

## NOTES ON *TRIGONOSTEMON* (EUPHORBIACEAE) FOR THE *FLORA OF CHINA*

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**Abstract.** This publication is a precursor for the account of *Trigonostemon* (Euphorbiaceae) for the *Flora of China*, based on specimens at several herbaria in the U.S.A. (Harvard University, Missouri Botanical Garden, and the Smithsonian Institution) and major herbaria in China. The genus *Trigonostemon* (Euphorbiaceae: Crotonoideae, *Trigonostemoneae*) in China is revised. Twelve species and varieties are placed in synonymy, that is, *Trigonostemon petelotii*, *T. kwangsiensis* vars. *kwangsiensis* and *viridulis*, and *T. lii* are combined with *T. bonianus*; *T. harmandii*, *T. leucanthus* var. *hainanensis*, and *T. wui* are combined with *T. chinensis*; *T. gagnepainianus* and *Prosartema gaudichaudii* are combined with *T. howii*; *T. heterophyllus* is combined with *T. flavidus*; and *T. lutescens* is combined with *T. fragilis*. *Trigonostemon fragilis* is reported as new to Myanmar. A key to the species of *Trigonostemon* in China is given.

**Keywords:** Euphorbiaceae, *Trigonostemon*, species, revision, China.

*Trigonostemon* Blume (*Trigonostemoneae*, Crotonoideae, Euphorbiaceae) contains ca. 50–60 species (Radcliffe-Smith, 2001). Ten species of *Trigonostemon* were previously recorded in China (Kiu, 1996), but only eight have been confirmed during the preparation of the treatment for the upcoming *Flora of China*.

The first specimen of *Trigonostemon* (K. K. Tsoong 1875) from China was collected by Professor Tsoong Kuan-kuang in Xingxin Xian, Guangxi, in 1918, and was the basis of the name *Trigonostemon chinensis* Merr. Since then, a number of additional species have been named in China or attributed to China. To prepare the treatment of the genus for the *Flora of China*, one of us (Li Ping-tao) inspected specimens of *Trigonostemon* in the Harvard University Herbaria (A/GH), the Missouri Botanical Garden (MO), and the Smithsonian Institution (US), and in the largest herbaria in China (CANT, GXMI, IBG, IBSC, KUN, PE, SYS), where many specimens of *Trigonostemon* from China, Vietnam, Laos, Myanmar, India, and Malaysia are housed. After examining these specimens, it was readily apparent that many species from China are similar to those from Indochina. A number of

species were reduced to synonymy, and, out of 12 species of *Trigonostemon* in China initially considered, only 8 are treated here. We present nomenclature and synonymy as well as a key for identifying these 8 species.

1. *Trigonostemon bonianus* Gagnep., Bull. Soc. Bot. France 69: 747, 1923. TYPE: VIETNAM. Tonkin, R. P. Bon 718 (Lectotype, designated here: P).

Synonyms: *Trigonostemon petelotii* Merr., Univ. Calif. Publ. Bot. 10: 425. 1940. *Syn. nov.* TYPE: VIETNAM. Tonkin: A. Petelot 795 (Isotype: A).

*Trigonostemon kwangsiensis* Hand.-Mazz., Sinensia 2 (10) : 130. 1932. *Syn. nov.* TYPE: CHINA. Guangxi: Bako Schan, 30 September 1928, R. C. Ching 7729 (Holotype: NY; Isotype: A).

*Trigonostemon lii* Y. T. Chang in Guihaia 3: 175. 1983. *Syn. nov.* TYPE: CHINA. Yunnan: Xishuangbanna, Y. F. Li 4576 (Holotype: KUN).

*Trigonostemon filipes* Y. T. Chang & X. L. Mo, Acta Phytotax. Sin. 27: 149. 1989. TYPE: CHINA. Guangxi: Longgang, Longgang Exped. 12240 (Holotype: IBG).

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*Trigonostemon kwangsiensis* Hand.-Mazz. var. *viridulis* H. S. Kiu, *Guihaia* 12 (3) : 210. 1992; G. Z. Li in *Fl. Guangxi* 2: 235. 2005. *Syn. nov.* TYPE: CHINA. Guangxi: Longzhou, *H. Y. Liang* 66719 (Holotype: IBSC).

