

## The Genus *Knoxia* (Rubiaceae) in Thailand

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**Abstract.**— A taxonomic revision of *Knoxia* in Thailand is presented. The following three species are recognized: *K. rosettifolia*, *K. roxburghii* and *K. sumatrensis*. A key to the species, ecological and distribution data, specimens examined and also photographs are provided. Lectotypification of five taxa, *Knoxia brachycarpa* R.Br. ex Hook.f., *K. brachycarpa* var. *congesta* Pit., *K. microcarpa* Kurz, *K. valerianoides* Thorel ex Pit. and *Hedyotis glauca* W.W.Smith are also selected.

**KEY WORDS:** *Knoxia*, revision, Rubiaceae, Thailand

### INTRODUCTION

*Knoxia* a small genus belongs to subfamily Antirheoideae, tribe Knoxieae (Kårehed & Bremer (2007). The genus consists of nine species and distributed in the tropics from Africa through Northern Australia (Mabberley, 2008). The genus is characterized by subscapose perennial, heterostylous flower, with slightly enlarged one calyx lobe and corolla which is valvate in bud and spreading in open flower with uncinata at apex. It is necessary to revise the genus as a precursor of the account for the Flora of Thailand.

### MATERIALS AND METHODS

This work was based on examination of dried material from AAU, BCU, BK, BKF, K, KKU, P, QBG and TCD (Theirs, 2015) and data collected of fieldwork. Citation of authors of plant names follows Brummitt & Powell (1992). Nearly all specimens cited

here have been seen, those that have not been seen are indicated by *n.v.*

### RESULTS AND DISCUSSION

### TAXONOMIC TREATMENT

#### *KNOXIA*

L., Sp. Pl.: 104. 1753. — *Vissadali* Adans., Fam. Pl. 2: 145. 1763. — *Cuncea* Buch.-Ham. ex D.Don, Prodr. Fl. Nep.: 135. 1825. — *Dentallaria* Kuntze, Rev. Gen. Pl. 1: 280. 1891. — *Spermacoce* Roxb., [Hort. Beng.: 10. 1814, *nom. nud.* ex] Fl. Ind. 1: 372. 1820, *pro parte*. Type: *K. zeylanica* L.

Annual or perennial herbs or undershrubs. *Stem* erect, subterete with axillary shoots, rarely unbranched or with basal rosette of leaves. *Leaves* opposite, petiolate or sessile; stipules interpetiolar, fimbriate. *Inflorescences* terminal or both terminal and axillary, thyrsopaniculate, lax and corymbose, variously congested or

head-like. *Flowers* 4-merous, dimorphic, heterostylous. *Calyx* tube short hairy inside; lobes unequal, sometimes foliaceous. *Corolla* white, pale lilac or pink; lobes valvate in bud, spreading in open flowers, uncinately at apex, dimorphic, hypocrateriform to infundibular in short-styled form or tubular-campanulate with narrow tube and swollen mouth in long-styled form. *Stamens* 4, epipetalous, exerted in short-styled form and included in long-styled form; anthers dorsifixed, linear-oblong, attached to the middle of the corolla tube; filaments pubescent near attachment. *Ovary* 2-locular, each with a solitary ovule; ovule pendulous from an apical placenta; style exerted or included; stigma bifid, equal. *Fruit* dry, dehiscent to tardily dehiscent into two indehiscent mericarps and supported by variously shaped carpophores. *Seed* ellipsoidal, dorsally compressed and keeled, ventrally concave.

Nine species in the Old World tropics, seven in Asia and two in Africa, distributed from Africa, India, China, SE Asia to Northern Australia. Three species in Thailand.

### Key to the species

1. Leaves basal ..... **1. *K. rosettifolia***
1. Leaves cauline ..... 2
2. Leaves typically linear-lanceolate, sessile or with petioles less than 3 mm long; fruit with obtuse apex, lateral grooves absent or present only towards the base; stipules with 2-4 bristles ..... **2. *K. roxburghii***
2. Leaves oblong-lanceolate or ovate-lanceolate with petioles (5-) 10-20 mm long; fruit with emarginate apex, lateral grooves running along whole length; stipules with 4-6 bristles ..... **3. *K. sumatrensis***

**1. *Knoxia rosettifolia*** E.T.Geddes, Bull. Misc. Inform., Kew 1927: 172. 1927. Type: Thailand, Chiang Mai, Mae Rim, 1,100 m, 5 July 1922, open grassy pine forest, alt. 1,100 m, 5 July 1922, A.F.G. Kerr 6249 (holotype **K**, isotype **BK** 257379). Fig. 1A.

