only; seed 0.8–1.3 cm long and ± ellipsoid, dark brown and shining but lacking an aril.

Two forms are recognised:

1a. Young parts glabrous or puberulous on axes and leaflet midrib and costae only **a.** forma **chrysogyne**

b. Young parts (incl. leaf lamina) velutinous ..... **b.** forma **velutina**

b. forma **velutina** (Ridley) T. Clark, *comb. & stat. nov.*

Walsura velutina Ridley, Bull. Misc. Info. Kew (1930) 371. — Type: *Hose 643,* Sarawak, Baram (K holo).

Notes – Most of the variation within this species is accounted for by three characters: 1) degree of pubescence on the young aerial parts, 2) number of leaflets, 3) length of inflorescence.

Walsura velutina was distinguished by its dense (tomentose) covering of erect trichomes on all young parts, including the whole undersurface of the leaflet, *W. chrysogyne* and the other species here reduced being glabrous or very sparsely pubescent or densely pubescent only on the midrib and costae of the leaflet undersurface. This is a good character but in the absence of any supporting character the species had to be reduced to forma status. Its distribution is fairly small, occurring only in Borneo and Mindanao.

Leaflet number varies considerably and more so than in any species of *Walsura,* from 3 to 15 per leaf, with the range 5–9 predominating. At the Philippines end of the range (e.g. *W. brachybotrys* type-specimen) there is a tendency towards 3–5-foliolate specimens, but only one specimen (from Mindanao) has exclusively 3-foliolate leaves. Specimens with 9+ leaflets predominate at the Sumatra end of the range (e.g. *W. chrysogyne* type-specimen) but also occur in Borneo and Palawan (e.g. *W. palawanensis* 'type'-specimen). Inflorescence length also varies considerably in this complex. In the 100+ specimens examined, those at anthesis ranged along a continuum from 0.8 to 10 cm. The graph of inflorescence length against leaflet number was plotted and no group segregated out. The distribution was continuous with the mode at 7 cm/7–9 leaflets. No combination of characters will maintain those species here reduced and the whole is held tightly together by several very good morphological and anatomical characters (see above).

It may be useful to distinguish informally between the three main morphological entities within forma *chrysogyne* however, even if they are all linked by intermediates (see also *W. pinnata* above).

1a. Inflorescence < 2 cm long at anthesis (Philippines) ..... **'brachybotrys'**
b. Inflorescence > 4 cm long at anthesis 2
2a. Leaf 5–9-foliolate ..... **'multijuga'**
b. Leaf 11–15-foliolate (Sumatra) ..... **'chrysogyne'**

In view of the variation demonstrated in this complex, the species *W. celebica, W. glabra* and *W. hosei* are here reduced since they have formerly been maintained by minor characters (of floral pubescence and/or leaf division), the intermediates of which are now known. *Walsura hosei* is perhaps the most unusual of the four with its glabrous ovary. Since the type-specimen is the only known example of this in the *Pseudoclausena* species, and considering the great variation shown in floral pubescence in the genus *Walsura,* this character is considered insufficient to maintain a distinct species (see also *W. glauca* = *W. pinnata,* above).

EXCLUDED SPECIES

Walsura intermedia Craib, Bull. Misc. Info. Kew (1926) 345. — Type: *Kerr 4959,* Thailand, Nan, Doi Pu Ka (K holo; BM iso) = **Heynea trijuga** Roxb. ex Sims.

[*Walsura lanceolata* Wall., Cat. (1828) n. 4886, nom. nud.] = **Aglaia elaeagnoidea** (Adr. Juss.) Benth. (det. C. Pannell).

Walsura pallida Craib, Bull. Misc. Info. Kew (1926) 345. — Type: *Kerr 5813,* Thailand, Dan Sai, Hui Nam Man (K holo; BM iso) = **Heynea trijuga** Roxb. ex Sims.

Walsura perrottetii C.DC., An. Cons. et Jard. Bot. Genève 10 (1907) 152. — Type: *Perrottet s.n.,* India, Nilgherries (G holo) = **Heynea trijuga** Roxb. ex Sims.

