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A revision of *Cinnadenia* Kosterm.
(Lauraceae)

Rogier P. J. DE KOK &
Seda SENGUN

Litsea ligustrina Lion
fid. Miss. Allen in
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A revision of *Cinnadenia* Kosterm. (Lauraceae)

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ABSTRACT

Cinnadenia Kosterm. (Lauraceae) consists of three species, namely, *C. paniculata* (Hook.f.) Kosterm. which occurs in India and Bhutan, *C. liuyuyingii* (H.Liu) de Kok & Sengun, comb. nov. from Northern Vietnam and South China and *C. malayana* Kosterm. which is endemic to Peninsular Malaysia. All species are rarely collected and consequently *Cinnadenia* is a poorly known genus. The genus is revised here with a summary of its taxonomic history, key, full descriptions, distribution map, conservation assessments, ecological data, and a delineation of its key morphology. *Cinnadenia liuyuyingii*, comb. nov. which was previously placed in *Litsea* or as a synonym of *C. paniculata*, is moved here to *Cinnadenia* for the first time.

KEY WORDS

Lauraceae,
Cinnadenia,
Asia,
lectotypification,
new combination.

RÉSUMÉ

Révision de *Cinnadenia* Kosterm. (Lauraceae).

Le genre *Cinnadenia* Kosterm. (Lauraceae) renferme trois espèces, à savoir *C. paniculata* (Hook.f.) Kosterm. de l'Inde et du Bhoutan, *C. liuyuyingii* (H.Liu) de Kok & Sengun, comb. nov. du nord du Vietnam et du sud de la Chine et *C. malayana* Kosterm. endémique de la péninsule malaise. Toutes ces espèces sont rarement collectées et le genre *Cinnadenia* demeure en conséquence mal connu. La révision de ce genre, présentée ici, est accompagnée d'un résumé de son histoire taxonomique, d'une clé d'identification, des descriptions détaillées, d'une carte de répartition, des statuts de conservation, des données écologiques et des caractères morphologiques diagnostiques. *Cinnadenia liuyuyingii*, comb. nov., précédemment placée sous *Litsea* ou comme synonyme de *C. paniculata*, est attribuée à *Cinnadenia* pour la première fois.

MOTS CLÉS

Lauraceae,
Cinnadenia,
Asie,
lectotypification,
combinaison nouvelle.

INTRODUCTION

The genus *Cinnadenia* Kosterm. was first described by Kostermans (1973) as a monotypic genus based on the Indian species *Dodecadenia paniculata* Hook.f. (Hooker 1886) with the Vietnamese and Chinese species *Litsea liyuyingii* H.Liu in synonymy. In addition, in 1977 Kostermans described a new species from Peninsular Malaysia as *Cinnadenia malayana* Kosterm. Species of *Cinnadenia* are rarely collected and the genus is poorly known. Currently, the genus is placed among the genera *incertae sedis* (Rohwer 1993) within the Lauraceae. Kostermans (1973) had placed the genus near *Cinnamomum* based on the paniculate inflorescence, the composition of the flowers and the fruit which sits on a slightly thickened pedicel with a small cupule. Indeed, its scientific name means the glandular *Cinnamomum* (Kochummen 1989). However, *Cinnadenia* differs from *Cinnamomum* by its unisexual flowers and its larger number of stamens with many glands. The only other genus with unisexual flowers and a paniculate inflorescence is *Actinodaphne*, which differs in having whorled leaves, perulate terminal buds and flowers with 9 stamens (Rohwer 1993; van der Werff 2001).

Rohwer (1993) stated that *Cinnadenia* needs a critical re-evaluation. As its inflorescences are paniculate without an obvious involucre, it cannot be placed in the Laureae. It does not fit in the Perseeae either, because all anthers are introrse, and their number is increased. However, the Chinese material of this genus fits very well in the Laureae, as it is placed in *Litsea* in the *Flora of China* (Li Xiwen *et al.* 2008). The genus as currently described is morphologically very variable and further molecular work is needed to illustrate the taxonomic position of the genus and its members. The genus can be recognised by having alternate leaves, unisexual flowers with more than six stamens and four celled anthers which are all introrse.