Subscapose perennial 8–35 cm high, with a basal leaf rosette made up of 2–4 pairs of decussate. *Leaves* sessile, obovate to ovate-elliptic, (2-) 2.5–6 by 1–1.5 cm, sparsely pubescent but with longer, stiff hairs on veins; flowering axis usually leafless or sometimes with few small, lanceolate leaves up to 2.5 cm long and less than 1 cm wide; stipules 3–4 mm long, with 3 bristles, sparsely hairy. *Inflorescence* several-flowered, congested, head-like, to ca. 1.5 cm in diam., on unbranched peduncle 7–33 cm long. *Flowers* shortly pedicellate to subsessile, ca. 1 mm long in fruit. *Calyx* slightly unequal, 1 lobe to ca. 0.5 mm long, the others up to 0.3 mm long. *Corolla* pink, mauve or purplish, glabrous outside; tube 1.5–2.5 mm long, cylindrical in brevistylous flower, widened above in longistylous flower; lobes 0.5–1 mm long, ovate to oblong. *Stamens* 4.5–5 mm long, exerted in brevistylous flower, included in the widened upper corolla tube portion, 1–2.5 mm long in longistylous flower; anthers ca. 1 mm. *Ovary* ca. 1 mm long, obovoid; style exerted, 3.5–4 mm long in longistylous flower, included, 2 mm long in brevistylous flower; stigma lobes ca. 0.5 mm long. *Fruit* dark brown, ovoid, 1–1.5 by 1.5–1.7 mm, laterally compressed, ventrally grooved; mericarps splitting from the base upwards, leaving behind the carpophore.

**Thailand.**– NORTHERN: Mae Hong Son [Khun Yuam, *K. Larsen* & *S.S. Larsen* 34087 (**BK**, **K**)]; Chiang Mai [Mae Rim, 5 July 1922, A.F.G. Kerr 6249 (**BK**, **K**)].

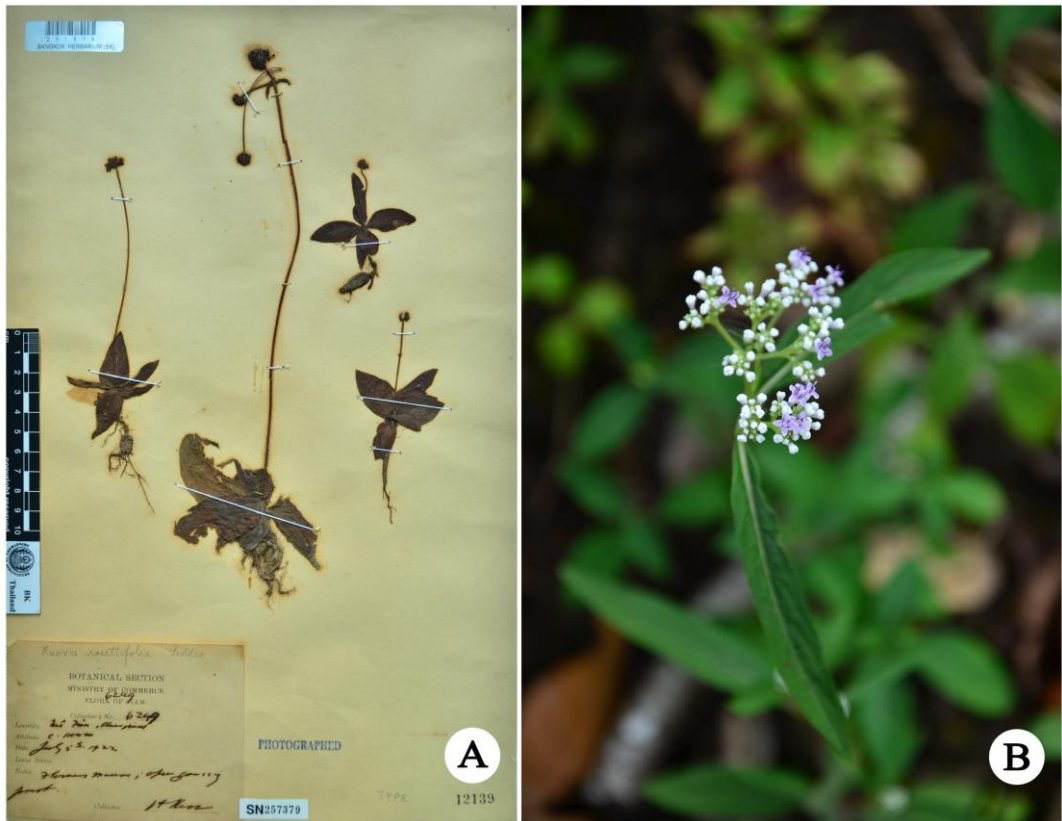


FIGURE 1. *Knoxia*.— A. *K. rosettifolia*. B: *K. roxburghii*.

**Distribution.**— Endemic.

**Ecology.**— Open, grassy pine forest, 600-1,100 m alt. Flowering and fruiting in June – July - October.

**Vernacular.**— Kradum bai jook (กระดุมใบจอก).

**Note.** — Rare and only known from few collections.

**2. *Knoxia roxburghii*** (Spreng.) M.A.Rau, Bull. Bot. Surv. India 10, suppl. 2: 40. 1969. --- *Spermacoce roxburghii* Spreng., Syst. Veg., ed. 16, 1: 404. 1824. Type: India, Interior of Bengal, Roxb., Icon.: t. 2032 (lectotype **CAL** *n.v.*, selected by R.Bhattacharjee & Deb, 1985). Fig. 1B.

