The Status of *Synstemon* (Brassicaceae) and the Discovery of a Second Species

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ABSTRACT. The taxonomic limits of *Synstemon* are established, and its relationship to *Dontostemon* is discussed. *Synstemon lulianlianus*, a new species from Gansu, is described and illustrated. Previously described taxa in *Synstemon* are reduced to synonymy of *S. petrovii*.

The genus *Synstemon* was established by Botschantsev (1959) to include one species and two varieties. It was compared with *Cymatocarpus* O. E. Schulz and *Arabidopsis* Heynhold and was said to differ from these in having ciliate petal claws, connate and pubescent median filaments, and margined seeds. *Synstemon* is unrelated to *Cymatocarpus* or *Arabidopsis*, and it also differs from both by having flattened and strongly crisped instead of the rigid and straight trichomes, strongly differentiated instead of undifferentiated petal claws, and apiculate instead of obtuse anthers. *Cymatocarpus* also has yellow flowers, long setose trichomes, and submoniliform fruits, whereas *Synstemon* has lavender flowers, soft trichomes, and torulose fruits. In our opinion, *Synstemon* is unrelated to these genera.

Botschantsev (1959) distinguished *Synstemon* from *Dontostemon* Andrzejowski ex C. A. Meyer because of the former's ciliate petal claws, veinless septa, and mucilaginous seeds, but a closer examination reveals that the difference in the fruit septum (veined vs. veinless) is unreliable, and most of the 10 species of *Dontostemon* have veinless septa. *Synstemon* differs in having pilose petal claws, entire stigmas, mucilaginous seeds, median stamens united only at the very base, terete replum, median nectaries present and confluent with the laterals, and flattened, strongly crisped trichomes, as well as in lacking the multicellular glands seen in some species of *Dontostemon*. By contrast, *Dontostemon* has glabrous filaments and petal claws, 2-lobed stigmas, nonmucilaginous seeds, median filaments united near to the apex, flattened replum, no median nectaries, straight or slightly twisted terete trichomes, and (in four species) well-developed multicellular glands. The two genera share many characters, and it appears that *Synstemon* is more closely related to *Dontostemon* than to any other Asian genus of Brassicaceae (Cruciferae).

Because of fear that *Synstemon* might be considered a later homonym of *Synostemon* F. Müller, which is a synonym of *Sauropus* Blume of the Euphorbiaceae, Botschantsev (1980) proposed *Synstemonanthus* as a replacement of *Synstemon*. However, the pronunciations of the two are quite different, and we agree with Brummitt (1992) in recognizing *Synstemon* instead of *Synstemonanthus*.

The presence in *Synstemon* of pilose petal claws and filaments is unique among all of the Old World Brassicaceae. This feature clearly supports the maintenance of the genus as independent of *Dontostemon*, as well as those Eurasian genera with connate median filaments. Pubescent petal claws and/or filaments are known among several genera in the New World, including the North American *Stanleya* Nuttall, *Warea* Nuttall, *Rollinsia* Al-Shehbaz, and a species of *Dryopetalon* A. Gray (Al-Shehbaz, 1982, 1985; Payson, 1923; Rollins, 1939, 1993), as well as the South American *Chilocardamum* O. E. Schulz, *Pterygiosperma* O. E. Schulz, *Sarcodraba* Gilg & Muschler, *Sisymbrium subscandens* Spegazzini, and *Trichotolinum* O. E. Schulz (Boelcke & Romanczuk, 1984; Schulz, 1924, 1936).

Synstemon remained monotypic until An (1981) added *S. linearifolius* An (as *linearifolia*) and *S. petrovii* var. *xinglongnicus* An (as *xinglongnica*). These two new taxa, along with Botschantsev's

(1959) *S. petrovii* and *S. petrovii* var. *pilosus*, were recognized by An (1987) and Zhao (1998a). Because *S. linearifolius* has glabrous filaments and petal claws and because its median stamens are connate to the apex, the species is clearly a *Dontostemon*, and we agree with Zhao (1998b) in reducing *S. linearifolia* to synonymy of *D. integrifolius* (L.) C. A. Meyer. Finally, Zhao (1998c) described *S. deserticola* Y. Z. Zhao from Nei Mongol, but we believe that this is only a minor variant of *S. petrovii* and, as it stands now, *Synstemon* remained monotypic until the present publication.

The discovery of a second species of *Synstemon* was made during a visit by Al-Shehbaz to the Komarov Botanical Institute in 1998. It prompted a closer study of the genus for the forthcoming account of the Brassicaceae for the *Flora of China*.

Synstemon Botschantsev, Bot. Zhurn. (Moscow & Leningrad) 44: 1487. 1959. *Synstemonanthus* Botschantsev, Novosti Sist. Vyssh. Rast. 17: 142. 1980. TYPE: *Synstemon petrovii* Botschantsev.

