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RESEARCH ARTICLE

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Census of *Stemona* (*Stemonaceae*) in Thailand

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Key words

Stemona
Stemonaceae
Thailand

Abstract The genus *Stemona* is represented in Thailand by 11 species. Two new species are described: *Stemona involuta* and *S. rupestris*. A key to the species and descriptions are presented.

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INTRODUCTION

The well-defined genus *Stemona* Lour. with some 20 species (Duyfjes 1993, Kubitzki 1998) is SE Asian in its distribution. It is known to contain insecticides. In Thailand it has attracted attention by its great diversity in morphological characters, whereby some species are difficult to define. Vegetatively, observations on plants taken into cultivation have resulted in apparently even more difficult species identification. Most species of *Stemona* occur in seasonal climates, each year dying off to the short rootstock with conspicuous tuberous roots, and sprouting again in or at the end of the dry season, often after burning. All over Thailand, but especially in the NE and E of the country, long dry seasons prevail, with extensive burning and sometimes inundation thereafter. Low, mostly (sub)erect growing plants, found in various types of scrub-savanna on poorer soils, at first sight looked taxonomically problematic through their level of variation, especially in leaf shape, but it was found that they could be placed together in the vegetatively variable taxon *S. cochinchinensis* Gagnep.

Our present enumeration is a result of herbarium, field and garden studies. As for literature, the treatments by Gagnepain (1934a, b) for Indochina are primarily taken into account. Other useful taxonomic studies or notes on the genus are those of Prain (1904) for Myanmar; Duyfjes (1993) for Malesia; Craib (1912, 1920), Maxwell (1991) and Chuakul (2000) for Thailand; Tsi (1978) and Ji & Duyfjes (2000) for China. The Flora of Thailand treatment of the family is in preparation.

SPECIES DELIMITATION AND MORPHOLOGICAL CHARACTERS

In all species the delimitation seems arbitrary in some or various aspects, the rather homogenous *S. kerrii* excepted. Three species, *S. aphylla*, *S. involuta*, and *S. phyllantha*, regularly flower precociously, when fully leafy shoots have not yet developed, and these may look quite dissimilar from the leafy growth form.

In addition to characters of the habit of the plant, (mainly climbing vs erect), leaf-disposition and the inflorescence (sessile vs pedunculate), useful taxonomic characters can be found in the flowers, their size and especially details of the stamens. Fruits, more commonly produced than in the other Thai genus of *Stemonaceae*, *Stichoneuron*, are in dried state often much resembling each other in shape and size and therefore less suitable for distinction in the 'difficult' species, although the perianth is often persistent in fruit and through this the dimensions of the tepals can be established. For aril and seed morphology, the same holds as for the fruits.

The stamens are peculiar in the long extension of the connective, which varies from awl-shaped or subulate to narrower than the anther, or more broader, band-shaped, about as broad as the anther, and then provided with 'thickened' tissue difficult to define in dried material. The growth form of all species, including the leaf arrangement and whether the inflorescences are sessile and/or pedunculate, is depicted in Fig. 1.

Apart from the conspicuous connective extension, a second additional appendage on top of the thecae may be present in some species. For Malesia (Duyfjes 1993) the presence or absence of the additional thecal appendage appeared useful in the species delimitation, and in Thailand the additional appendages are well-developed in *S. pierrei*, in the widespread *S. tuberosa* and in its close relative *S. phyllantha*; it is less conspicuous in *S. burkillii* and in *S. rupestris*. As verifying the absence or presence of the thecal-appendage needs closer inspection of the flower, this character is used only when necessary in discriminating much resembling species.

The colour of the tepals, which varies from purplish, dirty greenish, or pinkish, often with longitudinal stripes, may well be characteristic, but is difficult to define and unsuitable in the herbarium. The same holds for the possibly characteristic smell; the two large-flowered species *S. phyllantha* and *S. tuberosa* have differently smelling flowers, the other species have no apparent smell. Very little is known about the supposed pollinating insects (carrion flies).

Regarding the morphological explanation of the connective appendage and the thecal appendage it is our impression that the latter might represent a part of the sterile apical portion of the anther. This can be seen in various species where the fertile thecae continue in a sterile state (the thickened tissue as alluded to above) on the connective appendage. In species with an additional thecal appendage, the sterile thecae-remnants as present on the connective appendage in some species,

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Fig. 1 Growth habits of *Stemona* species in Thailand. — a. Small branched twiners, inflorescences pedunculate, flowers small or medium: 5. *S. curtisii*, 7. *S. kerrii.* — b. plant erect, leaves cordate, lowermost inflorescences sessile: 4. *S. collinsiae.* — c. plant erect, leaves cordate, all inflorescences pedunculate: 2. *S. burkillii.*— d. low, erect or decumbent herbs, or small unbranched twiners, leaf base cuneate or truncate, inflorescences (sub)sessile, flowers small: 3. *S. cochinchinensis*, 9. *S. pierrei*, 10. *S. rupestris.* — e. larger unbranched twiners, upper leaves opposite, flowers large: 8. *S. phyllantha*, 11. *S. tuberosa.* — f. medium-sized unbranched twiners, inflorescences (sub)sessile, flowers medium: 1. *S. aphylla*, 6. *S. involuta.*

might have become united and detached. See Fig. 2e, f; 3c, d; 4d–f; 5e, d.

The tubers differ between the species, but, specially in dried specimens, the difference is difficult to define, and is not practical. For the species the tubers are described in the field-notes. Inthachub (2008) pays attention to these differences and found that *S. curtisii* has the most slender tubers.

Stemona

Stemona Lour. (1790) 404; Hook.f. (1883) 747; (1892a) 298; C.H.Wright (1896) 490; Prain (1904) 39; Ridl. (1924) 320; Gagnep. (1934b) 745; Duyfjes (1993) 399; Kubitzki (1998) 422; Z.H.Ji & Duyfjes (2000) 70; Inthachub (2008) 37. — Type: *Stemona tuberosa* Lour.
Roxburghia Roxb. (1795) 29, t. 32. — Type: *Roxburghia gloriosoides* Roxb.

Erect, twining, or trailing herbs, glabrous or hairy, with short perennial rootstock; roots many, tuberous, fusiform; stem in lower part with sheathing cataphylls; prophyll inconspicuous.