*Spermacoce laevis* Roxb. [Hort. Beng.: 10. 1814, *nom. nud.* ex] Fl. Ind. ed. Carey &

Wall. 1: 374. 1820, *non* Lamk. (1792). --- *Knoxia laevis* (Roxb.) DC., Prodr. 4: 570. 1830. Type: as above, *fide* R.Bhattacharjee & Deb (1985).

*Spermacoce brunonis* Wall. ex G.Don, Gen. Hist. 3: 621. 1834. --- *Spermacoce brunonis* Blinkworth in Wall., Numer List: 822. 1829, *nom. nud.* --- *Knoxia brunonis* (Wall. ex G.Don) Benth. & Hook.f., Gen. Pl. 2(1): 104. 1873. --- *K. roxburghii* (Spreng.) M.A.Rau subsp. *brunonis* (Wall. ex G.Don) R.Bhattacharjee & Deb var. *brunonis* R.Bhattacharjee & Deb, J. Econ. Tax. Bot. 6(1): 85. 1985. Type: Kumaon, Blinkworth *s.n.* in Wall., Numer List: 822. 1829 (holotype **K-W**, isotype **CAL** *n.v.*).

*Knoxia brachycarpa* R.Br. [in Wall., Numer. List: 821. 1829] ex Hook.f., Fl. Birt. India 3: 130. 1880. Type: Nepal, Wall., Numer. List: 821. 1829 (lectotype **K-W** left-hand specimen, selected here; isolectotypes **CAL** microfiche *n.v.*, **P** 00836636 & **P** 00836637).

*Knoxia microcarpa* Kurz, J. Asiat. Soc. Bengal Pt. 2, Nat. Hist. 46(2): 138. 1877, erroneously as *K. macrocarpa* in Hook.f., Fl. Brit. India 3: 130. 1880. Type: Myanmar, Pegu, 27 December 1870, *S. Kurz* 3083 (lectotype **CAL** 0000016209, selected here; isolectotype **CAL** 0000016210).

*Hedyotis glauca* W.W.Smith, Bull. Misc. Inform., Kew 1911: 344. 1911. –*Knoxia roxburghii* (Spreng.) M.A.Rau subsp. *brunonis* (Hook.f.) R.Bhattacharjee & Deb var. *glauca* (W.W. Smith) Bhattacharjee & Deb, J. Econ. Tax. Bot. 6(1): 85. 1985. Type: Myanmar, Upper Burma, Kachin hill near Myit Kyina, June 1898, *Shaik Mokim* 86 (lectotype **CAL** 0000010826, selected here; isolectotypes **CAL** 0000010823, **CAL** 0000010824 & **CAL** 0000010827).

*Knoxia valerianoides* Thorel ex Pit. in Lecomte, Fl. Indo-Chine 3: 288. 1923. Type: Cambodia, Kampot, *Hahn* s.n. (lectotype **P** 03920651, selected here).

*Knoxia wallichii* L.Bruce ex Panigarhi, Bull. Bot. Soc. Beng. 21(1): 29. 1967. Type: India, Meghalaya, Garampani, 30 October 1956, *Panigarhi* 4246 (*BSD n.v.*).

*Knoxia brachycarpa* R.Br. ex Hook.f. var. *congesta* Pit. in Fl. Indo-Chine 3(2): 289. 1923. Type: Cambodia, Pursath province, Krewan, June 1870, *Pierre* 1989 (lectotype **P** 03920595, selected here; isolectotypes **P**

03920594, **P** 03920596, **P** 05024966 & **P** 05459686).

Herbaceous perennial 20–100 cm high. **Stems** mostly unbranched, sparsely adpressed pubescent, sometimes glabrescent below. **Leaves** (sub)sessile, typically linear-lanceolate, 5–16.5 by 0.5–2.5 cm, base cuneate, apex acute, sparsely greyish pubescent above, denser below, with rusty brown hairs along veins; stipules 2–10 mm long, with 2–4 bristles 5–7 mm long. **Inflorescence** thyrso-paniculate, lax, corymbiform, extensive or with several to few rather contracted to distinctly head-like partial inflorescences (cymes), in general, quite reduced; congested, head-like cymes somewhat elongating in fruit. **Flowers** shortly pedicellate to subsessile; pedicels up to *ca.* 3.5 mm in fruit. **Calyx** slightly unequal, 1 lobe to *ca.* 0.7 mm long, the others less than 0.5 mm long. **Corolla** violet, violet pink, pink, pale pink or lilac, glabrous outside; tube 2–4 mm long, sparsely pubescent inside around the throat, cylindrical in brevistylous flower, widened above in longistylous flower; lobes 1–1.5 mm long. **Stamens** 2–3.5 mm long, exerted in brevistylous flower, included in the widened upper corolla tube portion, 1–2 mm long in longistylous flower; anthers 0.5–1 mm. **Ovary** 0.5–1 mm long, obovoid to oblong-obovoid; style exerted, 4.5–5 mm long in longistylous flower, included, to *ca.* 2.5 mm long in brevistylous flower; stigma lobes *ca.* 0.5 mm long. **Fruit** greyish to dark brown, obovoid, 1–2 by 1–1.8 mm, laterally compressed, ventrally grooved, dorsally rounded; mericarps splitting from the base upwards, leaving behind the carpophore.