**Additional specimens examined:** CHINA. Guangxi: Longzhou, *X. X. Chen* 2782, 2925 (IBSC), *P. C. Tan* 57266 (IBSC), *S. H. Chun*, 13960 (IBSC), *S. Lee* 200566 (IBSC); Shangyu Xian, *H. Y. Liang* 66719 (IBSC). Yunnan: Xichou, *C. P. Chien* 929 (IBSC); Xishuangbanna, *Y. H. Li* 3054 (KUN), *Y. H. Li* 4104 (KUN); Menglun, *S. J. Pei* 59-9500, 59-9791, 59-10368 (KUN). VIETNAM. Tonkin: *R. P. Bon* 1883-1891 (A), *R. P. Bon* 5751 (syn-type of *Trigonostemon bonianus*, P).

After studying the relevant literature and the floral structure of the specimens cited above we have determined that the five names listed above must be relegated to the synonymy of *Trigonostemon bonianus*. Two specimens were cited as types of *Trigonostemon bonianus* by Gagnepain (1923). Following the International Code of Botanical Nomenclature (Greuter et al., 2000), *R. P. Bon* 718 is here designated as lectotype.

2. *Trigonostemon chinensis* Merr., *Philipp. J. Sci.*, C. 21: 498. 1922. TYPE: CHINA. Guangxi: Konxing, *K. K. Tsoong* (Holotype: NY; Isotype: PI).

Synonyms: *Trigonostemon harmandii* Gagnep., *Bull. Soc. Bot. France* 69: 750. 1923. *Syn. nov.* TYPE: VIETNAM. Tonkin: *D. Harmand* 187 (Holotype: P; Isotype: A).

*Trigonostemon fungii* Merr., *Lingnan Sci. J.* 11: 47. 1932. TYPE: CHINA. Hainan: Dan Xian, Hung Mo Shan, *W. T. Tsang & H. Fung* 18170 (Holotype: IBSC; Isotype: A).

*Trigonostemon huangmosu* Y. T. Chong, *Guihaia* 3: 174. 1983. *Syn. nov.* TYPE: CHINA. Yunnan: *Gejiu Luchun Exp.* 1961 (Holotype: KUN).

*Trigonostemon chinensis* Merr. forma *fungii* (Merr.) Y. T. Chang, *Acta Phytotax. Sin.* 27: 149, 1989. TYPE: CHINA. Hainan: Dan Xian, Hung Mo Shan, *W. T. Tsang & H. Fung* 18170 (Holotype: IBSC; Isotype: A).

*Trigonostemon leucanthus* Airy Shaw var. *hainanensis* H. S. Kiu, *Guihaia* 12 (3) : 211, 1992. *Syn. nov.* TYPE: CHINA. Hainan: Ya Xian, *H. Y. Liang* 62132 (Holotype: IBSC; Isotype: A).

*Trigonostemon wui* H. S. Kiu, *J. Trop. Subtrop. Bot.* 3 (4) : 17, fig. 2. 1992. *Syn. nov.* TYPE: CHINA. Guangdong: Fengke, *H. S. Kiu* 451 (Holotype: IBSC).

**Additional specimens examined:** CHINA. Guangdong: Fengke, *Q. Y. Cen* 151 (IBSC), *H. S. Kiu* 385 (IBSC), *G. J. Ding* 8636 (IBSC); Yunfu, *L. G. Shi* 15751 (IBSC); Lechang, *Y. C. Ko* 1242 (CANT). Guangxi: Fangcheng, *H. Y. Liang* 69919 (A, IBSC), *H. Y. Liang* 69250 (IBSC), *H. Y. Liang* 69922 (IBSC), *D. Fang* 76544 (GXMI). Hainan: Qi Zhi Shan, *H. Y. Liang* 61710 (A, IBSC), *H. Y. Liang* 69919 (A); Dongfang, *S. K. Lau* 3530 (SYS, A); Bai Sha, *S. K. Lau* 26304 (A, IBSC), *S. K. Lau* 27151 (A); Ya Xian, *C. Wang* 33086 (A, IBSC), *C. Wang* 36799 (A); *F. C. How* 70621 (A, IBSC), *F. C. How* 70622 (A, IBSC), *H. Y. Liang* 762132 (A); Jian Feng Ling, *Q. Huang* 820294 (IBSC), *Q. Huang* 820319 (IBSC), *K. S. Chow* 78487 (A, IBSC); Dan Xian, Hung Mo Shan, *W. T. Tsang & H. Fung* 17858 (A), 18160 (A), 17606 (A, IBSC), 18111 (A), *J. L. Gressitt* 1089 (A). VIETNAM. Guang Ning Xian, *W. T. Tsang* 29223 (A, IBSC, SYS), *W. T. Tsang* 29270 (A, IBSC, SYS), *W. T. Tsang* 29625 (A).

