Blumea 69, 2024: 93–121
www.ingentaconnect.com/content/nhn/blumea

RESEARCH ARTICLE

https://doi.org/10.3767/blumea.2024.69.02.01

Taxonomic revision of the *Vitex trifolia* complex (*Lamiaceae*)

S. Sengun[1,2], M. Ingrouille[2], A. Paton[1], R.P.J. de Kok[3]

Key words

Lamiaceae
morphology
new species
taxonomy
Vitex negundo
Vitex rotundifolia
Vitex trifolia complex

Abstract The *Vitex trifolia* complex is a well-circumscribed and monophyletic group. However, the species of the group are morphologically very similar and therefore, taxonomic boundaries within the group are uncertain. In addition, these medicinal plants have been cultivated and naturalised in many areas across the world and therefore their natural geographical distributions are not well known. A taxonomic account of the complex is presented in which nine species are recognized: *Vitex agnus-castus*, *V. benthamiana*, *V. bicolor*, *V. negundo, V. pseudonegundo, V. rotundifolia* and *V. trifolia*; a new species, *Vitex collium* Sengun, is described from frost prone regions of northern and Central China and an obscure name, *V. hybrida* Moldenke, is recognised for the Indian specimens previously recognized as *V. negundo*. In addition, *Agnus-castus*, *V. cannabifolia*, *V. chinensis*, *V. latifolia*, *V. negundo* f. *alba*, *V. negundo* f. *intermedia*, *V. negundo* f. *laxipaniculata*, *V. rotundifolia* and *V. trifolia* var. *acutifolia* are lectotypified, and *V. leucoxylon* Blanco has been neotypified. Also, many names have been placed in synonomy for the first time.

Citation: Sengun S, Ingrouille M, Paton A, et al. 2024. Taxonomic revision of the Vitex trifolia complex (Lamiaceae).
Blumea 69 (2): 93–121. https://doi.org/10.3767/blumea.2024.69.02.01.
Effectively published online: 9 August 2024.

INTRODUCTION

Vitex L. is a genus within the subfamily *Viticoideae* of the *Lamiaceae* (Zhao et al. 2021). There are c. 250 species mostly in the tropics and a few in temperate areas. The genus is defined by having leaves that are digitately compound, occasionally unifoliolate; inflorescence terminal or axillary; corolla with (4–)5(–6) lobes; fruit 1–4-seeded (Bramley et al. 2009). Although species of the *Lamiaceae* are mostly aromatic herbs in temperate regions, species of *Vitex* are shrubs and trees (Harley et al. 2004).

A revision of *Vitex* as a whole is lacking, but there are several regional treatments. The important recent treatments in Asia and the Pacific are for: India (Rajendran & Daniel 2002), Sri Lanka (Moldenke & Moldenke 1983, Singhakumara 1990), China (Chen & Gilbert 1994), Thailand (Chantaranothai 2011), New Caledonia (Mabberley & De Kok 2004), Flora Malesiana area (De Kok 2007, 2008, De Kok & Sengun 2019), Tree Flora of Sabah and Sarawak (Bramley at al. 2011), the Pacific (De Kok 2007) and Australia (Munir 1987). In Europe and in the Middle East, *Vitex* is covered by individual floras, such as, e.g., floras of Greece (Rechinger 1943), Turkey (Davis 1965, 1982), Iran (Zamjad 2012), Iraq (Townsend 1980). Most of these treatments are part of larger regional projects and usually are based on herbarium and literature studies. Therefore, they do not give a clear overall picture of the *V. trifolia* complex.

The *V. trifolia* complex was proposed for the first time by De Kok in 2004 in a Flora Malesiana Symposium and consisted of six taxa, namely *V. agnus-castus* L., *V. benthamiana* Domin, *V. negundo* L., *V. pseudonegundo* (Hausskn. ex Bornm.) Hand.-Mazz., *V. trifolia* L. subsp. *trifolia* and *V. trifolia* subsp. *littoralis* Steenis. De Kok (2007) defined the complex by its taxa having a white waxy undersurface of the leaf blades, which is the result of its unique hairs. Whilst most species of *Vitex* have appressed to erect multicellular hairs, which may have a gland at the apex, in the species of the complex, the conical apical cell of the hairs is covered with wax plates, which often become powdery when dry (De Kok 2007).

Although the *Vitex trifolia* complex is a well-circumscribed and a monophyletic group (Bramley et al. 2009), the taxonomic boundaries within the group are uncertain as the species are morphologically very similar. In flora accounts the taxa belonging to this complex are distributed from Greece eastwards through Asia to Japan and south-eastwards to Australia and Oceania. However, the natural geographical distribution of the individual species within the complex are not well known as their biogeographic patterns were obscured by the naturalization of species cultivated as medicinal plants.

The *Vitex trifolia* complex was studied for a doctorate by Sengun (2017) as there were several outstanding taxonomic problems within the complex. *Vitex pseudonegundo* was often confused with *V. agnus-castus* due to their very similar morphology. *Vitex negundo* showed a high degree of morphological variation in the leaf margin and the inflorescence, which resulted in many synonyms. The status of *V. bicolor* Willd. was uncertain as it was treated at different levels and finally placed under *V. trifolia* subsp. *trifolia* (De Kok 2007). *Vitex benthamiana*, the endemic Australian species, needed to be confirmed as part of the complex. Finally, there was still a debate whether *V. trifolia* has two subspecies (Van Steenis 1957, De Kok 2007), namely, subsp. *trifolia* and subsp. *littoralis*, or that the latter subspecies is a distinct species, *V. rotundifolia* (Munir 1987).

[1] Royal Botanic Gardens Kew, Richmond, Surrey TW9 3AE, U.K; corresponding author e-mail: s.sengun@btinternet.com.
[2] Birkbeck, University of London, Malet St, London WC1E 7HX, U.K.
[3] Honorary Research Associate Singapore Botanic Gardens, National Parks Board, 1 Cluny Road, Singapore.

METHODS AND MATERIALS

This article is based on the findings of a doctorate study by Sengun (2017). For the study, detailed analyses of morphological, molecular and chemical data were carried out. During the study extensive fieldwork was carried out in Bodrum, Turkey; Sabah, Malaysia; Beijing and Badaling, Northern China; Guangxi and Guangdong, Southern China; and Queensland coast and Cloncurry region, Australia, with the aim of validating the observations made on herbarium specimens and collecting fresh material. Loans and type material were obtained from B, BH, BRI and W. In addition, more than 1 500 specimens were seen in BM, BO, BRI, E, IBK, ISTE, K, LINN, PE, SAN and W. For on-line specimen information JStor Plants was consulted (https://plants.jstor.org). Specimens seen only as image are denoted with an asterisk (*). The cited specimens represent not only the typical form of the species but also more extreme forms (sometimes previously formally described) and the intermediates between them.

RESULTS

The overall results of the study, as published in the thesis (Sengun 2017), showed nine distinct species, which were supported by statistical morphological and the chemical analyses. However, the molecular analysis was inconclusive. The main results of the morphological analysis are as follow:

Despite their very similar morphology, *V. agnus-castus* and *V. pseudonegundo* are two different taxa. They are separated by *V. agnus-castus* having a corolla lip with only a few hairs on the corolla ridges and a glabrous ovary as well as shorter, mainly 7-foliolate leaves and bigger flowers as opposed to *V. pseudonegundo* having a semi-circular area of hairs at the corolla mouth, a hairy ovary, longer and 5–7-foliolate leaves and smaller flowers.

It has been established by statistical analyses and field and herbarium observations that *V. negundo* sensu lato (s.lat.) consists of two species: a lowland species, *V. hybrida* Moldenke, from the Indian subcontinent and *V. negundo* sensu stricto (s.str.) from China. The former *V. hybrida* has entire leaflets, ovate and often caducous bracteoles and the apex of the calyx lobes is acute to acuminate. In contrast, *V. negundo* s.str. has mostly dentate, occasionally entire leaflets, linear, persistent bracteoles that dry black and the apex of the calyx lobes is acuminate to aristate. In addition, *V. negundo* var. *heterophylla*, endemic to China, is distinct from *V. negundo* s.str. as it has a lobed leaf margin, much smaller leaves and bigger flowers.

Vitex bicolor, which was formerly placed in the synonymy of *V. trifolia*, is a distinct taxon. It has bigger leaves, that are mainly 5-foliate, sometimes trifoliate, with a long terminal petiolule as opposed to *V. trifolia*, that has mainly trifoliate, sometimes unifoliate leaves with either a sessile or a very shortly petiolulate terminal leaflet. *Vitex bicolor* also has smaller flowers.

Two subspecies of *V. trifolia*, subsp. *littoralis* (syn: *V. rotundifolia*) and subsp. *trifolia*, are two distinct taxa separated by vegetative and reproductive characters. *Vitex rotundifolia* has much smaller vegetative and inflorescence characters and clearly bigger flowers. In addition, *V. rotundifolia* roots from the nodes, which is not always visible in herbarium specimens, *V. trifolia* never does.

Despite its similar appearance to *V. agnus-castus* and being sympatric with *V. trifolia*, *V. benthamiana* is distinct from both taxa in terms of vegetative and floral characters.

The data on *V. bicolor*, *V. negundo*, *V. rotundifolia* and *V. trifolia* was published as part of the Flora Malesiana account of the family *Lamiaceae* (De Kok & Sengun 2019). However, in the printed form of the account Sengun was erroneously omitted (https://floramalesiana.org/new/families-treated/) and will subsequently be added in the online version of the flora as well as in the copy for the Biodiversity Heritage Library.

MORPHOLOGICALLY IMPORTANT CHARACTERS

Earlier treatments of the complex often relied on leaflet numbers and shape. However, these characters are correlated (Sengun 2017) and were not enough to distinguish various taxa from each other. For this study a new set of characters was used:

Habit

All species are shrubs or small trees, except *V. rotundifolia* and the beach populations of *V. trifolia*, which are prostrate shrubs. In addition, *V. rotundifolia* roots at the nodes and forms mats on the beach.

Leaf morphology

The leaf serration character was important for dividing the previously broadly circumscribed *V. negundo* into *V. negundo* s.str., *V. hybrida* and *V. collium*.

In addition to the character of leaf margin, i.e., entire or serrate, a new character was introduced for the shape of the serration with character states either dentate or lobed. In dentate serrations the apex of the dentation is acuminate and the tertiary venation arches back and anastomoses with other veins before reaching the apex (see Fig. 11). In lobed serrations, the apex of the lobe is sometimes acuminate but often aristate and the tertiary venation continues all the way to the apex (see Fig. 7). The length of the terminal petiolules was used to distinguish between *V. bicolor* (long) and *V. trifolia* (short or absent).

Inflorescences and flowers

The inflorescences are lateral cymes in dense or lax clusters. This is a taxonomic character used in the past and it proved to be helpful here too. The inflorescence axis is smooth except for *V. hybrida*, which often has a pitted axis due to the scarring caused by lower caducous flowers (i.e., flowers are persistent in all other species).

Other new characters used here are the shape, colour when dried and persistence of the bracteole; shape of the apex of the calyx lobe; as well as hairs on the corolla mouth and ovary.

TAXONOMIC TREATMENT

Vitex trifolia complex

Vitex L. sect. *Euagnus* subsect. *Paniculatae* Schauer (1847) 683, comb. illeg. — *Vitex* L. sect. *Euagnus* subsect. *Terminales* Briq. (1895) 172, nom. superfl. — Type: *Vitex agnus-castus* L.

Agnus-castus Carrière (1870–1871) 415. — *Vitex* L. sect. *Agnus-castus* (Carrière) Briq. (1895) 172. — Lectotype (designated here): *Agnus-castus vulgaris* Carrière (= *Vitex agnus-castus* L.).

Shrubs or small trees. *Leaves* opposite, (1–)3–5(–7)-foliolate; leaflets: venation pinnate, glabrous above or with only hairs on the veins, velutinous below; hairs whitish, occasionally purple in *V. trifolia* and *V. hybrida*, appressed, with a powdery exudate on apical cell, sessile glands absent; petiolules round in cross-section, with minutely curled hairs. *Inflorescence* an indeterminate thyrse consisting of lateral cymes in lax or dense clusters, terminal or axillary; axis square in cross-section, appressed pubescent; bracts usually 1-foliolate; bracteoles ovate to linear, appressed or patent, persistent or caducous, velutinous. *Calyx* erect in flower, patent to erect in fruit, 5-lobed, zygomorphic; calyx tube 5-ribbed; lobes clearly developed, accrescent, persistent, velutinous; glands absent to many. *Corolla*

5-lobed, lobes basally fused up to 10 % of length, margin entire, covered outside with appressed hairs; anterior lip orbicular to ovate or spathulate, apex round to acute, reflexed, two clear ridges and a semi-circular area of hairs at the corolla mouth (except in *V. agnus-castus*); lateral lobes erect or patent, apex rounded; posterior lip 2-lobed, erect or reflexed, apex acute or rounded. *Stamens*: filaments slightly didynamous, with anterior pair longer to equal than posterior pair, with a tuft of erect simple multicellular hairs at base, otherwise glabrous except in some *V. pseudonegundo* in which occasional hairs along the filament, inserted half to 1/3 of the way on the corolla tube, clearly exceeding the corolla tube; anthers beige to purple, thecae mostly parallel, occasionally divergent. *Ovary* globose, glabrous (except in *V. pseudonegundo*), glands few to many; style glabrous; stigma 2-lobed. *Fruit* drupaceous, 4-seeded, broadly obovoid to globose or ellipsoid, glabrous except in *V. pseudonegundo*, smooth, glaucous.

Distribution — The species of the complex are distributed from the Mediterranean, east to Japan and Hawaii and south to northern Australia and the Pacific.

Notes — 1. The *V. trifolia* complex was first defined by De Kok (2007) based on the species' unique hair type. It then only included the species *V. agnus-castus*, *V. benthamiana, V. negundo* s.lat., *V. pseudonegundo* and *V. trifolia* s.lat. This is expanded here to nine species, to include *V. bicolor*, *V. collium*, *V. hybrida* and *V. rotundifolia*. However, at this point in time, it would not be appropriate to formally recognise the *V. trifolia* complex as a section within *Vitex*. This is because it would require the complex being defined against other groups within the genus; however, not enough is known about the rest of the genus to do so.

2. Within the genus *Vitex*, section *Euagnus* was illegitimately described by Schauer (1847: 683) as having an erect corolla upper lip and a calyx that is bell-shaped with a short tube and with five lobes. Within this section, the species of the *V. trifolia* complex were part of a subsection *Paniculatae* Schauer. This subsection was based on the character of an inflorescence consisting of panicles with terminal cymes. The type of this group was *V. agnus-castus* and the rest of the species included were *V. alata* B.Heyne, *V. altissima* L.f., *V. bahiensis* Schauer, *V. bicolor*, *V. heterophylla* Roxb., *V. incisa* Lam., *V. loureirii* Wight ex C.B.Clarke, *V. negundo*, *V. peduncularis* Wall. ex Schauer, *V. pubescens* Vahl, *V. punctata* Schauer, *V. timoriensis* Walp., *V. trifolia* and *V. umbrosa* Sw.

3. Carrière (1870–1871) described a genus (*Agnus-castus* Carrière) based on a series of species, which are now considered to be synonyms of *V. agnus-castus*, *V. collium* and *V. negundo*. In 1895, Briquet (1895: 172) changed it to section *Agnus-castus*. He also changed the name of Schauer's subsection *Paniculatae* to *Terminales* Briq., a superfluous name. He kept the type species *V. agnus-castus*, but included a smaller number of species, namely, *V. alata*, *V. altissima, V. bahiensis*, *V. limonifolia* Wall. and *V. trifolia*.

KEY TO THE SPECIES

1. Anterior corolla lip with only a few hairs on the corolla ridges . . . . . 1. *V. agnus-castus*
1. Anterior corolla lip with a semi-circular area of hairs at the corolla mouth 2
2. Ovary hairy; leaves 5–7-foliolate. — Only naturally occuring from Eastern Turkey to Afghanistan and Pakistan . . . . . 7. *V. pseudonegundo*
2. Ovary glabrous; leaves 1–7-foliolate. — Naturally occuring from Pakistan to Japan and south to Australia and parts of the Pacific 3
3. Leaflet margins mostly dentate or lobed, though occasionally entire on some leaves; bracteoles linear, persistent and drying black; apex of calyx lobes acuminate to aristate . 4
3. Leaflet margins entire; bracteoles ovate to linear, often caducous and drying the same colour as the inflorescence, not black; apex of calyx lobes acute to acuminate 5
4. Leaflet margins lobed; apex of the lobe sometimes acuminate but often aristate and the tertiary venation continuing all the way to the apex . . . . . 4. *V. collium*
4. All or some leaflet margins dentate; apex of the dentation acuminate and the tertiary venation arching back and anastomosing with other vein before reaching the apex . . . . . 6. *V. negundo*
5. Leaves 1-foliolate; apex of leaflets rounded (sometimes subacute); shrubs, always prostrate, rooting at the nodes . . . . . 8. *V. rotundifolia*
5. Leaves (1–)3–5-foliolate; apex of leaflets acute to acuminate; small trees or shrubs, rarely prostrate and never rooting at the nodes 6
6. Inflorescences lateral cymes in dense clusters often with lower caducous flowers, which give the cyme axis a pitted appearance due to scarring . . . . . 5. *V. hybrida*
6. Inflorescences lateral cymes in dense or lax clusters with persistent flowers, cyme axis smooth 7
7. Leaflet blades narrowly elliptic to lanceolate, never unifoliolate; cymes in dense clusters. — Australia (Queensland) . . . . . 2. *V. benthamiana*
7. Leaflet blades ovate to ovate-lanceolate or obovate to oblanceolate, if unifoliolate then elliptic to lanceolate; cymes in lax clusters. — Widely distributed from India and Japan to Australia 8
8. Leaves 3–5-foliolate, very rarely unifoliolate; terminal leaflet ovate to ovate-lanceolate in trifoliate leaves, apex acuminate, base cuneate; terminal petiolules long, (0.4–)0.9–2 cm long, lateral leaflets mostly petiolulate . . . . . 3. *V. bicolor*
8. Leaves (1–)3-foliolate; terminal leaflet obovate to oblanceolate in trifoliate leaves (elliptic to lanceolate in unifoliate leaves), apex acute, rarely acuminate, base attenuate (rounded or cuneate in unifoliate leaves); terminal petiolules absent or short, 0.1–0.9(–1.4) cm long, lateral leaflets sessile . . . . . 9. *V. trifolia*

1. *Vitex agnus-castus* L. — Fig. 1, 2; Map 1

Vitex agnus-castus L. (1753) 638; C.C.Towns. (1972) 148. — *Vitex lupinifolia* Salisb. (1796) 106, nom. superfl. — *Vitex agnus-castus* L. var. *agnus-castus*: Kurz (1877) 269. — Lectotype (designated by Moldenke 1955a: 170): *LINN 811.4* (LINN), 'ex herb. Clifford'.

Vitex verticillata Lam. (1779) 363, nom. inval.

