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SCHISANDRACEAE

(Richard M. K. Saunders, University of Hong Kong)[1]

Schisandraceae Blume, Fl. Javae 32–33 (1830) 3, '*Schisandreae*', nom. cons.; G. Don, Gen. Hist. 1 (1831) 101, '*Schizandriaceae*'; Ridl., Fl. Malay Penins. 1 (1922) 20, '*Schizandraceae*'; A.C. Sm., Sargentia 7 (1947) 81–83; Backer & Bakh. f., Fl. Java 1 (1964) 98.

Woody *vines*, monoecious or dioecious. *Leaves* alternate or ± clustered, exstipulate, petiolate; lamina simple. *Flowers* generally solitary and axillary to leaves on ultimate branches, or in axils of fugacious bracts near base of ultimate shoots, occasionally in pairs or in clusters of up to 8, unisexual, hypogynous, few to numerous parts generally spirally arranged, pedicellate. *Perianth segments* free, not as distinct sepals and petals, outermost and innermost sometimes reduced. *Androecium* very variable, of few to many (4–80) stamens, sometimes of ± free stamens fused only at base of filaments, sometimes as head of fused stamens or free but tightly compressed stamens; anthers essentially basifixed, thecae dehiscing by longitudinal slits; filaments at least basally fused into modified column of variable shape. *Gynoecium* of numerous (12–300) carpels; carpels developmentally conduplicate; stigmatic crest as subulate to broad essentially unvascularised 'pseudostyle', sometimes modified as peltate or irregular 'pseudostigma'; ovary unilocular; ovules 2–5(–11), anatropous, ventrally attached or pendulous, bitegmic, crassinucellar. *Fruit* an aggregate of berries; receptacle ellipsoid to elongate; berries with carnose pericarp. *Seeds* 1–5, rarely more, ventrally attached or pendulous, laterally flattened, with copious oily endosperm.

DISTRIBUTION

The *Schisandraceae* have a disjunct distribution, occurring in Asia (c. 46 species, with a centre of diversity in continental Asia) and in south-eastern North America (1 species).

HABITAT AND ECOLOGY

The *Schisandraceae* are scrambling or twining woody vines of tropical to warm temperate (rarely cool temperate) forests.

Ueda (1988) has studied the occurrence of dicliny in *Schisandra chinensis* (Turcz.) Baill. Although this species is monoecious, it often appears to be dioecious, and has the capability to change sex expression over several years of growth; similar results are reported in *Kadsura japonica* (L.) Dunal by Okada (1971). Smith (1947) described 19 of

1) With a contribution by R.W.J.M. van der Ham, Leiden (pollen morphology). Drawings by H.L. Wilks.

the total 25 accepted species of *Schisandra* as dioecious; it is probable, however, that most if not all *Schisandraceae* species are monoecious, with many showing temporal separation of male and female flowers.

References: Okada, H., J. Jap. Bot. 46 (1971) 29–33. — Smith, A.C., Sargentia 7 (1947) 1–224. — Ueda, K., J. Jap. Bot. 63 (1988) 319–321.

FOSSILS

The geographical occurrence of fossils of the *Schisandraceae* indicates that the family previously possessed a wider distribution, with records from the Eocene of Europe (e.g., Mai & Walther 1985) and North America (e.g., Bones 1979), and the Pliocene of Japan (e.g., Tanai 1976). The records suggest a Laurasian origin for the family, with extension into the New World developing later.

Fossil pollen attributed to *Schisandra* is known from the Miocene of Borneo, and *Schisandra* section *Pleiostema* (pollen type A of Praglowski 1976) from the Upper Cretaceous (Maastrichtian) of California (Muller 1970; Chmura 1973)).

References: Bones, T.J., Oregon Mus. Ser. Industr. Occas. Pap. 1 (1979) 1–23. — Chmura, C.A., Palaeontographica 141 (1973) 89–171. — Mai, D.H. & H. Walther, Abh. Staatl. Mus. Mineral. Geol. Dresden 33 (1985) 1–260. — Muller, J., Biol. Review 45 (1970) 417–450. — Praglowski, J., World Pollen Spore Flora 5 (1976) 1–32. — Tanai, T., J. Fac. Sci. Hokkaido Univ. IV, 17 (1976) 277–346.

VEGETATIVE ANATOMY

The most comprehensive discussions of the vegetative structure of the family are by Bailey & Nast (1948) and Metcalfe (1987).

The leaves of the *Schisandraceae* frequently show marginal denticulation, although this is variable. Characteristic features of the leaf anatomy include: epidermal cells with undulating or sinuous anticlinal walls; and mixed paracytic and laterocytic stomata (Baranova 1983), with cuticular intrusions between the ends of the two members of each pair of guard cells (but with smaller intrusions than observed in the closely related family *Illiciaceae*). The nodes are unilacunar, with three leaf traces.

The internodal regions of the stem have either a eustelic or a siphonostelic vascular arrangement. The secondary xylem (Bailey & Nast 1948; Metcalfe 1987) is also variable, ranging from a relatively primitive dense to specialised highly porous arrangement. The more primitive type is characterised by narrow vessel members with scalariform perforation plates; thick-walled tracheids; multiseriate rays with intervening high-celled uniseriate rays; and scanty diffuse and abaxial paratracheal wood parenchyma. The more advanced type is characterised by broad vessel members with a single large lacuna; large, thin-walled profusely pitted tracheids; mostly uniseriate rays; and abundant paratracheal wood parenchyma. The phloem contains numerous elongated or cambiform elements with stratified mucilaginous contents. The sclerenchyma is linear, elongated and fibre-like.

References: Bailey, I.W. & C.G. Nast, J. Arnold Arbor. 29 (1948) 77–89. — Baranova, M., Brittonia 35 (1983) 93–102. — Metcalfe, C.R., Anatomy of the Dicotyledons, ed. 2, 3 (1987) 83–89.

FLORAL MORPHOLOGY

Inflorescence structure is discussed in detail by Weberling (1988). Many species produce solitary flowers from the leaf axils, on branches which bear numerous scale-like leaves (presumably acting as bud scales) at the base of the axis. Other species produce flowers in the axils of fugaceous bracts; the two lowermost bracts (prophylls) bear vigorous buds that enable continued growth. Transitional forms also occur.

The flowers of the *Schisandraceae* are relatively primitive structurally as in the *Illiciaceae*, with spirally arranged floral organs and perianth segments that do not form distinct sepals and petals. A major distinction between the *Illiciaceae* and the *Schisandraceae*, however, is that the latter family is monoecious (although possibly dioecious in some species), whereas the *Illiciaceae* possess hermaphrodite flowers.

The female flowers of the *Schisandraceae* are structurally primitive, with numerous (12–300) free conduplicate carpels spirally arranged around the receptacle, with stigmatic crests that lack a distinct style (although sometimes with an essentially unvascularised 'pseudostyle'). The two genera in the family are largely distinguished on the basis of the shape of the receptacle in the female flower (and consequently the shape of the aggregate fruit) and the structure of the stigmatic crest; the taxonomic significance of this is discussed further below.

The male flowers show great variation in androecial anatomy, although this cannot be used taxonomically at the generic level. The more primitive species in both genera in the family possess numerous stamens that are united by fusion of the base of the filaments. Many of the more advanced members of the family show an evolutionary change that is superficially parallel, with aggregation of stamens in compact (sub)globose heads; a distinction can be made between the two genera, however, as the stamens are either fused together to form a carnose mass, or else are tightly compressed but free. Other members of the family show an evolutionary reduction in the number of stamens, with as few as four in one species. The variation in the androecial structure is discussed in greater detail under the generic treatments.

Reference: Weberling, F., Taxon 37 (1988) 657–690.

POLLEN MORPHOLOGY

(R.W.J.M. van der Ham)

Pollen of both *Kadsura* and *Schisandra*, showing a suite of remarkable features, has been given much attention in the palynological literature (e.g., Wodehouse 1935, 1936; Erdtman 1952; Jalan & Kapil 1964; Agababian 1966; Mitroiu 1970; Walker 1974; Huynh 1976; Lieux 1980). The most extensive study, illustrated with light and electron micrographs, is by Praglowski (1976) and treats more than half of all species, including seven Malesian *Kadsura* species and one Malesian *Schisandra*.

Schisandraceae pollen grains are heteropolar 3- or 6-aperturate monads. Grain size is 22–35 µm. Grain shape is usually oblate (P/E = 0.44–0.78); the proximal pole is less convex than the distal pole. The equatorial outline is rounded to obtusely triangular or hexagonal. The aperture system is 3-demisyncolpate, the colpi being connected at the

distal pole, either withor without three free short colpi alternating with them. Huynh (1976) demonstrated that the long colpi are arranged according to Garside's law, and the short colpi according to Fischer's law. Deviating systems like the parasyncolpate and trischistoclasic type occasionally occur. All colpi are mostly provided with thickened edges and a broadly based median ridge (Roland 1971), which may act as a rigid frame (Wodehouse 1935; Praglowski 1976). There are no endoapertures. Germination takes place by dehiscence of the syncolpate apertures, starting at the pole, followed by extrusion of the pollen grain contents and then by pollen tube formation (Huynh 1976). The short colpi are not involved in germination or harmomegathy; the relatively thin-walled proximal apocolpium seems to accommodate the volume changes of the pollen grain. The exine is up to 2.5 μm at the distal pole, up to 1.5 μm at the proximal pole, and clearly stratified, showing a thin nexine and thick sexine, which consists of a columellate infratectum and a reticulate tectum with lumina of 2–8 μm. The nexine includes a distinct endexinous layer, which is differentiated under the colpi into a lamellate outer and a spongy inner sublayer.

Praglowski (1976) distinguished four pollen types in the *Schisandraceae*: type A is 3-aperturate, while types B, C, and D are 6-aperturate, differing only in the size of the lumina. Type A is restricted to a few species of the primitive *Schisandra* section *Pleiostema*, which all have a large number (20–60) of essentially free stamens, and therefore appears to be the plesiomorphic type. Type D, which possesses the largest lumina (6–8 μm), is found only in *Schisandra chinensis*. Types B and C occur in both *Kadsura* and *Schisandra*, which implies that these genera cannot be separated palynologically. Pollen of the *Schisandraceae*, especially the 3-aperturate type, resembles *Illicium* pollen very much; except for very rare intermediate forms, the latter can be distinguished by its isopolar aperture system (see *Illiciaceae*, this issue, p. 173–174). Walker & Doyle (1975) and Thanikaimoni (1984) noted the similarity of *Schisandra* pollen and that of the menispermaceous genus *Tinospora*.