Leaves alternate, opposite, or in whorls; petiole at base somewhat pulvinate, not sheathing; blade simple, ovate or (narrowly) elliptic, broadest at or below the middle, margin entire, apex acute-acuminate, 6–13-veined from the base, and curved to the apex, secondary venation fine, transverse and scalariform between the primary veins. *Inflorescences* axillary, sessile or pedunculate; flowers few, subumbellate, raceme-like, bracts narrow; buds elongate, 5–55 mm long, acute. *Flowers* with articulate pedicels, the part below articulation persistent; bracts narrow, acute, margin entire, (sub)persistent; perianth of 4 tepals; tepals imbricate, free, narrow (the outer ones narrower), recurved or reflexed at anthesis, apex mostly acute (-acuminate); longitudinally striped and veined; persistent in fruit; stamens 4, anthers with the thecae dorsally attached to a long connective with a petaloid outgrowth, the two thecae either apically with 1 common additional appendage and the apices of all 4 stamens connivent, or additional appendage lacking, filaments short, bases shortly connate and adnate to tepals; ovary superior, ovoid, small, 1.5–3(–4) by 1(–3) mm, glabrous, 1-celled, ovules few or many, basally attached, stigma minute, sessile. *Fruit* ripening green, glabrous, capsular, opening with 2 valves from the apex, elongate, apex acute or shortly beaked; pericarp thin; perianth persistent. *Seeds* 3–20, red or brown, mostly elongate, (5–)7–12(–15) by (2–)3–4 mm, often shortly beaked (globose in *S. kerrii*, c. 5 mm across), longitudinally ridged; aril consisting of finger-like or vesicular lobes, covering the base of the seed; funicle long, pseudo-funicle lacking.

A genus of about 20 species distributed in China and Japan, through Malesia east to Australia; 11 species in Thailand.

Note — Veldkamp (2007) gives the complicated history of the nomenclature of the genus *Roxburghia* Roxb.

KEY TO THE SPECIES

1. Plant hairy. Tepals 10–12 mm long . . . . . 7. *S. kerrii*
1. Plant glabrous. Tepals small or large, 5–55 mm long . . . 2
2. Tepals 6–15 mm long. Leaf base cuneate, rounded, truncate or subcordate 3
2. Tepals 15–55 mm long. Leaf base cordate 6
3. Plant twining, (0.7–)1–1.5 m high. Thecal appendage present . . . . . 9. *S. pierrei* (partly)
3. Plant c. 50 cm high (long) or less, erect, procumbent or weakly twining 4
4. Tepals 10–15 mm long. Thecal appendage present . . . . . 10. *S. rupestris*
4. Tepals 10 mm long or less. Thecal appendage present or absent 5
5. Thecal appendage present. Tepals 6–8 mm long . . . . . 9. *S. pierrei* (partly)
5. Thecal appendage lacking. Tepals 8–10 mm long . . . . . 3. *S. cochinchinensis*
6. Leaves all alternate 7
6. Most leaves opposite or ternate (basal leaves often alternate) 11
7. Plant erect, low (c. 30 cm high), apex proliferating into a short mostly sterile somewhat twining portion 8
7. Plant twining, c. 1 m high or more 9
8. Lowermost inflorescences sessile, usually 1-flowered, towards stem apex pedunculate, few-flowered. Inner tepals broad, to 10 mm broad, acute. Petaloid connective outgrowth broad, c. 1.5 mm broad, ± irregularly swollen . . . . . 4. *S. collinsiae*
8. All inflorescences pedunculate. Inner and outer tepals narrow, 3–5 mm broad, acuminate towards apex. Petaloid connective outgrowth narrowed, less than 1 mm broad, not swollen . . . . . 2. *S. burkillii*
9. Inflorescences pedunculate. Mainly in Peninsular and SW Thailand . . . . . 5. *S. curtisii*
9. Inflorescences sessile. (Sometimes precociously flowering.) NE Thailand 10
10. Tepals 20–25 mm long. Petaloid connective outgrowth (mostly) spreading . . . . . 1. *S. aphylla*
10. Tepals 15–19 mm long. Petaloid connective outgrowth involute . . . . . 6. *S. involuta*
11. Peduncle of inflorescence mostly (shortly) fused with petiole. Tepals 40–60 mm long. (Sometimes precociously flowering.) NE Thailand . . . . . 8. *S. phyllantha*
11. Peduncle not fused with petiole. Tepals 25–35 mm long . . . . . 11. *S. tuberosa*

1. *Stemona aphylla* Craib

Stemona aphylla Craib (1912) 408; Gagnep. (1934b) 750. — Type: *Kerr 2351* (holo K), Thailand, near Phre, Me Ta (Phrae, Mae Tha), Feb. 1912.

Twiner, stems 2–3(–4) m long, glabrous, sometimes precociously flowering on erect shoots. *Leaves* alternate; petiole 4–6.5 cm long; blade ovate or broadly ovate, 6–8 by 3–4.5 cm, 9–11-veined, base (shallowly) cordate or truncate. *Inflorescences* borne in the axils of scale-like leaves or in the axils of distal leaves, 1–2(–3)-flowered, sessile or on short peduncles to 5 mm long; bracts 8–10 mm long. *Flowers*: pedicel 5–20 mm long; tepals narrowly triangular, 20–25 by 4–6 mm; *stamens* (15–)20–27 by c. 2 mm, filaments c. 2 mm long, anthers 8–13 mm long, ridge separating the thecae fleshy, smooth and somewhat undulate, c. 1 mm high, petaloid outgrowth of the connective subulate, 8–14 mm long, additional appendage lacking. *Fruit* 20–30 by 13–16 mm. *Seeds* 5–6(–10), light brown, 10–12 by c. 4 mm; aril with finger-like lobes.

Field-notes — The tepals are recorded as pink or yellowish pink or greenish purple; stamens as purple or pink; the tuberous roots as 10–30 cm long, c. 1 cm thick.

Distribution — Endemic to Thailand (Northern: Chiang Mai (type), Lampang, Phrae, Nakhon Sawan; North-Eastern: Phetchabun, Loei, Udon Thani, Khon Kaen).

Habitat & Ecology — In dry evergreen forest, (mixed) deciduous hardwood forest with much bamboo; on shale bedrock and in rugged limestone terrain and on limestone foothill; 240–700 m altitude. Flowering: February to May. Quite frequently encountered flowering precociously on shorter shoots with scale-like leaves only, possibly following burning.

Notes — 1. *Stemona aphylla* resembles the smaller-sized *S. pierrei*, the latter differs in having tepals c. 8 mm long only, and a thecal appendage. Also *S. involuta* is closely related (see below).

2. The precociously flowering *S. squamigera* Gagnep., from Laos, is possibly a synonym of *S. aphylla*.

2. *Stemona burkillii* Prain

Stemona burkillii Prain (1904) 43; Craib (1912) 408; Gagnep. (1934b) 752; J.F.Maxwell (1991) 81. — Syntypes: *Burkill* (CAL, not seen), Myanmar, Katha; *Abdul Huq* (CAL, not seen), Myanmar, Shan Hills. (Collection numbers not indicated).