Vitex robusta Lebas (1869) 30. — *Agnus-castus robusta* (Lebas) Carrière (1870–1871) 416. — Type: not indicated, syn. nov.

Agnus-castus vulgaris Carrière (1870–1871) 415. — Type: not indicated, syn. nov.

Agnus-castus vulgaris Carrière var. *diversifolia* Carrière (1870–1871) 415. — Type: not indicated, syn.nov.

Agnus-castus vulgaris Carrière var. *alba* Carrière (1870–1871) 415. — *Vitex agnus-castus* f. *alba* (Carrière) Rehder (1902) 1947. — Type: not indicated, syn. nov.

Agnus-castus vulgaris Carrière var. *compacta* Carrière (1870–1871) 415. — Type: not indicated, syn. nov.

Vitex agnus-castus L. var. *laciniosa* Ces. (1874) 327. — *Vitex agnus-castus* L.f. *laciniosa* (Ces.) Moldenke (1979b) 342. — Type: not indicated.

Vitex agnus-castus L. var. *caerulea* Rehder (1902) 1947. — *Vitex agnus-castus* L.f. *caerulea* (Rehder) Moldenke (1979a) 134. — Type: not indicated.

Vitex agnus-castus L. var. *serrata* Moldenke [(1939) 40, nom. nud.] (1940) 753. — Type: *Abeleven s.n.* (holo L n.v.), The Netherlands, Botanical Garden Nijmegen.

Vitex agnus-castus L. var. *pseudo-negundo* Hausskn. f. *albiflora* Moldenke (1952) 59. — Type: *Dinsmore 172f* (holo S [S-G-6381]*), Israel, Jesr-ul-Ghajir.

[*Vitex agnus-castus variegata* Hort. ex Beissn., Schelle & Zabel (1903) 426, nom. inval.]. — *Vitex agnus-castus* Carrière f. *variegata* Moldenke (1967) 87, nom. inval. (no type). — Type: not indicated

Shrub or small tree, 1–3 m high, deciduous. *Bark* smooth, grey. *Leaves* 5(–7)-foliolate; petioles 1.6–6.2 cm long. *Leaflets*: blades elliptic to lanceolate, apex acuminate, base cuneate, margin entire, upper surface dull green, lower surface whitish green; secondary veins 11–15 per side, slightly prominent, visible on both surfaces; terminal leaflets 3–10 by 0.5–1.7 cm; terminal petiolules 0.1–1.2 cm long; lateral leaflets 1–8.4 by 0.3–3.9 cm; lateral petiolules 0–1 cm long; basal leaflets 0.4–4.5 by 0.1–2.2 cm; basal petiolules 0–0.6 cm long. *Inflorescence* terminal,

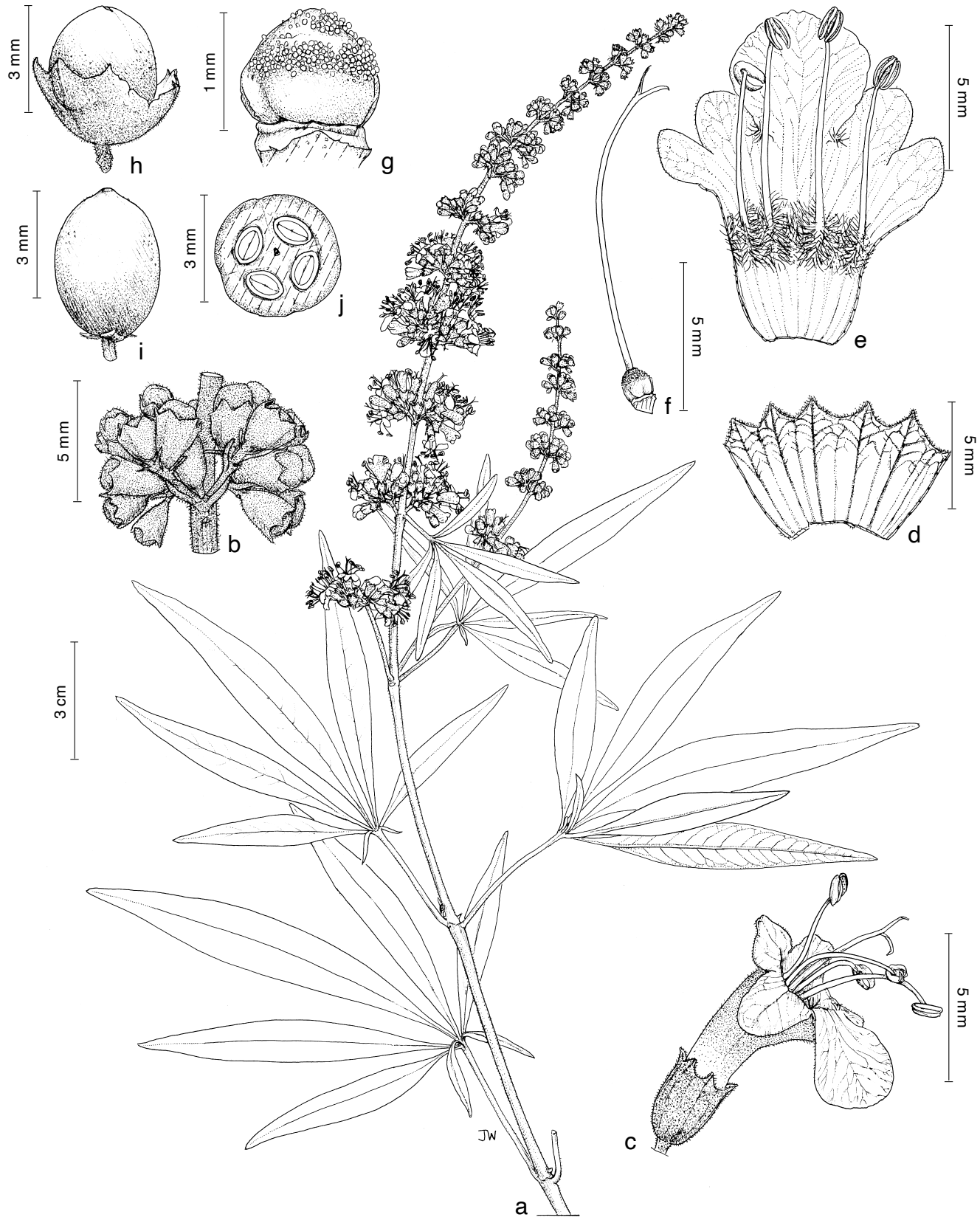
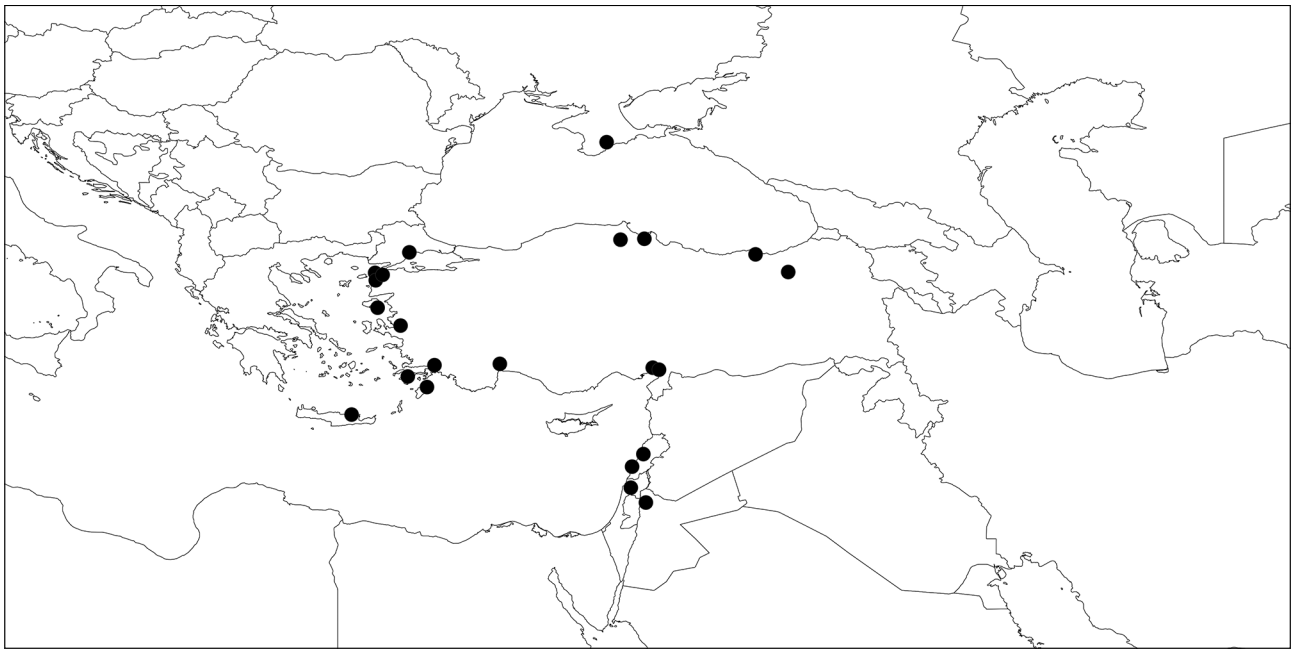


Fig. 1 *Vitex agnus-castus* L. a. Habit; b. inflorescence; c. flower, side view; d. calyx open, adaxial; e. corolla open, adaxial; f. style and young ovary; g. young ovary; h. fruit in calyx; i. fruit with calyx removed; j. fruit in cross-section (a, b: *Syngrassides 397*; c–g: *Balls 3365, sheet III*; h–j: *Balls B1204B*; all K). — Drawing by Juliet Beentje.

consisting of lateral cymes in dense clusters with persistent flowers; axis 7–35 cm long, smooth; bracteoles to 3 mm long, patent to appressed, caducous, drying the same colour as inflorescence. *Calyx* glands many; tube 1.5–3 mm long; lobes 5–10 by 3–5 mm, lobe apex acute; flowering calyx 3–3.6 mm diam; fruiting calyx 2.8–3.4 mm diam, patent to erect, covering half to most of the mature fruit. *Corolla* pale lilac to blue, rarely white or whitish; glands few; tube 4.2–7 mm long; anterior lip spathulate, 2.4–4.1 by 2.1–3.9 mm, apex round to acute, with a few hairs on the corolla ridges; lateral lobes 1.3–1.7 by 1.6–1.8 mm, apex round, erect; posterior lip lobes 1.8–2.5 by 1.4–1.9 mm, apex acute, erect. *Stamens*: filaments 3.1–6.7 mm long, slightly didynamous to equal, inserted at half to basal/upper 1/3 of the corolla tube; anthers c. 1 mm long. *Ovary* c. 1 mm diam, glabrous, glands many, sometimes covering the apex; style 6–10 mm long; stigma lobes 0.1–1.2 mm long. *Fruit* broadly obovoid to globose, when fresh 3–4 mm diam, dried 2.2–3.3 by 2.5–3.5 mm, glabrous, black to reddish when mature.

Distribution — Greece (Crete, Chios, Samos, Kos, Rhodes and Lesbos), Turkey (throughout the Aegean and the Mediterranean coast, the Black Sea coast up to Trabzon), Ukraine

Fig. 2 *Vitex agnus-castus* L. a. Deciduous shrub in riverine habitat; b. inflorescence detail with butterfly feeding; c. leaves; d. mature inflorescence erect above the leaves; e. flower; f. stems and bark. — Photos by R. de Kok.



Map 1 Natural distribution of *Vitex agnus-castus* L.

(the Crimea), coastal areas of Syria, Lebanon, Israel, Jordan. Cultivated and escaped from cultivation in many western and central Asian countries and around the Mediterranean.

Habitat & Ecology — Often along seasonally dry or permanently flowing rivers and creeks, in open vegetations. Soil: sandy and alluvial soils, sometimes on limestone, 0–750 m altitude. Flowering: June to December; fruiting: July to December.

Uses — Ornamental shrub and used medicinally in Europe and North America for the irregularities of the menstrual cycle, premenstrual syndrome (PMS) and painful breasts (mastodynia) (Sengun 2017).

Vernacular names — Abraham's balm, Chase tree, Chaste berry, Hemp tree or Monk's pepper (English); Gattilier (French); Hayit (Turkish); Mönchspfeffers (German).

Conservation status — Least concern (LC) as it is common throughout its range and there are no known threats (Sengun 2017).

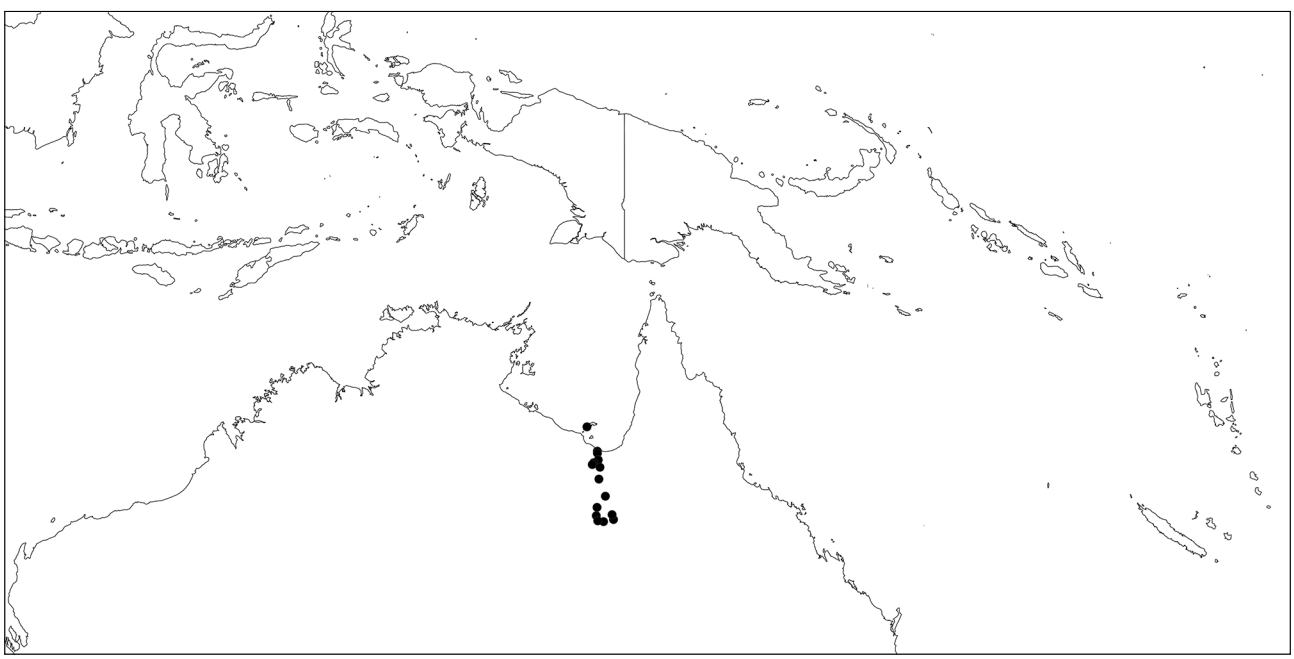
Notes — 1. Several forms and varieties of this species have been described, which are all based on plants growing in cultivation and are only different from the wild populations in flower colour or leaf variegation. None of these variants warrant formal recognition and therefore are placed in synonymy.

2. *Vitex agnus-castus* is often confused with *V. pseudo-negundo* from which it differs in having a glabrous corolla lip and ovary, while the latter has a hairy corolla lip and ovary.

2. *Vitex benthamiana* Domin — Fig. 3, 4; Map 2

Vitex benthamiana Domin (1928) 560; Munir (1987) 61. — Lectotype (designated by Munir 1987): *Domin 8164* (PRA n.v.), Australia, Queensland, Cloncurry.

Vitex trifolia L. var. *parviflora* Benth. (1870) 67; Munir (1987) 61. — Type: *Landsborough s.n.* (holo K [K000223177]; iso MEL [MEL 98012]), Australia, Queensland, Gulf of Carpentaria, possibly near Albert River.



Map 2 Natural distribution of *Vitex benthamiana* Domin.

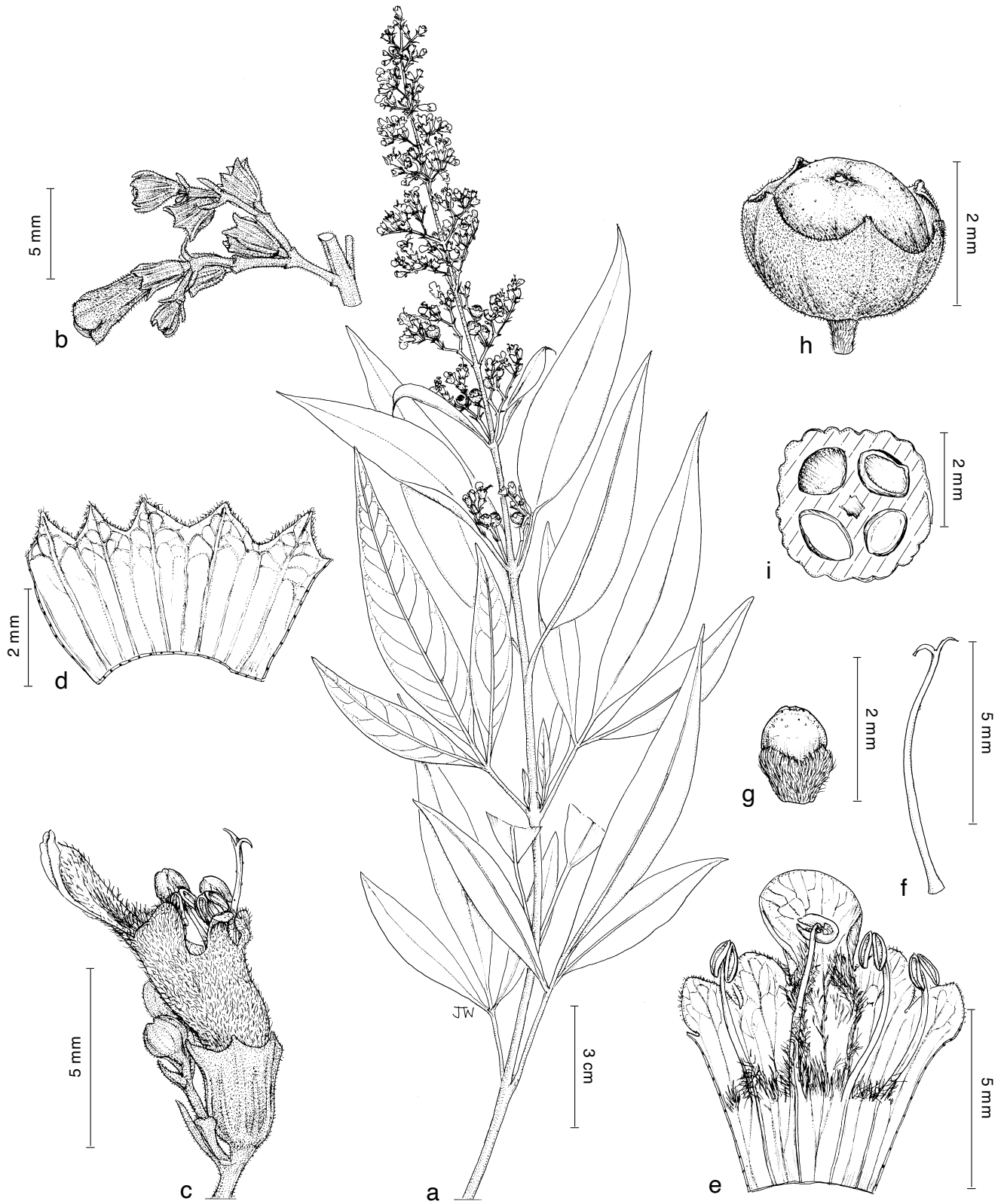


Fig. 3 *Vitex benthamiana* Domin. a. Habit; b. part of inflorescence; c. flower, side view; d. calyx open, adaxial; e. corolla open; f. style; g. ovary; h. fruit in calyx; i. fruit in cross-section (a: *Perry 1061*; b–d: *Gittins s.n.*; e, f: *Puttock 14410*; g: *Gittins s.n.*; h, i: *Halliday 428*; all K). — Drawing by Juliet Beentje.