**Thailand.**– NORTHERN: Mae Hong Son [between Mae Sariang – Mae La Noi, 18 Sept. 1967, *K. Iwatsuki* & *N. Fukuoka* T-

- 10333 (**AAU, BKF**); Mueang, 7 Jul. 1958, *T. Smitinand* 4564 (**BKF**); Chiang Mai [Bo Luang, 15 Dec. 1969, *C.F. van Beusekom & C. Phengklai* 2554 (**AAU, BKF, L**); *ibid.*, 6 Jul. 1968, *K. Larsen, T. Santisuk & E. Warncke* 2213 (**AAU, BKF, C, K, L, P**); Doi Chiang Dao WS, 2 Aug. 1968, *K. Larsen, T. Santisuk & E. Warncke* 3027 (**AAU, BKF, C, L, P**); *ibid.*, 25 Dec. 1987, *C. Puff & W. Uearchirakan* 871225-1/1 (**BKF**) & 871225-1/2 (**BKF**); Doi Inthanon NP, 1 Aug. 1988, *S. Tsugaru* T-61791 (**BKF**) & T-61794 (**AAU, BKF, L**); *ibid.*, 23 Jul. 1988, *C. Phengklai et al.* 6845 (**BKF-2 sheets, L**); *ibid.*, 1 Aug. 1988, *C. Phengklai et al.* 7213 (**BKF**); *ibid.*, 1 Aug. 1988, *C. Phengklai et al.* 7443 (**BKF-2 sheets**); *ibid.*, 18 Jul. 1988, *M.N. Tamura* T-60095 (**BKF**); *ibid.*, 1 Aug. 1988, *N. Fukuoka* T-62393 (**BKF**); *ibid.*, 1 Aug. 1988, *N. Fukuoka* T-62404 (**BKF**); *ibid.*, *N. Fukuoka*, 3 Aug. 1988, T-62479 (**BKF**); Doi Pha Dam, Jul. 1968, *K. Larsen, T. Santisuk & E. Warncke* 2158 (**AAU**); Doi Suthep-Pui NP, 27 Jul. 1948, *Soradet* 58 (**BKF**); *ibid.*, 22 Aug. 1987, *J.F. Maxwell* 87-869 (**BKF**); *ibid.*, 13 Jul. 1909, *A.F.G. Kerr* 721 (**P**); Fang, 27 Jul. 1968, *K. Larsen, T. Santisuk & E. Warncke* 2768 (**AAU, BKF, C, L, P**); Mae Taeng, 3 Sept. 1958, *Th. Sørensen, K. Larsen & B. Hansen* 4703 (**BKF, C, L**); *ibid.*, 12 Oct. 1958, *Th. Sørensen, K. Larsen & B. Hansen* 5614 (**BKF, C, L**); Hod, 22 Jun. 2001, *W. Sankamethawee* 200 (**BKF**); Om Koi, 10 Jan. 1983, *H. Koyama, H. Terao & T. Wongprasert* T-32260 (**BKF**); *ibid.*, 17 Oct. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yamara & T. Santisuk* T-19042 (**BKF**); Ob Luang NP, 11 Oct. 1966, *J.F. Maxwell* 96-1328 (**BKF**); Lamphun [Ban Kun Tan-Doi Khun Tan, 4 Sept. 1967, *M. Tagawa, K. Iwatsuki, H. Koyama, N. Fukuoka, A. Nalampoorn & A. Chintayungkun* T-9115 (**BKF**); Mae Tha, 27 Aug. 1993, *J.F. Maxwell* 93-966 (**BKF**); Pa Sang, 14 Sept. 2004, *J.F. Maxwell* 04-477 (**BKF**); Tak [Doi Car, Phob Phra, 21 Nov. 2005, *R. Pooma, C.C. Berg & M. Poopath* 5769 (**BKF**); Umphang, 11 Jun. 2011, *V. Chamchumroon, C. Puff & D. Wongngoen* 4912 (**BKF-2 sheets**); Phitsanulok [Thung Salaeng Luang NP, 24 Jul. 1966, *K. Larsen, T. Santisuk & E. Warncke* 830 (**AAU, BKF, L**); NORTH-EASTERN: Phetchabun [Nam Nao NP, 15 Aug. 1982, *T. Shimizu, F. Konta, T. Smitinand, T. Wongprasert & B. Sangkhachand* T-28602 (**BKF**); *ibid.*, 17 Jul. 1989, *O. Thaithong* 686 (**BCU**); Loei [Phu Kradueng NP, 26 Jun. 1948, *Dee* 29 (**BKF**); *ibid.*, 14 Jul. 1948, *Dee* 587 (**BKF, L**); *ibid.*, 3 Sept. 1967, *T. Shimizu, M. Hutoh & D. Chaiglom* T-8788 (**BKF**); *ibid.*, 10 Nov. 1970, *Ch. Charoenphol, K. Larsen & E. Warncke* 4872 (**AAU**); Nong Hin, Tham Phraphothisat, 9 May 1948, *Din* 25 (**BKF**); Sakon Nakhon [Phu Phan, 23 Nov. 1962, *Ploenchit* 137 (**BKF**); EASTERN: Chaiyaphum [Ban Nam Phrom-Tun Kramang, 9 Aug. 1972, *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 31642 (**AAU, BKF, K, P**); *ibid.*, *R. Geesink, T. Hattink & C. Phengklai* 6971 (**BKF, L**); Phu Khiao WS, 8 Nov. 1984, *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-50365 (**BKF**); SOUTH-WESTERN: Kanchanaburi [Si Sawat, 28 Jun. 1974, *K. Larsen & S.S. Larsen* 33887 (**AAU, K**); Khao Buing, 19 Aug. 1971, *C.P., B.S. & B.N.* 2976 (**BKF**); Ku-Jae, 21 Jul. 1946, *A. Kostermans* 1266 (**P**); Thong Pha Phum, 6 Aug. 2012, *D.J. Middleton, P. Karaket, S. Suddee & P. Triboun* 5259 (**BKF, QBG**); Sangkhla, 7 Jul. 1973, *J.F. Maxwell* 73-203 (**AAU, BK**)].