Erect, later on weakly proliferating and subscandent herb up to 1 m high, glabrous, the proliferating apical part usually sterile. *Leaves* alternate; petiole 4–17 cm long; blade (broadly) ovate, 9.5–17 by 5.5–10.5 cm, base cordate; (11–)13–17(–19)-veined. *Inflorescences* borne in the axils of basal scale-like leaves as well as in the axils of distal leaves, 1–4-flowered, pedunculate; peduncle 1.5–4.5 cm long; bracts 2–6 mm long. *Flowers*: pedicel 10–25 mm long, tepals narrowly triangular, (15–)18–22 by 3–5 mm; *stamens* 18–20 mm long, filaments 1.5–2 mm long, anthers 6–8 mm long, ridge separating the thecae fleshy,

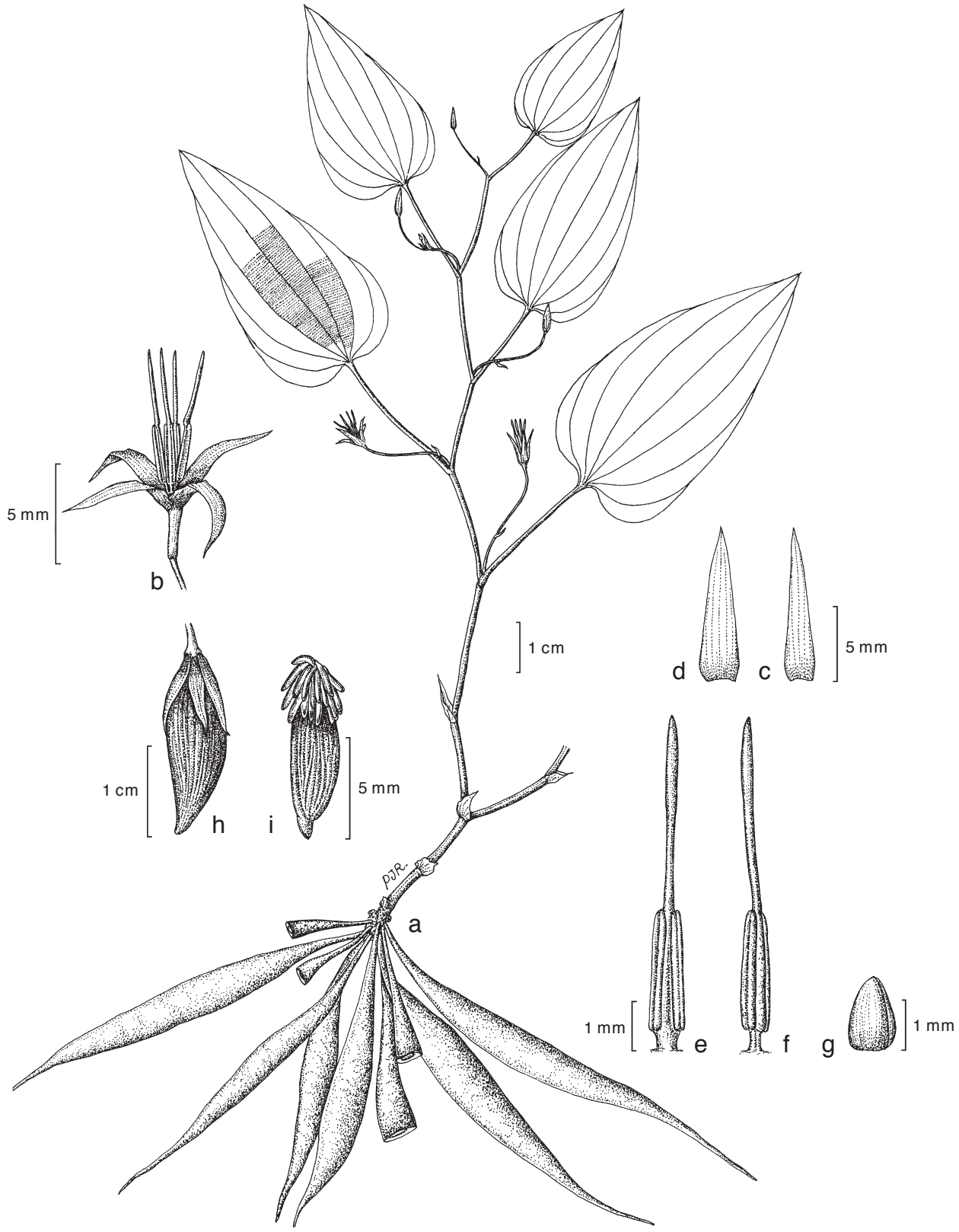

Fig. 2 *Stemona cochinchinensis* Gagnep. a. Complete plant; b. flower; c, d. outer and inner tepal, respectively; e, f. anthers, note subulate outgrowth of the connective; g. ovary; h. fruit, note persistent tepals; i. seed, base surrounded by finger-like lobed aril (all: *Inthachub 31*).

smooth, c. 1 mm high, petaloid outgrowth of the connective subulate, c. 7 mm long, minute additional appendage sometimes present. *Fruit* 25–35 by 12–15 mm. *Seeds* 3–5, dark pink, 10–12 by 3–4 mm; aril finger-like lobed.

Field-notes — The tepals are recorded as pink or yellowish pink or purple inside and paler outside; stamens as pink and yellowish; petaloid outgrowth of the connective as green at apex; the tuberous roots as 10–30 cm long, c. 1 cm thick.

Distribution — Upper Myanmar (syntypes), Thailand (Northern: Chiang Mai, Lamphun, Lampang, Tak, Phitsanulok; North-Eastern: Phetchabun, Loei; South-Western: Kanchanaburi; Central: Saraburi).

Habitat & Ecology — Deciduous dipterocarp-oak and dry dipterocarp forest, often with much bamboo; on shaded places and near streams; on limestone and granite bedrock; at 100–925 m altitude. Flowering: February to August; fruiting: July to August.

3. *Stemona cochinchinensis* Gagnep. — Fig. 2

Stemona cochinchinensis Gagnep. (1934a) 146; (1934b) 748. — Type: *Pierre s.n.* (holo P), Vietnam, Bienhoa, Bao-chian, Oct. 1877.
Stemona hutanguriana Chuakul (2000) 977. — Type: *Wongsatit Chuakul 274* (holo PBM, not seen; isotypes RAMA IX Herbarium, not in BK and BKF as stated in the protologue), Thailand, Eastern, Ubon Ratchathani, Pa Ban Dong Forest, 10 Nov. 1997.