Shrub or small tree, 1.6–4 m high. *Bark* smooth to slightly fissured, grey. *Leaves* (1- or) 3-foliolate; petioles 0.4–5.5 cm long. *Leaflets*: blades narrowly elliptic to lanceolate, apex acuminate, rarely acute, base attenuate when trifoliate, rounded or cuneate when unifoliate, margin entire, upper surface green, lower surface whitish; aromatic when bruised; secondary veins 9–14 per side, slightly prominent, visible on both surfaces; terminal leaflets 2.2–10.1 by 0.7–3.1 cm; terminal petiolules (0–)0.1–0.9(–1.9) cm long; lateral leaflets 1.4–9.3 by 0.3–2.6 cm, sessile. *Inflorescence* terminal, consisting of lateral cymes in dense clusters with persistent flowers; axis 5.4–18 cm long, smooth; bracteoles ovate to linear, up to 2(–3.8) mm long, patent, usually persistent, drying the same colour as inflorescence. *Calyx* glands many; tube 1.7–2.5 mm long; lobes 2–7 by 1–9 mm, lobe apex acute; flowering calyx 2–3 mm diam; fruiting calyx 5–6 mm diam, patent to erect, covering most of the mature fruit. *Corolla* light or pale mauve to lilac; glands few; tube 1.7–7 mm long; anterior lip spathulate, 2–5.5 by 2.5–5 mm,

Fig. 4 *Vitex benthamiana* Domin. a. Habitat; b. flower; c. mature inflorescence; d. leaves; e. infructescence detail with dried fruits; f. detail of bark. — Photos by R. de Kok.

apex round to acute, anterior corolla lip with a semi-circular area of hairs at the corolla mouth; lateral lobes 2–3 by 2–2.5 mm, apex round, erect; posterior lip lobes 1.2–2.2 by 1–2 mm, apex acute, erect. *Stamens*: filaments 3–5.8 mm long, slightly didynamous to equal, glabrous, inserted at half to lower 1/3 of the corolla tube; anthers c. 1 mm long. *Ovary* 1–1.5 mm diam, glabrous, glands many, covering the apex; style 3.6–7 mm long; stigma lobes 0.2–0.7 mm long. *Fruit* dried broadly obovoid to globose, 2.2–6 by 2.2–6.2 mm, glabrous.

Distribution — Australia (Queensland: from Cloncurry and Mt Isa along several rivers to Burketown on the Gulf of Carpentaria).

Habitat & Ecology — Along seasonally dry or permanently flowing rivers and creeks, in *Eucalyptus* woodland with an understory of *Acacia hemsleyi* Maiden (*Fabaceae*), *Eucalyptus camaldulensis* Dehnh. (*Myrtaceae*), *E. microtheca* F.Muell., *Melaleuca argentea* W.Fitzg. (*Myrtaceae*), *M. trichostachya* Lindl. and *Pandanus aquaticus* F.Muell. (*Pandanaceae*). Soil: sandy or alluvial black soils or brown clay, at 125–300 m altitude. Flowering: April to August, fruiting: April to August.

Conservation status — Least concern (LC) as it is common throughout its range and there are no known threats (Sengun 2017).

Fig. 5 *Vitex bicolor* Willd. a. Habit; b. habit; c. habit; d. infructescence; e. upper and lower leaf surface; f. inflorescence; g. inflorescence, detail (a: *Awa & Othman S 48714*; b, g: *Ismael IS 472*; c: *Loher 4433*; d: *Adaire 161*; e: *Sengun aus 3*; all K). — Photos by Seda Sengun.

Notes — 1. This Queensland endemic species has the most restricted range of all species in the complex, but where it occurs it is reported to be common. Its leaves are mostly trifoliolate like *V. trifolia*, but it differs from *V. trifolia* by its narrow lanceolate leaflets and cymes in dense clusters.

2. It has not been possible to see the type or an image of *V. benthamiana*, which is housed at PRA. However, Munir (1987) reports to have seen it when he selected it as a lectotype.

3. *Vitex bicolor* Willd. — Fig. 5, 6; Map 3

Vitex bicolor Willd. (1809) 660; Munir (1987) 66; De Kok & Sengun (2019) 400. — *Vitex negundo* L. var. *bicolor* (Willd.) H.J.Lam (1919) 191. — *Vitex trifolia* L. var. *bicolor* (Willd.) Moldenke (1942) 79; (1958) 174. — Type: *Herb. Willd. 11709* (holo B-W [B11709-010]*), 'Habitat in India Orientale', cult. Hort. Berlin from seeds sent by Klein ('Ind. 1797').

Vitex arborea Desf. (1829) 391, nom. illeg., not *Vitex arborea* Roxb. ex Jack (1820). — Type: *Anonymous s.n.* (iso MPU [MPU013116]*).

Vitex leucoxylon Blanco (1837) 516, nom. illeg., not *Vitex leucoxylon* L.f. — Type: *Merrill Sp. Blanc. 440* (neo L [L.2768327]*), Philippines, Luzon, Rizal Province, Antipolo.

Vitex neocaledonica Gand. (1918) 64; Mabb. & De Kok (2004) 37; De Kok (2007) 597. — Type: *Debeaux s.n.* (holo LY n.v.), New Calédonia, Nouméa.

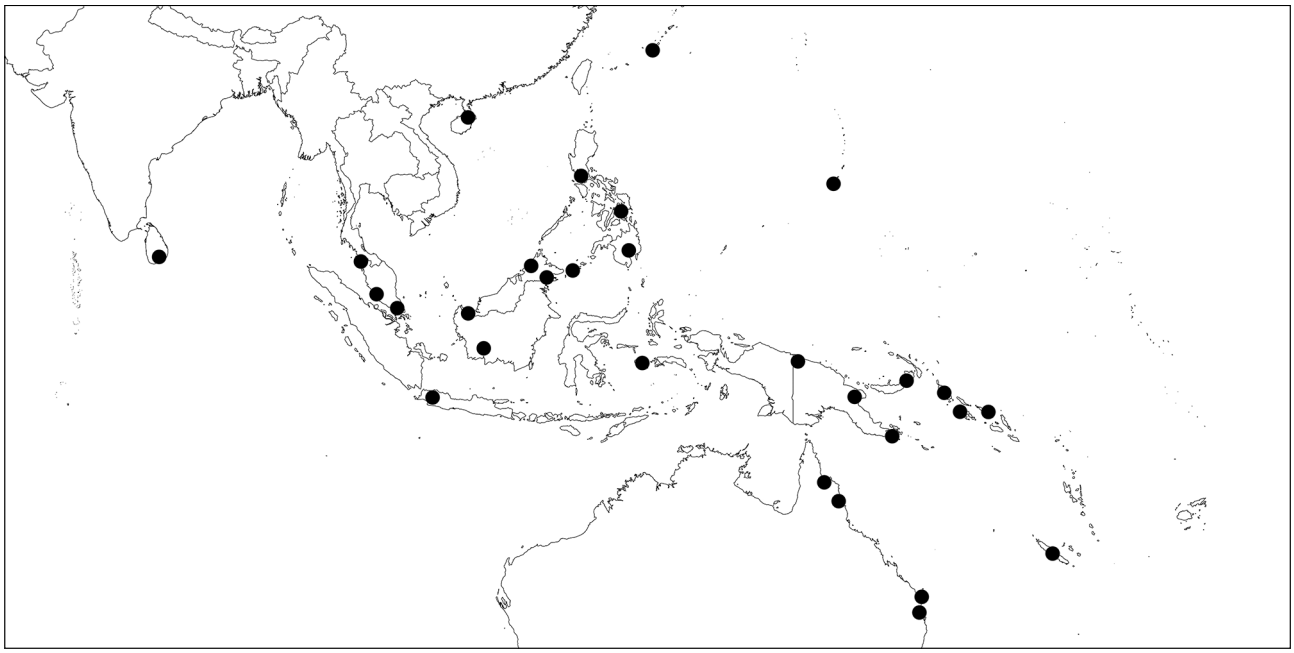
Vitex petiolaris Domin (1928) 561; Munir (1987) 67. — Type: *Domin 8167* (holo PR n.v.), Nordost-Queensland, an der Küste bei Cairns.

Vitex trifolia L. var. *bicolor* f. *albiflora* Moldenke (1961) 86; De Kok (2007) 597. — Type: *Parks 16178* (holo UC [UC297255]*; iso K, NY [NY01043251]*), Tonga Islands, Eua, Ohonua.

Vitex negundo L. var. *philippinensis* Moldenke (1978) 308; De Kok (2008) 32. — Syntypes: *Elmer 8125* (K, NY [NY00138511]), Luzon, Laguna Province, Los Baños.

Shrub or small tree, up to 1.5–5 m high. *Leaves* (1)3–5-foliolate; petiole 1.5–5.2 cm long. *Leaflets*: blades ovate to ovate-lanceolate, apex acuminate, base cuneate, margin entire, upper surface dark dull green, drying dark brown or black, lower surface pale green; secondary veins 6–16 per side, not prominent, usually not very visible; terminal leaflets 3.8–9.6 by 1.2–4 cm long; terminal petiolules (0.4–)0.9–2 cm long; lateral leaflets 2.6–8.2 by 1–2.9 cm; lateral petiolules (0.4–)0.8–1.5(–1.8) cm long in 5-foliolate leaves and sessile in trifoliate leaves; basal leaflets in 5-foliolate leaves 1.4–4.5 by 0.4–1.6 cm; basal petiolules 0(–0.1) cm long. *Inflorescences* terminal, consisting of lateral cymes in lax clusters with persistent flowers; axis 5.9–15 cm long, smooth; bracteoles ovate to linear, up to 2 mm long, patent, usually persistent, drying the same colour as inflorescence. *Calyx* glands absent to few; tube 1.4–2.3 mm long; lobes 0.2–0.8 by 0.3–0.8 mm, lobe apex acute, rarely acuminate; flowering calyx 1–1.5 mm diam; fruiting calyx 2–2.5 mm diam, erect, covering up to 1/3 of the mature fruit. *Corolla* pale lilac, blue to violet; glands few or absent; tube 3.2–6.2 mm long; anterior lip orbicular to ovate, 2.3–3.2 by 2.3–3.3 mm, apex round, anterior corolla lip with semi-circular area of hairs at the corolla mouth; lateral lobes 1.2–1.5 by 1–2 mm, apex round, patent; posterior lobes 1.2–1.5 by

Fig. 6 *Vitex bicolor* Willd. a. Habitat; b. old inflorescence; c. leaves; d. detail of branching pattern. — Photos by R. de Kok.



Map 3 Natural distribution of *Vitex bicolor* Willd.

1–1.2 mm, apex round, erect. *Stamens*: filaments 2.6–4.1 mm long, slightly to strongly didynamous, inserted halfway to lower 1/3 of the corolla tube; anthers c. 0.8 mm long. *Ovary* 0.6–0.8 by 0.5–0.7 mm, glabrous, glands few at apex; style 3.6–7 mm long; stigma lobes 0.2–0.7 mm long. *Fruits* ellipsoid when dried, 2.6–5.1 by 2.8–5.8 mm, glabrous, black or purple when mature.

Distribution — Sri Lanka; South China (Hainan); Japan (Okinawa); throughout Malesia; Australia (Queensland); W Pacific (Tonga, Samoa and Marianas).

Habitat & Ecology — Beaches and low hills, growing in sand, at 0–20(–300) m altitude. Flowering: August to May; fruiting: September to May.

Vernacular names — Andami (Bajawa language, Indonesia), Lagundi (Brunei-Malay).

Conservation status — Least concern (LC) as it is common throughout its range and there are no known threats (Sengun 2017).

Notes — 1. It was not possible to see the types of *V. petiolaris* or *V. neocaledonica*; however, the descriptions in the original publications clearly belong to *V. bicolor*.

2. The name *V. leucoxylon* Blanco (1837) may refer to this species. The illustrative specimen for *V. leucoxylon* selected by Merrill (1918) in his Species Blancoanae series is *V. bicolor.* The name is already occupied by *V. leucoxylon* L.f (1782); therefore, Blanco's name is illegitimate.

3. *Vitex bicolor* can be confused with *V. trifolia* if there are no 5-foliolate leaves in the herbarium specimen (Fig. 6b). However, it can be distinguished by its ovate to ovate-lanceolate terminal leaflet with a cuneate base and a distinct petiolule as opposed to *V. trifolia* that has an obovate or oblanceolate terminal leaflet with an attenuate base, sessile or very shortly petiolulate.

4. *Vitex collium* Sengun, *sp. nov.* — Fig. 7, 8; Map 4

This taxon differs from *V. negundo* L. in having lobed leaflet margins in which the tertiary venation continues to the apex of the lobe and the apex is often aristate and, very rarely and only its basal leaflets entire; as opposed to *V. negundo* that has a dentate margin with tertiary venation arching back before reaching the apex of the dentation and the apex acuminate and, frequently and any of the leaflets can be entire. In addition, it differs in its specific distribution that is in the frost prone regions of Central and Northern China as opposed to *V. negundo* occurring in Southern China as well as North India and Nepal. — Type: *Sengun 53a* (holo PE; iso K), China, Beijing.

Agnus-castus incisa (Lam.) Carrière var. *multifida* Carrière (1870–1871) 416. — *Vitex incisa* Lam. var. *multifida* (Carrière) C.K.Schneid. (1911) 594. — *Vitex negundo* L. var. *incisa* (Lam.) C.B.Clarke f. *multifida* (Carrière) Rehder (1917) 3481. — *Vitex negundo* L. var. *heterophylla* (Franch.) Rehder f. *multifida* (Carrière) Rehder (1947) 258. — Type: not indicated. Syn. nov.

Vitex incisa Lam. var. *heterophylla* Franch. (1883) 112. — *Vitex negundo* L. var. *heterophylla* (Franch.) Rehder (1947) 258. — Type: *Herbier Drake del Castillo s.n.* (holo P [P02888194]), (China,) environs de Pékin.

Vitex negundo L. var. *heterophylla* (Franch.) Rehder f. *albiflora* H.W.Jen & Y.J.Chang (1991) 2. — Type: *Jen 88654* (holo BFUH n.v.), China, Beijing, Songshan. Syn. nov.

Vitex negundo L. var. *sichuanensis* J.L.Liu (1995) 501. — Type: *J.L.Liu 505* (holo XIAS n.v.; iso PE [01477359]), (China,) Sichuan, Xichang. Syn. nov.

Shrub or small tree, up to 2 m high. *Bark* smooth, grey. *Leaves* 5–7-foliolate; petiole 1.1–7.3 cm long. *Leaflets*: blades oblong-elliptic to narrowly elliptic, apex acuminate, base cuneate, margin lobed in which the tertiary venation continues to the apex of the lobe and often forms an aristate tip, rarely basal leaflet(s) entire, upper surface dark green, lower surface light green; secondary veins 3–6 per side, slightly prominent, visible on both surfaces; terminal leaflets 2.3–13.4 by 1.1–4.8 cm; terminal petiolules 0.3–2.9 cm long; lateral leaflets 1.8–8.6 by 0.8–3.5 cm; lateral petiolules 0.1–1.7 cm long; basal leaflets 0.5–5.6 by 0.2–2.7 cm; basal petiolules 0–0.6 cm long. *Inflorescence* terminal, consisting of lateral cymes in dense clusters with persistent flowers; axis 8.5–14 cm long, smooth; bracteoles linear, up to (0.7–)1.4–3(–8.1) mm long, patent, persistent, drying black. *Calyx* glands absent to few; tube 1.1–2.1 mm long; lobes 0.5–1.1 by 0.3–1 mm, lobe apex sometimes acuminate but often aristate; flowering calyx 1.8–2.5 mm diam; fruiting calyx 2.7–3 mm diam, erect, covering most of the mature fruit. *Corolla* white or light purple to blue-violet; glands few or absent; tube 3.5–5.4 mm long; anterior lip orbicular, 2.7–5 by 2.9–4.9 mm, apex rounded, anterior corolla lip with semi-circular area of hairs at the corolla mouth; lateral lobes 2.4–2.5 by 1.6–3 mm, apex round, patent; posterior lip: lobes 2.1–2.6 by 1.7–2.1 mm, apex round, reflected to erect. *Stamens*: filaments 3.2–4.8 mm long, slightly to strongly didynamous, inserted at half to lower 1/3 of the corolla tube; anther c. 1 mm long, pale brown to violet. *Ovary* c. 1 mm diam, glabrous, glands sometimes present; style 3.8–7.2 mm long; stigma lobes 0.4–1 mm long. *Fruit* when dried ellipsoid, 2.5–3.5 by 2–3 mm, apex truncate, glabrous.

