Two new species and a new name in Thai *Croton* (Euphorbiaceae)

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ABSTRACT. Two new species of Croton are described from Thailand, *C. acutifolius* Esser and *C. decalvatus* Esser. Both are locally common, but were hitherto confused with *C. robustus* Kurz and *C. thorelii* Gagnep., respectively. The name of the important medicinal plant, *C. sublyratus* Kurz, is changed to *C. stellatopilosus* Ohba, perhaps identical with *C. longissimus* Airy Shaw

The revision of Euphorbiaceae for the Flora of Thailand, recently carried out by BKF staff and collaborators revealed several novelties. Some of them, in the difficult genus *Croton* L., are reported here.

Croton acutifolius Esser **sp. nov.** Species *Crotonis* pilis stellatis obtectis, laminis foliorum subintegris acutis (sub)glabris, inflorescentiis dense pubescentibus saepe masculinis tantum et pedicellis florum femineorum atque fructuum (5–)8–13 mm longis notabilis. Typus: Thailand, Lampang, Jae Sawn National Park, *J.F. Maxwell* 96-4 (holotypus BKF; isotypi A, CAS not seen, CMU, L).— *Croton robustus* auct. non Kurz: Craib, Bull. Misc. Inform. Kew 1911: 464. 1911; Contr. Fl. Siam, 190. 1912; Gagnep. in Lecomte, Fl. Gén. I.-C. 5: 289. 1925; Airy Shaw, Kew Bull. 26: 249. 1972, pro parte excl. *C. siamensis*.— *Croton oblongifolius* auct. non Roxb.: Hosseus, Beih. Bot. Centralbl. 28: 404. 1911.

Shrub or tree to 12 m, dbh up to 25 cm, deciduous; bark thick, scaly and roughly vertically cracked, brownish to dark grey; branching verticillate; branchlets slowly glabrescent. *Indumentum* consisting of greyish-yellowish-brown hairs with pale radii (appearing creamish-coloured), 0.2–0.3 mm (on flowers up to 0.5 mm) in diam., stellate with ca. (15–)20–25 plain to slightly ascending, not to very slightly webbed radii. *Stipules* ca. 3 mm long, densely pubescent, rarely seen. *Leaves* alternate, often crowded; petiole 10–35 mm long, densely pubescent, hardly glabrescent; blade elliptic, 12–27 by 4–9.5 cm, index 2.8–4.5, chartaceous, base acute, margin subentire with very shallow and indistinct serration, apex acute, slightly brighter below, glabrous above, below sometimes pubescent at the very base only, sparsely pubescent to glabrous on the midrib, otherwise glabrous to subglabrous with few scattered hairs; basal glands flat, sessile, ca. 0.5 mm in diam., lateral on the midrib base and very indistinct, marginal glands absent; complete venation visible on both surfaces, side veins in 15–20 pairs, loops indistinct,

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not triplinerv, tertiaries and smaller veinlets reticulate. *Inflorescences* whitish-green to greyish-green, always several in an apical, often leafless, whorl, each one 8–24 cm long, completely staminate or a basal part of 3–8 cm pistillate with 3–12 pistillate flowers, sometimes bracts bisexual with lateral staminate flowers surrounding the pistillate flower, the larger upper part or completely staminate, with 1–3 flowers per bract, densely and persistently pubescent on the whole axis and all surfaces outside; bracts 1.5–2 mm long, stiff, persistent, eglandular. *Staminate flowers*: densely pubescent outside; pedicel 3–7 mm long; sepals ovate-elliptic, 2 by 1 mm; petals 2 by 1 mm, stellate-pubescent outside; stamens ca. 10, with the filaments often pubescent. *Pistillate flower* densely pubescent outside; pedicel 5–10 mm long; sepals 2–3 by 1–1.5 mm, slightly shorter than the ovary, slightly fused at base, pubescent allover outside; petals absent or as ca. 1 by 0.2 mm, lineal lobes; ovary ca. 3 mm long; stigmas 2.5–4 mm long, not fused at base, undivided for ca. 1 mm at base and divided apically. *Fruits*: pedicel 10–13 mm long, densely pubescent; schizocarp 6–7 by 8–9 mm, sulcate, densely pubescent and smooth outside, exocarp later separating. *Seeds* 5.5–6 by 4 mm, elliptic, brown, with a very small caruncle.