Herb erect or weakly climbing or trailing, 20–30(–60) cm high, glabrous, sometimes branched. *Leaves* alternate; petiole 1–5 cm long; blade (broadly) ovate, 4–7 by 2–4.5 cm, base cuneate, truncate or shallowly cordate; 7–9-veined. *Inflorescences* 1–3-flowered, sessile or pedunculate; peduncle 1–3 cm long; bracts 2–17 mm long. *Flowers*: pedicel 3–5 mm long; tepals narrowly triangular, 8–10 by 2–2.5 mm; *stamens* 6.5–7(–9) by c. 0.5 mm, filaments c. 1 mm long, anthers 2.2–3 mm long, ridge separating the thecae smooth, petaloid outgrowth of the connective subulate, 3–4 mm long, additional appendage lacking. *Fruit* 16–20 by c. 7 mm. *Seeds* 1–3, dark brown, c. 7 by 3 mm; aril finger-like lobed.

Field-notes — The tepals are recorded as pink or white or dirty purplish greenish; the stamens as white; the roots as 10–16 cm long, c. 1 cm thick.

Distribution — Vietnam (type), Thailand (North-Eastern: Udon Thani, Nong Khai, Mukdahan; Eastern: Surin, Si Sa Ket, Ubon Ratchathani).

Habitat & Ecology — Dry evergreen and dry deciduous mixed dipterocarp forest; dry rice fields; shady, sandy, often rather wet places; at 120–250 m altitude. Flowering: March to August; fruiting: August.

4. *Stemona collinsiae* Craib

Stemona collinsiae Craib (1920) 305; Gagnep. (1934b) 750. — Syntypes: *Collins 131* (K, BM), *Collins 399* (K), *Kerr 4241* (K). — Type: *Collins 131* (lecto K, here designated; isolecto BM), Thailand, South-Eastern, Sriracha, Chon Buri, April 1913.

Erect, later on climbing or trailing, herb to 60 cm long, glabrous, rarely branched, sterile towards apex when climbing. *Leaves* alternate; petiole 5–15 cm long; blade broadly or narrowly ovate, 11–15 by 5–11 cm, base cordate; 11–15(–17)-veined. *Inflorescences* 1–8-flowered, sessile (basal ones) and pedunculate; peduncle 1–4.5 cm long; bracts c. 1 mm long. *Flowers*: pedicel 5–30 mm long; tepals narrowly ovate, 13–20 by 5–8 mm, the inner ones broadest, to 10 mm broad, and towards the apex rather abruptly narrowed; *stamens* 11–17 by 2 mm, filaments c. 1 mm long, anthers 5–7 mm long, ridge separating the thecae smooth, c. 1 mm high, petaloid outgrowth of the connective narrowly ovate, 8–9 mm long, only slightly narrower than anthers, with narrow thecal remnants, additional appendage lacking. *Fruit* 20–25 by 10–12 mm. *Seeds* 3–6, pink-red, 10–12 by 3–4 mm; aril finger-like lobed.

Field-notes — The tepals are recorded as whitish green or pinkish white, with green veins; the stamens as yellowish green, the petaloid outgrowth of the connective as yellow; the tuberous roots as 10–40 cm long, 1–1.5 cm thick.

Distribution — Laos, Thailand (Eastern: Nakhon Ratchasima; Central: Saraburi; South-Eastern: Sa Kaeo, Chon Buri (lectotype), Chanthaburi), Trat.

Habitat & Ecology — Dry evergreen, dry deciduous and bamboo forest, mixed deciduous scrub and swampy thicket; rugged limestone terrain; 25–450 m altitude. Flowering: January to May; fruiting: March to May.

Notes — 1. *Stemona collinsiae* is similar to *S. burkillii*; in the latter all inflorescences are pedunculate, in *S. collinsiae* the basal ones are sessile. In addition the petaloid outgrowth of the connective is different.

2. On the label of *Collins 131* the following information is written: “The roots are collected about November every year about Sriracha and neighbouring villages and sold to local agents to be exported to Chantabun to be used in the pepper gardens there – for spraying the vines when they come into bloom to destroy beetles and insects that attack them. – The roots are well bruised and soaked in water and the water is used for spraying on the vines. The roots are collected when the plant withers”.

5. *Stemona curtisii* Hook.f

Stemona curtisii Hook.f (1892a) 298, p.p.; (1892b) plate 7254; Ridl. (1907) 86; (1924) 320, f. 194; M.R.Hend. (1954) 172; Duyfjes (1993) 403. — Type: *Curtis 1522* (holo K; iso BM), Peninsular Malaysia, Penang, waterfalls.
Stemona tuberosa auct. non Lour.: Ridl. (1907) 86.

Twiner 1–2 m high, glabrous, somewhat branched. *Leaves* alternate, seldom opposite; petiole 4–12 cm long; blade (narrowly) ovate, 6–21 by 2.5–12.5 cm, sometimes slightly rough, base (shallowly or) broadly cordate; 11–17(–19)-veined. *Inflorescences* 1–many-flowered, pedunculate; peduncle 1–10 (–18) cm long, not fused with the petiole; bracts 6–20 mm long. *Flowers*: pedicel 10–20 mm long; tepals narrowly triangular, 17–30 by 5(–7) mm; *stamens* 18–25 mm long, filaments c. 2 mm long, anthers 12–15 mm long, with narrow sterile thecal remnants up to the apex, ridge separating the thecae smooth, 1–1.5 mm high, petaloid outgrowth of connective gradually tapering, 6–10 mm long, additional appendage lacking. *Fruit* 25–30 by c. 15 mm. *Seeds* 5–10, dark red, 10–15 by 3–3.5 mm; aril finger-like lobed.

Field-notes — The tepals are recorded as pink, brown-pink or dark brownish red; the stamens as reddish maroon; the tuberous roots as 10–60(–80) cm long, 1–1.5 cm thick.

Distribution — Sri Lanka, Thailand (South-Western: Kanchanaburi, Ratchaburi, Phetchaburi, Prachuap Khiri Khan; Peninsular: Chumphon, Surat Thani, Krabi, Nakhon Si Thammarat, Phatthalung, Trang, Satun, Songkhla, Pattani, Narathiwat), Sumatra (Lepar Archipelago), Peninsular Malaysia (type).

Habitat & Ecology — Deciduous, evergreen, and secondary forest, not far from the coast, on riverbanks, near waterfalls, in thickets and scrub; on sand, limestone, and poor granitic soil; from sea level to 600 m altitude. Flowering: December to July; fruiting: February to November.