The aim of this study is to clarify the number of species within the genus as presently described, and to elucidate some of their morphology.

MORPHOLOGY

LEAVES AND VENATION

Distinguishing characters between the species can be found in the shape of the leaf and its tertiary venation. In *C. paniculata* the leaves are elliptic to sub-obovate or narrowly ovate-elliptic. The apex is acute, and the blade has a tertiary venation that is clearly visible and forms a pitted leaf upper surface (reminiscent of *Endiandra* R.Br. leaves) which is clearly visible under a hand lens. The leaves of *C. liyuyingii*, comb. nov. are very similar: the leaves are elliptic or lanceolate with an acute or obtuse apex, the blade has a tertiary venation that is clearly visible and forms a pitted leaf upper surface well visible under a hand lens. In *C. malayana*, the leaves are oblong with an acuminate apex and the blade is smooth with reticulate tertiary venation on the upper surface that is hardly visible under a hand lens.

INFLORESCENCE

C. malayana fits well into inflorescence type 2 of the van der Werff system (2001), where the final node of each inflorescence branch has three stalked flowers of which the two laterals are strictly opposite each other. In contrast, the inflorescences of *C. liyuyingii*, comb. nov. and *C. paniculata* are unlike any of the types described in his system. Instead, the final node of each inflorescence branch has a whorl of 4-5 stalked flowers.

FLOWERS

Kostermans (1973) described the type species *Cinnadenia paniculata* as having trimerous flowers. This was later supported by Long (Grierson & Long, 1984) in his treatment of the Lauraceae in the *Flora of Bhutan*. Van der Werff (2001) reported that Kostermans' description (1977) of *Cinnadenia malayana* suggests that it also has trimerous flowers (18 stamens in 6 whorls of 3). However, Kochummen (1989) in the *Tree Flora of Malaysia* stated that all the flowers of *C. malayana* specimens he had seen were dimerous. Also, Van der Werff (2001) who had only seen an isotype of *Litsea liyuyingii* H. Liu (which Kostermans (1973) treated as a synonym of *C. paniculata*), reports that it has dimerous flowers. He adds that Jens Rohwer checked a flower of *C. malayana* for him and found that it had 4 tepals and 28 stamens which became progressively smaller towards the centre of the flower (van der Werff, 2001). The current study confirms that *C. malayana* has dimerous flowers, but the flowers of *C. paniculata* and *C. liyuyingii*, comb. nov. are trimerous.

OVARY

As in all other species of Lauraceae the ovary is superior. However, it is partly placed in a very small perianth cup, which gives the whole structure the appearance of a half inferior ovary. The style is short, the stigma is inconspicuous or peltate. In some male flowers, there is a rudimentary ovary which is smaller and narrower with a short style and discoid stigma.

MATERIAL AND METHODS

This study is based on observations of herbarium specimens from the following herbaria: K, FRIM, P and SING. In the following descriptions, all measurements and colour descriptions are from mature material; all measurements and all claims about the position of the veins relative to the remainder of the leaf are taken from dried material. All collections of *Cinnadenia* seen by the authors are cited; all synonyms of *Cinnadenia* are included; scans of type material were seen on <http://plants.jstor.org> on 27 May 2018; for the IUCN conservation assessment, all areas of occurrence and areas of occupancy were calculated using <http://geocat.kew.org> on 14 June 2018 (Fig. 1).

TAXONOMIC TREATMENT

Genus *Cinnadenia* Kosterm.

Adansonia, sér. 2, 13: 223 (1973); Grierson & Long, *Flora of Bhutan* 1 (2): 39 (1984); Kochummen, *Tree Flora of Malesia* 4: 123 (1989); Rohwer, *Families and Genera of Vascular Plants* 2: 389 (1993); Van der Werff, *Blumea* 46: 135 (2001). — Type species: *Dodecadenia paniculata* Hook.f. (1886) (synonym of *Cinnadenia paniculata* (Hook.f.) Kosterm.)