Walsura pubescens Kurz, J. As. Soc. Beng. 41 (1872) 297; For. Fl. Brit. Burma 1 (1877) 225. — Type: *Kurz s.n.* (CALC holo) = ?**Heynea trijuga** Roxb. ex Sims.
Kurz described this species from Burma as having a capsule which splits into two leathery valves containing a single seed enveloped in a white aril. This is almost certainly a *Heynea* species.

Walsura punctata Suesseng., Mitt. Bot. Staatss. Münch. 2 (1950) 58. — Type: *Clemens 28201,* Malaysia, Sabah, Mt Kinabalu (M holo; K iso) = **Heynea trijuga** Roxb. ex Sims.

Walsura punctata Suesseng. var. *papillosa* Suesseng. & Heine, Mitt. Bot. Staatss. Münch. 2 (1950) 58. — Type: *Clemens 28649 = 28668,* Malaysia, Sabah, Mt Kinabalu (M holo; K iso) = **Aphanamixis borneensis** (Miq.) Merr.

Walsura quinquejuga Kurz, Prel. Rep. Veg. Pegu, App. A (1875) 33, App. B (1875) 37, perhaps based on *Heynea quinquejuga* Roxb., Hort. Beng., 1814, nom. nud., (G. Don f., Gen. Syst. 1 (1831) 685; Roxb., Fl. Ind. ed. Carey 2 (1832) 391 = *H. trijuga* teste Bentv. [Acta Bot. Neerl. 11 (1962) 11] non *H. quinquejuga* Roxb. ex Sprengel [Syst. Veg. 4 (1827) 252] = **Aglaia rufinervis** (Blume) Bentv.

'Walsura sumatrana' = *Heynea sumatrana* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 60, *'Walsura sumatrana'*, emend.; Lam, Bull. Jard. Bot. Buitenzorg III, 12 (1932) 422; cf. Leenhouts, Fl. Males. I, 5 (1956) 249; cf. Bentv., Acta Bot. Neerl. 11 (1962) 11.
Lam seems to be the first to use *'Walsura sumatrana'* when he refers to Merrill's reduction of *Scutinanthe engleri* Elmer to it [Enum. Philipp. Pl. 2 (1923) 380], when in fact Merrill, rightly, uses *Heynea sumatrana* Miq. = **Heynea trijuga** Roxb. ex Sims.

Walsura tenuifolia Ridley, J. Roy. As. Soc. Str. Branch 75 (1917) 17. — Type: *Ridley 3022,* Malaysia, Perak (K holo) = **Heynea trijuga** Roxb. ex Sims.

Walsura trijuga (Roxb.) Kurz, J. As. Soc. Beng. 44 (1875) 148. — Type: as for *Heynea trijuga* Roxb. ex Sims, incl. var. *'genuina'* and var. *pubescens* (Kurz) Kurz. — Type: as for *Walsura pubescens,* above. Also, var. *microcarpa* (Pierre) H.H. Hu, J. Arnold Arbor. 5 (1924) 299. — Type: *Balansa 4040* (P) = **Heynea trijuga** Roxb. ex Sims.

Walsura xixangensis C.Y. Yu & H. Li, Acta Phytotax. Sinica 18 (1980) 110. — Type: Qinghai-Zizang (Tibet) Complex Exped. 74-4540; China, Xizang; (PE holo; FHO photo) = **Glycosmis** spec. (Rutaceae) (det. M.M.J. van Balgooy).

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SPECIMENS STUDIED

1 = *Walsura robusta* Roxb.
2 = *W. trifoliolata* (Adr. Juss.) Harms subsp. *trifoliolata*
2' = subsp. *acuminata* (Trimen) T. Clark
3 = *W. tubulata* Hiern
4 = *W. trichostemon* Miq.
5 = *W. gardneri* Thw.
6 = *W. bonii* Pellegrin
7 = *W. oxycarpa* Kurz
8 = *W. poilanei* Pellegrin
9 = *W. pinnata* Hassk.
10 = *W. pachycaulon* Mabb. ex T. Clark
11 = *W. sarawakensis* T. Clark
12 = *W. monophylla* Elmer ex Merr.
13 = *W. dehiscens* T. Clark
14 = *W. spec.* A
15 = *W. yunnanensis* C.Y. Wu
16 = *W. deccanensis* Mehrotra
17 = *Pseudoclausena chrysogyne* (Miq.) T. Clark forma *chrysogyne*
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