Thailand.— NORTHERN: Chiang Mai [Doi Chiang Dao, 20 Nov. 1963, *Adisai* 694 (BK), 24 Dec. 1931, *Put* 4526 (BK, BM, K, L), 2 Dec. 1955, *Suvanakoset* 925 (BKF, K, L, P); Doi Luang, alt. 1400 m, 27 Jan. 1996, *Maxwell* 96-91 (A, BKF, CMU); Doi Nang limestone mountain, alt. 1000 m, 20 March 1996, *Maxwell* 96-409 (A, BKF, CMU, L); Doi Inthanon, Mae Pan Waterfall, alt. 1000–1100 m, 13 Jan. 1994, *Fukuoka* T-62143 (BKF, TI), alt. 1100 m, 16 Dec. 1978, *Santisuk* 1602 (BKF), 8 Jan. 1983, *Koyama, Terao & Wongprasert* T-32111 (A, BKF), alt. 1400 m, 10 Dec. 1984, *Koyama & Nantasan* T-40100 (A, BKF, L); Doi Sang, alt. 800 m, 8 Feb. 1996, *BGO staff* 6 = QBG 5954 (QBG); Doi Sang Liang, alt. 1000 m, 9 Nov. 1997, *Maxwell* 97-1324 (A, BKF, CMU, L); Doi Suthep-Pui, alt. 800 m, 29 Dec. 1904, *Hosseus* 296 (A, BM, G, HBG, K, L, MO, P), 16 Jan. 1910, *Kerr* 943 (BM, K, L, TCD), alt. 750 m, 23 Feb. 1988, *Maxwell* 88-224 (BKF, CMU, L), 27 Sept. 1949, *Suvanakoses* 45 (BKF, K), alt. 600 m, 2 Feb. 1959, *Sørensen, Larsen & Hansen* 6823 (K, SING), *Sørensen, Larsen & Hansen* 6826 (BKF, K, L); Hot district, Huai Mae Lit Bridge, alt. 920 m, 13 Jan. 1983, *Koyama, Terao & Wongprasert* T-32409 (A, BKF); Mae Taeng district, Ba Bae village, alt. 950 m, 21 Jan. 1992, *Maxwell* 923 (CMU, GH, P); Mae Rim, Queen Sirikit Botanical Garden, alt. 800–900 m, 21 Jan. 1996, *BGO staff* 59 = QBG 5596 (QBG), alt. 600 m, 20 Nov. 1993, *BGO staff* 212 (QBG), 10 July 1999, *Esser* 99-24 (A, BKF); Mae Sa Na Valley, 20 km NW of Chiang Mai, alt. 1100 m, 23 Jan. 1977, *Anderson* 4185 (MO), alt. 800 m, 1 Feb. 1977, *Anderson* 4206 (MO); Mae Lao basin, between Pang Kia and Mae Kha Chan, alt. 750–900 m, 2 Jan. 1922, *Rock* 1631 (A)], Chiang Rai [Doi Luang National Park, alt. 1175 m, 30 Oct. 1997, *Maxwell* 97-1299 (A, BKF, CMU, L); Khun Chae National Park, alt. 1125 m, 31 Dec. 1997, *Maxwell* 97-1549 (A, BKF, CMU, L); Mae Chan district, Doi Mae Salong, alt. 1125 m, 16 March 1994, *Maxwell* 94-352 (A, CMU, L); Mae Fa Luang, 16 March 1996, *BGO staff* 6095 = QBG 6085 (QBG); Mae Suai district, Mae Tamaeo, alt. 860 m, 1 March 1989, *Bragg* 43 (CMU), *Bragg* 48 (CMU); 5 April 1989, *Bragg* 249 (CMU)], Nan [Doi Phu Kha Wildlife Sanctuary, alt. 600 m, *Suvarnasuddhi* 206 (BKF), Lamphun [Doi Khun Tan National Park, alt. 1050 m, 26 Dec. 1993, *Maxwell* 93-1556 (A, BKF, CMU, L), 4 March 1994, *Maxwell* 94-327

(A, CMU, L)], Lampang [Chae Son National Park, off the dirt road to Ba Miang village, alt. 1150 m, 6 Jan. 1996 (fl., fr.), *J.F. Maxwell* 96-4 (holotype BKF; isotypes A, CAS, CMU, L); Doi Khun Tan, Mae Tha district, alt. 1000–1370 m, 27 Dec. 1984, *Koyama & Phengklai* T-39097 (A, BKF, L)]; NORTH-EASTERN: Phetchabun [Nam Nao National Park, 10 Aug. 1976, *B.Sangkhachand* 3085 (AAU, BKF, K, L, P)]; without further data, 22 Nov. 1974, *T.S.(Santisuk)* 159 (BKF).