Wodehouse (1935, 1936; see also Jonker 1974), assuming the syncolpate pole to be the proximal one, considered 6-aperturate *Schisandraceae* pollen as a combination of features of pteridophyte spores (proximal trichotomous aperture with arms arranged according to Garside's law), gymnosperm and monocot pollen (thin distal area) and dicot pollen (three meridional colpi arranged according to Fischer's law), thus being a curious link between spores and the basic dicot pollen type. Erdtman (1952) and Muller (1970) proposed that the syncolpate pole has a distal orientation. Later, Huynh (1976) and Praglowski (1976) observed tetrad configurations which actually demonstrated the syncolpate pole to be at the distal side. It is now hypothesised that *Schisandraceae* and *Illiciaceae* pollen was derived from a type with a single distal aperture and united in tetrads, as in modern *Winteraceae* (see also *Illiciaceae*, this issue, p. 173–174). Then, the relatively thin-walled proximal apocolpium in *Schisandraceae* pollen might be a vestige of an ancestral tetrad configuration, as in most adult tetrads proximal walls are reduced (Doyle et al. 1990). At the same time the above hypothesis entails the independent origin of the three short colpi in *Schisandraceae* pollen and those in the basic dicot pollen type.

Fossil pollen is mentioned above, under Fossils.

References: Agababian, V.S., Biol. Zh. Armenii 19 (1966) 77–89. — Doyle, J.A., C.L. Hutton & J.V. Ward, Amer. J. Bot. 77 (1990) 1558–1568. — Erdtman, G., Pollen morphology and plant taxonomy (1952). — Huynh, K.L., Beitr. Biol. Pflanzen 52 (1976) 227–253. — Jalan, S. & R.N. Kapil, Grana Palynol. 5 (1964) 216–221. — Jonker, F.P., Adv. Pollen-Spore Res. 1 (1974) 50–61. — Lieux, M.H., Pollen et Spores 22 (1980) 17–57. — Mitroiu, N., Acta Bot. Hort. Bucurest. 1969 (1970) 3–243. — Muller, J., Biol. Rev. 45 (1970) 417–450. — Praglowski, J., World Pollen Spore Flora 5 (1976) 1–32. — Roland, F., Rev. Gén. Bot. 78 (1971) 329–338. — Thanikaimoni, G., Trav. Sect. Sci. Tech. Inst. Fr. Pondichéry 18 (1984) 1–135. — Walker, J.W., Amer. J. Bot. 61 (1974) 1112–1137. — Walker, J.W. & J.A. Doyle, Ann. Missouri Bot. Gard. 62 (1975) 664–723. — Wodehouse, R.P., Pollen grains (1935); Bot. Rev. 2 (1936) 67–84.

SPOROGENESIS AND EMBRYOLOGY

Microsporogenesis (Hayashi 1960; Kapil & Jalan 1964; Vijayaraghavan & Dhar 1975), megasporogenesis and embryology (Yoshida 1962; Hayashi 1963; Kapil & Jalan 1964; Swamy 1964; Davis 1966) have been studied in detail for several species of *Schisandra* and *Kadsura*. The tapetum is glandular and binucleate, pollen mother cell divisions are simultaneous and the pollen grains are 2-celled when the anther dehisces. The development of the embryo sac appears to be of the *Polygonum* type, and the development of the embryo is of the Asterad or Onagrad type.

References: Davis, G.L., Systematic embryology of Angiosperms (1966). — Hayashi, Y., Sci. Rep. Tôhoku Univ., IV (Biol.), 26 (1960) 45–52; 29 (1963) 403–411. — Kapil, R.N. & S. Jalan, Bot. Not. 117 (1964) 285–306. — Swamy, B.G.L., J. Ind. Bot. Soc. 43 (1964) 391–396. — Vijayaraghavan, M.R. & U. Dhar, J. Arnold Arbor. 56 (1975) 176–182. — Yoshida, O., J. Coll. Arts Sci. Chiba Univ. 3 (1962) 459–462.

CYTOLOGY

The base chromosome number of the family is regarded as x = 7, 13. As this base number is also shared by the closely related family *Illiciaceae*, Ehrendorfer et al. (1968) have suggested that these two families (collectively forming the order *Illiciales*) diverged from the basic Magnolialean stock and extinct precursors with x = 7 by dysploid reduction from the palaeotetraploid level of 2x = 14 to 2x = 13.

Reference: Ehrendorfer, F., et al., Taxon 17 (1968) 337–353.

PHYTOCHEMISTRY AND CHEMOTAXONOMY

See the relevant chapter in the treatment of *Illiciaceae* (this issue, p. 175).

USES

The uses of both *Kadsura* and *Schisandra* are discussed under these genera.

TAXONOMY

The most recent comprehensive taxonomic revision of the family is by A.C. Smith (1947, cited earlier), who accepted two genera, *Schisandra* with 25 species and *Kad-*

sura with 22 species. The distinction between the two genera is largely based on gynoecial and fruit characters. *Kadsura* is characterised by female flowers with obovoid, subclavate or ellipsoid receptacles that are only slightly longer than wide, and which remain comparatively short after fertilisation; the aggregate fruits are consequently subglobose clusters of berries. In marked contrast, *Schisandra* is characterised by female flowers with cylindrical or conical receptacles that are markedly longer than wide, and which become highly elongated in the fruits. Differences also exist in relation to the stigmas, which are broad and often peltate in *Kadsura*, but narrow and subulate in *Schisandra*. The generic distinctions are not reflected in androecial structure, however, which makes the identification of specimens that bear only male flowers problematic. This difficulty is particularly acute with regard to species belonging to the more primitive sections *Cosbaea* of *Kadsura* and *Pleiostema* of *Schisandra*, which tend towards the hypothetical ancestral type. This problem is obviated within Malesia, however, as none of the *Kadsura* species described in the region belong to sect. *Cosbaea*.

KEY TO THE GENERA
(applicable to Malesian taxa only)

1a. Androecium subglobose, composed of tightly compressed but free stamens (superficially appearing connate). Pseudostyle either subulate or enlarged distally to form subpeltate pseudostigma. Fruits aggregated in capitate head, without extension of the receptacle after fertilisation ..... **Kadsura** *(p. 190)*

b. Androecium *either* subglobose, composed of connate stamens, forming androecial mass with sessile anthers, *or* androecium composed of stamens with essentially free filaments, ± fused at base. Pseudostyle invariably subulate, without pseudostigma. Fruits borne on elongate axis, following extension of the receptacle after fertilisation ..... **Schisandra** *(p. 202)*

KADSURA

Kadsura Kaempf. ex Juss., Ann. Mus. Hist. Nat. 16 (1810) 340; Ridl., Fl. Malay Penins. 1 (1922) 20; A.C. Sm., Sargentia 7 (1947) 156; Backer & Bakh. f., Fl. Java 1 (1964) 99; Saunders, Gard. Bull. Sing. (in press). — Type species: *Kadsura japonica* (L.) Dunal.

Sarcocarpon Blume, Bijdr. (1825) 21. — *Sarcocarpum* Blume ex G. Don, Gen. Hist. 1 (1831) 101. — Type species: *Sarcocarpon scandens* Blume [= *Kadsura scandens* (Blume) Blume].

Panslowia Wight ex Arn., Mag. Zool. Bot. 2 (1838) 546, pro syn.

Pulcheria Noroña ex Hassk., Cat. Pl. Hort. Bot. Bog. (1844) 177, pro syn.; Noroña, Verh. Batav. Gen. 5 (1790) art. 5: 3, nom. nud.

Cosbaea Lem., Ill. Hort. 2 (1855) 71. — Type species: *Cosbaea coccinea* Lem. [= *Kadsura coccinea* (Lem.) A.C. Sm.].

Schizandra sect. *Kadsura* Baill., Hist. Pl. 1 (1868/69) 189. — Type species: *Kadsura japonica* (L.) Dunal.

Woody lianes, monoecious. *Leaves* alternate, exstipulate; lamina papyraceous to coriaceous, elliptic to ovate, apex acute or acuminate, base cuneate (especially when young),

obtuse, truncate or subcordate, margins denticulate to entire, venation pinnate, brochidodromous; petioles with groove on adaxial surface. *Flowers* unisexual, in axils of leaves or fugaceous bracts, generally solitary, occasionally with secondary flower growing in axil of prophyll, or in clusters of 2–4 growing from glomerules, occasionally cauliflorous. *Perianth segments* 7–24, imbricate at anthesis, outermost and innermost segments ± reduced, suborbicular, elliptic or ovate, rarely obovate, white, cream, yellow, pink or red, outer segments often green. *Androecium* of numerous (13–80) stamens; stamens sometimes ± free but connate at base of filaments and occasionally with several subulate appendages attached to distal apex of receptacle, stamens sometimes aggregated into subglobose head with connectives either broader than thick with thecae of adjacent stamens contiguous, or else with connective as broad as thick with thecae of adjacent stamens not contiguous; pollen grains hexacolpate, distally syncolpate. *Gynoecium* of numerous (17–c. 300) carpels; receptacle obovoid or subclavate or ellipsoid, only slightly longer than broad; stigmatic crest forming subulate or laterally flattened 'pseudostyle', or modified as subpeltate or irregular 'pseudostigma'; ovary with 2–5(–11) pendulous or ventrally attached ovules. *Fruit* a subglobose aggregate of berries attached to ellipsoid or clavate receptacle; berries subglobose to obovoid or elongate-obovoid, ripening red or yellow; peduncle often enlarged in fruit. *Seeds* 1–5, smooth, hilum lateral or apical. — **Fig. 1.**

Distribution — There are about 22 species in the genus, with a southern Chinese and Indo-Chinese centre of distribution, extending from southern Japan in the north-east to Sulawesi and Java in the south-east, and eastern India and Sri Lanka in the west. See A.C. Smith, Sargentia 7 (1947) 1–224. In *Malesia* 9 species, from Sumatra and peninsular Malaysia extending to the Philippines and east as far as Ceram, although absent from the Lesser Sunda Islands with the exception of Bali.

Habitat & Ecology — As for the family.

Floral morphology — The female flowers of *Kadsura* are characterised by receptacles that are obovoid, subclavate or ellipsoid (only slightly longer than wide) which do not become greatly elongated in the fruit, and by carpels with 'pseudostyles' that are either subulate or else expanded to form a subpeltate 'pseudostigma'. Although the difference in stigmatic crest structure is generally species specific, *K. lanceolata* King is highly variable. The great variation evident in the structure of the androecium was used by Smith (1947) as the basis of his sectional classification of the genus (discussed below). The most primitive androecial type in the genus consists of numerous essentially free stamens that are only fused by the base of the filaments. According to Smith (1947), three distinct evolutionary trends are evident: 1) development of several subulate appendages on the distal apex of the receptacle; 2) aggregation of the stamens to form a subglobose head in which the individual stamens bear their thecae dorso-laterally, so that the thecae of adjacent stamens are not in contact; and 3) a similar aggregation to the above, but with the thecae borne laterally and consequently in contact with the thecae of adjacent stamens.