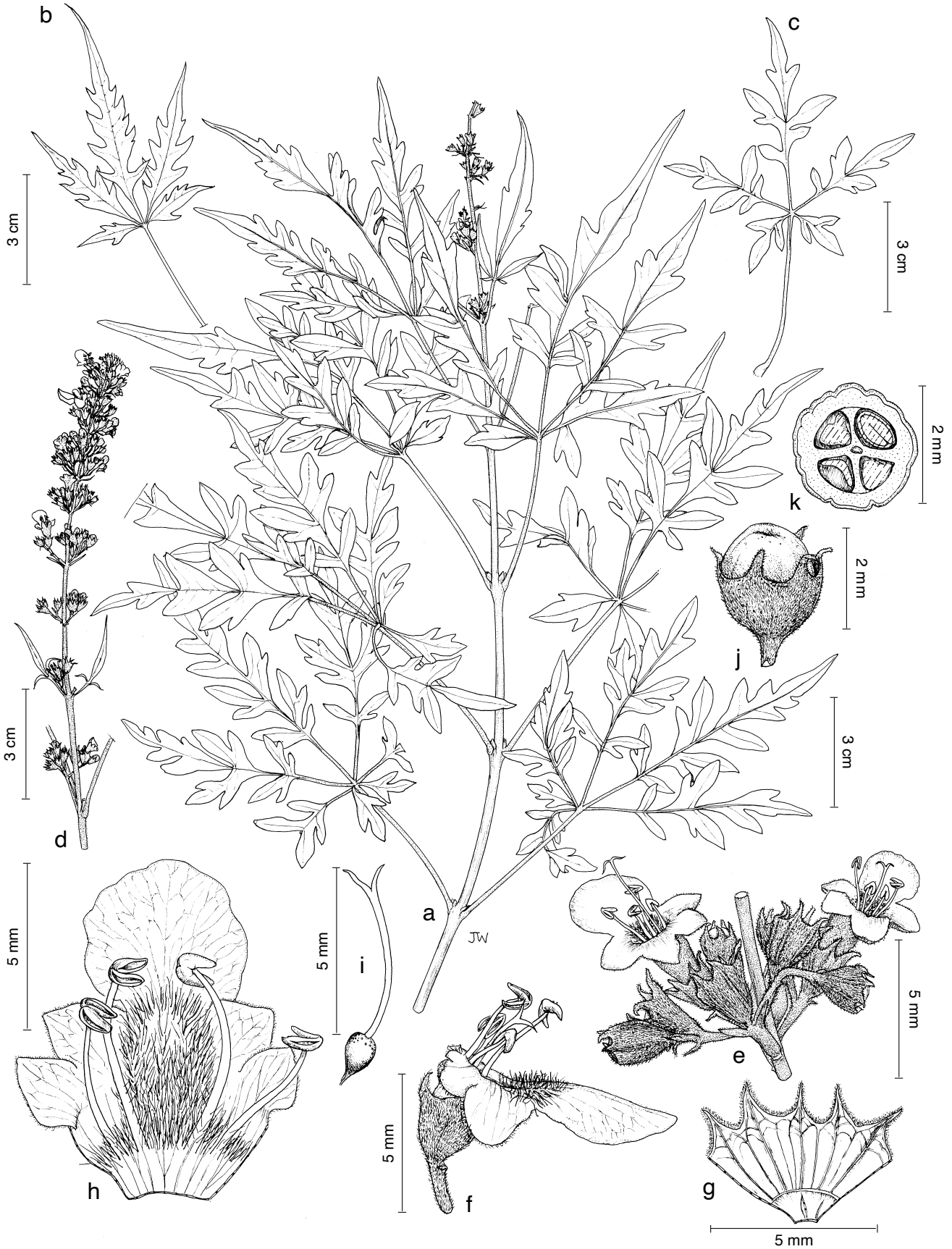
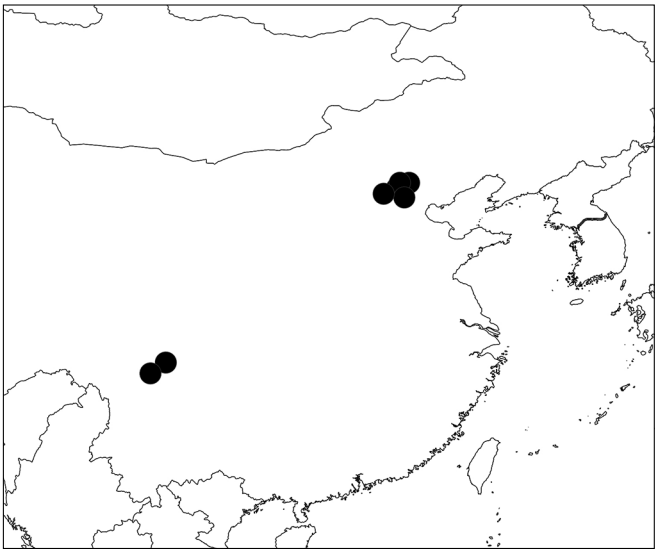


Fig. 7 *Vitex collium* Sengun. a. Habit; b. lobed leaflet; c. lobed leaflet; d. part of inflorescence; e. inflorescence detail; f. flower, side view; g. calyx open, adaxial; h. corolla open; i. ovary & style; j. fruit in calyx; k. fruit in cross-section (a: *Zhao & Wenbin s.n.*; b, d, g–h: *Sengun 53*; c, e–f: *Zhou et al. 7*; i: *Sengun 53*; j–k: *Sengun 50*; all K). — Drawing by Juliet Beentje.

Fig. 8 *Vitex collium* Sengun. a. Habit; b. infructescence and young fruit; c. leaves; d. flower (♂ phase); e. leaves; f. leaf detail. — Photos a–e by R. de Kok; f by Zhao Xue-li & Ju Wen-bin.



Map 4 Natural distribution of *Vitex collium* Sengun.

Distribution — North China (Beijing Municipality, the provinces of Hebei and Shanxi, an isolated population in Luding County in Sichuan Province).

Habitat & Ecology — Pine forests and mixed thickets on mountain slopes in frost prone regions at 160–1800 m altitude. Flowering and fruiting: August.

Vernacular name — Jing tiao (Chinese).

Conservation status — IUCN assessment gives the extent of occurrence (EOO) as greater than the threshold for a threatened category, thus the status would be least concern (LC) but the area of occurrence (AOO), meets the threshold for the Endangered (E) category. Unfortunately, we have found no data on the threats facing the localities or on the status of the populations. Therefore, we have categorised this species as Data Deficient (DD).

Note — This taxon has never been recognised at species level before. It has been named here *V. collium* Sengun for it translates to English as the '*Vitex* of the hills' in recognition of its native habitat in the hills of China.

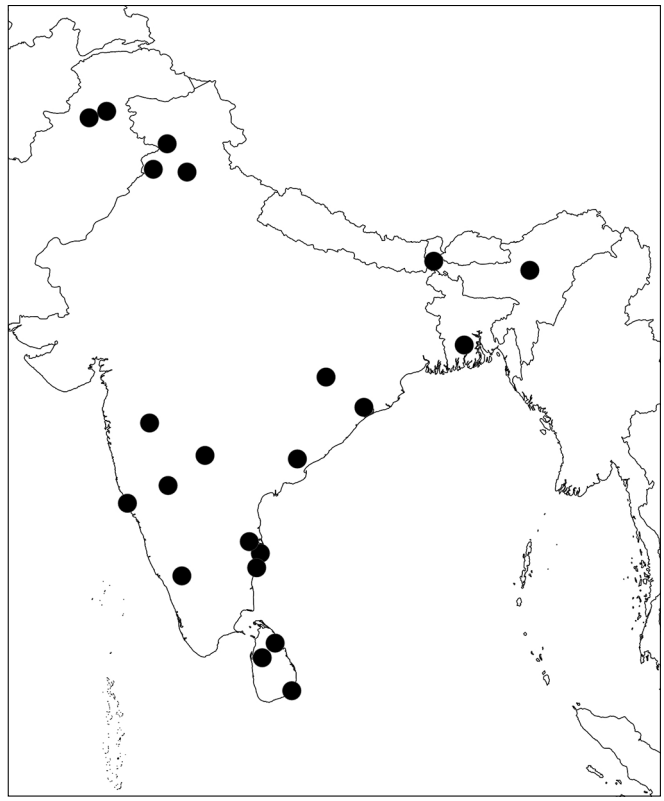
5. *Vitex hybrida* Moldenke — Fig. 9, 10; Map 5

Vitex hybrida Moldenke (1941) 29. — Type: *Anonymous s.n.* (holo MICH [1108448]*), India (Pakistan), Sindh, Bhola.

Vitex negundodes Kuntze f. *albiflora* Kuntze (1891) 510, nom. inval. — Type: *Kuntze 7367* (holo NY (n.v.); iso K [K000222901]*), [South India] Dekkan.

Vitex negundo L. var. *purpurascens* Sivar. & Moldenke (1974) 404. — Type: *Sivarajan 1849* (holo LL [LL00375281]*), (India, Kerala,) Calicut University campus. Syn. nov.

Shrub, 1–6 m high. *Leaves* 3–5-foliolate; petiole 1–6.7 cm long. *Leaflets*: blades lanceolate, apex acuminate, base cuneate, margin entire, upper surface dark green, lower surface light green to grey or purple; secondary veins 13–16 per side, slightly prominent, visible on both surfaces; terminal leaflets 4.7–13.3 by 1–2.9 cm; terminal petiolules 0.5–2 cm long; lateral leaflets 3.2–11.6 by 0.6–2.5 cm; lateral petiolules 0–2.1 cm long; basal leaflets 0.9–8.1 by 0.5–2.1 cm; basal petiolules 0–0.5 cm long. *Inflorescence* axillary or terminal, consisting of lateral cymes in dense clusters, lower flowers caducous; axis 8–27.4 cm long, often pitted due to aborted flowers, sometimes mauve tinged or purple; bracteoles ovate, up to 2 mm long, patent, caducous, drying the same colour as inflorescence. *Calyx* glands absent to few; tube 1.1–2.4 mm long; lobes 0.3–1 by 0.5–1 mm, apex acute to acuminate; flowering calyx 3–3.5 mm diam; fruiting calyx 1.4–2.4 mm diam, erect, covering most of the fruit. *Corolla* dull or pinkish purple to violet or white; glands few or absent; tube 3–6.1 mm long; anterior lip orbicular, 1.5–4 by 1.6–3.7 mm, apex round, semi-circular area of hairs at the corolla mouth; lateral lobes 2–2.4 by 1.8–2 mm, apex round, patent; posterior lobes 1.2–1.7 by 1.7–1.9 mm, apex round, reflected to erect. *Stamens*: filaments 3–4.5 mm long, slightly to strongly didynamous, inserted at half to lower 1/3 of the corolla tube; anther c. 0.8 mm long, pale brown to violet. *Ovary* c. 1 mm diam, glabrous, glands sometimes present; style 5.1–8.6 mm long; stigma lobes 0.3–0.6 mm long. *Fruit* ellipsoid, when dried 3–4 by 3–3.8 mm, apex truncate, glabrous, black when mature.



Map 5 Natural distribution of *Vitex hybrida* Moldenke.

Distribution — Pakistan, India, Sri Lanka, Bangladesh. It is also known to be grown for horticultural purposes in Peninsular Malaysia, Singapore and Vietnam.

Habitat & Ecology — Growing in secondary (dry) forest, mixed thickets and along roadsides, streams and in wastelands, often cultivated. Soil: Laterite, from sea-level up to 1200 m altitude. Flowering: June to February; fruiting: July to December.

Uses — Used medicinally for many ailments throughout the Indian subcontinent.

Vernacular names — Mărwăn (Punjabi); Nalla vavili (Telugu); Nika (Sinhala); Nirgudi (Hindi); Nishinda, Samalu (Bengali); Nochi (Tamil); Pushto (Urdu); Senduar (Nagpur).

Conservation status — Least concern (LC) as it is common throughout its range and there are no known threats (Sengun 2017).

Notes — 1. This species has never been recognised as a distinct species before. Even Moldenke (1941), who published the oldest name at species level for this taxon, thought that he was dealing with a hybrid between *V. negundo* and *V. pseudo-negundo*. According to the nomenclature rules (Turland et al. 2018) even though it is misleading and never been used, the name *V. hybrida* has to be adopted for this species.

2. It is the common species from the *V. trifolia* complex in India, Pakistan and Sri Lanka but known and studied as *V. negundo*. *Vitex hybrida* can easily be distinguished from the latter

Fig. 9 *Vitex hybrida* Moldenke. a. Habit; b. part of inflorescence; c. flower, side view; d. calyx open, adaxial; e. corolla open; f. style and ovary; g. fruit in calyx; h. detail of inflorescence; i. cross section of fruit (a: *Rich 571*; b–f, h: *Worthington 6378*; g, i: *Gamble 3623A*; all K). — Drawing by Juliet Beentje.

Fig. 10 *Vitex hybrida* Moldenke. a. Habit; b. young inflorescence; c. flower; d. young fruits; e. leaves and flower; f. old inflorescence detail — Photos a–d by Jagan Gadpayale; e–f by Seda Sengun.

taxa by its purely entire leaflets, long, pitted cyme axes due to the scarring caused by aborted flowers, short (up to 2 mm), ovate bracteoles, often caducous, drying the same colour as the rest of the inflorescence and acute to acuminate calyx lobe apices as opposed to *V. negundo* that has dentate leaflets (all or some), short, smooth cyme axes with flowers regularly disposed, long (3–7 mm) linear bracteoles, persistent, drying black and acuminate to often aristate calyx lobe apices.

3. Some specimens are known to have purple undersides of the leaves and twigs as a result of purple hairs. However, this is not visible in herbarium specimens.

4. The name described by Kuntze (1891) *V. negundodes*, does not seem to be a typographical error for *negundoides* as he uses it consistently throughout his publication. The species *V. negundodes* has never been validly published and therefore the form *albiflora* is also invalid. From the description and locality, it is clear that *V. negundodes* f. *albiflora* sensu Kuntze must be *V. hybrida*.

5. *Vitex hybrida* can be confused with *V. bicolor*. However, it can be distinguished by its dense cymes on a pitted axis (due to aborted flowers) as opposed to *V. bicolor* having lax cymes on a smooth axis.

6. *Vitex negundo* L. — Fig. 11, 12; Map 6

Vitex negundo L. (1753) 638 (page number printed erroneously as 938); H.J.Lam (1919) 189; De Kok & Sengun (2019) 407. — *Agnus-castus negundo* (L.) Carrière (1870–1871) 416. — *Vitex agnus-castus* L. var. *negundo* (L.) Kuntze (1891) 511. — Lectotype (designated by Moldenke 1955b: 490): *Herb. Linnaeus LINN 811/8* (lecto LINN), India.

[*Vitex incisa* Wall. (1829) no. 1746, nom. nud. — Based on: *Wallich no. 1746* (K-W).]

Vitex latifolia Mill. (1768). — *Vitex agnus-castus* L. var. *latifolia* (Mill.) Loudon (1830) 246. — Lectotype (designated here): De l'Obel, Pl. Icon 139, tome 2 (1591) t. 161.

Vitex chinensis Mill. (1768). — Lectotype (designated here): *Miller s.n.* (BM [BM000757489]; isolecto BM [BM000757490]), ex Hort. (unknown which).

Vitex incisa Lam. (1786) 612. — *Agnus-castus incisa* (Lam.) Carrière (1870–1871) 416. — *Vitex negundo* L. var. *incisa* (Lam.) C.B.Clarke (1885) 584. — Type: *Jardin du Roi*, *'originaire de la Chine'* (holo P–Lam.; Micofiche LM-509/2, Picture at K), originally from China.

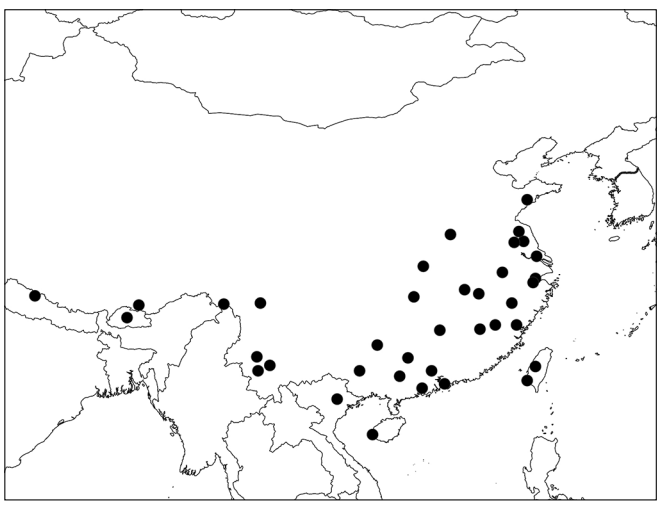
Vitex spicata Lour. (1790) 475. — Type: *de Loureiro s.n.* (n.v.), Cultaque in Cochinchina et China.

Vitex gracilis Salisb. (1796) 107, *nom. illeg.*, in synonymy.

Vitex cannabifolia Siebold & Zucc. (1846) 152. — *Vitex negundo* L. var. *cannabifolia* (Siebold & Zucc.) Hand.-Mazz. (1934) 67. — Lectotype (designated here): *Siebold s.n.* (W [W0022974]; isolecto: M [M0111716, M0111717]*, W [W0022975, W0285058]), Japan. Syn. nov.

Agnus-castus incisa (Lam.) Carrière var. *alba* Carrière (1870–1871) 416. — Type: not indicated. Syn. nov.

Vitex negundo L.f. *alba* C.Pei (1932) 104. — Lectotype (designated here): *Forrest 10123* (PE [PE0095990]; isolecto K), (China,) Yungpeh. Syn. nov.



Map 6 Natural distribution of *Vitex negundo* L.

Vitex negundo L.f. *laxipaniculata* C.Pei (1932) 104. — Lectotype (designated here): *Henry 13210* (NY [NY00138480]; isolecto K), (China,) Yunnan. Syn. nov.

Vitex negundo L.f. *intermedia* C.Pei (1932) 105; De Kok (2008) 25. — *Vitex negundo* L. var. *intermedia* (C.Pei) Moldenke (1937) 2. — Lectotype (designated here): *Wright s.n.* (NY [NY00076777]; isolecto L), (China,) Hong Kong. Syn. nov.

Vitex negundo L. var. *microphylla* Hand.-Mazz. (1936) 906. — *Vitex microphylla* (Hand.-Mazz.) C.Pei ex C.Y.Wu (1977) 452, nom. superfl., non Moldenke. — Type: *von Handel-Mazzetti 8781* (holo W; iso A [A00143801]*, E [E00284233], WU [WU0060375]*), (China,) in regionis subtropicae vallis fluvii Dijnscha-dijang ("Yangtse") ad occid urbis Lidjiang ('Likiang') dumetis supra vicum Ahsi. Syn. nov.

Vitex negundo L. var. *macrophylla* Moldenke [(1939) 40, nom. nud.;] (1940) 753. — *Walther 174* (holo BH [BH000 046 022, BH000 046 023]), USA, California, Los Angeles, Huntington Botanic Garden.

Vitex negundo L. var. *sessilis* Moldenke [(1939) 40, nom. nud.;] (1940) 754. — *Heuer* [*F.P.I. 63649*] (holo BH [BH000 046 021]), USA, Florida, Dade County.

Vitex elmeri Moldenke (1978) 307; De Kok (2008) 25. — Type: *Elmer 5611* (holo NY (NY00138505)), Philippines, Luzon, Union Province, Bauang.

Vitex negundo L. var. *thyrsoides* C.Pei & S.L.Liou (1982) 212. — Type: *Dai Tianlun 104763* (holo NAS [NAS 00218250]*), China, Sichuan province, Chengkou County. Syn. nov.

Vitex simplicifolia B.N.Lin & S.W.Wang (1994) 209, nom. superfl., non Oliv. — *Vitex negundo* L. var. *simplicifolia* (B.N.Lin & S.W.Wang) D.K.Zang & J.W.Sun (2009) 22. — Type: *Bingham 9007* (holo JSBI n.v.), China, Shandong, Jinan, Shi, Changqing Xian, Suzhuang. Syn. nov.