Distribution.— Endemic to Thailand.

Ecology.— In disturbed hill evergreen, evergreen hardwood, hardwood and pine, or mixed evergreen/deciduous forest, secondary thickets, clearings and fire-prone places; on lateritic or clayey soil, over granite or limestone, alt. 600–1400 m. The inflorescences are fragrant.

Vernacular.— Chi-mi-chi-ya (จิมิจิยา) (Akha - Chiang Rai); mado kai (มะดอไก่) (red Lahu, Chiang Mai); plao (เปล้า), plao phae (เปล้าแพะ) (Northern).

Uses.— The leaves, in mixture with other plants, are used for cuts.

Notes.— *Croton acutifolius* is notable for its sharply acute, entire leaves and the densely pubescent inflorescences that are nearly always clustered apically and more often unisexual than in all other Thai species. Pistillate flowers are rare, and the type is one of the few collections including flowers of both sexes as well as fruits. Together with *Croton roxburghii* N.P.Balakr., this is the most common *Croton* in Chiang Mai province. *Croton roxburghii* is easily distinguished by the lepidote hairs, serrate leaves, glabrescent, solitary and usually bisexual inflorescences, and the shorter pedicels in particular of the fruits. *Croton acutifolius* has been known under the name *C. robustus* Kurz ever since Craib (1912). Both species are indeed very similar superficially, but are nevertheless sufficiently distinct. *Croton robustus* has stellate-lepidote to dentate-lepidote, yellowish hairs (instead of stellate, creamish-coloured hairs); the leaf blades are rounded to slightly acutish at apex (never sharply acute) and have scattered but distinct hairs below (not completely glabrous); the inflorescences are usually bisexual (instead of mostly staminate); all pedicels of flowers and fruits are very short (1–2 mm long, even in fruits); it is restricted to lowland forests of less than 700 m altitude; and it is locally common in Myanmar but in Thailand rare and only known from few places in the South-Eastern region.

In the provisional generic subdivision of Webster (1993) *C. acutifolius* might fall into section *Cascarilla* Griseb., despite the occasional presence of bisexual bracts. This section is probably unnatural, as Webster admitted, and the relationships of *C. acutifolius* remain uncertain.

Croton decalvatus Esser **sp. nov.** Habitu similis *Crotoni thorelii* sed pilis stellatis 0.3–0.7 mm diam., inflorescentiis partim glabrescentibus (praesertim sepalis), bracteis floralibus 3–5 mm longis caducis differt. Type: Thailand, Sa Kaeo, Wang Nam Yen, Roi Pi Botanical Garden, *Esser* 98-105 (holotypus BKF; isotypi A, AAU, K, L, P).— *Croton thorelii* auct. non Gagnep.: Airy Shaw, Kew Bull. 26: 250. 1972, pro parte.

Shrub to 3 m tall; bark grey-brown, smooth; young branchlets densely stellate-pubescent at the top, soon glabrescent. *Indumentum* consisting of cream-brown hairs, flat, 0.3–0.7 mm (on pistillate flowers up to 0.75 mm) in diam., stellate with ca. 20–25 radii. *Stipules* 2–4 mm long, pubescent to subglabrous. *Leaves* crowded to pseudo-verticillate at nodes, alternate between; petiole 4–16 mm long, distinctly to indistinctly (but barely densely) pubescent; blade elliptic (hardly obovate), 12–30 by 3–8 cm, index 2.7–5.8, chartaceous, base acute with very base rounded-subcordate, margin distinctly serrate or double-serrate to subentire (teeth 4–8 mm apart), apex acute to subacuminate, brighter or of same colour below, glabrous above, very sparsely pubescent below and soon glabrescent; basal glands sessile, flat to slightly elevated, 1–1.5 mm large, lateral on the abaxial midrib base, marginal glands absent; complete venation visible on both surfaces, side veins in 15–20 pairs, not triplinerv, veinlets visible. *Inflorescences* whitish-green, erect, solitary or more often few in an apical whorl, (3–)8–12 cm long, sometimes completely pistillate or staminate, if bisexual the basal part of ca. the lower half with 8–20 pistillate flowers, all bracts unisexual, the upper part staminate with 1(–3) flowers per bract, initially densely pubescent throughout but the bracts and sepals very soon glabrescent, the axis slowly glabrescent; bracts 3–5 by 1 mm, membranous, usually glabrous, eglandular, very soon and already in late bud caducous, bracteoles of ca. 1 mm common. *Staminate flowers*: pedicel 2–3 mm long, distinctly pubescent to glabrescent; sepals, 2.5 by 1–1.5 mm, soon nearly glabrous; petals 2.5 by 1 mm; stamens ca. 12, glabrous. *Pistillate flowers*: pedicel (1.5)2.5–3.5 mm long, densely pubescent; sepals 4 by 1–1.5 mm, slightly fused at base to nearly free, pubescent at base but nearly glabrous above, longer than the ovary; petals absent; ovary 2–3 mm long, densely pubescent; stigmas free at base, 4 mm long, bifid from the base, each branch not divided but sometimes slightly emarginate apically. *Fruits*: pedicel 5–7 mm long, subglabrous; sepals ca. 4 by 2 mm, subglabrous; schizocarp 7–9 mm long, oblong, slightly sulcate, surface scatteredly pubescent but otherwise smooth, pericarp quite thin (0.5 mm). *Seeds* flattened-elliptic, 6–7 by 4.5–5 mm, brown, with a small caruncle.