**Distribution.**— India, Nepal, Myanmar, China, Cambodia, Laos, Vietnam.

**Ecology.**— Open thicket or grassy places in deciduous, deciduous dipetrocarp-oak, mixed deciduous and dry dipterocarp forests and pine savannah, usually growing in open, sometimes disturbed, grassy areas, on clayish soil and also over limestone; occasionally in marshy, water-logged areas. 50-1,300 m alt. Flowering in March - September, fruiting in July - October.

**Vernacular.**— Kradum bai yai (กระดุมใบใหญ่), ya khamen (หญ้าขมระ), ya khamen lek (หญ้าขมระเล็ก) (Genral), ya klet hoi (หญ้าเกิ้ล็ดหอย), ya rak khao (หญ้ารากขาว) (Prachin Buri).

**Note.**— Bhattacharjee & Deb (1985) separated *Knoxia roxburghii* into subsp. *roxburghii*, subsp. *brunonis* var. *brunonis* and subsp. *brunonis* var. *glauca* on the basis of “lax, cormybose” vs “dense, rarely lax capitate to globose heads” is not accepted because, at least in Thai material, there is too much variation in this character, and because development of the plant and its inflorescence appears to depend on the habitat conditions. However, we have examined all materials and can find no differences and we also agree with Puff & Robbrecht (1989) that the inflorescence can vary considerably within the species.

Two collections from Myanmar (Burma), *S. Kurz* 1433 (CAL 0000016211, CAL 0000016212 & CAL 0000016213) & 3083 (CAL 0000016209 & CAL 0000016210) were cited in the original description of *Knoxia microcarpa*. *S. Kurz* 3083 (CAL 0000016209) is selected as the lectotype because it is has more flowers and well preserved and has one duplicate as isolectotype.

*Hedyotis glauca* was described based on two collections, *Shaik Mokim* 86 (CAL 0000010823, CAL 0000010824,

CAL 0000010826 & CAL 0000010827) from Burma and *I.H. Burkill* 32470 (CAL 0000010825) from India. *Shaik Makim* 86 (CAL 0000010826) is selected here as lectotype because of its well preserved and three duplicates as isolectotypes.

The original description of *Knoxia valerianoides* was based on the syntypes *Hahn* s.n., *Kony Tcheon* s.n. and *Thorel* s.n. Only *Hahn* s.n. (P 03920651) was available for examination and, therefore, the specimen is selected here as the lectotype.

Seven different collections, *Godefray* 172 (P 03920600), 381 (P 03920601) & s.n. (P 03920607 & P 05177127), *Harmand* s.n. *n.v.*, *Pierre* 1989 (P 03920594, P 03920595, P 03920596, P 05024966 & P 05459686), *Spire* 412 (P 03920591) and *Thorel* s.n. (P 03920598) were cited in the original description of *K. brachycarpa* var. *congesta* Pit. *Pierre* 1989 (P 03920595) is the selected as the lectotype because is well preserved and has four duplicates as isolectotypes.