Shrub or small tree, up to 4 m high. *Leaves* 3–5(–7)-foliolate; petioles 1.8–5.5 cm long. *Leaflets*: blades oblong-elliptic to narrowly elliptic to lanceolate, apex acuminate, base cuneate, margin entire to dentate (always some leaflets dentate), dentations with the tertiary venation arching back before reaching the apex of the tooth, upper surface dark green, lower surface light green, aromatic when crushed; secondary veins 4–7(–9) per side, slightly prominent, visible on both surfaces; terminal leaflets 3.7–11.8 by 0.7–3.3 cm; terminal petiolules (0.2–)0.8–1.4(–2.4) cm long; lateral leaflets 2.9–9 by 0.3–3.1 cm; lateral petiolules (0–)0.2–1(–1.8) cm long; basal leaflets absent (trifoliolate) or 1.3–5 by 0.3–1.4 cm; basal petiolules 0–0.5 cm long. *Inflorescences* terminal, consisting of lateral cymes in dense clusters with persistent flowers; axis 6–20 cm long, smooth; bracteoles linear, up to (0.6–)2.5–5 mm long, patent, persistent, drying black. *Calyx* glands absent to few; tube 0.9–2.1 mm long; lobes 5–10 by 4–10 mm, lobe apex sometimes acuminate but often aristate; flowering calyx 1–1.5 mm diam; fruiting calyx 2–2.5 mm diam, erect, covering most of the mature fruit. *Corolla* white or light purple to blue-violet; glands few or absent; tube 2.6–3.6 mm long; anterior lip orbicular, 1.5–3 by 1.3–2.7 mm, apex rounded, anterior corolla lip with semi-circular area of hairs at the corolla mouth; lateral lobes 1.2–1.5 by 1–2 mm, apex rounded, patent; posterior lip: lobes 1.2–1.5 by 1–1.2 mm, apex rounded, reflected to erect. *Stamens*: filaments 2–3.8 mm long, slightly to strongly didynamous, inserted halfway to lower 1/3 of the corolla tube; anther c. 0.8 mm long. *Ovary* 0.6–0.8 by 0.5–0.7 mm, glabrous; style 1.9–5.6 mm long; stigma lobes 0.4–0.7 mm long. *Fruit* ellipsoid, when dried 1.5–2.7 by 1.1–2.2 mm, apex truncate, glabrous, black when mature.

Distribution — Nepal, Bhutan, China and Vietnam. Reported to be introduced and cultivated in at least Peninsular Malaysia, Singapore, Borneo, Sumatra, Java, the Philippines and possibly in the whole of the Flora Malesiana area.

Habitat & Ecology — Growing in secondary forest (rarely in primary), mixed thickets and along roads and in wastelands, from sea-level up to 3200 m altitude. Flowering: June to April; fruiting: July to November in more temperate regions; reported to be flowering and fruiting throughout the year in the tropics.

Uses — The species is grown for ornamental purposes and in China as a source of fibre. It is used medicinally throughout the region.

Fig. 11 *Vitex negundo* L. a. Habit; b. part of inflorescence; c. flower, side view; d. calyx open, adaxial; e. corolla open; f. style; g. fruit in calyx; h. fruit in cross-section; i. calyx; j. inflorescence axis in cross-section (a, c, e–f, j: *Sengun 31*; b, d, g–i: *Xiao Bai-Zhong 3849*; all K). — Drawing by Juliet Beentje.

Fig. 12 *Vitex negundo* L. a. Habit; b. inflorescence; c. flower (♀ phase); d. infructescence; e. thyrsoid inflorescence; f. serrated leaves; g. serrated leaves; h. entire leaves. — Photos by R. de Kok.

Vernacular names — Five-leaved chaste tree (English); Huang jing, Mu jing, Ni huang jing, Xiao ye jing (China); Lagundi (Philippines); Merbok (Malaysia); Talaun mohou (Malaysia, Sabah).

Conservation status — Least concern (LC) as it is common throughout its range and there are no known threats (Sengun 2017).

Notes — 1. Although some specimens on herbarium sheets have entire leaflets, in situ, all plants have some dentate leaflets.

2. The name *V. latifolia* Mill. with as the type the illustration De l'Obel (1591: t. 161) (rather than t. 139 as was mentioned in Miller 1768), is clearly *V. negundo*. The information given in Miller agrees with the De l'Obel t. 161 plate including the text: '*Vitex folio latiore ferrato*'. Plate 139 clearly shows a monocotyledonous herb.

3. The type of *V. spicata* Lour. may not even be extant as many of De Loureiro's specimens did not survive. However, Merrill (1918) states that the 'excellent description applies unmistakably to *V. negundo*'.

7. *Vitex pseudonegundo* (Hausskn. ex Bornm.) Hand.-Mazz. — Fig. 13; Map 7

Vitex pseudonegundo (Hausskn. ex Bornm.) Hand.-Mazz. (1913) 408; C.C.Towns. (1972) 148. — *Vitex agnus-castus* L. var. *pseudonegundo* Hausskn. ex Bornm. (1907) 117. — Lectotype (designated by Townsend 1972): *Strauss s.n.* (JE [JE00000041]*), Iran, Burujird.

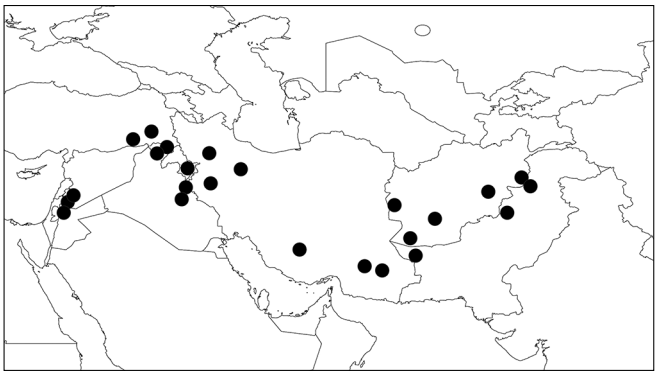
Vitex hausknechtii Bornm. (1907) 118. — Type: *Haussknecht s.n.* (holo JE (not found); iso B [B 10 0365967]), Syria, Marasch, prope Dschilan-Köprü.

Vitex negundo L. var. *trifoliolata* Moldenke (1973) 432. — Type: *Rechinger 29984* (holo US [US00119275]), (Pakistan,) Sulaiman Mountains, 100 km east of Fort Sandeman, between Mughal Kot and Daraban.

Vitex agnus-castus auct. non L.: Boiss. (1879) 535, p.p.

Shrub or small tree, 1–3 m high, deciduous. *Bark* smooth, grey. *Leaves* 5–7-foliolate; petioles 1–6.1 cm long. *Leaflets*: blades lanceolate, apex acuminate, base cuneate, margin entire, upper surface dull green, lower surface whitish; side veins 11–15 per side, slightly prominent, visible on both surfaces; terminal leaflets 4–12.5 by 0.5–2.7 cm; terminal petiolules 0–1.2 cm long; lateral leaflets 2.5–10.4 by 0.5–2.1 cm; lateral petiolules 0(–0.9) cm long; basal leaflets 1.2–7 by 0.1–2.2 cm; basal petiolules 0–0.3 cm long. *Inflorescences* terminal, consisting of lateral cymes in dense clusters with persistent flowers; axis 15–25 cm long, smooth; bracteoles ovate to linear, up to 2 mm long, appressed, caducous, drying the same colour as inflorescence. *Calyx* glands many; tube 1.3–2.4 mm long; lobes 0.5–0.7 by 0.5–1 mm, apex acute; flowering calyx 2.8–3.2 mm diam; fruiting calyx 2.7–4.2 mm diam, patent to erect, covering half to most of the mature fruit. *Corolla* pale lilac to blue; glands

Fig. 13 *Vitex pseudonegundo* (Hausskn. ex Bornm.) Hand.-Mazz. a. Habit; b. inflorescence detail; c. flower, side view; d. calyx open; e. corolla open; f. ovary & style; g. ovary detail; h. fruit side view; i. fruit in cross-section (a: *Köle 2090*; b–c, h: *Andursky 280*; d–g: *Furse 8226*; i: *Jones 2*; all K). — Drawing by Juliet Beentje.



Map 7 Natural distribution of *Vitex pseudonegundo* (Hausskn. ex Bornm.) Hand.-Mazz.

few; tube 3.3–4.9 mm long; anterior lip spathulate, 2–4.3 by 2.1–4 mm, apex rounded to acute, anterior corolla lip with semi-circular area of hairs at the corolla mouth; lateral lobes 1.3–1.5 by 1.2–1.5 mm, apex rounded, erect; posterior lip lobes 1.3–1.6 by 1.7–1.8 mm, apex acute, erect. *Stamens*: filaments 2.2–5 mm long, slightly didynamous to equal, glabrous to hairy, inserted halfway to lower 1/3 of the corolla tube; anthers c. 1 mm long. *Ovary* c. 1 mm diam, hairy, glands absent to many covering the apex; style 2.7–6.9 mm long; stigma lobes 0.1–0.7 mm long. *Fruit* broadly obovoid to globose, when fresh 3–4 mm diam, dried 2.5–3.1 by 2.3–3 mm, glabrous to few hairs on top, black to reddish when mature.

Distribution — Southeast Turkey, Syria, Israel, Lebanon, Jordan, Iraq, Iran, Afghanistan and Pakistan.

Habitat & Ecology — Along rivers and creeks, in open vegetations. Soil: clay, sandy or gravel, at 5–750 m altitude. Flowering and fruiting: March to September.

Conservation status — Least concern (LC) as it is common throughout its range and there are no known threats (Sengun 2017).

Note — Often confused with *V. agnus-castus*, see notes under this taxon.

8. *Vitex rotundifolia* L.f. — Fig. 14, 15; Map 8

Vitex rotundifolia L.f. (1782) 294; Munir (1987) 52; De Kok et al. (2016) 189; De Kok & Sengun (2019) 413. — Lectotype (designated here): *Thunberg s.n. (Hb. Thunb. 14619)* (lecto UPS-THUNB*; isolecto LINN-SM), Japan.

Vitex ovata Thunb. (1784) 578. — *Vitex trifolia* L. var. *obovata* (Thunb.) Benth. (1870) 67. — *Vitex agnus-castus* L. var. *ovata* (Thunb.) Kuntze (1891) 511, nom. superfl. — *Vitex trifolia* L. var. *ovata* (Thunb.) Makino (1903) 92, nom. superfl. — Type: *Bladh s.n. (Hb. Thunb. 14618)* (holo UPS-THUNB*), China, Macao.

Vitex trifolia L. var. *simplicifolia* Cham. (1832) 107; De Kok (2008) 32. — Type: *Chamisso s.n.* (holo LE n.v.).

Vitex repens Blanco (1837) 513; Merr. (1918) 332. — Neotype (designated by Sengun in De Kok et al. 2016): *Merrill 814* (neo K [K000182650]), Philippines, Luzon, Batangas.

Vitex trifolia L. var. *unifiolata* Schauer (1847) 683. — Lectotype (designated by Sengun in De Kok et al. 2016): *Thunberg s.n.* (lecto UPS [UPS-THUNB 14619]*), Japan.

Vitex trifolia L. var. *repens* Ridl. (1923) 631; Munir (1987) 53. — Lectotype (designated by Sengun in De Kok et al. 2016): *Ridley s.n.* (lecto K; isolecto SING), Malaya, Kelantan.

Vitex rotundifolia L.f. f. *albescens* Hiyama (1948) 56. — Type: *Makino s.n.* (n.v.). Syn. nov.

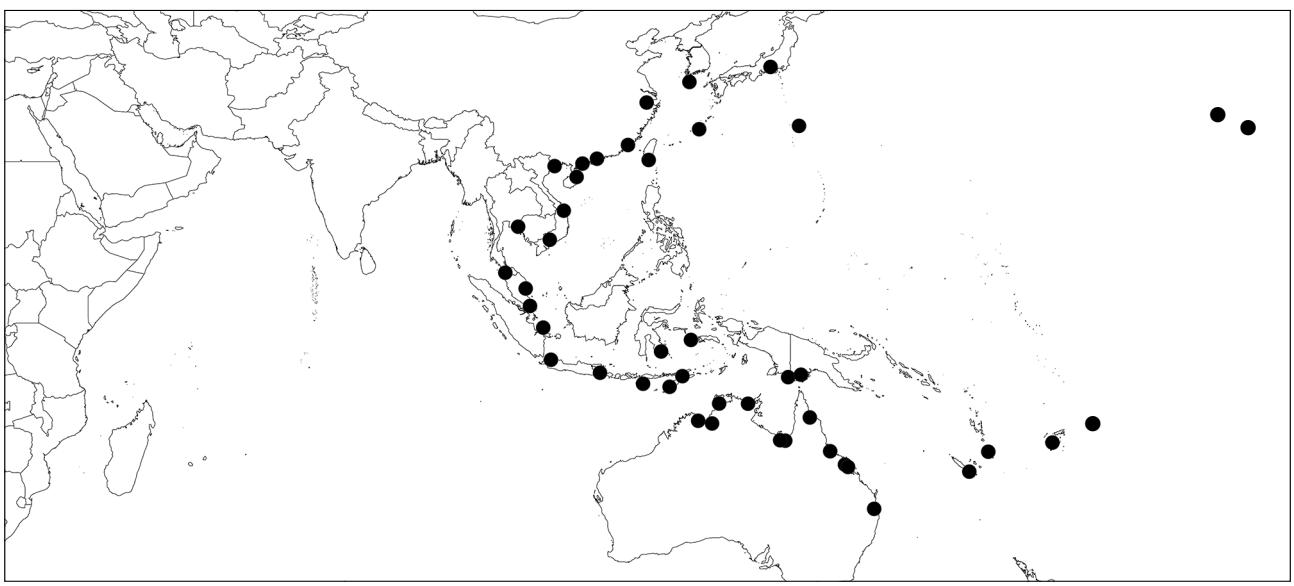
Vitex trifolia L. subsp. *littoralis* Steenis (1957) 516. — Type: *Bloembergen 3894* (holo L [L0003970]; iso BRI [BRI-AQ0430200]*), Lesser Sunda Islands, Kisar, E of Wonreli.

Vitex rotundifolia L.f. f. *rosea* Satomi (1983) 30. — Type: *Satomi s.n.* (holo KANA n.v.), Japan, Honshu, Shuonya, Kaga city, Ishikawa Prefecture. Syn. nov.

[*Vitex rotundifolia* L.f. f. *albiflora* S.S.Ying (1987) 504, nom. inval., type lacking].

Vitex rotundifolia L.f. f. *albiflora* Y.N.Lee in Y.N.Lee & Y.S.Kim (2005) 26. — Type: *Kim You Sung s.n.* (holo Korean Plant Research Institution Seoul n.v.), Korea, Daebudo, Gyeonggi-do.

Prostrate to small erect shrub, 10–60 cm high, sometimes forming dense mats of several meters diam, rooting at stem nodes. *Leaves* 1-foliolate; petioles 3–12 mm long. *Leaflets*: blades round to obovate or obovate-spathulate, apex mostly rounded, sometimes subacute, base cuneate, margin entire, upper surface green, lower surface pale green to grey-green or silvery, aromatic when crushed; secondary veins 4–7(–9) per side, slightly prominent, visible on both surfaces; terminal leaflets 1.4–5.3 by 0.8–3.3 cm. *Inflorescences* terminal and axillary, consisting of lateral cymes in dense clusters with persistent flowers; axis 4–12 cm long, smooth; bracteoles ovate to linear, up to 2 mm long, appressed, usually caducous, drying the same colour as inflorescence. *Calyx* glands few; tube 2.3–4.4 mm long; lobes 2–6 by 3–11 mm, apex acute, rarely acute to acuminate; flowering calyx 3–4 mm diam; fruiting calyx 3.5–4.5 mm diam, erect, covering most of the mature fruit. *Corolla* purplish blue to white; glands many; tube 5.3–8.3 mm long; anterior lip spathulate, 3.9–7 by 3.3–7.4 mm, apex round to truncated, anterior corolla lip with semi-circular area of hairs at the corolla mouth; lateral lobes 3–4.2 by 2–3 mm, apex rounded, reflexed; posterior lip lobes 3–3.5 by 3–3.5 mm, apex



Map 8 Natural distribution of *Vitex rotundifolia* L.f.

acute, reflexed to erect. *Stamens*: filaments 5.2–8.2 mm long, slightly to strongly didynamous, inserted halfway to lower 1/3 of the corolla tube; anthers 1.5–2 mm long. *Ovary* 1–1.5 mm diam, glabrous, glands many, covering the apex; style 9.8–14.6 mm long; stigma lobes 6–13 mm long. *Fruit* globose, when dried 4.4–5.3 by 4.3–5 mm, glabrous, turning first purplish, then black when mature.

Distribution — Widespread from Japan, Korea and China to Australia (from the north of Western Australia to Southern Queensland) and into the Pacific to Samoa and Fiji. The species is apparently absent from most of the central Pacific, but an isolated population occurs in Hawaii.

Habitat & Ecology — Growing on sandy seashores, coastal dunes and on sandbars along rivers up to 10 km from the coast. Growing just above the high-water mark to 200 m altitude. Flowering and fruiting: June to January.

Uses — Medicinal uses, particularly in Chinese and Japanese medicine systems.