6. *Stemona involuta* Inthachub, *sp. nov.* — Fig. 3

A *Stemona aphylla* tepalis brevioribus 15–19 mm longis, connectivi appendice petaloidea distaliter involuta differt. — Typus: *Inthachub 130* (holo BKF; iso L), cultivated at Kasetsart University Bangkok from plants collected in Eastern, Nakhon Ratchasima, 19 Mar. 2005.

Twiner or trailer to 1 m high, glabrous, regularly precociously flowering, occasionally branched. *Leaves* alternate; petiole 3.5–6.5 cm long; blade cordate or triangular-ovate, 5–11 by 4–7 cm, base shallowly cordate or truncate; 7–9-veined. *Inflorescences* 1-flowered, borne in the axils of leaf-like scales or leaves, sessile; bracts c. 7 mm long. *Flowers*: pedicel 5–17 mm long; tepals narrowly ovate, 15–20 by 3–5 mm; *stamens* 13–15 by c. 2 mm, filaments c. 1 mm long, anthers c. 5 mm long, ridge separating the thecae smooth, 0.5 mm high or less, petaloid outgrowth of the connective c. 12 mm long with involute margins, additional appendage lacking. *Fruit* c. 13 by 10 mm. *Seeds* 3–6, light brown, 7–8 by 3–4 mm broad; aril finger-like lobed.

Field-notes — The tepals are recorded as pink or dark purple, outside green-veined; the tuberous roots as 10–30 cm long, c. 1 cm thick.

Distribution — Possibly endemic to Thailand (Northern: Sukhothai; North-Eastern: Khon Kaen; Eastern: Nakhon Ratchasima (type), Buri Ram; (perhaps also South-Western: Kanchanaburi)).

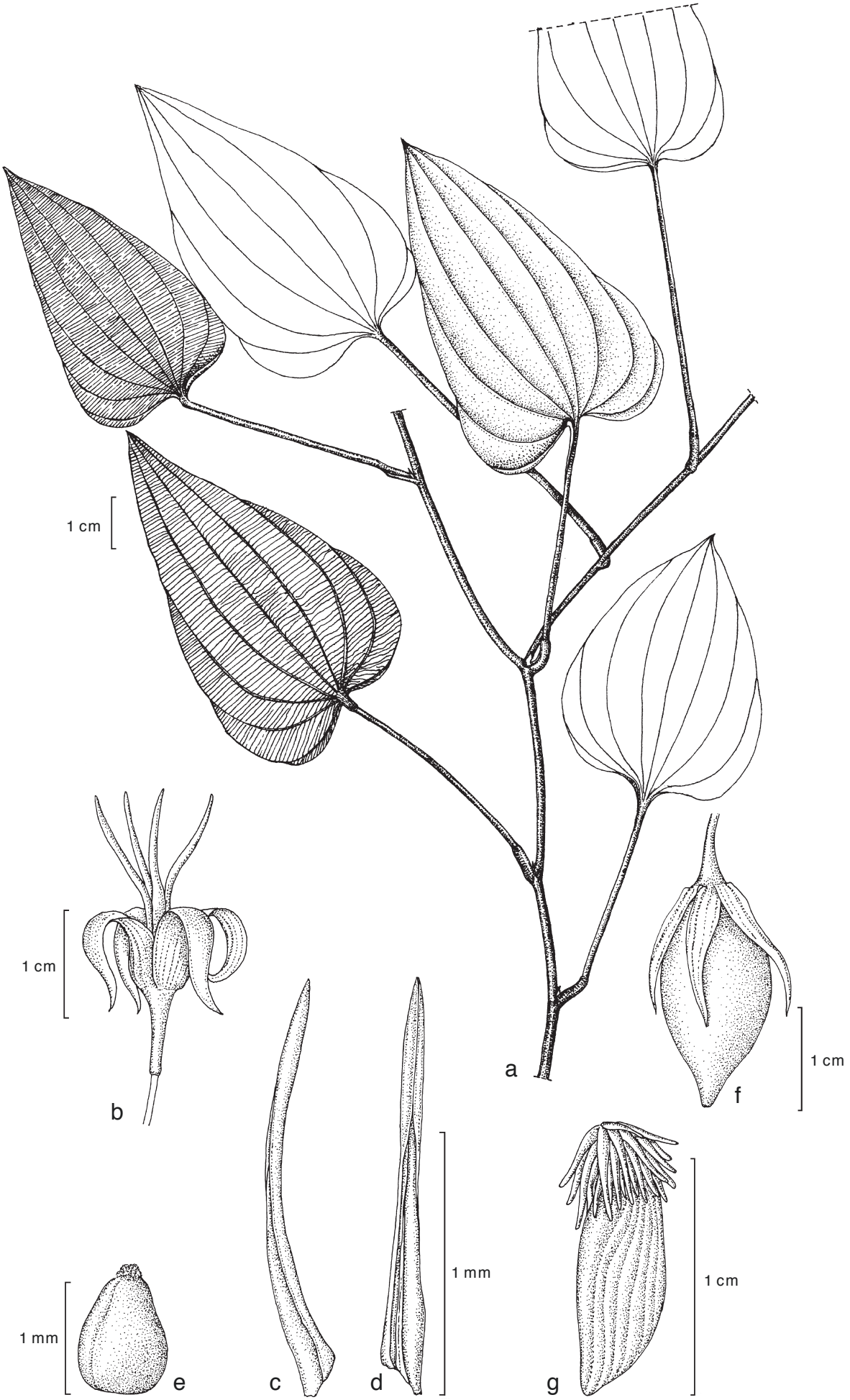

Fig. 3 *Stemona involuta* Inthachub. a. Detail of habit; b. flower; c, d. anthers; e. ovary; f. fruit; g. seed (all: *Inthachub 130*).