**3. *Knoxia sumatrensis*** (Retz.) DC., Prodr. 4: 569. 1830. --- *Spermacoce sumatrensis* Retz., Observ. Bot. (Retzius) 4: 23. 1786. Type: Indonesia, Sumatra, *Wennerberg* s.n. (holotype LUND *n.v.*).

*Knoxia sumatrensis* Wall., Numer. List: 6183. 1831, *nom. nud.*

*K. corymbosa* Willd., Sp. Pl. 1: 582. 1798, *nom. illeg.*

*K. stricta* Gaertn., Fruct. Semi. Pl. 1: 122, t. 25. 1788. Type: Sri Lanka, *Koenig* s.n. (BM *n.v.*, *fide* R.Bhattacharjee & Deb, 1985).

*Cuncea trifida* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.: 135. 1825. Type: Nepal, Buch.-Ham. s.n. (holotype CAL 00000-25266, isotype CAL 0000025267).

*K. mollis* R.Br. in Wall., Numer. List: 820. 1829, *nom. nud.*

**var. *sumatrensis***

Subshrubby perennial to 1 m high. **Stems** often branched, sparsely to densely tomentose above, glabrescent below. **Leaves** oblong-lanceolate or ovate-lanceolate, 4–10 by 1–4 cm, base acute to attenuate or obtuse, apex acute to acuminate, above sparsely pubescent, below pubescent, particularly on the veins, with 5–12 pairs of lateral veins; petioles (5–) 10–20 (–30) mm long; stipules 3.5–10 (–15) mm long, with typically 4–6 bristles 5–10 mm long. **Inflorescence** thyrsoid-paniculate, often corymbiform and rather lax; cymes much elongating in fruit; peduncle 2–7 (–10) cm long. **Flowers** shortly pedicellate to subsessile; pedicels up to *ca.* 2 mm in fruit. **Calyx** slightly unequal, 1 lobe to *ca.* 0.7 mm long, the others less than 0.5 mm long. **Corolla** white, yellowish-white, pinkish-white, pale rose, pale lilac or pale blue-violet, glabrous outside; tube 2–6 mm long, pubescent inside at least around the throat, cylindrical in brevistylous flower and widened above in longistylous flower; lobes 1–3 mm long. **Stamens** 2–4 mm long, exserted in brevistylous flower, included in the widened upper corolla tube portion, 1.5–2 mm long in longistylous flower; anthers 0.5–1 mm long. **Ovary** to 1–1.5 mm long, ovoid to oblong; style exserted, 5–10 mm long in longistylous flower, included, 1–5 mm long in brevistylous flower; stigma lobes *ca.* 0.5 mm long. **Fruit** greyish to dark brown, 1–3 by 0.8–2.4 mm, faintly to

distinctly quadrangular; mericarps often remaining (partially) united, leaving behind the column-like, apically 2-forked carpophore, but sometimes splitting from the base into 2 one-seeded units.

**Thailand.**— NORTHERN: Chiang Mai [Mueang, 16 Sept. 1993, P. Palee 154 (BKF-2 sheets); Doi Inthanon NP, Mae Klang, 18 Oct. 1955, Umpai 172 (BK); *ibid.*, 1 Oct. 1971, G. Murata, K. Iwatsuki, C. Phengklai & C. Charoenphol T-15496 (BKF); *ibid.*, 2 Aug. 1988, H. Koyama & N. Fukuoka T-62425 (BKF); *ibid.*, 28 Jul. 1988, M.N. Tamura T-60300 (BKF); *ibid.*, 21 Jul. 1988, C. Phengklai *et al.* 6665 (BKF-2 sheet, K); Doi Chiang Dao WS, 2 Aug. 1968, K. Larsen, T. Santisuk & E. Warncke 3023 (AAU, BKF, C, K, L, P); *ibid.*, 27 Sept. 1971, J.E. Vidal 5220 (AAU); *ibid.*, 31 Aug. 1935, H.B.G. Garrett 1007 (AAU, BKF, K, L); *ibid.*, 14 Jan. 1973, S. Sutheesorn 2249 (BK); *ibid.*, 25 Sept. 1971, G. Murata, K. Iwatsuki & C. Phengklai T-15000 (BKF); *ibid.*, 30 Oct. 1987, J.F. Maxwell 87-1314 (BKF); *ibid.*, 3 Jul. 1955, Khantchai 236 (BKF); *ibid.*, 17 Feb. 1958, T. Smitinand 4236 (BKF); Doi Suthep, 28 Jul. 1968, K. Larsen, T. Santisuk & E. Warncke 2783 (AAU, BKF, C, P); *ibid.*, M.N. Tamura, S. Khoaim, W. Boonsawat & J.F. Maxwell T-60724 (BKF); *ibid.*, 18 Jul. 1945, Suradet 48 (BKF); *ibid.*, Th. Sørensen, K. Larsen & B. Hansen 4552 (BKF, C, L); *ibid.*, Th. Sørensen, K. Larsen & B. Hansen 4592 (BKF, C); *ibid.*, Th. Sørensen, K. Larsen & B. Hansen 4863 (BKF, C, L); *ibid.*, 23 Jul. 1958, Th. Sørensen, K. Larsen & B. Hansen 4355 (BKF, C, K, L); Doi Tao, 23 Oct. 1987, J.F. Maxwell 87-1254 (BKF) Hod, Ob Luang, 11 Oct. 1996, J.F. Maxwell 96-1332 (BKF); Mae Rim, 18 Sept. 1995, K. Larsen, S.S. Larsen, C. Tange & D. Sookchaloem 46657 (AAU, L); Samoeng,