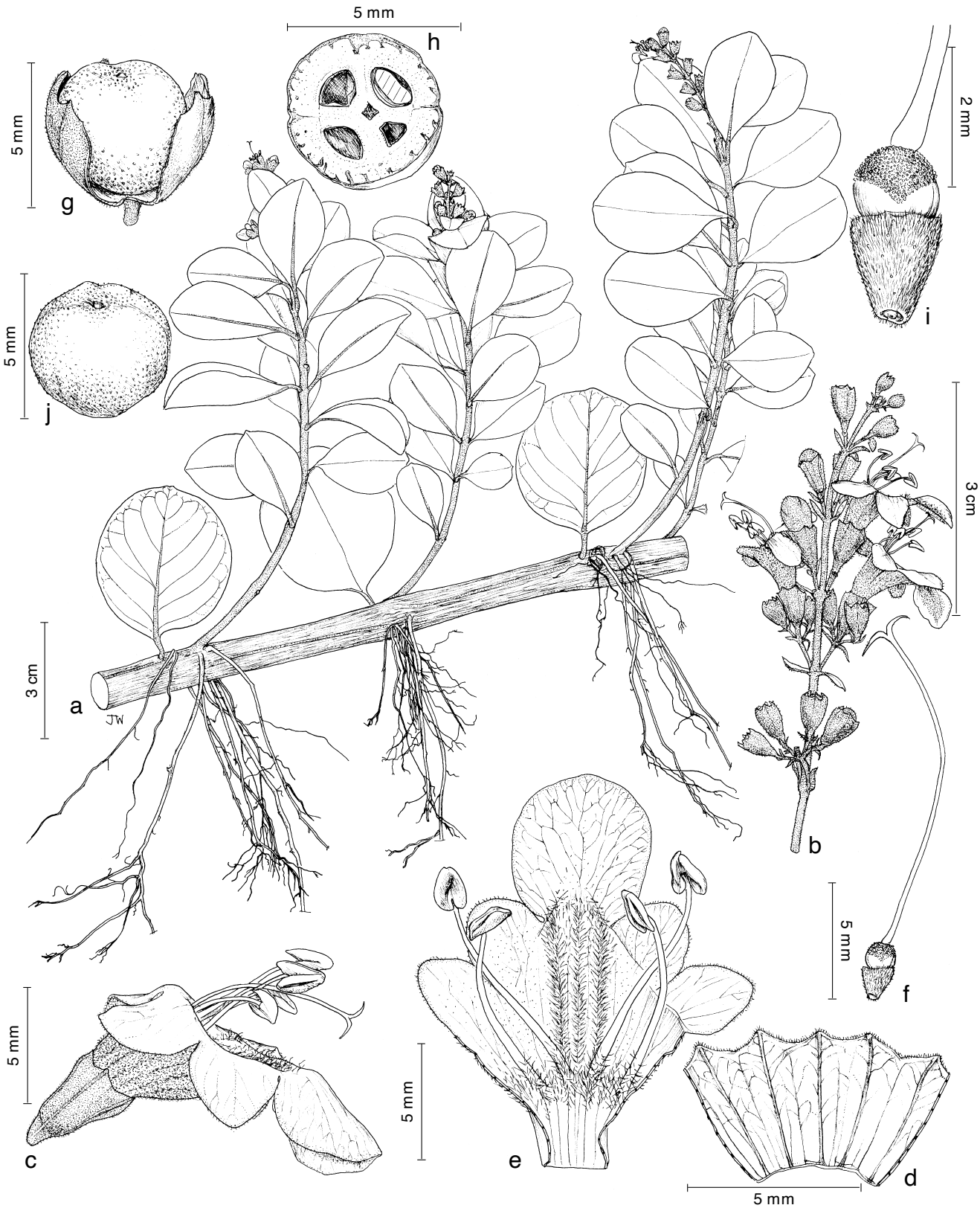


Fig. 14 *Vitex rotundifolia* L.f. a. Habit; b. part of inflorescence; c. flower, side view; d. calyx open, adaxial; e. corolla open; f. ovary & style; g. fruit in calyx; h. fruit in cross-section; i. detail of ovary; j. fruit (a: *Corrick 1409*; b–f, i: *Larsen & Larsen 33723*; g–h, j: *Sinclair 39805*; all K). — Drawing by Juliet Beentje.

Fig. 15 *Vitex rotundifolia* L.f. a. Habitat with first author; b. flower (♂ phase); c. habit and leaves; d. rhizomes with roots; e. inflorescences; f. habit. — Photos by R. de Kok.

Vernacular names — Beach Vitex (English); Dĕmunla, Gunong pantai, Lagundi, Lagundi Laud **(**Malay); Hamago (Japanese); Wora tach (local language in Western Flores, Indonesia).

Conservation status — Least concern (LC) as it is common throughout its range and there are no known threats (Sengun 2017).

Notes — 1. The whole plant has a pungent smell despite the flowers being reported to smell as lavender.

2. It can be confused with *V. trifolia*, see notes under this taxon.

3. From Blanco's original description it is clear that *V. repens* is indeed *V. rotundifolia*. However, what Merrill suggested as the example specimen for *V. repens* (*Merrill Species Blancoanae 814*, Philippines, Luzon, Batangas Province, Bauang Is.), is *V. trifolia*. Therefore, a different specimen, which exhibits all the characteristics of the species, is designated here as the neotype.

4. The type materials of *V. rotundifolia* L.f. f. *albescens* and *V. rotundifolia* L.f. f. *rosea* Satomi were not seen, but from the original descriptions it is clear that they are a flower colour variation within this species and, therefore, they were placed in synonymy.

9. *Vitex trifolia* L. — Fig. 16, 17; Map 9

Vitex trifolia L. (1753) 638 (‘*trifoliis*’), 938; Royle (1836) 299 (‘*triphylla*’); H.J.Lam (1919) 180; Munir (1987) 65; De Kok (2007) 596; De Kok & Sengun (2019) 416. — *Vitex trifolia* L. var. *trifoliolata* Schauer (1847) 683. — *Vitex integerrima* Mill. (1768), nom. superfl. — *Vitex indica* Mill. (1768) in Erratum section, nom. superfl. — *Vitex variifolia* Salisb. (1796) 107, nom. superfl. — *Vitex agnus-castus* L. var. *trifolia* (L.) Kurz (1877) 270; De Kok (2008) 32. — Lectotype (designated by Moldenke & Moldenke 1983: 378): *Herb. Linn. 811/7* (lecto LINN), India.

Vitex paniculata Lam. (1786) 612. — Type: Rumpf (1743) 50, t. 19.

Vitex trifolia L. var. *acutifolia* Benth. (1870) 67. — Lectotype (designated here): *Brown s.n.* (*Bennett 2321*) (lecto K; isolecto BM), (Australia,) Queensland, along the coast from Cape York to Moreton Bay.

Vitex agnus-castus L. var. *subtrisecta* Kuntze (1891) 510. — *Vitex trifolia* L. var. *subtrisecta* (Kuntze) Moldenke (1961) 88; Munir (1987) 71; De Kok (2007) 597. — Type: *Kuntze 5817* (holo NY n.v.), (Indonesia,) Java, Willisgebirge.

[*Vitex langundi* W.G.Maxwell (1906) 50, nom. nud.]

Vitex iriomotensis Ohwi (1938) 29. — Type: *Koidzumi s.n.* (holo KYO n.v.), Japan, Riukiu, Iriomate island.

Vitex trifolia L. var. *variegata* Moldenke (1941) 31. — Type: *Busell s.n.* (holo BH [BH000 046 020)]), (USA,) Florida, Dade County, near Miami. Syn. nov.

Vitex rotundifolia L.f. var. *heterophylla* Makino ex H.Hara (1948) 191; De Kok (2007) 597. — *Vitex trifolia* L. var. *heterophylla* (Makino ex H.Hara) Moldenke (1949) 178. — *Vitex rotundifolia* L.f. f. *heterophylla* (Makino ex H.Hara) Kitam. in Kitam. & Murata (1972) 34. — Type: Makino (1948) pl. 558.

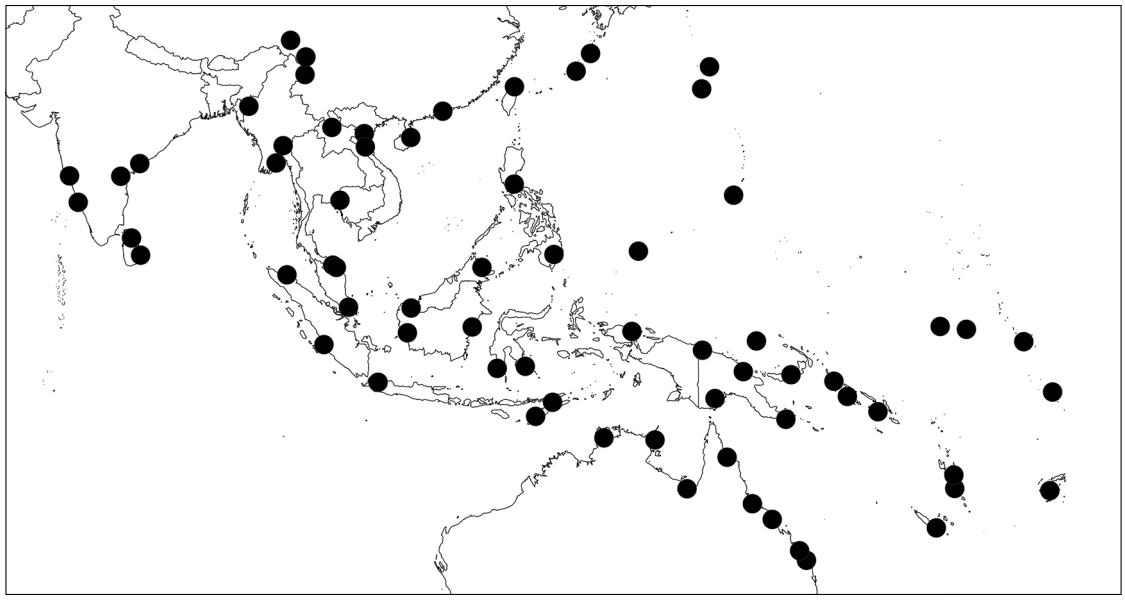
Fig. 16 *Vitex trifolia* L. a. Habit; b. habit; c. inflorescence; d. infructescence; e. attenuate terminal leaflet base (a: *Kunstler 57*; b: *Fung 20500*; c: *Du Puy CI. 63*; d: *van Borssum Waalkes 1726*; e: *Afriasstina 1222a*; all K). — Photos by Seda Sengun.

Vitex trifolia L. var. *subtrisecta* L.f. f. *albiflora* Moldenke (1961) 90; De Kok (2007) 597. — Type: *St. John 16705* (holo UC n.v.; iso K), Austral Islands, Rurutu, Peva.

Vitex taihangensis L.B.Guo & A.Q.Zhou (1989) 61. — *Vitex trifolia* L. var. *taihangensis* (L.B.Guo & A.Q.Zhou) S.L.Chen (1991) 58. — Type: *Guo Lan-bin 688* (holo NMFC n.v.), China, Shanxi, Tai Hang Shan. Syn. nov.

Shrub (prostrate on seashore) or small tree, 1–6.5 m high (up to 60 cm when prostrate, then not rooting at nodes). *Bark* smooth to finely fissured, light brown or dark grey. *Leaves* (1- or) 3-foliolate; petioles 0.4–5.5 cm long. *Leaflets*: terminal blade obovate to oblanceolate in trifoliate leaves, elliptic to lanceolate in unifoliate leaves, apex acute, rarely acuminate, base attenuate in trifoliate leaves, rounded or cuneate in unifoliate leaves, margin entire, upper surface light to dark dull green, lower surface pale green to silvery/whitish or sometimes purplish, aromatic when bruised; secondary veins 9–14 per side, slightly prominent, visible on both surfaces; terminal leaflets 2.2–9.1 by 1.1–3.1 cm; terminal petiolules 0–0.9(–1.4) cm long, lateral leaflets 1.4–7.6 by 0.5–2.6 cm, sessile. *Inflorescences* terminal, consisting of lateral cymes in lax clusters with persistent flowers; axis 5.4–18.1 cm long, smooth, sometimes mauve tinged or purple; bracteoles ovate to linear, up to 2 mm long, patent, usually persistent, drying the same colour as the rest of the inflorescence. *Calyx*: glands many; tube 1–2.8 mm long; lobes 2–7 by 3–9 mm, lobe apex acute to acuminate; flowering calyx 2–3 mm diam; fruiting calyx 5–6 mm diam, patent to erect, covering up to most of the mature fruit. *Corolla* pale purplish

Fig. 17 *Vitex trifolia* L. a. Habit (the usual erect form); b. inflorescence; c. flower; d. infructescence; e. habitat and habit (prostrate form on the beach front); f. inflorescence (prostrate plant); g. leaves (prostrate plant). — Photos by R. de Kok.



Map 9 Natural distribution of *Vitex trifolia* L.

to blue, sometimes with sweet smell; glands few; anterior lip spathulate, 2–5.5 by 2.5–5 mm, apex rounded to acute, reflexed, anterior corolla lip with semi-circular area of hairs at the corolla mouth; lateral lobes 2–3 by 2–2.5 mm, apex rounded, erect; posterior lip lobes 1.2–2.2 by 1–2 mm, apex acute, erect; tube 3.1–7 mm long. *Stamens*: filaments 3–5.8 mm long, slightly didynamous to equal, inserted at half to lower 1/3 of the corolla tube; anthers c. 1 mm long. *Ovary* 1–1.5 mm diam, glabrous, apex covered with glands; style 3.6–7 mm long, purple; stigma lobes 0.2–0.7 mm long, acuminate with a whitish appendix at each lobe. *Fruit* broadly obovoid to globose, when dried 2.2–6 by 2.2–6.2 mm, glabrous, purple, turning brown or black as it matures.

Distribution — The species is widespread from India and Sri Lanka to Southern Japan, southeast to the north coast of Australia and into the Pacific to Tahiti. Because of its uses as an ornamental and a medicinal plant, it is also widely cultivated outside its natural distribution area.

Habitat & Ecology — Beaches, inland edge of mangrove swamps, grasslands, littoral forests and in secondary vegetations. Soil: sand or more rarely in clay, often over limestone, coral, volcanic soils or shale, at 0–150(–1500) m altitude. In humid areas the species is usually common at low altitudes, becoming rare higher up. In dryer areas the species can also be common at high elevation. Often a solitary tree but sometimes occurring in thickets. Flowering and fruiting: all year round.

Uses — Various medicinal and horticultural uses.

Vernacular names — Epaskè (local language, South Sumatra), Kajo kemérū (local language, Flores), Kámaling bata (local language, Lesser Sunda Islands), Lamentang, memeongan (Sundanese), O soi (local language, Moluccas, Halmahera Island), Salagundih (Karo language, Sumatra), Tasi (Dawan language, Timor, Indonesia); Kyaung-ban (Burmese); Namulega (local language, Samoa); Nirnochi (Tamil); Mitsuba-hamago, Tachihamago, Yaeyama-hamago (Japanese); Panisamalu (Bengali); Surasa (Sanskrit).

Conservation status — Least concern (LC) as it is common throughout its range and there are no known threats (Sengun 2017).

Notes — 1. *Vitex trifolia* can have a prostrate form on beaches. Then, it can occur together with and look like *V. rotundifolia*, and therefore, the two species can be confused. However, they can be distinguished from each other as *V. rotundifolia* has only one leaflet and roots at the nodes. *Vitex trifolia* can also be confused with *V. bicolor* or, possibly, *V. benthamiana*; see notes under those species.

2. *Vitex trifolia* L. var. *taihangensis* (L.B.Guo & A.Q.Zhou) S.L.Chen describes a specimen with 'presence of simple instead of trifoliate leaves'. However, in situ there are no *V. trifolia* plants with only unifoliate leaves. Therefore, this is an ordinary *V. trifolia* specimen, but likely to be cut from a specific part of the plant. Another example of this is shown in Fig. 11b.

DOUBTFUL NAMES

Vitex negundo Noronha (1791) 1, *nom. nud*.

There is no type material associated with this name. It is known to be from Java and its vernacular name is Lagondi-Laut (= Sea-Lagundi) which is a name often ascribed to both *V. rotundifolia* and *V. trifolia*. As it is not possible to know which of these two species is meant, this name remains in doubt.

Vitex agnus-castus L. var. *javanica* Kuntze (1891) 510; De Kok (2008) 32. — Type: *Anonymous s.n.* (n.v.), (Indonesia,) Java, Plabuan.

The original description reads: 3–5 leaflets, petiolulate. This could be either *V. bicolor* or an introduced and naturalised *V. negundo*.

Acknowledgements We would like to thank the curators of the various herbaria, which made the type specimens and other key material available for this study: A, B (including B-W), BFUH, BH, BM, BRI, E, JE, JSBI, K, KANA, KYO, L, LE, LINN (including LINN-SM), LL, M, MEL, MICH, MPU, NAS, NMFC, NTUF, NY, P, PE, S, SAN, SBRI, SING, UC, UPS-THUNB, US, W and WU (for abbreviations see Thiers continuously updated). In addition, the first author would like to thank the following colleagues for their help during various fieldwork: In Malaysia: Dr Berhaman Ahmad from the Universiti Malaysia Sabah and Dr Peter Wilson of the Royal Botanic Garden, Sydney for allowing me to join their field trip and giving me my first experience of fieldwork. In China: Prof Chengxin He, Prof. Y.G. Wei and Dr. Fang Wen and all staff of the Guangxi Institute of Botany. Dr. Gao Xin-Fen and her students Zhao Xue-li and Ju Wen-bin from the Chengdu Institute of Biology for collecting from the Luding population of *V. collium*. Dr. Xian-Chun Zhang, Director of the Institute of Botany, Chinese Academy of Sciences for his help during the fieldwork in the Beijing region. In Australia: The curatorial staff of the Queensland Herbarium. In Turkey: Prof Neriman Özhatay for her warm reception and encouragement.

REFERENCES

Beissner L, Schelle E, Zabel H. 1903. Handbuch der Laubholz-Benenung. Parey, Berlin.

Bentham G. 1870. Flora Australiensis 5. Reeve & Co, London.

Blanco FM. 1837. Flora de Filipinas. Lopez, Manila.

Boissier E. 1879. Flora Orientalis 4. Georg, Geneva.

Bornmüller J. 1907. Plantae Straussianae sive enumeration plantarum a Th. Strauss annis 1889–1899 in Persia occidentali collectarum. Pars III. Beihefte zum Botanischen Centralblatt 22: 102–142.

Bramley GLC, Forest F, De Kok RPJ. 2009. Troublesome tropical mints: re-examining generic limits of Vitex and relations (Lamiaceae) in South East Asia. Taxon 58: 500–510.

Bramley GLC, Go R, De Kok RPJ. 2011. Lamiaceae. In: Soepadmo E, Saw LG, Chung RCK, et al. (eds), Tree Flora of Sabah and Sarawak 7: 1–86. Sabah Forestry Department, Sandakan; Forest Institute Malaysia, Kepong; Sarawak Forestry Department, Kuching.

Briquet J. 1895. Verbenaceae. In: Engler A, Prantl K (eds), Die natürlichen Pflanzenfamilien Teil 4, Abt. 3a. Engelmann, Leipzig.

Carrière EA. 1870–1871. Quelques espèces d'Agnus castus. Revue Horticole 42: 415–416.

Chamisso LA. 1832. De plantis in expeditione Romanzoffiana et in herbariis Regiis observatis disserere pergitur. Linnaea 7: 107.

Chantaranothai P. 2011. A revision of the genus Vitex (Lamiaceae) in Thailand. Tropical Natural History 11: 91–118.

Chen SL. 1991. A new variety and new varietal combinations in Chinese Verbenaceae. Novon 1: 58–59.

Chen SL, Gilbert MG. 1994. Verbenaceae. In: Wu ZY, Raven PH (eds), Flora of China 17. Science Press, Beijing; Missouri Botanical Garden, St. Louis.

Clarke CB. 1885. Verbenaceae. In: Hooker JD (ed), Flora of British India 4: 560–604. Reeve, Ashford.

Davis PH. 1965. Flora of Turkey 1. Edinburgh University Press, Edinburgh.

Davis PH. 1982. Flora of Turkey 7. Edinburgh University Press, Edinburgh.

De Cesati V. 1874. Compendio della flora Italiana. Vallardi, Milano.

De Kok RPJ. 2007. The genus Vitex L. (Lamiaceae) in New Guinea and the South Pacific Islands. Kew Bulletin 62: 587–603.

De Kok RPJ. 2008. The genus Vitex (Labiatae) in the Flora Malesiana region, excluding New Guinea. Kew Bulletin 63: 17–40.