Litsea section *Octolitsea*, H.Liu, *Bulletin de la Société botanique de France* 80: 568 (1933). — Type species: *Litsea liyuyingii* H.Liu (synonym of *Cinnadenia liyuyingii* (H.Liu) de Kok & Sengun, comb. nov.).

DISTRIBUTION. — Three species, one in North India and Bhutan, one in South China and North Vietnam and one in Peninsular Malaysia (see Fig. 1).

DESCRIPTION

Trees 3–30 m tall. Terminal leaf buds not perulate. Leaves alternate, venation pinnate, domatia absent. Inflorescence umbellate or a panicle or with 3 or 4–5 terminal flowers, axillary, rarely terminal, involucre bracts absent or present. Flowers unisexual, dimerous or trimerous; perianth lobes 4 or 6, equal, persistent, partly truncate or deciduous in fruit; tube short, funnel-shaped, enlarged and indurate in fruit. Male flowers, stamens 8–12, 18–26 or 32, 3rd row with a pair of stalked or sessile glands on the filaments; anthers 4-celled, all introrse. Female flowers, ovary sessile, at the bottom of

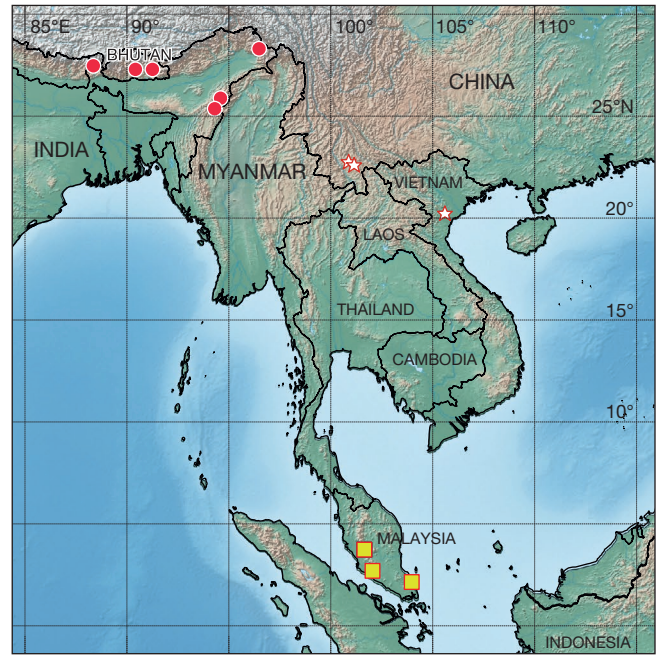


Fig. 1. — Distribution of the species of *Cinnadenia* Kosterm.: ●, *Cinnadenia paniculata* (Hook. f.) Kosterm.; ☆, *Cinnadenia liyuyingii* (H.Liu) de Kok & Sengun, comb. nov.; ■, *Cinnadenia malayana* Kosterm.

perianth tube; style slender; stigma discoid or obscurely 3-lobed. Fruit a drupe, seated on a cup-shaped perianth tube (cupule), margin entire.

KEY TO THE SPECIES OF *CINNADENIA* KOSTERM.

1. Leaves lanceolate; apex acuminate; upper surface smooth (hand lens), secondary venation hardly visible. Inflorescence with an apical whorl of 2–3 flowers; flowers with 4 perianth lobes 2. *C. malayana* Kosterm.
— Leaves elliptic to lanceolate, sub-obovate or narrowly ovate; apex acute to indistinctly acuminate to obtuse; upper surface pitted (hand lens), secondary venation clearly visible. Inflorescence with apical whorl of 4–5 flowers or umbellate; flowers with 6 perianth lobes 2
2. Twigs sparsely hairy to glabrous when young; terminal leaf bud 6.4–7.4 mm long, apex acuminate, glabrous to velutinous; flowers with 26 or 32 stamens 1. *C. liyuyingii* (H.Liu) de Kok & Sengun, comb. nov.
— Twigs velutinous when young, glabrescent; terminal leaf bud 2.3–2.5 mm long, apex acute to indistinctly acuminate, velutinous; flowers with 9–12 stamens 3. *C. paniculata* (Hook. f.) Kosterm.