- Th. Sørensen, K. Larsen & B. Hansen* 4956 (**BKF, C, L**); Chiang Rai [Mae Sruai, 26 Jan. 1981, *Y. Paisooksantivatana* y-578-81 (**BK-2** sheets); Chiang Khong, 27 Sept. 1967, *N. Fukuoka, M. Hutoh & D. Chaiglom* T-11202 (**BKF**); Chiang Khong, Doi Fa Hom Pok, 11 Sept. 1967, *K. Iwatsuki, N. Fukuoka & A. Chintayungku* T-9549 (**BKF, K**); Nan (Doi Phu Wae, 13 Oct. 2000, *P. Srisanga* 1838 (**BKF, QBG**); *ibid.*, 5 Sept. 2001, *P. Srisanga* 2172 (**BKF**); Doi Cham On, 6 Sept. 1995, *K. Larsen, S.S. Larsen, C. Tange & D. Sookchaloem* 46125 (**AAU, BKF**); Lamphun [Mae Tha, 27 Jul. 1915, *Winit* 384 (**BKF**); Ban Hong, 24 Dec. 1987, *C. Puff & W. Ueachirakan* 871224-4/3 (**BKF**); Lampang (Doi Khun Tan NP, 1 Sept. 1994, *J.F. Maxwell* 94-967 (**BKF**); Doi Luang NP, *J.F. Maxwell* 97-939 (**BKF**); Doi Pa Lad, 26 Sept. 1967, *T. Shimizu, H. Koyama & A. Nalampoon* T-10857 (**BKF**); Chae Son NP, 25 Aug. 1996, *J.F. Maxwell* 96-1139 (**BKF-2** sheets)]; Tak [Bhumipol Dam, 10 Dec. 1959, *Sonchai* 648 (**BK**); Mae Kor, 20 Jul. 1915, *Winit* 385 (**BKF**); Kamphaeng Phet [Mae Wong, Khlong Lan, 22 Sept. 1998, 22 Sept. 1998, *M. van de Bult* 119 (**BKF**); NORTH-EASTERN: Loei [Phu Kradueng, 16 Sept. 1968 *P.B.* 68 (**BKF**); *ibid.*, 11 Nov. 1970, *C. Charoenphol, K. Larsen & E. Warncke* 4918 (**AAU, K**); *ibid.*, 27 Aug. 1988, *N. Fukuoka* T-63654 (**BKF**); Wang Saphung, 20 Nov. 1958, *T. Smitinand* 4882 (**BKF**); Sakon Nakhon [Pha Sawoi, 29 Dec. 1962, *Adisai* 261 (**BK**); Mukdahan [Dong Luang, Huai Huad NP, 24 Aug. 2001, *R. Pooma, W.J.J.O. de Wilde, B.E.E. Duyffjes, V. Chamchumroon & K. Phatarahirankanok* 2486 (**BKF-2** sheets)]; Kalasin [Somdet, 23 Oct. 1975, *S. Suthesorn* 3501 (**BK**). EASTERN: Chaiyaphum [Phu Khiao, Thung Kramang, 4 Apr. 1972, *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 31416 (**AAU, BKF, C, K, P**); *ibid.*, 7 Aug. 1972, *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 31509 (**AAU, K**); Phu Khiao WS, 7 Nov. 1984, *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-41704 (**BKF**); *ibid.*, 7 Nov. 1984, *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-41710 (**BKF**); *ibid.*, 8 Nov. 1984, *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-41704 (**BKF**); Nakhon Ratchasima [Bua Yai, 31 Oct. 1931, *Put* 4231 (**AAU, BK, K**); Pak Thong Chai, 1 Nov. 1969, *C.F. van Beusekom & C. Charoenpol* 1999 (**AAU, BKF, C, K, L**); Wang Nam Khiao, 17 Jul. 1973, *Damrongsak* 92 (**BKF**); *ibid.*, 14 Nov. 1967, *Damrongsak* 386 (**BKF**); *ibid.*, 5 Aug. 1967, *S. Phengnaren* 417 (**BKF & K**); Buriram [Mueang, 26 Nov. 1976, *C. Phengklai et al.* 3460 (**BKF-2** sheets)]; Ubon Ratchathani [Khong Chiam, 19 Sept. 2001, *J.F. Maxwell* 01-493 (**BKF**). SOUTH-WESTERN: Uthai Thani [Huay Kha Kaeng, 12 Nov. 1979, *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-22388 (**BKF**); Kanchanaburi [Hin Dat, 14 Jul. 1928, *Put* 136 (**BK**); Khao Buing, 15 Aug. 1971, *C.P., B.S. & B.N.* 2476 (**AAU, K**); Si Sawat, 28 Jun. 1964, *K. Larsen & S.S. Larsen* 33902 (**AAU, BKF**); *ibid.*, 5 Nov. 1971, *C.F. van Beusekom, R. Geesink, C. Phengklai & B. Wongwan* 3441 (**BKF, C, K, L**); *ibid.*, 8 Nov. 1984, *T. Shimizu, F. Konta, T. Smitinand, T. Wongprasert & B. Sangkhachand* T-28467 (**BKF**); Thong Pha Phum), Phetchaburi [Huai Sai, 12 Sept. 1999, *C. Niyomdham* 5830 (**BKF-2** sheets)]; Prachuap Khiri Khan [Thap Sakae, 25 Aug. 1982, *T. Shimizu, F. Konta, T. Smitinand, T. Wongprasert & B. Sangkhachand* T-28795 (**BKF**). CENTRAL: Lop Buri [Lam Narai,