De Kok RPJ, Sengun S. 2019. Vitex. In: Bramley GLC (ed), Lamiaceae. In: Van Welzen PC (ed), Flora Malesiana Ser. I, 23: 397–421. Singapore Botanic Gardens, Singapore.

De Kok RPJ, Sengun S, Bramley GLC. 2016. Two new records for the Lamiaceae of Singapore. Gardens' Bulletin Singapore 67: 189–200.

De Lamarck JBAP. 1779. Flore Françoise 2. Agasse, Paris.

De Lamarck JBAP. 1786. Encyclopédie méthodique: botanique 2. Panckoucke, Paris.

De l'Obel M. 1591. Icones Stirpium, tomus secundus. Plantiniana, Antwerp.

De Loureiro J. 1790. Flora Cochinchinensis. Academia Lisboa, Ulyssipone.

Desfontaines RL. 1829. Tableau de l'École de Botanique du Muséum d'Histoire Naturelle ed. 3. J.S. Chaudè, Paris.

Domin K. 1928. Beitrage zur Flora und Pflanzengeographie Australiens. Bibliotheca Botanica 89: 551–562.

Franchet MA. 1883. Plantae Davidianae es Sinarum Imperio. Nouvelles Archives du Muséum d'Histoire Naturelle ser. 2, 6: 1–126.

Gandoger MM. 1918. Sertum plantarum novarum, pars prima. Bulletin de la Société Botanique de France 65: 24–69.

Guo LB, Zhou AQ. 1989. A new species of Vitex from Shanxi. Bulletin of Botanical Research 9: 61–63.

Hara H. 1948. Enumeratio Spermatophytarum Japonicarum 1. Iwanami Shoten, Tokyo.

Harley RM, Atkins S, Budantsev AL, et al. 2004. Labiatae. In: Kadereit JW (ed), The families and genera of vascular plants 7. Springer-Verlag, Berlin, Heidelberg.

Hiyama K. 1948. Fragmental notes on the Japanese plants. Journal of Japanese Botany 22: 56–57.

Jack W. 1820. Malayan Miscellanies 1: 1–27.

Jen X, Chang YJ. 1991. Study on the plants of Songshan Mountain in Beijing. Journal of the Beijing Forestry University 13: 1–6.

Kitamura S, Murata G. 1972. New names and new conceptions adopted in our coloured illustrations of woody plants of Japan, I. Acta Phytotaxonomica et Geobotanica 25: 33–44.

Kuntze CEO. 1891. Revisio generum plantarum. Felix, Leipzig.

Kurz S. 1877. Forest flora of British Burma 1. Office of the Superintendent of Government Printing, Calcutta.

Lam HJ. 1919. The Verbenaceae of the Malayan Archipelago. De Waal, Groningen.

Lebas E. 1869. Vitex robusta. Revue Horticole (Paris) 1869: 30–31.

Lee YN, Kim YS. 2005. A new form of Vitex rotundifolia Linné f. Bulletin of Korea Plant Research 5: 26.

Lin BN, Wang SW. 1994. A new species of Vitex from China. Guihaia 14: 209–210.

Linnaeus C. 1753. Species plantarum 2. Laurentius Salvius, Stockholm.

Linnaeus f C. 1782. Supplementum plantarum. Impensis Orphanotrophei, Braunscheig.

Liu JL. 1995. A new variety of Vitex from China. Acta Phytotaxonomica Sinica 33: 501.

Loudon JC. 1830. Loudon's Hortus Britannicus. Longman, Rees, Orme, Brown & Green, London.

Mabberley DJ, De Kok RPJ. 2004. Labiatae. In: Morat P, Mackee HS (eds), Flore de la Nouvelle-Calédonie et Dépendances 25. Bulletin du Muséum National d'Histoire Naturelle, Paris.

Makino T. 1903. Observations on the Flora of Japan. Botanical Magazine (Tokyo) 17: 85–92.

Makino T. 1948. An illustrated Flora of Japan. Hokuryukan, Tokyo.

Maxwell WG. 1906. Mantra Gaja. Journal of the Straits Branch of the Royal Asiatic Society 45: 1–55.

Merrill ED. 1918. Species Blancoanae. Bureau of Printing, Manila.

Miller P. 1768. The Gardener's Dictionary ed. 8, 5. John & Francis Rivington, A. Millar, T. Payne, London.

Moldenke HN. 1937. Some needful nomenclatural changes. Revista Sudamericana de Botánica. 5: 1–3.

Moldenke HN. 1939. The geographic distribution of the Avicenniaceae and certain genera of Verbenaceae. New York Botanical Garden, New York.

Moldenke HN. 1940. Verbenaceous novelties. The American Midland Naturalist 24: 750–754.

Moldenke HN. 1941. Novelties in the Eriocaulaceae and Verbenaceae. Phytologia 2: 6–32.

Moldenke HN. 1942. The known geographic distribution of the members of the Verbenaceae and Avicenniaceae 2. Edwards Brothers, Ann Arbor.

Moldenke HN. 1949. Notes on new and noteworthy plants IX. Phytologia 3: 162–178.

Moldenke HN. 1952. Notes on new and noteworthy plants XIII. Phytologia 4: 41–65.

Moldenke HN. 1955a. Materials towards a monograph of Vitex. I. Phytologia 5: 142–176.

Moldenke HN. 1955b. Materials towards a monograph of Vitex. VII. Phytologia 5: 465–508.

Moldenke HN. 1958. Materials toward a monograph of the genus Vitex. Phytologia 6: 129–192.

Moldenke HN. 1961. Additional notes on the genus Vitex. II. Phytologia 8: 61–95.

Moldenke HN. 1967. Additional notes on the genus Vitex. III. Phytologia 15: 73–113.

Moldenke HN. 1973. Notes on new and noteworthy plants LVIII. Phytologia 25: 430–432.

Moldenke HN. 1978. Notes on new and noteworthy plants CVII. Phytologia 38: 307–308.

Moldenke HN. 1979a. Notes on new and noteworthy plants. CXXVIII. Phytologia 44: 134.

Moldenke HN. 1979b. Additional notes on the genus Vitex. CXXX. Phytologia 44: 328–361.

Moldenke HN, Moldenke AL. 1983. Verbenaceae. In: Dassanayake MD, Fosberg FR (eds), A revised handbook of the Flora of Ceylon 4: 196–487. Amerind Publishing, New Delhi.

Munir AA. 1987. A taxonomic revision of the genus Vitex L. (Verbenaceae) in Australia. Journal of the Adelaide Botanical Garden 10: 31–79.

Noronha F. 1791. Relatio Plantarum Javanensium. Verhandelingen van het Bataviaasch Genootschap der Kunsten en Wetenschappen 5: 1–28.

Ohwi J. 1938. Symbolae ad Floram Asiae Orientalis 16. Acta Phytotaxonomica et Geobotanica 7: 29–41.

P'ei C. 1932. The Verbenaceae of China. Memoirs of the Science Society of China 1: 1–193.

P'ei C, Liou SL. 1982. Verbenaceae. In: Zhongguo KXY (ed), Flora Reipublicae Popularis Sinicae 65. Academia Sinica, Beijing.

Rajendran A, Daniel P. 2002. The Indian Verbenaceae. Shiva Offset Press, Dehra Dun.

Rechinger KH. 1943. Flora Aegaea. Staatdruckerei, Wien.

Rehder A. 1902. Vitex agnus-castus. In: Bailey LH (ed), Cyclopedia of American Horticulture 4. The Macmillan Company, New York / London.

Rehder A. 1917. Vitex negundo. In: Bailey LH (ed), Cyclopedia of American Horticulture 6. The Macmillan Company, New York/London.

Rehder A. 1947. Notes on some cultivated trees and shrubs V. Journal of the Arnold Arboretum 28: 253–258.

Ridley HN. 1923. The Flora of the Malay Peninsula 2. Reeves, London.

Royle JF. 1836. Illustrations of the botany and other branches of the natural history of the Himalayan Mountains. Alland & Co., London.
Rumpf GE. 1743. Herbarium Amboinense 4. Hermannum Uytwerf, Amsterdam.
Salisbury RA. 1796. Prodromus Stirpium in Horto ad Chapel Allerton vigentium. W. Hooker, London.
Satomi N. 1983. New names in 'Ishikawaken Syokubutsu Shi'. The Journal of Phytogeography and Taxonomy 31: 30.
Schauer JC. 1847. Verbenaceae. In: De Candolle AP (ed), Prodromus Systematis Naturalis Regni Vegetabilis 11: 522–700. Paschoud, Geneva.
Schneider CK. 1911. Illustriertes Handbuch der Laubholzkunde 2. Gustav Fischer, Jena.
Sengun S. 2017. Taxonomy, phylogenetics and chemosystematics of the Vitex trifolia complex. Doctoral thesis, RBG Kew & University of London. Royal Botanic Gardens Kew Research Repository. https://doi.org/10.34885/nfba-4a66.
Singhakumara BMP. 1990. Biology of Vitex (Verbenaceae) in Sri Lanka. D.Phil. thesis, Oxford University.
Sivarajan VV, Moldenke HN. 1974. Notes on new and noteworthy plants LXIX. Phytologia 28: 401–404.
Thiers B. 2016. Continuously updated. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/science/ih/.
Thunberg CP. 1784. Vitex. In: Linnaeus C, Murray JA (eds), Systema Vegetabilium. Dieterich, Gottingae.
Townsend CC. 1972. Contributions to the flora of Iraq, xi. A note on the Verbenaceae. Kew Bulletin 27: 148.
Townsend CC. 1980. Verbenaceae. In: Townsend CC, Guest E (eds), Flora of Iraq 4(2). Ministry of Agriculture & Agrarian Reform, Baghdad.
Turland NJ, Wiersema JH, Barrie FR, et al. 2018. International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. Königstein, Koeltz Botanical Books.
Van Steenis CGGJ. 1957. Miscellaneous botanical notes VIII. Blumea 8: 514–517.
Von Handel-Mazzeti HF. 1913. Pteridophyta und Anthophyta aus Mesopotamien und Kurdistan sowie Syrien und Prinkipo. Annalen des Naturhistorischen Hofmuseums, Wien 27: 391–458.
Von Handel-Mazzeti HF. 1934. Plantae Sinensis, XXVII, Verbenaceae. Acta Horti Gothoburgensis 9: 67–69.
Von Handel-Mazzeti HF. 1936. Symbolae Sinicae, Botanische Ergebnisse der Expedition der Akademie der Wissenschaften in Wien nach Sudwest-China 1914/1918, part 7. Von Julius Springer, Wien.
Von Siebold F, Zuccarini JG. 1846. Florae Japonicae. Abhandlungen der Mathematisch-Physikalischen Klasse der Königlich Bayerischen Akademie der Wissenschaften 4: 1–239.
Wallich N. 1828–1849. A numerical list of dried plants in the East India Company's Museum collected under the superintendence of Dr Wallich of the Company's botanic garden at Calcutta.
Willdenow KL. 1809. Enumeratio Horti Regii Botanici Berolinensis. Taberna Libraria Scholae Realis, Berolini.
Wu CY. 1977. Flora Yunnanica 1. Science Press, Beijing.
Ying SS. 1987. Coloured Illustrations of Ligneous Plants of Taiwan 1. Shao-Shun Ying, Taipei.
Zamjad Z. 2012. Lamiaceae. In: Assadi M, Maassoumi AA, Mozaffarian V (eds), Flora of Iran 76. Research Institute of Forests & Rangelands, Tehran.
Zang DK, Sun JW. 2009. A revision of Vitex simplicifolia B.N.Lin et S.W.Wang. Journal of Wuhan Botanical Research 27: 22.
Zhao F, Chen YP, Salmaki Y, et al. 2021. An updated tribal classification of Lamiaceae based on plastome phylogenomics. BMC biology 19: 1–27.

IDENTIFICATION LIST OF SPECIMENS

1 = *Vitex agnus-castus* L.
2 = *V. benthamiana* Domin
3 = *V. bicolor* Willd.
4 = *V. collium* Sengun
5 = *V. hybrida* Moldenke
6 = *V. negundo* L.
7 = *V. pseudonegundo* (Hausskn. ex Bornm.) Hand.-Mazz.
8 = *V. rotundifolia* L.f.
9 = *V. trifolia* L.

Abbe 9223: 8; 9588: 8 – Abbury 8323: 8 – Abel 155: 5 – Ablan Raur 19928: 1 – Adaire 161: 9 – Adduru 1: 8; 173: 6 – Aet & Idjan 348: 9 – Afriastini 1216: 6 – Agama 9496: 9 – Aguon 107: 9 – Ah To 2195: 6; 3193: 9 – Ahern 25: 9; 102: 6; 166: 9; 223: 9; 671: 9; 814: 9 – Aitchison 981: 5 – Akram 19: 5 – Al-Kaisi 42890: 7; 46100: 7 – Al-Kaisi & Hamad 43533: 7 – Al-Rathi 5272: 7 – Alizzi 34682: 7; 35272: 7 – Allen 124: 8 – Alphonso & Samsuri 92: 3 – Alston & Sandwich 2710: 1 – Alvins 934: 9 – Ambri 1235: 9 – Amdursky 280: 7 – Amin SAN 126807: 3 – Amin Sigun SAN 126977: 9 – Anderson 2143: 9 – Anderson & Petersen 443: 7 – Andrews 379: 9 – Annabel 3151: 8 – Anta 359: 8 – Archbold 13691: 9 – Archley 146: 1 – Ashton S 17812: 3.
Bakhuizen van den Brink 1645: 6; 1876: 6 – Bakhuizen van den Brink Jr. 6580: 3 – Balansa 426: 9; 938: 9 – Balls 565: 1; 1204A: 1; 1204B: 1 – Bally 12452: 1 – Banyeng Ludong S 38523: 9 – Barber 930: 5; 4785: 5 – Barbon PPI 1917: 6; PPI 2047: 9; PPI 5590: 9; PPI 22403: 9 – Barchet 556: 6 – Barclay 260: 1; 3037:1; 3444: 9 – Barkley & Agnew 2390: 7 – Bartholomew 2024: 6; 7883: 8 – Bartholomew et al. 1241: 6 – Bartlett 6267: 6 – Bateson 37: 9 – Beach 145: 4 – Bean 24185: 2 – Beccari PB 1773: 8; PS 269: 9 – Bedi 453: 6 – Berkhout 440: 6 – Bikin 170: 9 – Billiet 551: 9 – Blake 22530: 8 – Bloembergen 3291: 8; 3894: 8; 4788: 3 – Bola 98: 9 – Boratynska et al. 97: 1; 148: 1 – Borden 1940: 8; 2035: 9 – Bornmuller 645: 1; 1236: 1 – Bot. Gard. Bogoriense 42133: 6; XV.J.A.XXXV 6: 6; 7: 9 – Boue 408: 1 – Boulos 17113: 6 – Bourdy 89: 9; 528: 9; 1134: 9 – Bourne 3013: 5; 3328: 5 – Bowden 120: 1 – Braidy 18: 1; 859: 9; 1919: 8; 21928: 9; 28095: 9 – Brenan 14909: 8 – Brickeu & Mathew 8006: 1 – Brooke 8121: 9; 10585: 9 – Brown 151: 9; 1456: 9; 2322: 8 – Brumier 128: 6 – Bryan 556: 9; 972: 8 – Buchholz 1536: 9 – Bullock 211: 8 – Bünnemeijer 4439: 9; 11153: 9 – Bunpheng 1134: 9 – Burges 7: 9 – Burkill 1922: 8; 2255: 8; 2538: 9.
Cabalion 3092: 9 – Cailipan 25637: 3 – Canfield 726: 9 – Carr 11851: 9 – Carrick 1409: 8 – Carrick & Enoch 255: 3 – Carroll 2: 9 – Castillo BS 22747: 5 – Chai S 45222: 6 – Chan & Chan 1504: 8 – Chapman 25366: 7 – Cheeseman 2: 8; 627: 9 – Cheo 145: 6 – Chevalier 1448: 8 – Chew Wee-Lek 36: 9; 396: 9 – Chi-Hsien Lin 593: 8; 665: 8; 699: 6 – Chiao 2774: 6; 3052: 6; 14054: 6; 14580: 6; 14644: 8; 18774: 6; 21384: 4 – Chin 3150: 9 – Chin-Hsiung Chen 721: 8 – Ching 1967: 8; 2429: 6; 2739: 6; 5450: 6 – Chippendale 8159: 8; 8235: 8 – Chow 2: 6; 7: 6; 78054: 6 – Christophersen 36: 9; 2849: 9 – Chun 6943: 8; 7625: 9 – Chung 2031: 8; 2371: 6; 3028: 6 – Churchill 2782: 1 – Clark 20: 9; 2527: 9 – Clarkson 2663: 8; 3406: 8 – Clason-Laarman 70: 9 – Clemens & Clemens 3028: 8; 3804: 6; 11067: 9; 15774: 6 – Clement 2081: 9 – Clifford 210: 8 – Cockburn SAN 68413: 8 – Corner 25784: 8 – Cribb 50: 6; 578: 6 – Cruz 193: 9 – Cuadra 1228: 3 – Cuming 1866: 9 – Cumming 23560: 2 – Curle 13: 1 – Cushing 551: 9.
Damanu 5: 9 – Daniker 705: 9 – Darwin 1083: 8 – Davidse 7345: 5; 9025: 3 – Davidson 68: 1– Davis 13484: 1; 24967: 1; 32033: 1; 37457: 1 – De Halacsy 240: 1 – De Heldreich 599: 1 – De Joncheere 1018: 9 – De Vogel 4212: 9 – Degener 20: 8; 226: 8; 9504: 8; 9505: 9; 9507: 8; 10018: 8; 13620: 9; 13691: 9; 14058: 9; 15044: 9; 34381: 8; 35594: 8; 36617: 8; 131985: 8 – Deplanche 84: 9 – Dinsmore 172: 7; 10172: 7 – Dissing 2722: 3 – Drake 679: 8 – Drummond 903: 5; 1366: 5; 21982: 5; 26697: 5 – Dudley 35709: 1 – Duthie 4824a: 5; 10521: 5; 18964: 7; 20040: 5 – Dyg. Awa S 48714: 9.
Eberhardt 2535: 9; 3161: 9 – Ecoyomides S. 972: 1 – Edwards 28: 5 – el Takt 101670: 7 – Elmer 5611: 6; 7877: 9; 8125: 9; 11999: 9; 12135: 8; 15236: 9; 18119: 3 – Escritor 21171: 8 – Espiritu 91477: 9 – Eurell 78/7: 8 – Evans 1446: 9.
Fairchild 499: 9 – Falanrow 3008: 9 – Falconer 739: 5 – Faulkner 2389: 9 – Faurie 1016: 6; 2524: 8; 11504: 8 – Fay 203: 9; 1491: 1 – Fernandes 1195: 5 – Fernandez 757: 7; 763: 7 – Fielden C. 2: 1 – Florence 3456: 9 – Forbes 346: 6; 3326a: 9 – Fortune 90: 8; 9226: 9; 13177: 6; 16456: 6 – Fosberg 11981: 9; 27125: 8; 34926: 9; 36709: 9; 44519: 9; 53663: 8; 56392: 5; 58635: 9; 58825: 9; 59909: 9; 60324: 9 – Franc 56: 9; 1024: 9 – Frankfurst 865: 7 – Friedmann 1631: 9 – Frodin 2143: 9 – Frost 2/23: 1 – Fukuaka 14654: 8 – Fung 20300: 9; 21196: 6 – Furuse 3251: 9; 3428: 9; 3429: 9; 3773: 3; 3827: 9; 7690: 8; 8226: 8; 21790: 8; 38963: 8; 43484: 9; 45190: 9; 45350: 9.
Gaerlan PPI 2927: 8; PPI 4774: 9 – Gafui 18850: 3 – Gamble 33: 7; 3621B: 5; 3622a: 9; 3622b: 9; 12223: 5; 16468: 5; 27117: 5 – Gandoger 1374: 1; 2914: 1; 7256: 1; 7645: 1 – Garber 611: 3 – Garcia PPI 10053: 9; PPI 18449: 8 – Gay 329: 1 – George 270: 9 – Gibbs 6290: 9 – Gilbert 9432: 7 – Gilbert-Smith 3196: 1 – Gillespie 2953: 9; 4503: 9 – Gillison 22154: 9 – Gittins 775: 2 – Giuseppi 39: 1 – Godefroy-Lebeuf 781: 9; 806: 6 – Goklin 2066: 3; 3216: 3 – Gopal Sowalia NIR 6001: 5 – Graeff 1581: 9; 1599: 3 – Graham 764: 7 – Gray 04767: 3; 06485: 8; 06588: 3 – Greenway 1399: 9 – Greenwood 146: 9 – Gressitt 461: 6 – Grey-Wilson & Hewer 1030: 7 – Grierson 1431: 6 – Griffith 592: 7; 6058: 5; 6059: 7 – Guest 800: 7; 25461: 1 – Guest & Husain 15861: 7 – Guest et al. 25413: 7 – Guillaumin 5176: 9; 8540: 9; 11493: 9.
Haenke 576: 8; 657: 9; 772: 9 – Haines 131: 5; 3465: 5; 4522: 5 – Halliday 428: 2 – Hamad et al. 46358: 7 – Hamzah 139: 9 – Handel-Mazzetti 1687: 6 – Haniff 3584: 9; 13297: 6; 15275: 9; 17600: 8 – Haradjian 3097: 1 – Harini 82: 9 – Haselfoot 3464: 5 – Haviland 1631: 6; 1645: 6; 2083: 6 – Haviland & Hose 3552: 6 – Hefler 6057: 9 – Heller 2731: 8 – Hemming 176: 6 – Henderson 20462: 8 – Henrichson 3933: 9 – Henry 1142: 6; 9750: 6; 12302: 9; 12302A: 9 – Henty 10588: 9; 11514: 9 – Hepburn I4: 1 –