1. *Cinnadenia liyuyingii*
(H.Liu) de Kok & Sengun, comb. nov.

Litsea liyuyingii H.Liu, *Bulletin de la Société botanique de France* 80: 566 (1933); C.K. Allen, *Annals of the Missouri Botanic Gardens* 25: 380 (1938); H.W.Li et al., *Flora of China* 7: 132 (2008). — Type: China, Yunnan, Szemao, Henry 12839 (holo-, P[not seen]; iso-, K[2x], MO[MO-1889408; Fig. 2]).

Cinnadenia paniculata sensu P.H.Hô, *Illustrated Flora of Vietnam* 1: 401 (1999).

DISTRIBUTION. — South China and Northern Vietnam.

ECOLOGY. — Growing in primary lowland evergreen broadleaved forest, sometimes over limestone, at 600–1375 m altitude. Flowering from October to March; fruiting in March.

CONSERVATION ASSESSMENT. — Endangered (EN B1ab(i,iii), B2ab(ii,iii)). This species is known only from a small number of collections from a few localities in Yunnan in Southern China and in the Northern part of Vietnam. An analysis of the Extent of Occurrence (EOO) gives a IUCN Conservation Assessment of Vulnerable, but the Area of Occupancy (AOO) suggests an assessment of Endangered. Given that it is known from less than five populations and has small area of occupancy as well as the intensive logging and landscape modification that has occurred in the region during the last 50 years, this species must be considered endangered.

ADDITIONAL COLLECTIONS SEEN. — **Vietnam:** Ninh Binh prov., Nho Quan Dist., Cuc Phuong Nat. Park, 12.III.2007, *Nguyen et al.* HNK 1432 (K[K000705428], P[P00806944]).
China. Yunnan, Szemao, Henry 12025A (K).

DESCRIPTION

Tree 3-10 m tall, DBH 10-12 cm. Twigs slender, 1.8-3 mm thick, rounded in cross-section, sparsely hairy to glabrous; terminal leaf bud ovoid, 6.4-7.4 mm long, apex acuminate, glabrous to velutinous. Leaves alternate; leaf blade elliptic or lanceolate, 8-25 × 2.2-8 cm, apex acute or obtuse, base cuneate, pinninerved, secondary nerves 7-12 pairs, tertiary nerves scalariform; upper surface glabrous, midrib and secondary veins raised, tertiary veins distinct and giving the upper surface a pitted appearance; lower surface glabrous, midrib and secondary veins raised, tertiary veins distinct, glaucous; petiole half-terete 15-20 mm, slender, glabrous. Inflorescences umbels on branchlets, 3-4 cm long, axillary, sparsely hairy, umbels with 4 or 5 flowers; hairs yellowish, erect to appressed; bracteoles unknown, caducous, 1-4 fruits per infructescence. Flower unisexual, white to yellow; male flowers perianth lobes 6, ovate 3.2-3.7 × 2-3 mm, apex acute, outside and inside glabrous; stamens 26 or 32, 1.8-2 mm long, sparsely hairy; female flower unknown. Fruit globose, 1.5-2.5 cm long, apex rounded, glabrous, smooth; cupule 4-5 mm diameter, sparsely hairy, margin entire; stalk sparsely hairy, slightly swollen, up to 1.6 mm thick.

2. *Cinnadenia malayana* Kosterm.

Adansonia, sér. 2, 17: 90 (1977); Kochummen, *Tree Flora of Malaysia* 4: 123 (1989). — Type: Peninsular Malaysia, Negeri Sembilan, Pedas, Gunung Angsi, 16.II.1971, *Zainuddin bin Sohadi*, FRI 14593 (holo-, L[L0035682; Fig. 3]; iso-, KEP[KEP168419]).