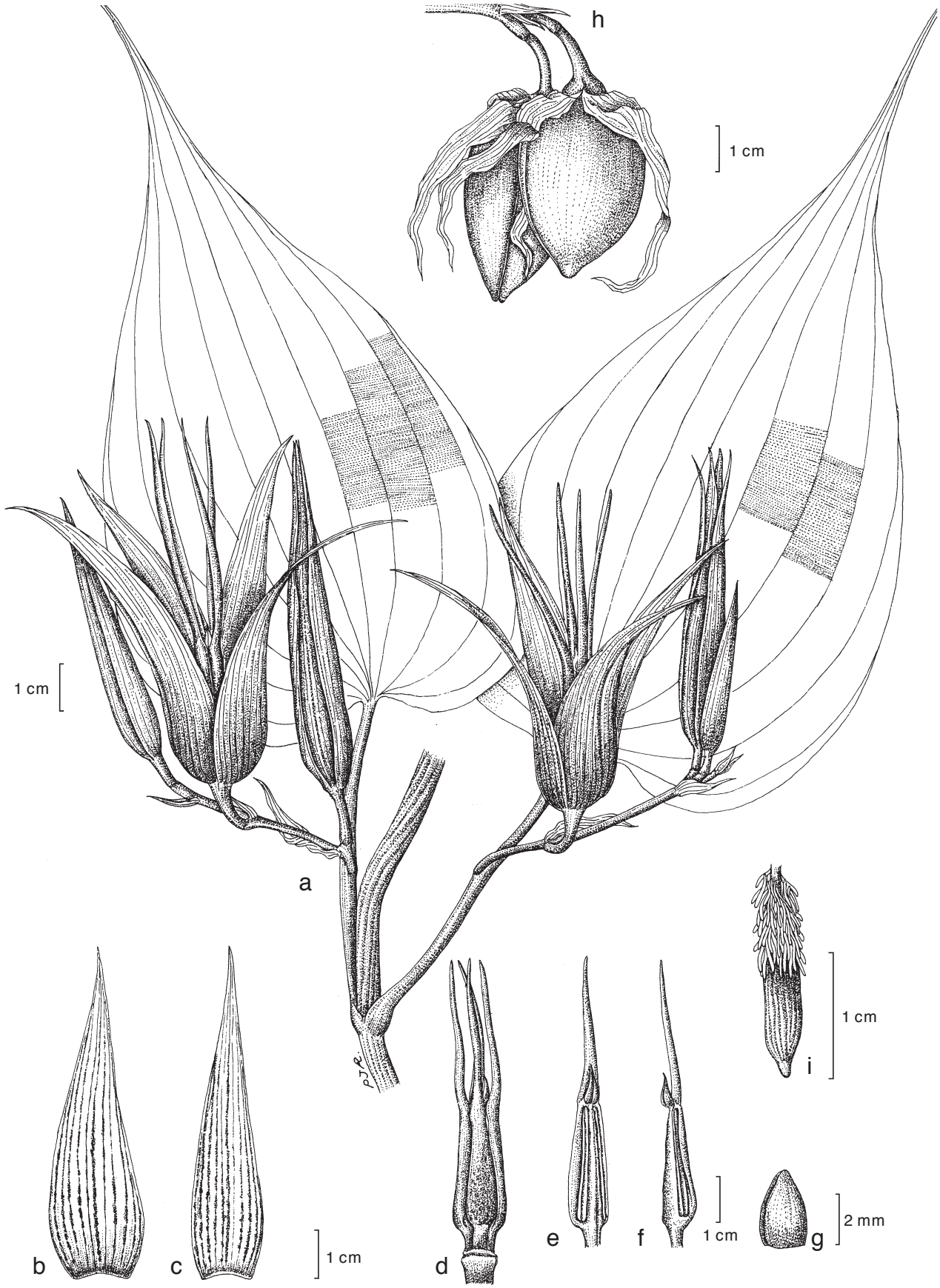

Fig. 4 *Stemona phyllantha* Gagnep. a. Flowering node; b, c. outer and inner tepal, respectively; d. anthers with subulate outgrowth of connective seen from outside, tepals removed; e, f. anthers, note subulate additional appendages; g. ovary; h. node with 2 fruits; i. seed, base surrounded by finger-like lobed aril (a–g: *Inthachub 148*, h, i: *Inthachub 153*).

Habitat & Ecology — In deciduous forest on rocky ground, edge of fallow fields; at 100–300 m altitude. Flowering: February to March and October; fruiting: March.

Note — *Stemona involuta* is similar to *S. aphylla*; the latter differs in having larger flowers with flat petaloid outgrowth of the connective.

Selected specimens examined. *Greger et al. 896* (WU), Eastern, Nakhon Ratchasima, 16 Feb. 2003; *Greger 943* (WU), Eastern, Nakhon Ratchasima, 6 Oct. 2003; *Inthachub 130* (BKF, L, type), Eastern, Nakhon Ratchasima, 19 March 2005; *Kerr 20660* (L), North-Eastern, Khon Kaen, 16 March 1932; *Put 2817* (L), Eastern, Buri Ram, 14 March 1930.

7. *Stemona kerrii* Craib

Stemona kerrii Craib (1912) 408; Gagnep. (1934b) 752; J.F.Maxwell (1991) 82; Z.H.Ji & Duyfjes (2000) 71. — Type: *Kerr 707* (holo K, barcode K000292143; iso BM, K (3 sheets), L (4 sheets)), Thailand, Northern, Chiang Mai, Doi Suthep, 27 June 1909.

Twiner (50–)100 cm high, finely hairy all over, branched. *Leaves* alternate; petiole 1.5–4 cm long; blade broadly ovate, 4–7 by 3–5 cm, base cordate; (9–)13–17-veined. *Inflorescences* axillary or rarely fused with petiole, 1–4-flowered, pedunculate; peduncle 1–2.5 cm long; bracts c. 5 mm long. *Flowers*: pedicel 15–45 mm long; tepals narrowly ovate, 10–12 by 3–4 mm, margin with short hairs; *stamens* 8–12 by c. 2 mm, filaments less than 0.5 mm long, anthers 2–4 mm long; ridge separating the thecae c. 0.5 mm high, smooth, continuing above the thecae as a c. 1 mm high ridge on the outgrowth of the connective, with distally a c. 1 mm long patent, elongate yellow body, petaloid outgrowth of the connective narrowly triangular, c. 6 by 2 mm, somewhat folded, additional appendage lacking. *Fruit* ovoid, 12–14 by 8–10 mm, glabrous. *Seeds* 1–3, light brown, nearly globose, c. 5 mm across; aril broadly finger-like lobed.

Field-notes — The tepals are recorded as yellowish purple; the stamens as dark purple or maroon, the outgrowth of the connective deep purple-blackish; the tuberous roots as 5–10 cm long, c. 1 cm thick.

Distribution — China (S Yunnan), Laos, Thailand: (Northern: Mae Hong Son, Chiang Mai (type), Lamphun, Lampang, Tak).

Habitat & Ecology — Deciduous forest with bamboo, mixed dipterocarp-oak forest, often with much bamboo and near streams; on granite and limestone; at 200–900 m altitude. Flowering: November to March and June to August; fruiting: July and November.

Note — The above described ‘body’ on the connective appendage reminds of an additional thecae-appendage, but it is not connected with the apices of the thecae. Its origin and possible function is unknown. The petaloid outgrowth of the connective is finely serrately ribbed all over, which may have some function in pollination.

8. *Stemona phyllantha* Gagnep. — Fig. 4

Stemona phyllantha Gagnep. (1934a) 147; (1934b) 747. — Type: *Pierre 82* (holo P; iso K), Thailand, South-Western, Phetchaburi, Mt Talang, June1868.