Reference: Smith, A.C., Sargentia 7 (1947) 1–224.

Cytology — Only two species of *Kadsura*, *K. japonica* (L.) Dunal and *K. longipedunculata* Finet & Gagnep., have been examined cytologically. Both are reported to have 2n = 28 (Whitaker 1933; Okada 1971, 1975; Chen et al. 1993; Wu & Huang 1995). The generic base number is therefore taken to be x = 14.

References: Chen, R.-Y., et al., Chromosome Atlas of Chinese Principal Economic Plants 1 (1993) 321–322. — Okada, H., J. Jap. Bot. 46 (1971) 29–33; J. Sci. Hiroshima Univ. B (Bot.) 15 (1975) 115–200. — Whitaker, T.W., J. Arnold Arbor. 14 (1933) 376–385. — Wu, Z. & C. Huang, Guihaia 15 (1995) 47–51.

Uses — *Kadsura* is of little economic value, although *K. scandens* (Blume) Blume is used for various medicinal purposes and produces edible fruits (discussed under the species, below).

Taxonomy — The most comprehensive taxonomic revision of the genus is by A.C. Smith (1947), who accepted 22 species. As with *Schisandra*, Smith recognised several sections in *Kadsura* on the basis of differing androecial structure: 1) sect. *Cosbaea* (Lem.) A.C. Sm., in which the stamens are aggregated into a conical structure, sometimes surmounted by numerous subulate appendages; 2) sect. *Sarcocarpon* (Blume) A.C. Sm., in which the androecium is subclavate, with essentially sessile anthers closely appressed in a subglobose or ellipsoid head, and connectives that are as broad as thick, so that the thecae of adjacent stamens are not contiguous; and 3) sect. *Kadsura* (as '*Eukadsura*'), which is essentially the same as sect. *Sarcocarpon*, except that the connectives are considerably broader than they are thick, so that the thecae of adjacent stamens are contiguous. Section *Cosbaea* is also distinct in having its outermost perianth parts considerably smaller than the largest parts. Smith (1947) hypothesised that the most primitive section is *Cosbaea*, and that the other two sections have been derived by processes of shortening of the filaments and enlargement of the connectives. Y.-W. Law (1996) raised the sections of *Kadsura* to the subgeneric level.

Two of the Malesian species belong to section *Kadsura*, viz. *K. heteroclita* (Roxb.) Craib and *K. philippinensis* Elmer; the remaining seven Malesian species all belong to section *Sarcocarpon*.

References: Law, Y.-W. (= Y. Liu), Fl. Reipubl. Pop. Sin. 30/1 (1966) 231–273. — Smith, A.C., Sargentia 7 (1947) 1–224.

KEY TO THE SPECIES

1a. Leaf margins entire or denticulate. Stamens with connectives that are broader than thick, so that thecae of adjacent stamens are contiguous 2
b. Leaf margins entire. Stamens with connectives that are as broad as thick, so that thecae of adjacent stamens are not contiguous 3
2a. Perianth segments 10–17. Stamens 39–62(–72). Carpels 28–47 **4. K. heteroclita**
b. Perianth segments 10–12. Stamens 24–42. Carpels 17–36 **7. K. philippinensis**
3a. Stamens 15–32. Carpels 18–68; pseudostyles narrow, subulate 4
b. Stamens 21–57. Carpels 40–200(–300); pseudostyles broad with subpeltate pseudostigmas 5

4a. Leaves small, (5.5–)6.5–13(–14.5) by (2.5–)3–5.5(–6) cm, with (3–)4–6(–9) pairs of secondary veins. Flower peduncle comparatively long, (2–)4–11(–15) mm ..... **5. K. lanceolata**
b. Leaves comparatively large, (10.5–)12–17.5(–21.5) by 6.5–11(–15) cm, with (5–)7–8(–9) pairs of secondary veins. Flower peduncle short, 0–2(–5) mm ..... **2. K. borneensis**
5a. Leaves broadly ovate, with long acuminate apex; lamina length:width ratio (1.7–)1.8–2.6(–2.7). Outer perianth segments generally large, 4.0–8.9 by 2.3–7.3 mm, innermost slightly reduced to 0.4–0.7 of length of largest ..... **1. K. acsmithii**
b. Leaves elliptic to ovate, with acute to (short-)acuminate apex; lamina length:width ratio (1.1–)1.4–2.1(–3.0). Outer perianth segments generally smaller, 1.5–3.8 by 2.0–4.7 mm, innermost highly reduced to 0.1–0.4 of length of largest 6
6a. Flower peduncles comparatively thick, (1.1–)1.7–2.2(–2.8) mm. Outer perianth segments broad, length:width ratio 0.6–0.8 7
b. Flower peduncles comparatively thin, 0.5–1.3(–2.1). Outer perianth segments narrow, length:width ratio 0.7–1.2 8
7a. Carpels numerous, 100–200(–300) ..... **6. K. marmorata**
b. Carpels few, 35–40 ..... **3. K. celebica**
8a. Leaf intercostal venation indistinct adaxially, prominent abaxially. Berries small, (3.6–)6.8–10.9(–11.8) by (3.3–)6.1–10.1(–12.0) mm, subglobose with length:width ratio of 0.9–1.3, borne on stipes (1.8–)2.9–10.8(–15.2) mm long ..... **9. K. verrucosa**
b. Leaf intercostal venation prominent both adaxially and abaxially. Berries comparatively large, 9.5–22(–30) by 6.5–14(–17.5) mm, elongate with length:width ratio of 1.2–1.8(–2.1), sessile ..... **8. K. scandens**

1. **Kadsura acsmithii** R.M.K. Saunders

Kadsura acsmithii R.M.K. Saunders, Blumea 42 (1997) 109. — Type: *Chai S 33578* (L holo; K, KEP, MO, SAN).

Woody vines. *Leaves* papyraceous to coriaceous, (5–)8–20(–29) μm thick; lamina elliptic to ovate, (11–)13.5–18.5 by 5.5–10.5 cm, length:width ratio (1.7–)1.8–2.6 (–2.7); primary vein variably slightly to highly impressed above, (very) prominent below; secondary veins (3–)4–6 pairs, (slightly) arcuate; base acute to obtuse (occasionally cuneate); apex acute to long acuminate; margin entire; petiole 20–35(–41) mm long, (0.1–)1.3–2.5(–2.9) mm diameter. *Flowers* either borne solitary in axils of leaves or in axils of fugaceous bracts, occasionally cauliflorous; peduncle 5–35(–43) mm long, 0.7–1.9(–2.2) mm diameter. *Perianth segments* (9–)12–17, outer segments pale (yellowish-) green, tinged red, innermost pink to deep red; outermost perianth segment generally ovate, rarely obovate, 4.0–8.9 by 2.3–7.3 mm, length:width ratio 1.2–2.3, reduced to 0.4–0.6 of length of largest; innermost perianth segment ovate, elliptic or obovate, 4.1–8.5 by 2.4–5.0(–6.0) mm, length:width ratio (1.1–)1.3–1.8, reduced to 0.4–0.7 of length of largest; largest perianth segment generally ovate, rarely elliptic or obovate,

10.1–14.6 by 7.9–11.3 mm, length : width ratio 1.2–1.6. *Male flowers* with 22–53 stamens, pink to red, anthers ± sessile, closely appressed in subglobose to ellipsoid head, 4.5–5.6 mm diameter, connectives broad, with dorso-lateral thecae so that thecae of adjacent stamens not contiguous. *Female flowers* with 35–110 carpels, gynoecium c. 5.7 mm diameter; ovaries 1.1–1.3 by 0.8–0.9 mm, length : width ratio 1.3–1.6; pseudostyle ± broad with subpeltate pseudostigma. *Fruit* peduncle ± elongated, 30–50 mm long; berries 35–110, ripening reddish-purple, 7–8 by 6–7.5 mm, length : width ratio 1.1–1.2, berries sessile, pericarp ± uniform in thickness or slightly thicker distally. *Seeds* 1 to 2 per berry, discoid or reniform, 5.8–6.5 by 6.8–7 mm, length : width ratio 0.8–1.0.

Distribution — *Malesia:* Borneo (Sarawak and Kalimantan).

Habitat — Tropical to submontane forests, from sea level to 1160 m altitude.

2. **Kadsura borneensis** A.C. Sm.

Kadsura borneensis A.C. Sm., Sargentia 7 (1947) 205. — Type: *Clemens 34425* (UC holo; A, K, L), Sabah, Mt Kinabalu.

Woody vines. *Leaves* highly coriaceous, 17–22 µm thick; lamina elliptic to ovate, (10.5–)12–17.5(–21.5) by 6.5–11(–15) cm, length : width ratio (1.1–)1.5–1.9(–2.2); primary vein (highly) impressed above, very prominent below; secondary veins (5–)7–8 (–9) pairs, arcuate; base obtuse to truncate; apex acute to acuminate; margin entire; petiole (14.5–)16.5–32 mm long, 1.6–3.6 mm diameter. *Flowers* either borne solitary in axils of leaves or in axils of fugaceous bracts, on young growth; peduncle very short, 0–1.9 (–4.4) mm long. *Perianth segments* 12–20, yellow; outermost perianth segment ovate, 0.6–5.2 by 0.8–5.2 mm, length : width ratio 0.8–1.0, highly reduced to 0.1–0.4 of length of largest; innermost perianth segment elliptic, 2.1–10.0 by 1.6–6.0 mm, length : width ratio 1.2–1.7, reduced to 0.4–0.8 of length of largest; largest perianth segment generally elliptic, 5.8–12.3 by 4.0–11.7 mm, length : width ratio 1.0–1.6. *Male flowers* with 18–28 stamens, pink, anthers ± sessile, closely appressed in subglobose to ellipsoid head, 2.0–4.7 mm diameter, connectives broad, with dorso-lateral thecae so that thecae of adjacent stamens not contiguous. *Female flowers* with c. 35 carpels, pink; ovaries c. 2.2 by 1.8 mm, length : width ratio c. 1.2; the pseudostyle subulate, without pseudostigma. *Fruit* with c. 35 berries, ripening reddish-purple, (10.5–)14–22(–24) by (9–)9.5–11.5 (–12.5) mm, length : width ratio (1.0–)1.3–2.3, berries sessile, pericarp greatly thickened distally, with basal locule and seeds. *Seeds* 1 per berry, reniform, c. 7.4 by 8.0 mm, length : width ratio c. 0.9.

Distribution — *Malesia:* Borneo (Sabah, in vicinity of Mt Kinabalu).

Habitat — Tropical to montane forests, to 2000 m altitude.

Note — The pollen morphology of *Kadsura borneensis* is described in detail by Praglowski, World Pollen Spore Fl. 5 (1976) 1–32.