**Distribution:** China (Guangdong, Guangxi, Hainan), Vietnam.

The specimens and descriptions of the plants from Guangxi, Guangdong, Hainan, and Vietnam are quite similar. Some minor or transitional variation exists, such as stems hairy or glabrescent, leaf texture thinly chartaceous to chartaceous, leaf shape varying from elliptic to oblong or obovate, leaf apex obtuse, acute or acuminate to caudate; nerves from the leaf base obscure or prominent, lateral veins 4–8; petiole 1–11 cm long, hairy or glabrous. Staminate flowers: pedicels filamentous, 2–10 mm long; sepals usually long ovate, unequal; 1.2–2.0 mm long, usually sparsely pubescent outside, petals obovate, 5–7 mm long, yellow; disc ring-like, stamens 3, filaments fused but apex separate; carpellate flowers: pedicels clavate, 8–15 mm long; sepals long ovate, 3 larger, 5–6 mm long, usually sparsely pubescent outside, petals obovate, 7–12 mm long, yellow, ovary glabrous, styles 3, 1.5 mm long, stigma capitate. Capsule subglobose, 1–2 cm in diam., 3-sulcate, glabrous.

3. *Trigonostemon howii* Merr. & Chun, *Sunyatsenia* 2: 262, pl. 53, 1935. TYPE: CHINA. Hainan: Nyai Yuen, *F. C. How* 7094 (Holotype: IBSC; Isotypes: A, NY).

Synonyms: *Trigonostemon gagnepainianus* Airy Shaw, *Kew Bull.* 32 (2) : 415. 1978. Basionym: *Prosartema gaudichaudii* Gagnep.

in Bull. Sci. Bot. France 72: 486. 1925 [et in Lecomte, Fl. Indoch. 5: 306, fig. 34 (6–12) & 35 (1–2). 1925], non *Trigonostemon gaudichaudii* (Baill.) Müll. Arg. (1865). TYPE: VIETNAM. Gu Phon, *L. Fenilles* & *S. Baigner* 1022 (Syntype: P; Isosyntype: A), *L. Fenilles* & *S. Baigner* 10446 (Syntype: P; Isosyntype: A, K); *C. Gaudichaud-Beaupré* 167 (Syntype: P), *M. E. Poilane* 8036 (Syntype: P).

**Additional specimens examined:** CHINA. Hainan: Ya Xian, *C. Wang* 33983 (A, IBSC); same locality, *G. E. Fu* 2801 (IBSC).

The senior author examined an isotype of *T. howii* (*How* 7094, A) and two isosyntypes of *Prosartema gagnepainianus* (*Fenilles* & *Baigner* 1022 & 10446, A) and concluded that they were conspecific. Although *Prosartema gaudichaudii* was published in 1925, J. Müller Argoviensis's combination pre-occupied the epithet in *Trigonostemon* after 1865. Airy Shaw (1978) proposed a new name, *T. gagnepainianus*, but it does not have priority over *T. howii*, as the latter had been proposed for the same plant in 1935.

4. *Trigonostemon flavidus* Gagnep., Bull. Soc. Bot. France 69: 749. 1923. TYPE: LAOS. Lakhone, *Harmand s. n.* (Holotype: herb. Pierre).

*Trigonostemon heterophyllus* Merr. in Lingnan Sci. J. 9: 38. 1930. *Syn. nov.* TYPE: CHINA. Hainan: Ya Xian, 30 May 1928, *W. T. Tsang* 17343 (Holotype: IBSC; Isotype, A, NY).