Thailand.— NORTH-EASTERN: Sakon Nakhon [Doi Phu Phan National Park, alt. 500 m, 21 Oct. 1998, *Esser* 98-201 (A, AAU, BKF, L)]; EASTERN: Buri Ram [Nang Rong, alt. 200 m, 3 Jan. 1924, *Kerr* 8208 (BK, K, L); alt. 350–400 m, 17 Nov. 1976, *Phengklai et al.* 3262 (BKF), *Phengklai et al.* 3265 (A, BKF)], Surin [Sangkha, alt. 200 m, 12 Jan. 1924, *Kerr* 8269 (BK, K, L, P)]; SOUTH-EASTERN: Sa Kaeo [Pang Sida National Park, alt. 300 m, 10 Aug. 1996, *Wongprasert* s.n. = BKF 104624 (BKF); Wang Nam Yen district, Roi Pi Botanical Garden, 17 Sept. 1998 (fl.), *Esser* 98-105 (holotype BKF; isotypes A, AAU, K, L, P); Roi Pi Botanical Garden, alt. 300 m, 16 Sept. 1998, *Esser* 98-84 (A, AAU, BKF, CMU, L, TCD), 16 Sept. 1998, *Greijmans* 70-98 (BKF), without date, *Pholsena* 1238 (BKF); Kao Takrup, alt. 400 m, 10 Sept. 1999, *Middleton* 218 (A, BKF, K, L)], Prachin Buri [Prachanthakham, 13 Nov. 1964, *Sakol Sutheesorn* 90 (BK)], Chon Buri [Nong Nam Khiao, 29 Feb. 1924, *Collins* 964 (BK, K), *Collins* 964A (BK, K), alt. 150 m, 5 April 1920, *Kerr* 4168 (K, L), Khao Chomphu, alt. 300 m, 24 Oct. 1976, *Maxwell* 76-702 (AAU, BK, L)], Chanthaburi [Khao Phra Bat, alt. 100 m, 27 Aug. 1978, *Larsen, Larsen, Nielsen & Santisuk* 32145 (AAU, BKF, K, L, P); Makham, Seang-Thong Herbal Garden, 8 Sept. 1977, *Phromdej* 216 (BKF)].

Distribution.— Endemic? To be expected in Cambodia.

Ecology.— In disturbed evergreen and bamboo/deciduous forest, old clearings, along streams, shaded or exposed, alt. 100–500 m.

Notes.— The name, meaning 'made or become glabrous', refers to the partly glabrescent inflorescences. *Croton decalvatus* is the most common species of *Croton* in Sa Kaeo province besides *C. roxburghii*. It has been confused with *C. thorelii*, including ourselves in earlier annotations. Both species are similar in habit and most leaf characters (shape, glands, pubescence, etc.). *Croton thorelii* also occurs in most of the South-Eastern region, but is more widespread in Thailand and beyond, extending into Vietnam. It differs from *C. decalvatus* in smaller hairs 0.2–0.3 mm (instead of 0.3–0.7 mm) in diameter, inflorescences densely and persistently pubescent on all parts (instead of glabrescent, in particular on the sepals), smaller and persistent bracts 1.5–2 mm long (instead of 3–5 mm long and caducous), stigmas usually distinctly although not always quadrifid (instead of bifid), and in shorter pedicels of the fruits (2–3 instead of 5–7 mm long).