3. **Kadsura celebica** A.C. Sm.

Kadsura celebica A.C. Sm., Sargentia 7 (1947) 202–203. — Type: *Sarasin 584* (K holo), Celebes, Minahasa.

Woody vines. *Leaves* subcoriaceous; lamina ovate, c. 13 by 9 cm, length : width ratio c. 1.5; primary vein ± plane above, prominent below; secondary veins 5 or 6 pairs, arcuate; base obtuse to truncate; apex acute to short acuminate; margin entire; petiole c. 15 mm long, c. 2 mm diameter. *Flowers* borne solitary in axils of leaves (occasionally with secondary flower borne in axil of prophyll), possibly also in axils of fugaceous bracts; peduncle c. 15 mm long, 1.7–1.8 mm diameter. *Perianth segments* c. 12; outermost perianth segment c. 2.5 by 3.7 mm, length : width ratio c. 0.7, highly reduced to 0.2 of length of largest; innermost perianth segment c. 9.5 by 8 mm, length : width ratio c. 1.2, slightly reduced to c. 0.8 of length of largest; largest perianth segment c. 12.5 by 8 mm, length : width ratio c. 1.5–1.6. *Male flowers* with c. 35 stamens, anthers ± sessile, closely appressed in subglobose to ellipsoid head, c. 6.0 mm diameter, connectives broad, with dorso-lateral thecae so that thecae of adjacent stamens not contiguous. *Female flowers* with c. 40 carpels, gynoecium c. 9 mm diameter; pseudostyle irregularly broad with subpeltate pseudostigma. *Fruit* and *seed* not seen.

Distribution — Only known from type collection which bears no notes on habitat etc.

4. **Kadsura heteroclita** (Roxb.) Craib

Kadsura heteroclita (Roxb.) Craib, Fl. Siam. Enum. 1 (1931) 28; A.C. Sm., Sargentia 7 (1947) 187; Keng in Fl. Thailand 2 (1972) 113. — *Uvaria heteroclita* Roxb., Hort. Beng. (1814) 43, nom. nud.; Fl. Ind., ed. 2, 2 (1832) 455; Griff., Notul. Pl. As. 4 (1854) 711. — Type: *M.R. Smith s.n.*, 1812 (BM holo), India, Silhet.

Kadsura roxburghiana Arn., Jard. Mag. Zool. Bot. 2 (1838) 546; King, J. As. Soc. Beng. 58, ii (1889) 376; Ann. Bot. Gard. Calcutta 3 (1891) 222. — Type: *F. de Silva s.n.* (*Wallich, Cat. no. 4987*) (K lecto; A, NY).

Kadsura scandens var. *cuspidata* Blume ex Koord., Exk. Fl. Java 2 (1912) 242, pro syn.

Kadsura parvifolia A. Agostini, Atti Reale Accad. Fisiocrit. Siena, X, 1 (1926) 193. — Type: *Beccari 367* (FI-B holo; K, L), Sumatra, Mt Singalan.

Woody vines. *Leaves* ± papyraceous, (3–)4–11(–14) µm thick; lamina elliptic, rarely ovate-elliptic, (6.5–)7–13(–14.5) by (2–)3–6.5(–7.5) cm, length : width ratio (1.7–)1.8–2.8(–3.2); primary vein (slightly) impressed above, (slightly) prominent below; secondary veins (4–)5–8(–10) pairs, straight to slightly arcuate; base cuneate, rarely obtuse, often short-attenuate; apex acute to acuminate; margin entire, rarely denticulate, 0(–8) teeth; petiole (8–)10–19(–23) mm long, (0.5–)0.7–1.7(–1.9) mm diameter. *Flowers* borne solitary in axils of leaves, occasionally with secondary flower borne in axil of prophyll, always on young growth; peduncle length highly variable, 1–6.5(–42.5) mm long, (0.6–)0.7–1.2(–2.4) mm diameter. *Perianth segments* 10–17, white, cream or yellow; outermost perianth segment ovate, 1.1–2.6(–3.2) by 1.7–2.5(–3.5) mm, length : width ratio 0.6–1.0(–1.2), highly reduced to 0.2–0.4 of length of largest; innermost perianth segment elliptic to ovate, (1.8–)3.2–5.7(–7.5) by 1.1–4.1 mm, length : width ratio (1.3–)1.6–2.5(–2.8), slightly reduced to (0.3–)0.6–0.9 of length of largest; largest perianth segment ovate (rarely elliptic or orbiculate), 5.4–7.5(–10.9) by (3.6–)4.5–6.5(–9.4) mm, length : width ratio (1.0–)1.1–1.4(–1.6). *Male flowers* with 39–62(–72) stamens, red, absent from apex of torus, anthers ± sessile, closely appressed in subglobose to ellipsoid head, 2.0–4.5 mm diameter, connectives broad, with lateral thecae so

that the thecae of adjacent stamens contiguous; pollen hexacolpate. *Female flowers* with 28–47 free carpels, green, gynoecium 3.2–4.1 mm diameter; ovaries (1.3–)1.5–1.9 (–2.2) by 1.0–1.2(–1.9) mm, length : width ratio 1.0–1.7; pseudostyle broad with subpeltate pseudostigma. *Fruit* peduncle slightly elongated, 14–46 mm long; berries 28–41, ripening red, 19.4–24.2 by 7.9–11.2 mm, length : width ratio 2.1–3.0, berries sessile. *Seeds* 1 or 2 per berry, pyriform, discoid or reniform, 4.6–5.6 by 4.3–5.5 mm, length : width ratio 0.9–1.2.

Distribution — Southern China to north-east India, and in peninsular India, Sri Lanka and Andaman Islands. See A.C. Smith, Sargentia 7 (1947) 189. In *Malesia:* Sumatra, Malay Peninsula, Borneo.

Habitat — Submontane to montane forests, 800–2000 m altitude.

Note — Detailed descriptions of microsporogenesis [M.R. Vijayaraghavan & U. Dhar, J. Arnold Arbor. 56 (1975) 176–182], pollen structure [Vijayaraghavan & Dhar, l.c.; Praglowski, World Pollen Spore Fl. 5 (1976) 1–32] and carpel structure [Vijayaraghavan & Dhar, Bot. Jahrb. Syst. 98 (1977) 273–277] have been published.

5. **Kadsura lanceolata** King

Kadsura lanceolata King, J. As. Soc. Beng. 58, ii (1889) 376; Ridl., Fl. Malay Penins. 1 (1922) 21; A.C. Sm., Sargentia 7 (1947) 203–204. — Type: *King's coll. (Kunstler) 3463* (K lecto).

Kadsura scandens auct. non Blume: Ridl., Sarawak Mus. J. 1, 3 (1913) 72; A. Agostini, Atti Reale Accad. Fisiocrit. Siena, X, 1 (1926) 194.

Kadsura ultima A.C. Sm., Sargentia 7 (1947) 207. — Type: *Robinson 2005* (US holo; K, L), Ambon.

Woody vines. *Leaves* coriaceous, (5–)7–22(–27) µm thick; lamina (ovate-)elliptic, rarely ovate, (5.5–)6.5–13(–14.5) by (2.5–)3–5.5(–6) cm, length : width ratio (1.3–)1.6–2.7(–2.9); primary vein (slightly) impressed above, prominent below; secondary veins (3–)4–6(–9) pairs, slightly arcuate; base obtuse, rarely truncate (cuneate in younger leaves); apex acuminate, rarely acute; margin entire; petiole (5–)7–18(–22) mm long, 0.9–2.2(–2.6) mm diam. *Flowers* borne solitary in axils of leaves, occasionally with secondary flower borne in axil of prophyll, always on young growth; peduncle (2–)4–11(–15) mm long, (0.3–)0.7–1.3(–1.6) mm diameter. *Perianth segments* 7–12 (–14), outer segments pink to dark red, inner segments cream to bright yellow; outermost perianth segment ovate, 1.0–2.5(–8.0) by 1.2–2.5(–7.3) mm, length : width ratio 0.6–1.0 (–1.3), highly reduced to 0.1–0.4(–0.9) of length of largest; innermost perianth segment elliptic to obovate, (1.6–)4.0–7.8(–11.0) by (0.8–)2.3–4.3(–8.1) mm, length : width ratio 1.2–1.7(–2.7), slightly reduced to (0.3–)0.7–1.0 of the length of the largest; largest perianth segment shape variable, generally elliptic to ovate, 5.0–7.8 (–13.5) by 3.5–6.3(–14.7) mm, length : width ratio 0.9–1.5(–2.2). *Male flowers* with 15–32 stamens, anthers ± sessile, closely appressed in subglobose to ellipsoid head, 2.3–6.2 mm diameter, connectives broad, with dorso-lateral thecae so that thecae of adjacent stamens not contiguous. *Female flowers* with 18–68 carpels, gynoecium 2.5–5.0 mm diameter; ovaries 0.9–1.5(–1.6) by 0.6–1.0(–1.2) mm, length : width ratio (0.8–)0.9–1.4(–2.5); pseudostyle subulate, without pseudostigma. *Fruit* peduncle not markedly elongated, 4–14 mm long; berries 18–32 (possibly more), ripening red or yellow, 5.1–

6.6 by 3.8–6.0 mm, length: width ratio 1.0–1.7, berries sessile, pericarp ± uniform in thickness or slightly thicker distally. *Seeds* 1–3 per berry, discoid to pyriform, (3.7–) 4.1–4.5(–5.2) by (3.0–)3.4–5.0 mm, length: width ratio 0.8–1.3.

Distribution — *Malesia:* Sumatra, Malay Peninsula, Borneo, Celebes, and Moluccas (Halmahera and Ambon).

Habitat — Tropical to submontane forests (to 1400 m altitude), occasionally montane and subalpine forests (to 2900 m altitude).

Note — Accounts of the structure of the leaf cuticle and pollen of *Kadsura lanceolata* have been published by H.S. Rao [Proc. Ind. Acad. Sci., B 9 (1939) 99–116 + 21 pl.] and Praglowski [World Pollen Spore Fl. 5 (1976) 1–32], respectively.

6. **Kadsura marmorata** (Hend. & A. Hend.) A.C. Sm.

Kadsura marmorata (Hend. & A. Hend.) A.C. Sm., Sargentia 7 (1947) 196. — *Sphaerostema marmoratum* Hend. & A. Hend., Ill. Bouquet 2 (1859–61) pl. 40. — Lectotype: the plate mentioned.
Kadsura scandens auct. non Blume: Merr., Philipp. J. Sc., Bot. 2 (1907) 422.
Kadsura apoensis Elmer, Leafl. Philipp. Bot. 8 (1915) 2748; Merr., Univ. Calif. Publ. Bot. 15 (1929) 60. — Type: *Elmer 11718* (GH lecto; A, E, F, K, L, MO, NY), Mt Apo, Mindanao.
Kadsura sulphurea Elmer, Leafl. Philipp. Bot. 8 (1915) 2750. — Type: *Elmer 13505* (GH lecto; A, E, F, K, L, MO, NY, UC), Mt Urdaneta, Mindanao.
Kadsura clemensiae A.C. Sm., Sargentia 7 (1947) 206. — Type: *Clemens 22115* (A holo; K iso), Sarawak.