**Additional specimens examined:** CHINA. Hainan: Ling Shui, *C. Wang* 36215 (A, IBSC), *C. Wang* 36374 (A, IBSC); Bao Ting, *H. D. Chang* 976 (IBSC), *F. C. How* 71767 (A, IBSC) *F. C. How* 73135 (A, IBSC), *Hainan East Team* 967 (IBSC); Ya Xian, *C. Wang*

34122 (A, IBSC); Le Dong, *S. K. Lau* 27074 (A, IBSC), *G. E. Fu* 91 (IBSC); Yu Lin, *H. D. Chang* 4141 (IBSC); San Ya, *Z. X. Li* 2986 (IBSC), 2485 (IBSC); Qing Zhong, *L. Teng* 3636 (IBSC); Wang Ling, *F. W. Xing* 5495 (IBSC); *F. A. McClure* 8298 (A). MYANMAR. Northeast, Nong Khai Province: Phu Wua Wildlife Sanctuary, 14 Oct. 1998, *H. J. Esser* 98-154 (A).

**Distribution:** China (Hainan), Laos, Myanmar.

The specimen from Myanmar (*H. J. Esser* 98-154) was identified as *Trigonostemon flavidus* Gagnep. on the basis of the flowers and by comparing it with the description in the original literature. This is the first report of *T. flavidus* in Myanmar.

5. *Trigonostemon fragilis* (Gagnep.) Airy Shaw in Kew Bull. 32 (2): 415. 1978.

*Poilaniella fragilis* Gagnep., Bull. Soc. Bot. France 72: 467. 1925, et 307, fig. 36. 1925. TYPE: VIETNAM. Jle Tre, Pres Nhatrang, *E. Poilane* 2927 (Holotype: P).

*Trigonostemon lutescens* Y. T. Chang & J. Y. Liang, *Guihaia* 3: 173. 1983. *Syn. nov.* TYPE: CHINA. Guangxi: Ningming, *Longgang Exped.* 12083 (Holotype: IBG).

**Additional specimens examined:** CHINA. Guangxi: Ningming, *C. C. Huang* & *B. S. Huang* 23018 (IBSC); Longzhou, *S. P. Ko* 55253 (A, IBSC), *H. H. Soo* 68558 (A, IBSC). Hainan: Ya Xian, *F. C. How* 70889 (A), *H. Y. Liang* 62949 (A); *C. Wang* 32737 (A); Changjiang, *S. K. Lau* 1698 (A); *C. I. Lei* 1182 (A).

**Distribution:** China (Guangxi, Hainan), Vietnam.

The above specimens at A were identified as *Trigonostemon fragilis* (Gagnep.) Airy Shaw by H. J. Esser. We agree with his determinations.

#### KEY TO THE SPECIES OF *TRIGONOSTEMON* IN CHINA

- 1a. Leaves usually densely pseudowhorled apically on branches; petiole less than 1 cm long; inflorescences racemose . . . . . 2
- 1b. Leaves alternate; petiole 1–11 cm long; inflorescences paniculate . . . . . 4
- 2a. Leaf blade glabrous; sepals equal in size; petals yellow; ovary and fruits glabrous. . . . . 1. *T. xyphophylloides*
- 2b. Leaf blade villose or hirsute; sepals unequal; petals purplish red; ovary and fruits densely hirsute . . . . . 3
- 3a. Bracts leaf-like; 1.0–2.5 cm long; racemes less than 6 cm long . . . . . 2. *T. flavidus*
- 3b. Bracts linear or linear-lanceolate, unlike leaves, 3–6 mm long; racemes 15–25 cm long . . . . . 3. *T. howii*
- 4a. Leaf blade glabrous, apex shortly acuminate to acuminate . . . . . 5
- 4b. Leaf blade pilose or pubescent, apex obtuse to caudate . . . . . 6
- 5a. Leaf blade obovate, margins sparsely serrate; veins pinnate; petals yellow; stamens 5. . . . . 4. *T. thyrsoideus*
- 5b. Leaf blade broadly elliptic, margins entire or obscurely serrulate; basinerved; petals white or yellowish white; stamens 3. . . . . 5. *T. leucanthus*
- 6a. Pedicel filamentous; petals elliptic . . . . . 6. *T. bontanus*
- 6b. Pedicel not filamentous; petals obovate. . . . . 7
- 7a. Sepals unequal in size; leaves adaxially usually densely tuberculate. . . . . 7. *T. chinensis*
- 7b. Sepals equal in size; leaves adaxially not tuberculate . . . . . 8. *T. fragilis*

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