In several characters of the inflorescences *C. decalvatus* is most similar to *C. delpyi* Gagnep., which differs in alternate leaves with longer petioles, and inflorescences with glabrescent sepals but a persistently pubescent axis.

Croton decalvatus might again fall into section *Cascarilla* fide Webster (1993), which shows the heterogeneity of his huge section.

Croton stellatopilosus Ohba, J. Jap. Bot. 55: 97. 1980; Chakrab. & N.P. Balakr., Bull. Bot. Surv. India 34: 70. 1997 ('1992'; under *C. wallichii*). Type: Thailand, South-Eastern, Prachinburi, 22 Feb. 1978 (fl., fr.), *Ogiso & Phromdej* 229 (holotype TI).— *Croton sublyratus* auct. non Kurz: Airy Shaw, Kew Bull. 26: 250. 1972.

Under the name *Croton sublyratus* Kurz an important medicinal plant is known in Thailand. This low tree of the south-eastern and central regions is the source of active chemical substances which are under intense investigation in Thailand and Japan, in particular plaunotol, an anti-ulcer drug. There are many recent studies on molecular genetics, pharmacology, micropropagation, anatomy etc., such as Mahidol et al. (1994), Shibata et al. (1996), Vongcharoensathit & de Eknamukul (1998).

Unfortunately, a name change for this important plant is necessary. The species belongs to a complex of several similar southeast Asian species. These species are characterised by: stellate-dendritic hairs; the leaves often obovate to sometimes subpanduriform (constricted near their base); the leaves, including the petiole, usually neither completely pubescent nor completely glabrous but with scattered hairs; their basal glands more on the blade surface than on the midrib; and a tendency towards strongly proterogynous flowering and fruiting, the fruits often even developing when the staminate flowers are still in bud. The complex includes species described from the Andaman Islands of India (*C. sublyratus* Kurz), from Myanmar (*C. meeboldianus* Chakrab. & N.P.Balakr., *C. rhodostachyus* Müll.Arg., *C. wallichii* Müll.Arg.,) from Thailand (*C. longissimus* Airy Shaw and *C. stellatopilosus* Ohba), from China (*C. laui* Merr. & Metcalfe, including *C. hainanensis* Merr. & Metcalfe), and perhaps the Vietnamese *C. cubiensis* Gagnep.

Airy Shaw (1972) introduced the name *C. sublyratus* for the Thai plants. Working in Kew, Airy Shaw had ample collections from the Andaman Is. to compare. *Croton sublyratus* agrees with the Thai plants in the distinctly obovate-panduriform leaf shape (usually less distinctly so in *C. wallichii*, a species from south-western and peninsular Thailand). The Thai collections, however, differ in at least two characters from the Andaman plants: the basal leaf glands are sessile and flat (distinctly protruding to nearly stipitate in *C. sublyratus*), and many plants have been collected with peculiarly cone-like, dense, pyramidal inflorescence buds (not found on the Andaman Is.). Also leaves are generally slightly smaller in Thailand. These differences should be sufficient to separate plants from the two countries. *Croton stellatopilosus* was described from south-eastern Thailand and is the correct name for the source plant of plaunotol in the strictest sense.

Besides *Croton wallichii*, which is sufficiently distinct, the other related Thai species is *C. longissimus* Airy Shaw, described in 1969. That species differs mainly in narrower leaves (only 3–4 cm wide, with a leaf index up to 6). It is only known from cultivation in Lamphun and Lampang provinces, there cultivated as a medicinal plant, but is still poorly known. It has been misidentified as *C. joufra* Roxb. by Brun & Schumacher (1987), and records for a medicinal use of *C. joufra* in Thailand are probably referable to *C. longissimus*. It is possible that it is only a narrow-leaved variety of *C. stellatopilosus* in which case *C. longissimus* would have priority as the correct name.

The whole complex, perhaps even deserving sectional status in *Croton*, needs further study. Species limits are weak and 'somewhat elusive', as Airy Shaw (1972: 251) wrote. Recently, Chakrabarty & Balakrishnan (1983) applied a narrow concept when describing *C. meeboldianus*, but a wide concept when citing *C. stellatopilosus* as a synonym of *C. wallichii* (1997). If a wider species concept is preferred, *C. stellatopilosus* should, in particular, be compared with the similar *C. laui*, described from Hainan Island. *Croton sublyratus*, on the other hand, is very similar to *C. wallichii* and will perhaps have to be united with it. Balakrishnan & Chakrabarty (1997) recently reported it from mainland Myanmar, and it most probably does not grow in Thailand.

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