Twiner 2–6 m high, glabrous, ± branched, regularly precociously flowering. *Leaves* alternate, opposite, or whorled; petiole 5–9 cm long; blade (broadly) ovate, 12–17 by 8–10 cm, base (shallowly) cordate, 9–13-veined. *Inflorescences* axillary to lower scale-like leaves (precociously flowering) or fused with the petiole of leaves for (0.2–)0.5–1.5 cm, 1–3-flowered, pedunculate; peduncle 3–8 cm long; bracts 5–10 mm long. *Flowers*: pedicel 5–15 mm long; tepals narrowly triangular, 55–65 by 12–20 mm; *stamens* 50–60 mm long, filaments c. 5 mm long, anthers 17–20 mm long and c. 5 mm broad, ridge separating the thecae smooth, c. 2 mm high, petaloid outgrowth of connective conical, 27–30 mm long, additional appendage 5–7 mm long. *Fruit* (narrowly) ovoid, 30–40 by 20–30 mm. *Seeds* 10–12 (ovules 20–25), dark brown, c. 15 by 2.5–3 mm; aril finger-like lobed.

Field-notes — The tepals are recorded as outside green or yellowish green with dark green and purple-red veins towards the tips, inside with purple-red stripes, the stamens as purple at base, and yellowish green towards the apex, the anthers as red-brown; the tuberous roots as 40–50 cm long, 2–4 cm thick. The flowers have a carrion smell.

Distribution — Cambodia, Thailand (Northern: Nakhon Sawan, North-Eastern: Loei, Khon Kaen; Eastern: Chaiyaphum, Nakhon Ratchasima; South-Western: Kanchanaburi, Phetchaburi (type); South-Eastern: Chon Buri, Rayong, Chanthaburi).

Habitat & Ecology — Mixed deciduous forest; near waterfalls; on limestone and granite rocks near the coast; sea level up to (probably) over 1 000 m altitude. Flowering: February to April; fruiting: September.

9. *Stemona pierrei* Gagnep.

Stemona pierrei Gagnep. (1934a) 147; (1934b) 749. — Syntypes: *Thorel 1088*; *Pierre s.n.*, 25 April 1870, 28 March 1870, April 1870; *Poilane 162*. — Type: *Thorel 1088* (lecto P, here designated; isolecto BO, K), Laos, Stung-Streng, Phuoc-Than, between 1862 and 1866.

Twiner 1–1.5 m high, or sometimes erect herb c. 30 cm high, glabrous. *Leaves* alternate; petiole c. 2 cm long; blade ovate, 4–7 by 2–3.5 cm, base subtruncate, 5–9-veined. *Inflorescences* 1–3(–6)-flowered, sessile; bracts c. 4 mm long. *Flowers*: pedicel c. 4 mm long; tepals narrowly ovate, 6–8 by c. 2 mm; *stamens* 7–8 mm long, filaments 1.3–2 mm long, anthers 2–2.5 mm long, ridge c. 0.5 mm high, petaloid outgrowth of the connective subulate, 3–4 mm long, additional appendage 1.5–2.5 mm long. *Fruit* ovoid, c. 20 by 10 mm. *Seeds* 1 or 2, brown, c. 10 by 3 mm; aril irregularly vesicular-lobed.

Field-notes — The tepals are recorded as dark red or purple-black, contrasting with white pollen shed from the anthers, the outgrowth of the connective as almost black; the tuberous roots as 10–20 cm long, c. 1 cm thick.

Distribution — Laos (lectotype), Vietnam, Thailand (Eastern: Surin, Si Sa Ket, Ubon Ratchathani).

Habitat & Ecology — Scattered in open scrub vegetation and rather wet area of dry dipterocarp forest. Flowering: February and September.

Note — Specimens may be short and erect or later on growing through into twiners.

Specimens examined. *De Wilde & Duyfjes 22327* (L), cultivated from roots bought in market, Sept. 2009; *Greger & Vajrodaya 910* (WU), Eastern, Surin, 22 Feb. 2002; *Inthachub 156* (BKF), Ubon Ratchathani; *Thorel 1088* (P, K, type), Laos, Stung-Streng, between 1862 and 1866.

10. *Stemona rupestris* Inthachub, *sp. nov.* — Fig. 5

A *Stemona pierrei* et *S. cochinchinense* tepalis longioribus 10–15 mm longis, a posteriore praesentia thecarum appendice differt. — Typus: *Inthachub 87* (holo BKF; iso L), Thailand, North-Eastern, Sakon Nakhon, Phu Phan NP, Tham Seri Thai cave trail, 1 Aug. 2004.

Erect or procumbent somewhat branched herb to 30 cm high, glabrous. *Leaves* alternate; petiole 2–5 cm long; blade ovate or narrowly ovate, 5.5–12 by 2.5–7.5 cm, base cuneate, rounded, or truncate, 5–7-veined. *Inflorescences* 1–5-flowered, sessile; bracts c. 3.5 mm long. *Flowers*: pedicel 4–10 mm long; tepals narrowly ovate, 10–15 by 2–3.5 mm; *stamens* 9–10 mm long, filaments less than 0.5 mm long, anthers 5–6 mm long, ridge separating the thecae fleshy, smooth, c. 0.5 mm high, petaloid outgrowth of the connective smooth, subulate, c. 7 mm long, additional appendage 1–1.5 mm long. *Fruit* (immature) c. 15 by 6 mm. *Seeds* 2–4, brown, c. 11 by 2 mm; aril vesicular-lobed.