13 Nov. 1975, *T. Smitinand* 12100 (**BKF**); Saraburi [Pu Kae, 7 Aug. 1976, *Dee* 200 (**BKF**); Sam Lan, 27 Oct. 1973, *J.F. Maxwell* 73-557 (**AAU, BK**)]. SOUTH-EASTERN: Sa Kaeo [Watana, 14 Oct. 1928, *Put* 1910 (**BK, K**)]; Prachin Buri [Aranyaprathet, 9 Aug. 1930, *A.F.G. Kerr* 19597 (**BK, K, TCD**); *ibid.*, 14 Sept. 1930, *Put* 3117 (**BK**); Khao Yai NP, 13 Jul. 1966, *K. Larsen, T. Smitinand & E. Warncke* 410 (**AAU**)]; Chon Buri [Khao Kiao, 19 Oct. 1975, *J.F. Maxwell* 75-1041 (**BK**); Si Racha, Si Chang, *J.F. Maxwell* 93-839 (**BKF**)]. PENINSULAR: Chumphon (Pathio, Thung Maha, 13 Jan. 1927, *A.F.G. Kerr* 12885 (**BK, K**); Phangnga [Ko Yao Noi, 13 Jul. 1966, *C. Phengklai et al.* 15603 (**BKF**)].

**Distribution.**—Sri Lanka, India, Bhutan, Bangladesh, China, SE Asia, Northern Australia.

**Ecology.**—Sandy ground in dipterocarp, dry deciduous, mixed deciduous, open pine-oak and hill evergreen forests, usually growing in undisturbed or disturbed open (grassy) areas on sandy to rocky ground; sometimes over limestone, 0-1,700 m alt., Flowering and fruiting in May - November (till January).

**Vernacular.**—Tong lai (ตองลาย) (Chiang Rai), ma khok taek (ไม้ดอกแตก), hak ma han (ฮักมะหาน) (Chiang Mai).

**Note.**—Bhattacharjee & Deb (1985) accepted four infraspecific taxa viz. var. *sumatrensis*, var. *hookeriana*, var. *glaberrima* and var. *linearis* in *Knoxia sumatrensis* but these seem to be difficult to distinguish and may have to be united Puff & Robbrecht (1989). Only typical variety is widely distributed from India through SE Asia and Australia but var. *hookeriana* is found in India and Sri Lanka and the last two varieties are endemic to India. Although *K. sumatrensis* super-

ficially resembles *K. roxburghii* in having cauline leaves, it differs in possessing a fruit which has an emarginate apex, oblong-lanceolate or ovate-lanceolate leaves with distinct petioles and fimbriate stipules with 4-6 bristles.

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#### LITERATURE CITED

- Bhattacharjee, R. & Deb, D.B. 1985. A revision of *Knoxia* (Rubiaceae). *Journal of Economic Taxonomy Botany* 6(1): 73-95.
- Brummitt, R.K. & Powell, E. (eds.) 1992. *Authors of Plant Names*. Royal Botanic Gardens, Kew.
- Kårehed, J. & Bremer, B. 2007. The systematics of *Knoxia* (Rubiaceae) —molecular data and their taxonomic consequences. *Taxon* 56(4): 1051-1076.
- Mabberley, D.J. 2008. *Mabberley's Plant-book : a portable dictionary of plants, their classification and uses*. Cambridge University Press.
- Puff, C. & Robbrecht, E. 1989. A survey of *Knoxieae* (Rubiaceae-Antirrhoideae). *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 11(4): 511-558.
- Thiers, B. 2015. *Index Herbariorum: A global directory of public herbaria and Associated staff*. New York Botanical Garden's Virtual Herbarium. Available from: <http://sweetgum.nybg.org/ih/>, 13 July 2015.