Woody vines. *Leaves* ± coriaceous, (5–)8–15(–20) μm thick; lamina elliptic to ovate, (10–)13–18(–21) by (5–)6–11(–18) cm, length: width ratio (1.1–)1.4–2.1(–3.0); primary vein slightly to highly impressed above, (very) prominent below; secondary veins (3–)5–6(–8), generally arcuate; base obtuse to truncate; apex acute to acuminate; margin entire; petiole (15–)19–33(–79) mm long, (1.4–)1.9–3.0(–4.7) mm diameter. *Flowers* either borne solitary in axils of leaves or in axils of fugaceous bracts, occasionally cauliflorous, often growing as glomerules on trunk; peduncle (2.5–)5–43 mm long, (1.1–) 1.7–2.2(–2.8) mm diameter. *Perianth segments* 12–21, yellowish, outermost segments sometimes greenish; outermost perianth segment ovate, 1.8–8.9 by 2.8–7.3 mm, length: width ratio 0.6–0.8, highly reduced to 0.2–0.3 of length of largest; innermost perianth segment generally elliptic, (1.8–)6.5–10.5 by (0.8–)4.6–7.3 mm, length: width ratio 1.3–1.4(–2.3), reduced to (0.3–)0.5–0.8 of length of largest; largest perianth segment elliptic to ovate, (6.3–)9–13 by 6.1–9.7 mm, length: width ratio (1.0–)1.3–1.5. *Male flowers* with 38–53 stamens, anthers ± sessile, closely appressed in subglobose to ellipsoid head, 7–8 mm diameter, connectives broad, with dorso-lateral thecae so that thecae of adjacent stamens not contiguous. *Female flowers* with 100–200 (to 300, fide Smith 1947: 197) carpels, gynoecium 5.7–7.5 mm diameter; ovaries 1.1–2.0 by 0.8–1.2 mm, length: width ratio 1.3–2.1; pseudostyle broad with subpeltate pseudostigma. *Fruit* with 100–200 berries (possibly more), ripening cream to dull yellow or red, (16–) 19–39 by 6–14 mm, length: width ratio (1.4–)2.4–4.2(–5.6), berries sessile, pericarp greatly thickened distally, with basal locule and seeds. *Seeds* 1 or 2 per berry, discoid to pyriform, 5.0–8.6 by 4.6–5.2(–6.6) mm, length: width ratio 1.0–1.4(–1.8).

Distribution — *Malesia:* Borneo (Sabah, Sarawak), Philippines (Mindanao, Palawan).

Habitat — Tropical to submontane forests, to 1500 m altitude.

Notes — Stomatal characteristics of *Kadsura marmorata* are illustrated by Metcalfe [Anat. Dicot., ed. 2, 3 (1987) 83–89], and pollen structure by Praglowski [World Pollen Spore Fl. 5 (1976) 1–32].

7. **Kadsura philippinensis** Elmer

Kadsura philippinensis Elmer, Leafl. Philipp. Bot. 1 (1908) 277; A.C. Sm., Sargentia 7 (1947) 192. — Type: *Elmer 8700* (A lecto; E), Luzon.

Kadsura paucidenticulata Merr., Philipp. J. Sc., Bot. 5 (1910) 176; A.C. Sm., Sargentia 7 (1947) 193. — Type: *McGregor 8498* (K lecto; L, NY), Luzon.

Kadsura macgregorii Merr., Philipp. J. Sc., Bot. 5 (1910) 177. — Type: *McGregor 8340* (destroyed), Luzon.

Kadsura sorsogonensis Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 153, pro syn.

Woody vines. *Leaves* ± papyraceous, (4–)5–7(–10) μm thick; lamina elliptic, rarely ovate-elliptic or ovate, (6.5–)7–10(–11.5) by 3–5(–6) cm, length : width ratio (1.7–)1.9–2.5(–2.7); primary vein plane to slightly impressed above, prominent below; secondary veins 5–6(–7) pairs, often indistinct due to presence of intersecondary veins, slightly arcuate; base cuneate to obtuse; apex acute to acuminate; margin entire to denticulate, 0–4 (–6) teeth; petiole (6.5–)7.5–15(–17) mm long, 0.8–1.4(–1.7) mm diameter. *Flowers* borne solitary in axils of leaves, always on young growth; peduncle (10–)15–32 mm long, 0.4–0.8(–0.9) mm diameter. *Perianth segments* 10–12, white or dull yellow; outermost perianth segment ovate, 1.2–1.8(–3.4) by 1.3–2.2(–4.1) mm, the length : width ratio (0.5–)0.8–1.1, highly reduced to 0.2–0.4 of length of largest; innermost perianth segment elliptic to ovate, (3.6–)4.3–5.5 by 2.5–2.9 mm, length : width ratio (1.3–)1.5–1.9(–2.2), slightly reduced to (0.4–)0.6–0.9 of length of largest; largest perianth segment orbicular to ovate, 4.2–10.6 by 4.7–8.4 mm, length : width ratio 0.9–1.1(–1.3). *Male flowers* with 24–42 stamens, absent from apex of torus, anthers ± sessile, closely appressed in subglobose to ellipsoid head, c. 2.6 mm diameter, connectives broad, with lateral thecae so that thecae of adjacent stamens contiguous; pollen hexacolpate. *Female flowers* with 17–36 free carpels, gynoecium c. 3.1 mm diameter; ovaries 1.0–3.0 by 0.7–2.8 mm, length : width ratio 1.0–1.3(–1.7); pseudostyle broad with subpeltate pseudostigma. *Fruit* peduncle slightly elongated, 28–38 mm long; berries 20–45, ripening white to brown, (2.6–)5.0–5.9 by (2.6–)3.1–3.6(–5.0) mm, length : width ratio 1.0–1.7, sessile or on short stipe, to c. 1.2 mm. *Seeds* 1 or 2 per berry, reniform, 2.6–4.2 by 3.4–4.7 mm, length : width ratio c. 0.8–0.9.

Distribution — *Malesia:* Philippines (Luzon and Mindanao).

Habitat — Submontane to montane forests, 850–2100 m altitude.

Note — Pollen structure is described by Wodehouse [Pollen Grains (1959) 340] and Praglowski [World Pollen Spore Fl. 5 (1976) 1–32].

8. **Kadsura scandens** (Blume) Blume

Kadsura scandens (Blume) Blume, Fl. Javae (1830) 9; King, J. As. Soc. Beng. 58, ii (1889) 375; Ann. Bot. Gard. Calc. 3, 2 (1891) 221, pl. 71; Ridl., J. Str. Br. Roy. As. Soc. 33 (1900) 38; Backer,

Schoolfl. Java (1911) 16; Koord., Exk. Fl. Java 2 (1912) 242; Ridl., Fl. Malay Penins. 1 (1922) 20; A.C. Sm., Sargentia 7 (1947) 199; Backer & Bakh. f., Fl. Java 1 (1964) 99; Keng in Fl. Thailand 2 (1972) 114; Conc. Fl. Sing. (1990) 9; R.M.K. Saunders, Gard. Bull. Sing. (in press). — *Sarcocarpon scandens* Blume, Bijdr. (1825) 21. — *Kadsura scandens* var. *normalis* Kuntze, Rev. Gen. Pl. 1 (1891) 6. — Type: *Blume s.n.* (L lecto; K, NY), Java, Mt Gedeh/Pangrango.

Kadsura cauliflora Blume, Fl. Javae (1830) 11; Backer, Schoolfl. Java (1911) 17. — *Kadsura scandens* var. *cauliflora* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 6. — Type: *Blume s.n.* (L lecto; K), Java, Mt Burangrang.

Kadsura scandens var. *intermedia* Kuntze, Rev. Gen. Pl. 1 (1891) 6. — Type: *Kuntze 5210* (NY lecto), Java, Sagaranten-Rambai.

Schizandra ovalifolia Parment., Bull. Sc. Fr. Belg. 27 (1896) 237, 312. — Type: *Beccari 667* (MEL holo; K, L), Sumatra, Padang.

Kadsura wallichii Korth. ex Koord., Exk. Fl. Java 2 (1912) 242, pro syn.

Woody vines. *Leaves* papyraceous to coriaceous, 5–16(–19) μm thick; lamina elliptic to ovate, (9–)10–15(–21) by (4.5–)5–9(–15) cm, length : width ratio (1.3–)1.4–2.1 (–2.4); primary vein variably plane to highly impressed above, (very) prominent below; secondary veins 4–6(–8) pairs, (slightly) arcuate; base obtuse to truncate (cuneate in younger leaves); apex acute to acuminate; margin entire; petiole (7.5–)11.5–30(–48) mm long, 1.2–2.3(–2.8) mm diameter. *Flowers* either borne solitary in axils of leaves (occasionally with secondary flower borne in axil of prophyll) or in axils of fugaceous bracts, occasionally cauliflorous; peduncle (4–)8–42(–70) mm long, 0.6–1.3 mm diameter. *Perianth segments* (7–)11–18, white, pale yellow or red, outer segments occasionally pale green, tinged red; outermost perianth segment generally ovate, 1.5–3.8 by 2.0–3.3 mm, length : width ratio 0.7–1.2, highly reduced to 0.1–0.4 of length of largest; innermost perianth segment (sub)elliptic, 4.3–7.3(–10.5) by 2.9–6.2 mm, length : width ratio (1.2–)1.5–2.1, reduced to 0.4–0.7(–0.9) of length of largest; largest perianth segment generally ovate, occasionally orbiculate or elliptic, (7.4–)9–16(–18.9) by (4.7–) 7.0–12.0(–14.3) mm, length : width ratio 1.0–1.6. *Male flowers* with 24–52 stamens, pink to dark red, anthers ± sessile, closely appressed in subglobose to ellipsoid head, 4.1–6.0 mm diameter, connectives broad, with dorso-lateral thecae so that thecae of adjacent stamens not contiguous. *Female flowers* with 50–82 (–110) carpels, gynoecium 4.9–6.5 mm diameter; ovaries 1.8–2.7 by 0.9–1.4 mm, length : width ratio (1.6–)1.9–2.6(–3.0); pseudostyle broad with subpeltate pseudostigma. *Fruit* peduncle not markedly elongated, 21–25 mm long; berries 40–93 (possibly more), ripening red, 9.5–22(–30) by 6.5–14(–17.5) mm, length : width ratio 1.2–1.8 (–2.1), berries sessile, pericarp greatly thickened distally, with basal locule and seeds. *Seeds* 1 or 2 per berry, pyriform, discoid or reniform, (4.5–)5.5–8.5(–10) by (4–)5–9 (–11) mm, length : width ratio 0.8–1.1(–1.5). — **Fig. 1.**

Distribution — *Malesia:* Sumatra, Malay Peninsula, Java and Bali.