DISTRIBUTION. — Endemic to Peninsular Malaysia: Selangor, Negeri Sembilan and Johor.

ECOLOGY. — Growing in hill forests between 60-1000 m altitude. Flowering from February to April; fruiting unknown.

CONSERVATION ASSESSMENT. — Endangered (EN B1ab(i,iii), B2ab(ii,iii)). This species is known only from few collections from three locations in central Peninsular Malaysia, where it is reported to be locally abundant. An analysis of the Extent of Occurrence (EOO) gives an IUCN Conservation Assessment of Vulnerable, but the Area of Occupancy (AOO) suggests an assessment of Endangered. Given the small area of occupancy and the intensive logging and landscape modification that has occurred in the region during the last 50 years, this species must be considered endangered.

ADDITIONAL SPECIMENS SEEN. — Peninsular Malaysia: Selangor: Semangkok Forest Reserves, 10.II.1972, *T. Suppiah* FRI 14930 (KEP); Semangkok Forest Reserves, Kompt. 8, 10.IV.1972, *Baharudin Alias KEP 120202* (KEP); Semangkok Forest Reserves, Kompt. 8, 10.IV.1972, *Baharudin Alias KEP 120203* (KEP); Semangkok Forest Reserves, Kompt. 8, 11.IV.1972, *Baharudin Alias KEP 120204* (KEP); Johor: Mersing, Tenggaroh Forest Reserves, Kompt. 101, 7.IV.1968, *K. Ogata* KEP 105193 (L, KEP).

DESCRIPTION

Tree, 7-25 m tall, DBH 10-25 cm. Bark yellowish brown to yellowish grey, smooth. Twigs slender, 1.8-2.7 mm thick, rounded to slightly angular in cross-section, glabrous; terminal leaf buds ovate to lanceolate, c. 2.8 mm long, glabrous. Leaves alternate; leaf blade lanceolate, 9.7-19.5 × 3.5-6.9 cm,

apex acuminate, base cuneate to slightly rounded, sometimes asymmetric, leathery, pinninerved, secondary nerves 6-15 pairs, tertiary nerves reticulate; upper surface glabrous, midrib and secondary nerves slightly raised, secondary and tertiary nerves inconspicuous; lower surface glabrous, midrib and secondary nerves raised, tertiary nerves faintly visible; petiole channelled 8.9-16.3 mm long, glabrous, wrinkled and slightly swollen. Inflorescence axillary, paniculate, involucre bracts absent, female panicles few flowered 1.5-2.6 cm long, male panicles 2.5-14.3 cm glabrous; bracteoles unknown, caducous. Flowers unisexual, white to yellow; tepals in two rows of two, glabrous with a few hairs inside at the base or along the spine or at the margins; perianth lobes 3-3.3 × 1.5-4 mm, apex rounded; stamens number variable per flower, 18-26 per flower (reported up to 32), 1.4-2.6 mm long, sparsely hairy; ovary globose, 0.6-0.7 mm in diameter, glabrous; style c. 0.2 mm long; stigma inconspicuous. Fruit unknown.

3. *Cinnadenia paniculata* (Hook. f.) Kosterm.

Adansonia, sér. 2, 13: 223 (1973); Grierson & Long, *Flora of Bhutan* 1 (2): 39 (1984). — *Dodecadenia paniculata* Hook.f., *Flora of British India* 5: 181 (1886); Kanjilal *et al.*, *Flora of Assam* 4: 93 (1940). — Type: Bhutan, *Griffith* 2472 (lecto-, K[K000778754], here designated, Fig. 4; isolecto-, BM[BM000951009]).

Tetranthera chartacea var. *areolata* Meisn. ex Hook.f., *Flora of British India* 5: 181 (1886). — Type: Bhutan, *Griffith* 2472 (holo-, K[K000778754]).

Tetranthera chartacea sensu Meisn., in DC, *Prodromus Systematis Naturalis Regni Vegetabili* 15: 186 (1864).

DISTRIBUTION. — North India (Assam, Sikkim) and Bhutan.