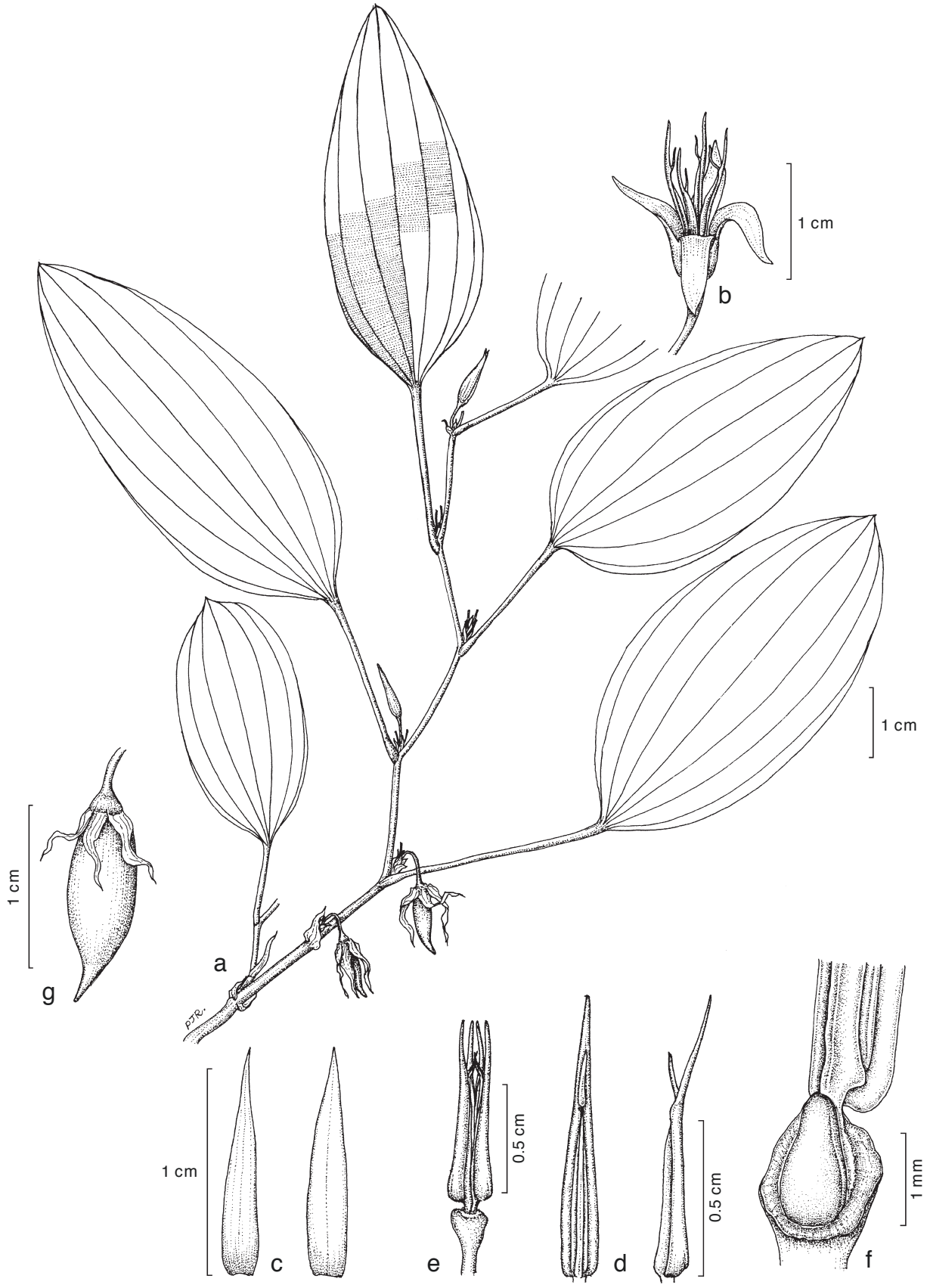

Fig. 5 *Stemona rupestris* Inthachub. a. Detail of habit; b. flower; c. outer (left hand) and inner tepal; d. stamens; e. androecium; f. detail of flower, tepals removed, showing ovary and base of stamen; g. fruit (all: *Inthachub 87*).

Field-notes — The tepals are recorded as dark purple, greenish veined; the tuberous roots as 10–25 cm long, c. 1 cm thick.

Distribution — Endemic to Thailand (North-Eastern: Sakon Nakhon (type), Mukdahan).

Habitat & Ecology — Scattered in blanket marsh vegetation on sandstone hill; dry or rarely wet area in deciduous dipterocarp forest; at c. 300 m altitude. Flowering: August.

Specimens examined. *Inthachub 87* (BKF, L, type), North-Eastern, Sakon Nakhon, 1 Aug. 2004; *Siriseree s.n.*, (BKF), North-Eastern, Mukdahan, 12–13 Aug. 2005.

11. *Stemona tuberosa* Lour.

Stemona tuberosa Lour. (1790) 404; Hook.f. (1892a) 298; C.H.Wright (1896) 494; Prain (1904) 40; Ridl. (1924) 320; Gagnep. (1934b) 746; Duyfjes (1993) 405; Z.H.Ji & Duyfjes (2000) 71. — Type: *Rumphius Herb. Amb.* 5 (1747) 365 'Ubi Gorita nigrum', with illustr. t. 129 (lecto Duyfjes 1993).

Twiner 2–5 m high, branched, glabrous. *Leaves* opposite or whorled, in the lower part of the stem often alternate; petiole 6–10 cm long; blade narrowly or broadly ovate, 10–21 by 5–12 cm, base (shallowly) cordate, 13–15-veined. *Inflorescences* axillary, 1–many-flowered, pedunculate; peduncle 0.8–3.5 cm long; bracts 5–25 mm long. *Flowers*: pedicels 5–18 mm long; tepals narrowly triangular, 25–35 by 5–6 mm; *stamens* c. 30 mm long; filaments 1–2 mm long; anthers c. 9 mm long, ridge separating the thecae smooth, 1–1.5 mm high, petaloid outgrowth of connective conical, c. 20 mm long, additional appendage 5–6 mm long. *Fruit* (narrowly-)ovoid, 20–45 by 8–25 mm. *Seeds* 10–20, brown, 10–12 by c. 5 mm; aril finger-like lobed.

Field-notes — The inner surface of the tepals are recorded as yellowish green with brownish red, the outer surface as yellowish green with green stripes towards the apex; the stamens as brownish red and yellowish green at the apex; the tuberous roots as 10–30 cm long, 2–3 cm thick. The flowers have an antiseptic smell.

Distribution — Widespread: NE India, China, Cambodia, Laos, Vietnam (type), Thailand (Northern: Mae Hong Son, Chiang Mai, Phayao, Nan, Lamphun, Lampang, Uttaradit, Phitsanulok, Kamphaeng Phet; North-Eastern: Loei; Eastern: Nakhon Ratchasima; South-Eastern: Chon Buri), Taiwan, through Peninsular Malaysia and Indonesia east to Ambon and the Philippines.

Ecology — Deciduous hardwood and dry dipterocarp forest with lots of bamboo, primary evergreen forest; on granite and shale bedrock and limestone outcrops; at 250–1200 m altitude. Flowering: April to July and October; fruiting: May to October.

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IDENTIFICATION LIST

Stemona				
1	=	*aphylla*	6 =	*involuta*
2	=	*burkillii*	7 =	*kerrii*
3	=	*cochinchinensis*	8 =	*phyllantha*
4	=	*collinsiae*	9 =	*pierrei*
5	=	*curtisii*	10 =	*rupestris*
			11 =	*tuberosa*

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Niyomdham 2983: 5; 6512: 7.
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