Habitat — Tropical to montane forests, to 2400 m altitude.

Uses — *Kadsura scandens* is reported to have a variety of medicinal uses. Decoctions of the roots and/or stems are used as a lotion to combat rheumatism or as an expectorant; the sap is drunk as a remedy for urinary problems, abdominal pains and diarrhoea, or applied to alleviate skin diseases; and the bark is further used to combat fever. See Burkill, Dict. Econ. Prod. Malay Penins. 2 (1966) 1296; K. Heyne, Nutt. Pl. Indon.,

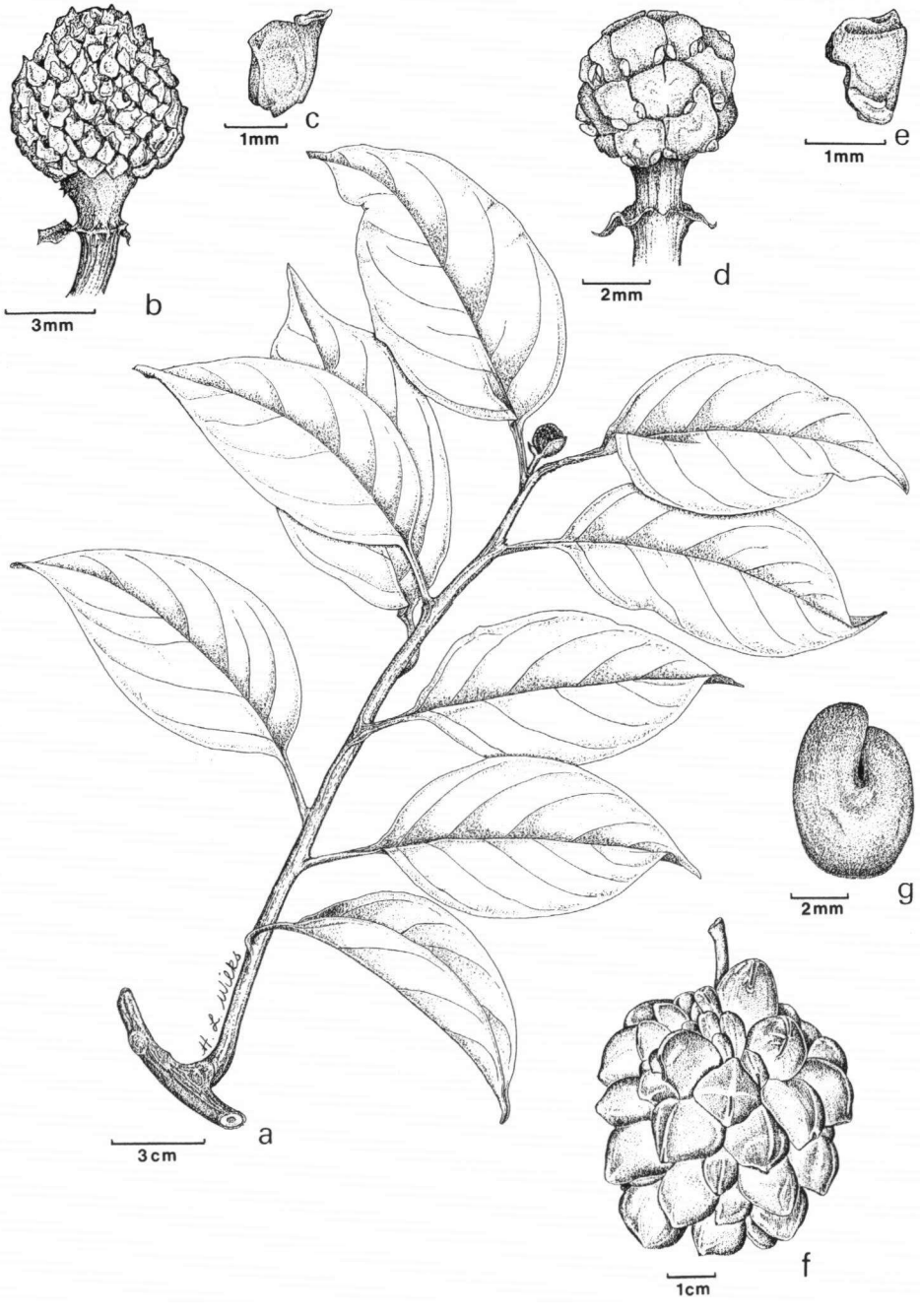

Fig. 1. *Kadsura scandens* (Blume) Blume. a. Flowering branch; b. gynoecium; c. isolated carpel (lateral view); d. androecium; e. isolated stamen (lateral view); f. aggregate fruit of separate berries; g. seed (a: *Ridley 6354*; b, c: *Nur 26103*; d, e: *Korthals s.n.*; f: redrawn from Van Steenis, Mountain Fl. Java (1972) f. 29.3; g: *Wirawan 134*). Drawing by H.L. Wilks.

ed. 3 (1950) 626; L.M. Perry, Medic. Pl. S. & SE. Asia (1980) 381–382. The fruit is also reported to be edible, although rather astringent (Burkill 1966; Heyne 1950).

Note — Cuticular features are discussed by H.S. Rao [Proc. Ind. Acad. Sc., B 9 (1939) 99–116 + 21 pl.], and pollen structure by Wodehouse [Pollen Grains (1959) 340] and Praglowski [World Pollen Spore Fl. 5 (1976) 1–32].

9. Kadsura verrucosa (Gagnep.) A.C. Sm.

Kadsura verrucosa (Gagnep.) A.C. Sm., Sargentia 7 (1947) 195. — *Schisandra verrucosa* Gagnep. in Fl. Indochine, Suppl. 1 (1938) 56, nom. inval., '*Schizandra*'; Not. Syst. Mus. Nat. Paris 8 (1939) 66, '*Schizandra*'. — Type: *Poilane 25429* (P lecto; A, K).

Kadsura cauliflora auct. non Blume: King, J. As. Soc. Beng. 58, ii (1889) 375; Ann. Roy. Bot. Gard. Calc. 3 (1891) 222; Ridl., Fl. Malay Penins. 1 (1922) 20; A. Agostini, Atti Reale Accad. Fisiocrit. Siena, X, 1 (1926) 194, pro parte.

Woody vines. *Leaves* coriaceous, (5–)8–12(–20) μm thick; lamina elliptic to ovate, (8.5–)10–15(–21) by (4–)4.5–12.5(–14) cm, length : width ratio (1.1–)1.4–2.1(–2.8); primary vein plane to slightly impressed above, (very) prominent below; secondary veins (4–)5–7(–8) pairs, arcuate; base obtuse to truncate; apex acute to acuminate; margin entire, rarely subdentate; petiole (14–)15.5–30(–60) mm long, (1.1–)1.3–3.0(–3.7) mm diameter. *Flowers* either borne solitary in axils of leaves or in axils of fugaceous bracts, occasionally cauliflorous, growing as glomerules on trunk; peduncle 11–27(–35) mm long, 0.5–1.3(–2.1) mm diameter. *Perianth segments* 12–15, yellow, cream or pink; outermost perianth segment ovate, 2.0–3.5 by 1.8–4.7 mm, length : width ratio 0.7–1.2, highly reduced to 0.1–0.2 of length of largest; innermost perianth segment shape variable, generally elliptic, 5.8–8.0(–15.9) by 3.4–6.2(–10.3) mm, the length : width ratio 1.3–1.7, reduced to 0.4–0.7 of length of largest; largest perianth segment generally ovate, 11.3–15.0(–21.5) by 9.6–14.0(–19.7) mm, length : width ratio 1.1–1.3. *Male flowers* with 40–57 stamens, anthers ± sessile, closely appressed in subglobose to ellipsoid head, 4.0–5.8 mm diameter, connectives broad, with dorso-lateral thecae so that thecae of adjacent stamens not contiguous. *Female flowers* with 47–55 carpels, gynoecium c. 5 mm diameter; ovaries 1.7–3.8 by 0.5–1.7 mm, length : width ratio 2.1–3.8; pseudostyle broad with subpeltate pseudostigma. *Fruit* peduncle ± elongated, 20–50 mm long; berries 30–50, ripening red or yellow, (3.6–)6.8–10.9(–11.8) by (3.3–)6.1–10.1(–12.0) mm, length : width ratio 0.9–1.3, berries borne on stipes, (1.8–)2.9–10.8(–15.2) mm long, articulate at apex of stipe, pericarp ± uniform in thickness, not distally thickened. *Seeds* (1 or) 2 per berry, discoid to reniform, 5–6.3(–6.6) by (3.8–)5.0–6.6 (–7.8) mm, length : width ratio 0.8–1.1.

Distribution — Indochina; *Malesia:* Sumatra, Malay Peninsula, and Java.

Habitat — Tropical to submontane forests, up to 1300 m altitude, rarely montane to 2000 m altitude.

INSUFFICIENTLY KNOWN

Kadsura billitonensis A. Agostini, Atti Reale Accad. Fisiocrit. Siena, X, 1 (1926) 193. — Type: *Riedel s.n.* (FI-B holo), Belitung (Billiton). Not identifiable.

SCHISANDRA

Schisandra Michx., Fl. Bor.-Amer. 2 (1803) 218, t. 47, nom. conserv.; DC., Syst. 1 (1818) 544; A.C. Sm., Sargentia 7 (1947) 86; Backer & Bakh. f., Fl. Java 1 (1964) 99. — Type species: *Schisandra coccinea* Michx. [syn. *S. glabra* (Brickell) Rehder].

Sphaerostema Blume, Bijdr. (1825) 22. — Type species: *Sphaerostema axillare* Blume [= *Schisandra propinqua* (Wall.) Baill. subsp. *axillaris* (Blume) R.M.K. Saunders].