Herald 112: 9 – Herbst 997: 8; 5733: 8; 8824: 9 – Hewer 1337: 7 – Hikmat Abbas Al-Ani & Mohammad 9830: 7 – Hildebrandt 335: 8; 1254: 9 – Hill 83: 8 – Hmama MSHH 882: 1 – Hohenacker 703: 9 – Hollrung 486: 9; 986: 9 – Holman 99: 6 – Hoogland 5172: 9 – Hopkins 1716: 9 – Horsfield 125: 8 – Hose 267: 8 – Hsiao 1338: 6 – Hu 12464: 9 – Hu & But 23106: 8; 23203: 8 – Hubbard & Winders 6603: 8 – Hunt 2668: 3 – Hupeh 1241: 6 – Hürlimann 74: 9; 582: 9.

Ingoldly 405: 1; 406: 1 – Isles 32225: 9 – Ismael 472: 3 – Iwatsuki & Matsumura 5479: 8.

Jacobs 4747: 9 – Jacquemont 1498: 5 – Jiang 2: 6 – John SAN 145653: 9 – Jones 2: 7 – Jumaa Brahim 6119: 7 – Jury 15299: 1.

Kai Yik Shaan 13095: 8 – Kairo 35608: 9 – Kajewski 66: 9; 84: 9; 690: 8; 801: 9; 2417: 3 – Kamesara NKR 10: 5 – Kanehira 1025s: 9; 2273: 9; 12892: 9 – Karim 39241: 7 – Kato & Hiki 346: 8 – Kaudern 452: 9 – Keith 1: 9; 17: 9 – Kelsall 763: 9; 764: 9 – Keng 154: 3 – Kere 5040: 9 – Kerr 1248: 9; 14238: 9; 16627: 9 – Kett 18: 1– Khalid 41177: 7 – Khalid Feddo 5360: 7 – Khan 4: 1; 107: 1; 6626: 5; K-6995: 9 – Kingdom Ward 7350: 9; 8929: 9; 37513: 8 – Kjellberg 3888: 9 – Koie 2090: 7 – Kokawa 1233: 9 – Kondo PNH 38739: 9 – Kornassi 926: 9 – Kostermans 19106: 9 – Krajina 620507063: 6 – Krishna 1660: 5 – Kunstler 57: 9 – Kuntze 4448: 9; 5817: 9; 7767: 5; 23006: 9.

Lace 2770: 9; 3022: 9; 3619: 7; 4389: 9 – Lai 364: 6 – Lakshnakara 78: 8; 604: 6 – Lammers 8481: 8 – Lamoureux 2174: 9; 2896: 9 – Larivata 70526: 9 – Larsen 33723: 8 – Lau 270: 9; 293: 6; 20133: 6 – Law 734: 6 – Lay 9: 8 – Le D'Savatier 915: 8 – Le Roy Topping 9504: 8 – Lee SAN 70826: 9 – Leeuwenberg 14570: 9 – Leggett H2760: 1 – Lei 202: 3; 700: 3 – Leonard 5884: 7 – Levine 250: 6; 376: 6; 1070: 6; 1420: 6; 1585: 6; 3224: 9; 3305: 6; 3442: 6 – Lewis 521: 1 – Li Zhen-Yu 403: 6 – Liang 62926: 8; 64661: 6 – Licent 99: 6; 6451: 8 – Lin Yu Tai 11063: 6 – Ling 9113: 4; 9366: 4; 9386: 4 – Link II/8: 6 – Liou 5518: 6 – Loher 4432: 6; 4433: 5; 4434: 8; 4435: 8; 4436: 9; 4437: 9; 6531: 6 – Lorzing 16011: 6 – Lotan 0601081107: 1 – Lowne 243: 7– Ludlow 6726: 6 – Luke 2348: 6 – Lutjeharms 4655: 9.

MacGilvray 175: 8; 356: 8 – MacKee 1769: 8; 2401: 9 – MacMillan 340: 7 – MacNaughtan 2836: 9 – Maconochie 3125: 1 – Madulid PPI 23736: 8; PPI 23841: 8 – Maingay 47: 8; 1206: 9 – Maire 1776: 6 – Mandlik & Godbole 45074: 5 – Mangubat 926: 8; 1343: 3 – Manisadjan 133: 1 – Manoharan 22657: 5 – Marcan 332: 8 – March TWR 525: 2 – Martindale 1: 1 – Maruyama & Okamoto 1600: 8 – Mattfeld 2035: 1; 2644: 1 – Matthew 47651: 5 – Mauriasi 12405: 3; 14003: 3; 17041: 3 – Maximowicz 11000: 6 – Maxwell 11730: 9 – Maxwell & Soon 2: 3 – McClatchey 527: 9 – McClure 8888: 3 – McGregor 379: 9 – McNeill 510: 7; 807: 1 – Meebold 21385: 9 – Meijer 58806: 9 – Mellor 5321: 1 – Merrill 147: 6; 302: 9; 323: 8; 440: 5; 814: 8; 898: 8; 957: 9; 1106: 9; 1503: 3; 1636: 6; 2320: 3; 2876: 6; 2917: 9; 3429: 9; 3627: 6; 11270: 6 – Merrill & Darling FB 14051: 6 – Meyer 1008: 6; 2276: 9 – Meyers 6172: 7 – Millar 1106: 9 – Millar & Vandenberg 40909: 3 – Miller 176: 7 – Milne 122: 9; 167, 9; 266: 9 – Miranda 17976: 9 – Misra 103: 5 – Mooney 448: 5 – Moore 9372: 8; 9384: 8 – Morrison 106: 9 – Moseley 7/74: 9; 8/74: 9 – Mueller-Dombois 68041901: 9 – Munir 6058: 8 – Musat 1593: 7.

Nafelay Ku 25: 5 – Nanakorn 88220: 6 – Native Collector 738: 6; 1078: 9 – Ng Chung Lam 3224: 9 – Nie Min-Xiang 92229: 6; 92365: 6 – Niering 659: 9 – Niyomdham et al. 274: 8 – Noel 30: 7 – Noosi 41177: 7 – Norton 1558: 6 – Nur 11946: 6.

Okada 3525: 9 – Oldham 226: 8; 382: 8; 626: 8 – Ollerenshaw 1444: 8 – Omar et al. 38316: 7 – Orchard 6009: 8 – Ordonez 13620: 9 – Osborne 243: 7 – Osmar et al. 38240: 7 – Otanes 17995: 6.

Parham 112: 9; 244a: 9; 244b: 9; 402: 9; 10866: 9 – Parkinson 4335: 9 – Parks 16178: 9; 22573: 9 – Parris 75524: 9 – Patzak 19268: 7 – Pereira 43419: 9 – Perrotel 46: 5 – Perry 1061: 2; 1223: 8 – Petelot 317: 8; 676: 6; 1409: 8 – Phengkhlai 37894: 9 – Phengnaren & Smitinand 201: 8 – Phillipson 10362: 9 – Pierre 389: 5; 4551: 6 – Pitard 1574: 1 – Platt 336: 1 – Pleyte 487: 9 – Podlech 17162: 7; 18581: 7; 18645: 7 – Poilane 8130: 6 – Poore 2: 6 – Popov 308: 7 – Powell 48: 9 – Prain 9070: 7 – Price 494: 8; 650: 8; 1400: 8; 1419: 8 – Prior 1026: 1 – Psiang Ying 1263: 6 – Pulagis 9: 9 – Purdie 3586: 2; 3592: 2; 5858: 2 – Purseglove 5015: 3 – Puttock 14410: 2.

Qasim 32799: 1; 32800: 1 – Qoro 13105: 9; 13592: 9 – Quisumbing PNH 18826: 6.

Rabil 55: 9 – Rahman 6283: 9 – Rahmat si Boea 551: 9 – Rambi 10: 9 – Ramos 440: 9 – Ran 0601081107: 1 – Rawi 23145: 7 – Rawi et al. 28973: 7; 29413: 7 – Rawson 110: 1 – Raynal 16070: 9 – Read 357: 8 – Rechinger 1308: 7; 3996: 7; 5778: 7; 14424: 1; 19268: 7; 30985: 5 – Reed 4: 9 – Rein 261: 1 – Rein & von Fritsch 190: 1 – Reith 1: 8 – Reverchon 185: 1; 2182: 1 – Reynoso 3663: 8; PNH 87701: 9; PPI 21565: 9 – Rich 69: 5; 571: 5 – Ridley 1622: 9 – Riley 52: 9 – Riswan 50: 9 – Rix 398: 7 – Robinson 56: 9; 2449: 9; 3052: 9 – Rock 47: 8; 48: 8; 2669a: 9; 2969: 9; 6981: 6; 7838: 9; 10465: 6 – Rodin 5427: 5 – Rogers 308: 7; 309: 7; 402: 7 – Roldeans 128: 1 – Romero PPI 10619: 9; PPI 15356: 9 – Royal Liberty School 82: 1; 123: 1 – Runikera 9901: 9; 13031: 9.

Sachet 896: 9 – Sahira 37568: 7; 37569: 7 – Saifan15: 1 – Saifan et al. 2006JOR15-2: 1 – Saldanha 16393: 5 – Samat 15: 6 – Sampson 503: 6; 504(A): 8 – Sands 3022: 3 – Sangkhachand 1118: 8 – Santos 5258: 9; 6210: 8; 6267: 8 – Sasaki & Togasi 606: 8 – Saunders 1774: 6 – Scaith-Johnsen 1433A: 8 – Schindler 51: 6 – Schlechter 15548: 8 – Schodde 4544: 9 – Schomburgk 242: 8 – Schweinfurt 79: 1 – Scortechini 644: 9 – Sehock 427: 6 – Seimund 13176: 6 – Seidenfaden 2632: 6 – Sengun 21: 6; 22: 6; 23: 6; 24: 6; 25: 6; 26: 6; 27: 6; 28: 6; 29: 6; 30: 6; 31: 6; 32: 6; 33: 6; 34: 6; 35: 6; 36: 6; 37: 6; 38: 6; 39: 6; 40: 6; 41: 6; 42: 6; 43: 6; 44: 6; 45: 6; 46: 6; 47: 4; 53a: 4; 95591: 1 – Sengun & De Kok AUS 1: 9; AUS 2: 8; AUS 3: 3; AUS 4: 3; AUS 5: 9; AUS 6: 2; AUS 7: 2 – Shah & Shukor 2477: 8 – Sharme 162909: 5 – Sheehan 98: 4 – Shiu Ying Hu 5607: 6; 5894: 8; 6003: 8; 6858: 6; 7837: 8; 8076: 8; 8311: 6; 8635: 8; 9243: 6; 10244: 6; 10675: 6; 12286: 8; 12464: 8; 12469: 8 – Sial Ratti 5272: 7 – Sidek bin Kiah 92: 9 – Sidiyasa 169: 9 – Silva 74293: 8 – Simpson 5149: 1 – Sinclair 9673: 8; 39805: 8 – Singer 0101050907: 1 – Singhakumara S 3: 5; 76: 8; 81: 5; 104: 5; 105: 5; 264: 5; 297: 5; 299: 5; 302: 5; 318: 5; 326: 5; 330: 5; 357: 5 – Sintenis 645: 1; 1184: 1 – Sirute'e 18148: 9 – Skottsberg 242140: 8; 242201: 8 – Smith 314: 9; 1075: 9; 1200: 9; 4559: 9; 6078: 9; 6610: 9; 6622: 9; 7088: 9; 16862: 9 – Soakao 449: 3 – Soepadmo & Mahaunt 9173: 8 – Sooi 478: 9 – Spare 980: 9 – Specht 677: 8 – St John 9946: 8; 16705: 9; 22718: 8; 24321: 8 – Steiner 1322: 8 – Steward 2387: 6 – Stoddart 4041: 8; 4189: 8; 4577: 8; 4756: 8; 4815: 8; 4849: 8; 4974: 8; 5074: 8 – Stokes 1: 9 – Stone PPI 5475: 8; 10420: 9 – Story 8310: 8 – Streimann 52594: 9 – Sumithraarachchi 861: 9 – Suvarnakoses 1056: 9 – Swinhoe 24: 8 – Syngrassides 397: 1.

Taai Ue Shaan 16629: 6; 16649: 8 – Taam 782: 6; 1702: 8; 1728: 6 – Takamatsu M 134: 9; 328: 9; 1697: 9 – Taku Miyazaki 310243: 8 – Tan 28818: 3 – Tanaka 97: 6; 17878: 6 – Tandom 2654: 3; 4254: 9 – Tang 1587: 3 – Tanner 2960: 9 – Taouet 1196: 8 – Tateishi 3158: 8 – Taylor 4: 7; 2033: 9 – Telford 2022: 8; 8498: 8; 9234: 9 – Tengwall 29: 1 – Teo 619: 6 – Teruya 918: 8; 1934: 6 – Teysmann 16728: 6 – The American Colony 10172: 7 – Thompson 189: 5; 743: 5 – Thorel 120: 5; 2098: 9 – Thorne 9052: 8; 10249: 8 – To Kang Peng 12670: 6 – Todaro 400: 1 – Todd 773a: 1; 773b: 1 – Tothill 660: 9; 673: 9 – Trapnell & Williams 106: 2 – Trott 2123: 1 – Tsang 868: 9; 27733: 6; 27843: 6; 28047: 6 – Tsiang 466: 6; 5725: 6 – Tsiang Ying 669: 8 – Tsui 286: 9; 303: 6 – Turbet 6052: 9 – Turner 42: 9; 64: 9; 214: 1 – Turrill 1081: 1 – Tyson-Doneley GAQLDO161: 8.

U Thein Lwin 61: 9.

Vaccari 356: 1 – Van Balgooy 2305: 9 – Van Royen 3115: 3; 6291: 9; 8249: 9; 10192: 8; 16492: 9 – Van Slageren 602: 1 – Van Slageren et al. MS-SKMh602: 1 – Van Steenis 18010: 9: 1 – Vaughan 347: 8; 3165: 9; 3204: 9 – Vaugleau 473: 9 – Vaupel 389: 9 – Verdcourt 4127: 1; 4799: 1 – Vidal 850: 9; 1648: 9; 3450: 8 – Vieillard 1048: 9; 3065: 9 – Villamil 284: 9 – Vine 5: 1 – Vollolahia 136: 3.

Waas 810: 5; 2137: 3 – Wagner 6736: 8 – Walker 6749: 9 – Wallich 1743: 9; 1744: 5 – Walsh 134: 9 – Walter 615: 9; 806: 9 – Wan 79016: 6 – Wang Ke-hua 2008: 6 – Waterhouse 60: 9; 63: 9; 63B: 9; 83: 3 – Watson 1344: 8 – Watt 6: 5 – Wen 9049: 9 – Wen et al. 1379: 6 – Wen He Qun 124: 6 – Wheeler Haines W 420: 7 – Whistler 3830: 9; 4527: 9; 5196: 9; 5296: 9; 6192: 9; 6758: 3; 8403: 9; 11212: 9 – White 2148: 9 – Whitford 674: 9; 755: 8; 853: 9; 988: 9 – Whitmee 20: 9; 148: 9 – Whitmore 1473: 3; 1864: 3; 15102: 3 – Wight 2324: 5 – Wilford 210: 8 – Williams 41: 9; 185: 9; 2978: 9; 3026: 9; 11435: 6; 85089: 2 – Wilson 790: 6; 1241: 6; 1697: 6; 2701: 6; 2702: 6; 4308: 6; 4308a: 6; 8338: 8; 9392: 8; 10927: 6; 10978: 8 – Winit 257: 9 – Winson 108: 8 – Womersley 4711: 9; 8617: 9 – Wong 2586: 9 – Wood 231: 5 – Worthington 177: 9; 184: 5; 1976: 5; 6378: 5 – Wright 386: 8; 453: 1 – Wrigley 1179: 8; 1435: 8 – Wyak 2: 1 – Wyatt 209: 1.

Xiao Bai-Zhong 3622: 6; 3849: 6.

Yahud 59961: 6 – Yao 53012: 8 – Yates 1480: 9; 1941: 9 – Yen 19918: 3 – Yinger et al. 2384: 8; 3411: 8 – Young 96-03: 3; 1622: 8 – Yuncker 10041: 3; 15011: 9; 15801: 9.

Zimmermann 2: 6; 442: 6 – Zohab 676: 1.