ECOLOGY. — Growing along the edges of broad-leaved forest, between 730 and 2000 m elevation. Flowering from October to March; fruiting from April to June.

CONSERVATION ASSESSMENT. — Least Concern. This species is known from an arch shaped area from Sikkim and Bhutan via Northern Assam to Nagaland and Manipur on the border between India and Myanmar. An analysis of the Extent of Occurrence (EOO) gives a IUCN Conservation Assessment of Least Concern, but the Area of Occupancy (AOO) suggests an assessment of Endangered. However, the Lauraceae tend to be under-collected and therefore a greater weight is given to the EOO. Hence, this species must be considered as Least Concern.

ADDITIONAL COLLECTIONS SEEN. — **India:** Assam, Naga Hills, Kohima, 30.XI.1935, *Bar* 42 (K); Assam, Howai, *King's collector s.n.* (K, P[P01749138, P01749139]); Manipur, Imphal, XI.1907, *Meebold* 6726 (K); Manipur, Lingi village, 5.I.1883, *Watt* 5008 (K); Manipur, 28.X.1885, *Clarke* 43361 (K); Manipur, 28.X.1885, *Clarke* 43360 (K); Naga Hills, Reksima, 1.III.1935, *Bar* 2825 (K); Sikkim, *Hooker s.n.* (K[K000778753], P[P01749136]); *Clarke* 27565, Mik, 23.IV.1876 (K[K000778752]).

Bhutan. *Grierson & Long* 4271, Tongsa district, near Pertimi, 3.IV.1982 (K); *Grierson & Long* 1645, 2 km south of Shamgong, near Pertimi, 5.VI.1979 (K).

DESCRIPTION

Trees 10-30 m tall. Twigs slender, 1.6-3.2 mm thick, rounded to slightly angular in cross-section, velutinous when young,



FIG. 2. — Isotype of *Cinnadenia liuyingii* (H.Liu) de Kok & Sengun, comb. nov. (MO-1889408).