Woody *vines*; monoecious. *Leaves* alternate on long shoots or clustered on short shoots, exstipulate; lamina papyraceous to coriaceous, elliptic to ovate, apex acute to acuminate, base generally acute to decurrent, margins denticulate to entire, pinnate venation; petioles with groove on adaxial surface. *Flowers* generally solitary and axillary, occasionally in clusters of up to 8, sometimes ramiflorous. *Perianth segments* 5–20, imbricate at anthesis, outermost and innermost segments ± reduced, elliptic to suborbicular or obovate, white, (orange-)yellow, pink, or (purple-)red. *Androecium* of few to numerous (4–60) stamens; stamens sometimes ± free but fused at base of filaments, sometimes fused to form subglobose carnose mass with thecae embedded in cavities, sometimes fused to form flattened pentagonal mass ('staminal shield'); pollen grains tri- or hexacolpate, distally syncolpate. *Gynoecium* of numerous (12–120) carpels; receptacle cylindrical or conical, distinctly longer than wide; stigmatic crest forming subulate 'pseudostyle', lacking 'pseudostigma'; ovary with 2 (or 3) ventrally attached ovules. *Fruit* an aggregate of berries attached to elongated receptacle; berries ellipsoid to obovoid, ripening red; pedicel not enlarged in fruit. *Seeds* (1–)2(–3), smooth to rugulose, hilum lateral. — **Fig. 2.**

Distribution — There are c. 25 species in the genus, with an extensive distribution from southern Sakhalin in the north-east to the Himalayas in the west; the centre of diversity lies in Assam and southern China. The genus shows two major disjunctions: two species, *S. propinqua* (Wall.) Baill. and *S. elongata* (Blume) Baill., occur in Java and Bali; and *S. glabra* (Brickell) Rehder is endemic to the south-east United States [A.C. Smith, Sargentia 7 (1947) 1–224]. In *Malesia:* Java and Bali (2 species).

Habitat & Ecology — As for the family.

Vegetative anatomy — In addition to the references given in the discussion of the morphology and anatomy of the family, the following aspects of the vegetative anatomy of *Schisandra* have received particular attention: stomatal structure and development (Rao 1939; Jalan 1962); nodal anatomy (Jalan 1968a); crystalliferous sclereids (Jalan 1968b); ethereal oil cells (Jalan 1965); and mucilage cells (Jalan 1975).

References: Jalan, S., Phytomorphology 12 (1962) 239–242; Curr. Sci. 18 (1965) 527–528; Bot. Jahrb. 88 (1968a) 311–316; Beitr. Biol. Pflanzen 44 (1968b) 277–288; J. Ind. Bot. Soc. 54 (1975) 62–65. — Rao, H.S., Proc. Ind. Acad. Sci., B 9 (1939) 99–116.

Floral morphology — The female flowers of *Schisandra* are characterised by carpels with subulate stigmatic crests, and cylindrical or conical receptacles that are markedly longer than wide and become highly elongated in the fruit. The male flowers show great variation in androecial structure: the most primitive androecia consist of a large number

of essentially free stamens that are only fused at the base of the filaments. According to Smith (1947), three distinct evolutionary trends are evident in the genus: 1) reduction of the number of stamens, ultimately giving rise to an extreme of only 4–5 in *S. chinensis* (Turcz.) Baill.; 2) complete fusion of the filaments to form a carnose mass with the anthers embedded in cavities; and 3) fusion of the filaments to form a 'staminal shield' of five stamens, with the thecae borne on the lower (morphologically dorsal) margins of the connectives. The androecial variation was used by Smith (1947) as the basis for his sectional classification of the genus (discussed below). Floral ontogeny is described and illustrated in detail by Tucker & Bourland (1994).

References: Smith, A.C., Sargentia 7 (1947) 1–224. — Tucker, S.C. & J.A. Bourland, Pl. Syst. Evol., Suppl. 8 (1994) 137–158.

Cytology — Six species of *Schisandra* have been examined cytologically, although none of these species occur in Malesia. Most reports are of n = 14 (Whitaker 1933; Ehrendorfer et al. 1968; Stone 1968; Ratter & Milne 1976; Sandhu et al. 1989) and 2n = 28 (Janaki-Ammal, unpubl., cited in Darlington & Wylie 1955; Stone 1965, 1968; Okada 1975; Singhal et al. 1980; Gill et al. 1982; Chen et al. 1993; Wu & Huang 1995), although Bostick (1965) reports n = 13 for *S. glabra* (syn. *S. coccinea*). Other studies have revealed a diploid cytotype of n = 7 for *S. grandiflora* (Wall.) Hook. f. & Thoms. (Malla et al. 1977; Sandhu et al. 1989). The base number for the genus is therefore regarded as x = 7, 13.

References: Bostick, P.E., Sida Contrib. Bot. 2 (1965) 165–168. — Chen, R.-Y., et al., Chromosome Atlas of Chinese Principal Economic Plants 1 (1993) 319–320. — Darlington, C.D. & A.P. Wylie, Chromosome Atlas of Flowering Plants (1955) 14. — Ehrendorfer, F., et al., Taxon 17 (1968) 337–353. — Gill, B.S., et al., in G.S. Paliwal, The Vegetational Wealth of the Himalayas (1982) 497–515. — Malla, S.B., et al., in Á. Löve, Taxon 26 (1977) 443–452. — Okada, H., J. Sci. Hiroshima Univ. B (Bot.) 15 (1975) 115–200. — Ratter, J.A. & C. Milne, Notes Roy. Bot. Gard. Edinb. 35 (1976) 143–145. — Sandhu, P.S., et al., Curr. Sci. 58 (1989) 925–926. — Singhal, V.K., et al., in Á. Löve, Taxon 29 (1980) 355–357. — Stone, D.E., Madroño 18 (1965) 122–126; J. Elisha Mitchell Sci. Soc. 84 (1968) 351–356. — Whitaker, T.W., J. Arnold Arbor. 14 (1933) 376–385. — Wu, Z. & C. Huang, Guihaia 15 (1995) 47–51.

Uses — *Schisandra* is not very important economically, although the North Asian species *S. chinensis* and *S. propinqua* are used for various medicinal purposes [L.M. Perry, Medic. Pl. S. & SE Asia (1980) 381–382].

Taxonomy — The most comprehensive taxonomic revision of *Schisandra* is by A.C. Smith (1947), who accepted 25 species. Smith recognised four different androecial types in the genus, which he used as the primary criterion for the delimitation of sections, as follows:

Sect. *Pleiostema* A.C. Sm., with few to numerous essentially free stamens, arranged in irregular whorls on an elongated column or torus;

Sect. *Maximowiczia* (Rupr.) Nakai, with the filaments fused into a short column, bearing few sessile anthers at its apex;

Sect. *Schisandra* ('*Euschisandra*'), with the androecium composed of a flattened pentagonal shield with five radiating anthers bearing thecae on the dorsal margin;

Sect. *Sphaerostema* (Blume) Nakai, with the androecium composed of a subglobose or ellipsoid carnose mass, derived by the fusion of filaments, with anthers borne in cavities on the surface.

Smith hypothesised that the most primitive section was *Pleiostema*, and that the other sections have been derived by processes of filament fusion and the reduction in stamen number. Although the delimitation of the sections was primarily based on androecial structure, there is also an imperfect correlation with seed coat structure.

Y.-W. Law (1996) proposed a revised supraspecific classification for the genus, involving both the raising of the sections to subgeneric level, and the recognition of two new subgenera, viz.: '*Sinoschisandra*' for those species (previously classified in sect. *Pleiostema*) which possess a sterile 'shield' over the apex of the torus; and '*Plenischisandra*' solely for *S. plena* A.C. Sm., which differs from the other species previously classified in sect. *Sphaerostema* in possessing sessile anthers.

The two Malesian species belong to different supraspecific taxa: *S. elongata* (Blume) Baill. belongs to sect. *Pleiostema* sensu Smith (= subg. *Pleiostema* sensu Law), whereas *S. propinqua* subsp. *axillaris* (Blume) R.M.K. Saunders belongs to sect. *Sphaerostema* sensu Smith (= subg. *Sphaerostema* sensu Law).

References: Law, Y.-W. (= Y. Liu) in Fl. Reipubl. Pop. Sin. 30, 1 (1996) 231–273. — Smith, A.C., Sargentia 7 (1947) 1–224.

KEY TO THE SPECIES

1a. Leaves comparatively narrow (length : width ratio 2.2–2.6–3.2), ± coriaceous. Flowering pedicel short, 0–5–11 mm, fruiting pedicel 3–12 mm. Androecium a fused mass of 10–12–17 stamens, with anthers embedded in cavities ..... **1. S. propinqua** subsp. **axillaris**

b. Leaves comparatively broad (length : width ratio 1.7–2.0–2.3), papyraceous or occasionally membranaceous. Flowering pedicel long, 28–38–63 mm, fruiting pedicel long, 40–60 mm. Androecium of 27–30 stamens, fused only at the base of the filaments ..... **2. S. elongata**

1. Schisandra propinqua (Wall.) Baill. subsp. **axillaris** (Blume) R.M.K. Saunders

Schisandra propinqua (Wall.) Baill. subsp. *axillaris* (Blume) R.M.K. Saunders, Edinb. J. Bot. (in press). — *Sphaerostema axillare* Blume, Bijdr. Fl. Ned. Ind. (1825) 22, '*axillaris*'; Fl. Javae (1830) 14, t. 3. — *Sphaerostemma axillare* Blume ex G. Don, Gen. Hist. Dichlam. Pl. 1 (1831) 101, '*axillaris*'. — *Schisandra axillaris* (Blume) Hook. f. & Thomson in Hook. f., Fl. Brit. India 1 (1872) 45, '*Schizandra axillaris*'; Backer, Schoolfl. Java (1911) 16; A.C. Sm., Sargentia 7 (1947) 147; Backer & Bakh. f., Fl. Java 1 (1964) 99; Steenis, Mountain Fl. Java (1972) t. 29.4. — Type: *Blume s.n.* (BO lecto; K, L, NY), Java, Mt Tjareme.

Sphaerostema pyrifolium Blume, Fl. Javae (1830) 16, t. 4. — *Uvaria pyrifolia* Reinw. ex Blume, Fl. Javae (1830) 16, pro syn. — *Sphaerostemma pyrifolium* Blume ex Walp., Rep. Bot. Syst. 1 (1842) 92. — *Sphaerostemma pyrifolium* Blume ex Koord., Exk. Fl. Java 2 (1912) 243, pro syn., '*pirifolium*'. — Type: *Blume s.n.* (L lecto & iso), Java, Ciancur.

Sphaerostemma pyrifolium var. *denticulatum* Blume ex Koord., Exk. Fl. Java 2 (1912) 243, pro syn., '*pirifolium*'.
Schizostigma axillare Hook. f. & Thomson ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 153, sphalm.

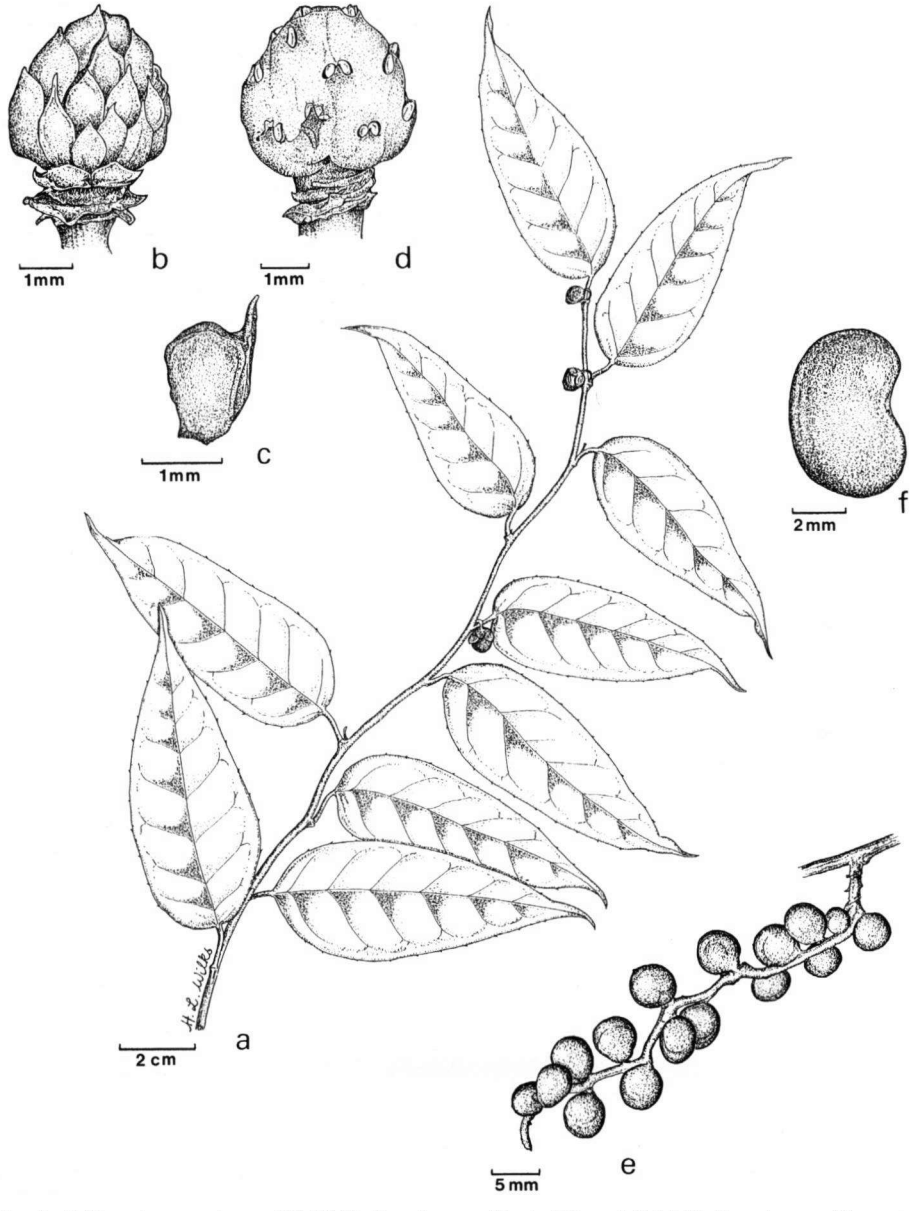

Fig. 2. *Schisandra propinqua* (Wall.) Baill. subsp. *axillaris* (Blume) R.M.K. Saunders. a. Flowering branch; b. gynoecium; c. isolated carpel (lateral view); d. androecium; e. aggregate fruit of separate berries; f. seed (a: *Blume s.n.*; b, c: *Coert 944*; d: *Brinkman 874a*; e, f: *Backer 3656*). Drawing by H.L. Wilks.

Woody *vines*, monoecious. *Leaves* coriaceous, 5–20 µm thick; lamina elliptic to ovate, 6–11.5 by 2–4.5(–5) cm, length : width ratio (2.0–)2.3–3.2(–3.5); primary vein plane to slightly impressed above, prominent to very prominent below; secondary veins (4–)5–6(–7) pairs, ± straight; base obtuse to truncate (acute in younger leaves), often short-decurrent; apex acute to acuminate; margin entire to denticulate, 0–8 teeth; petiole (8–)10–17(–21) mm long, (0.8–)1.0–1.5(–1.8) mm diameter. *Flowers* borne axillary to leaves on young growth, solitary; pedicel (2–)3–5(–12) mm long, 0.6–1.1 mm in diameter. *Perianth segments* 9–14, outer segments (green-)yellow, inner red; outermost perianth part ovate, 1.0–2.4 by 1.1–2.4 mm, length : width ratio 0.7–1.0(–1.5); innermost perianth part elliptic to ovate, (2.3–)3.5–4.0(–5.3) by 1.9–3.5 mm, length : width ratio 1.2–1.8; largest perianth part ovate, 4.3–7.8 by 4.1–6.0(–7.0) mm, length : width ratio 0.9–1.3; outermost perianth part highly reduced to 0.2–0.4 of length of largest; innermost perianth part reduced to 0.5–0.8 of length of largest. *Male flowers* with 10–13(–17) stamens, fused into carnose mass 2.8–3.9 mm diameter, with anthers borne in cavities; pollen hexacolpate. *Female flowers* with 18–37 free carpels, gynoecium 2.8–3.8 mm diameter; ovaries 1.2–1.5 by 0.7–0.8 mm, length : width ratio 1.7–2.0; pseudostyle flat-subulate, without pseudostigma. *Fruit* pedicel short, 3–8 mm long; torus 30–50 mm long; berries 15–20 (possibly more), 6.7–8.5 by 6.6–8.2 mm, length : width ratio 0.9–1.2, berries borne on short stipes. *Seeds* (1 or) 2 per berry, ± discoid. — **Fig. 2.**

Distribution — *Malesia:* Java and Bali.

Habitat — Submontane to montane forests, 1200–2200 m altitude, although Koorders (l.c.) reports '*S. axillaris*' growing at altitudes of only 400 m.

Note — Although there are numerous reports of '*S. axillaris*' from Assam, Burma and Yunnan, Smith (l.c.) has shown that these refer to *S. propinqua* (Wall.) Baill. var. *intermedia* A.C. Sm. [= subsp. *intermedia* (A.C. Sm.) R.M.K. Saunders]. It is unclear whether the '*S. axillaris*' pollen described by N. Mitroiu [Acta Bot. Hort. Bucurest. '1969' (1970) 3–243] refers to *S. propinqua* subsp. *intermedia* or subsp. *axillaris* since no voucher specimens were cited, although the pollen structure appears to be identical nevertheless.

2. **Schisandra elongata** (Blume) Baill.

Schisandra elongata (Blume) Baill., Hist. Pl. 1 (1868) 148, f. 182; Backer, Schoolfl. Java (1911) 16; A.C. Sm., Sargentia 7 (1947) 120; Backer & Bakh. f., Fl. Java 1 (1963) 99; Steenis, Mountain Fl. Java (1972) t. 2.10. — *Sphaerostema elongatum* Blume, Bijdr. (1825) 23, '*elongata*'; Fl. Javae (1830) 17, t. 5. — *Sphaerostemma elongatum* Blume ex G. Don, Gen. Hist. Dichlam. Pl. 1 (1831) 101, '*elongata*'. — Type: *Blume 1422* (L lecto), Java, Mt Burangrang.

Woody *vines*, monoecious. *Leaves* papyraceous, occasionally membranous, (3.5–)5–10 µm thick; lamina ovate, occasionally elliptic, (7–)9–12(–15) by (3.5–)4.5–7(–8.5) cm, length : width ratio (1.5–)1.7–2.1(–2.5); primary vein slightly impressed to impressed above, prominent below; secondary veins (3–)4–5 pairs, arcuate; base obtuse to truncate (acute in younger leaves), often short-decurrent; apex acuminate; margin denticulate, occasionally entire, 0–11(–15) teeth; petiole (13–)16–25(–46) mm long, (0.6–)

0.7–1.1(–1.5) mm diameter. *Flowers* borne axillary to leaves on young growth, solitary; pedicel (24–)30–40(–65) mm long, (0.2–)0.3–0.6(–0.7) mm diameter. *Perianth segments* 8–10; outermost perianth part ovate, 1.5–1.9(–3.2) by (1.5–)2.0–3.0 mm, length : width ratio (0.6–)0.9–1.2; innermost perianth part orbiculate, elliptic, ovate or obovate, (2.4–)4.2–5.2 by (2.2–)2.8–3.3 mm, length : width ratio (1.1–)1.3–2.0; largest perianth part ovate, 7.0–8.2 by (4.6–)6.9–8.4(–10.0) mm, length : width ratio 0.8–1.2(–1.5); outermost perianth part highly reduced to 0.2–0.4 of length of largest; innermost perianth part reduced to (0.3–)0.6–0.7 of length of largest. *Male flowers* with 27–30 stamens, filaments fused at the base only, androecium c. 3.5 mm diameter; pollen hexacolpate. *Female flowers* with 20–45 free carpels, gynoecium 3.0–3.4 mm diameter; ovaries 1.3–1.8 by 0.6–0.7(–0.8) mm, length : width ratio 2.0–3.0; pseudostyle round-subulate, without pseudostigma. *Fruit* pedicel elongated, 40–67 mm long; torus 31–75 mm long; berries 10–20 (possibly more), 6.8–8.6 by 4.5–6.2 mm, length : width ratio (1.1–)1.5–1.8, berries borne on short stipes 1.3–2.3 mm long. *Seeds* 2 per berry, discoid, 2.6–3.3 by 2.8–3.3 mm, length:width ratio 0.9–1.0.

Distribution — *Malesia:* endemic to Java.

Habitat — Submontane to montane forests, 1000–2000 m altitude.

Note — Although there are numerous reports of *S. elongata* from the Himalayas and Yunnan, Smith (l.c.) has shown that these refer to *S. neglecta* A.C. Sm. The '*S. elongata*' pollen described by J. Praglowski [World Pollen Spore Fl. 5 (1976) 1–32] represents *S. neglecta*.

EXCLUDED SPECIES

Kadsura blancoi Azaola in Blanco, Fl. Filip., ed. 2 (1845) 594; ed. 3 (1879) 118 = **Phytocrene blancoi** (Azaola) Merr., Philipp. J. Sc., Bot. 2 (1907) 432 (*Icacinaceae*).

Kadsura pubescens Miq., Fl. Ned. Ind., Eerste bijv. (1861) 620 = **Actinidia miquelii** King, J. As. Soc. Beng. 59, ii (1890) 196 (*Actinidiaceae*).

Schizandra elongata Hook. f. & Thomson var. *marmorata* Hallier f., Bull. Herb. Boiss. 6 (1898) 214.

The taxonomic identity unclear, although not related to '*Schizandra marmorata*' or to '*Sphaerostema marmorata*' (= *Kadsura marmorata*) as suggested by Hallier, l.c.