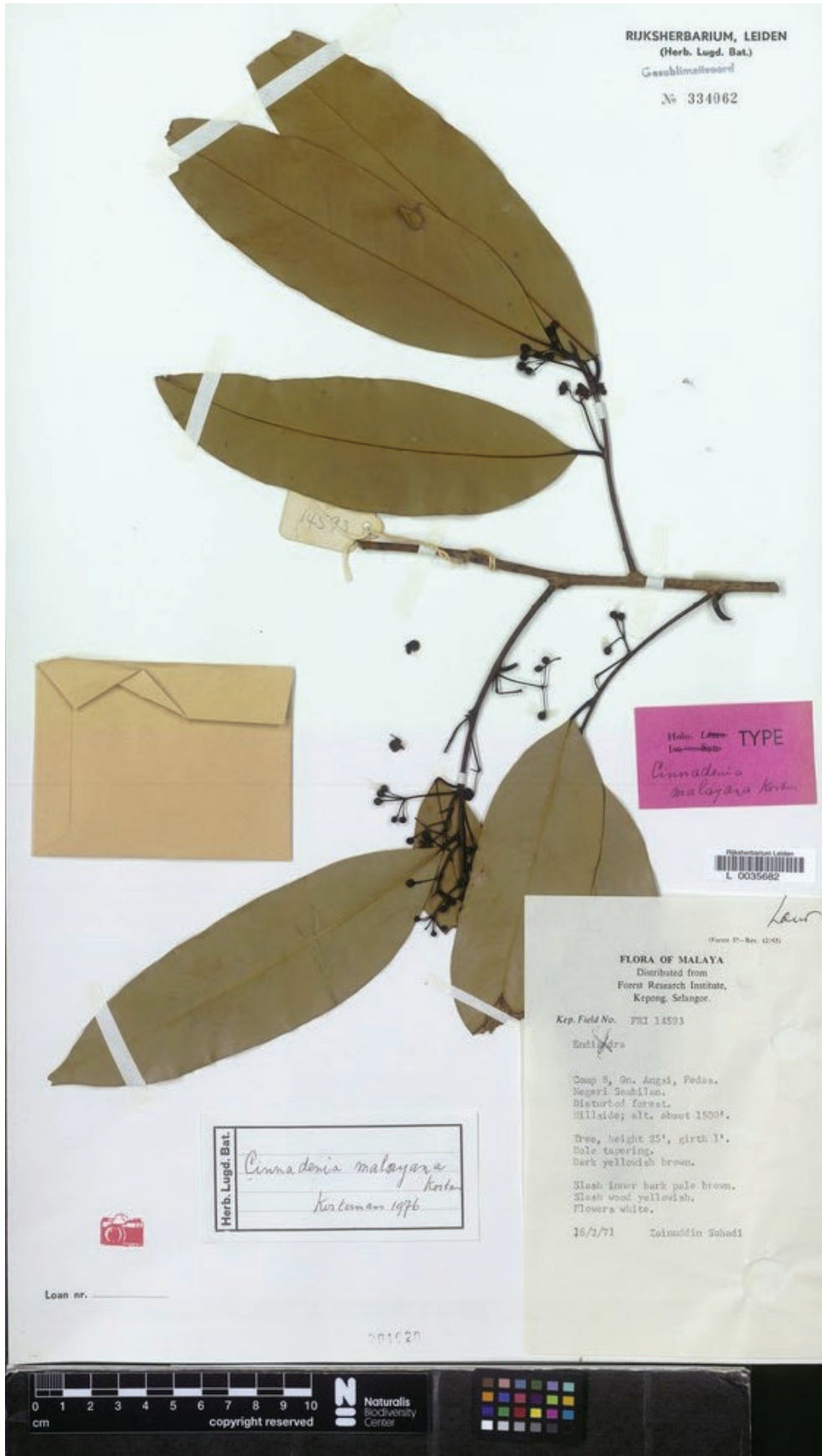


Fig. 3. — Holotype of *Cinnadenia malayana* Kosterm. (L0035682).



FIG. 4. — Lectotype of *Cinnadenia paniculata* (Hook. f.) Kosterm. (K000778754)

glabrescent; terminal leaf bud lanceolate, 2.3-2.5 mm long, apex acute, velutinous. Leaves alternate; leaf blade ovate-lanceolate, 11-22 × 4-7 cm, apex acute to indistinctly acuminate, base broadly cuneate, obtuse or almost rounded, leathery, pinninerved, secondary nerves 9-11 pairs, brochidodromous, tertiary nerves scalariform, thickly to thinly; upper surface glossy, glabrous, midrib sunken, secondary nerves sunken, tertiary nerves conspicuous, forming a distinct pitted surface (hand lens); lower surface pale green, glabrous, midrib and secondary nerves raised, tertiary nerves distinct; petiole half-terete, 9-20 mm long, slender, glabrous. Inflorescences panicles, 3-5 cm long, axillary, sparsely hairy, with 4 or 5 flowers, involucre bracts absent; bracts leaf like; bracteoles unknown, caducous. Flowers unisexual; perianth lobes 6, ovate to orbiculate, 2.6-3.6 × 2.2-2.6 mm, apex acute, outside sparsely hairy, inside glabrous; stamens 9-12, 1.6-2.4 mm long, sparsely hairy; ovary 1.5-2.5 mm in diameter, glabrous; style *c.* 1 mm long, stigma peltate. Fruits 1-2 per infructescence, (dried) obovoid, 20-25 × 10-17 mm, apex rounded, glabrous, smooth, pink when cut; cupule fleshy, 4.7-8 mm diameter, margin entire, glabrous; stalk slightly swollen, up to 3 mm thick.

NOTES

Three gatherings are cited in the original description of *Dodecadenia paniculata* (Hooker 1886): *J.D. Hooker s.n.* from Sikkim, *C.B. Clarke 27565* from Mik and *Griffith 2472* from Bhutan. The Griffith specimen at K is the only one that has flowers, and as flowers are a more important character for species and genus recognition, it is selected here as the lectotype.

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