Herbs annual or biennial. Trichomes flattened, strongly crisped, simple or minutely stalked and forked. Stems erect to ascending, often branched basally. Basal leaves petiolate, rosulate or not, simple, pinnatipartite to pinnatisect, often withered by flowering. Cauline leaves petiolate or sessile, not auriculate, entire to pinnatisect. Racemes ebracteate, elongated in fruit. Fruiting pedicels ascending to divaricate. Sepals oblong, ascending, base of inner pair not saccate. Petals lavender, much longer than sepals; blade obovate, apex rounded; claw subequaling sepals, sparsely to densely pubescent. Stamens 6, tetradynamous; filaments glabrous or sparsely to densely pubescent on proximal half, slightly dilated at base, median pairs united only basally; anthers oblong, apiculate at apex. Nectar glands confluent and subtending bases of all stamens; median nectaries present. Ovules 10–16 per ovary. Fruit dehiscent siliques, linear, latiseptate, sessile or short stipitate; valves papery, with a distinct midvein, sparsely pubescent basally when young, torulose; replum rounded; septum complete, membranous, translucent, veinless; style to 1 mm; stigma capitate, entire. Seeds uniseriate, winged distally, oblong, somewhat plump; seed coat minutely reticulate, mucilaginous when wetted; cotyledons incumbent.

Two species: endemic to China (Gansu Province and Nei Mongol Autonomous Region).

KEY TO THE SPECIES OF *SYNSTEMON*

1a. Annuals; stem leaves linear, sessile, entire, 0.5–1.7 mm wide; fruit straight; filaments sparsely to densely pilose . . . . . 1. *S. petrovii*
1b. Biennials; stem leaves narrowly lanceolate, petiolate, pinnatifid to pinnatisect, 5–10 mm wide; fruit arcuate; filaments glabrous 2. *S. lulianlianus*

1. Synstemon petrovii Botschantsev, Bot. Zhurn. (Moscow & Leningrad) 44: 1487. 1959. *Synstemonanthus petrovii* (Botschantsev) Botschantsev, Novosti Sist. Vyssh. Rast. 17: 142. 1980. TYPE: China. Gansu: Injtshuanj, Hoangho, near Injtshuanj, 18 June 1958, *M. Petrov s.n.* (holotype, LE).

Synstemon petrovii var. *pilosus* Botschantsev, Bot. Zhurn. (Moscow & Leningrad) 44: 1488. 1959. *Synstemonanthus petrovii* (Botschantsev) Botschantsev var. *pilosus* (Botschantsev) Botschantsev, Novosti Sist. Vyssh. Rast. 17: 142. 1980. Syn. nov. TYPE: China. Gansu: Tshizhanji, Beida Shan, near Junt Shan, 28 June 1958, *M. Petrov s.n.* (holotype, LE).

Synstemon petrovii var. *xinglongnicus* An, Bull. Bot. Res., Harbin 1(1 & 2): 101. 1981. Syn. nov. TYPE: China. Gansu: Xinglong Shan, *Anonymous s.n.* (holotype, NWTC).

Synstemon deserticola Y. Z. Zhao, Acta Phytotax. Sin. 36: 373. 1998. Syn. nov. TYPE: China. Nei Mongol: Alxa Right Banner, Ailibugaisumu, Longshoushan, 8 June 1983, *X. T. Lei et al. 83002* (holotype, HIMU).

Herbs annual, 15–30 cm tall. Stems often branched basally and above, sparsely pilose or glabrescent. Basal leaves short petiolate, not rosulate, often withered by flowering, pinnatipartite, 1–2 cm × 3–5 mm, apex acute. Stem leaves linear, sessile, 0.5–4 cm × 0.5–1.7 mm, somewhat fleshy, margin entire, apex acute, sparsely pilose. Fruiting pedicels divaricate to ascending, slender, glabrous, 4–10 mm long. Sepals oblong, 2–2.5 × 0.9–1.2 mm, glabrous to densely pilose. Petals lilac, obovate, 4–5.5 × 1.7–2.8 mm, apex rounded; claw 1–2.5 mm long, sparsely to densely pilose. Filaments of median stamens 2–3.5 mm long, united at base, sparsely to densely pilose on basal half; lateral stamens 1–2 mm long, pilose basally; anthers oblong, 0.6–0.8 mm long. Ovules 10 to 12 per locule. Fruit linear, compressed, (0.5–)1.3–3 cm × 0.8–1.5 mm, straight; valves sparsely pubescent basally when young, soon glabrescent, with a distinct midvein; gynophore ca. 0.5 mm long; style 0.5–1 mm long. Seeds oblong, 1.2–1.7 × 0.7–0.9 mm. Flowering and fruiting in June.

Synstemon petrovii grows on slopes and rocky and sandy flats at 1500–2400 m. It is restricted to Gansu and neighboring Nei Mongol and is known

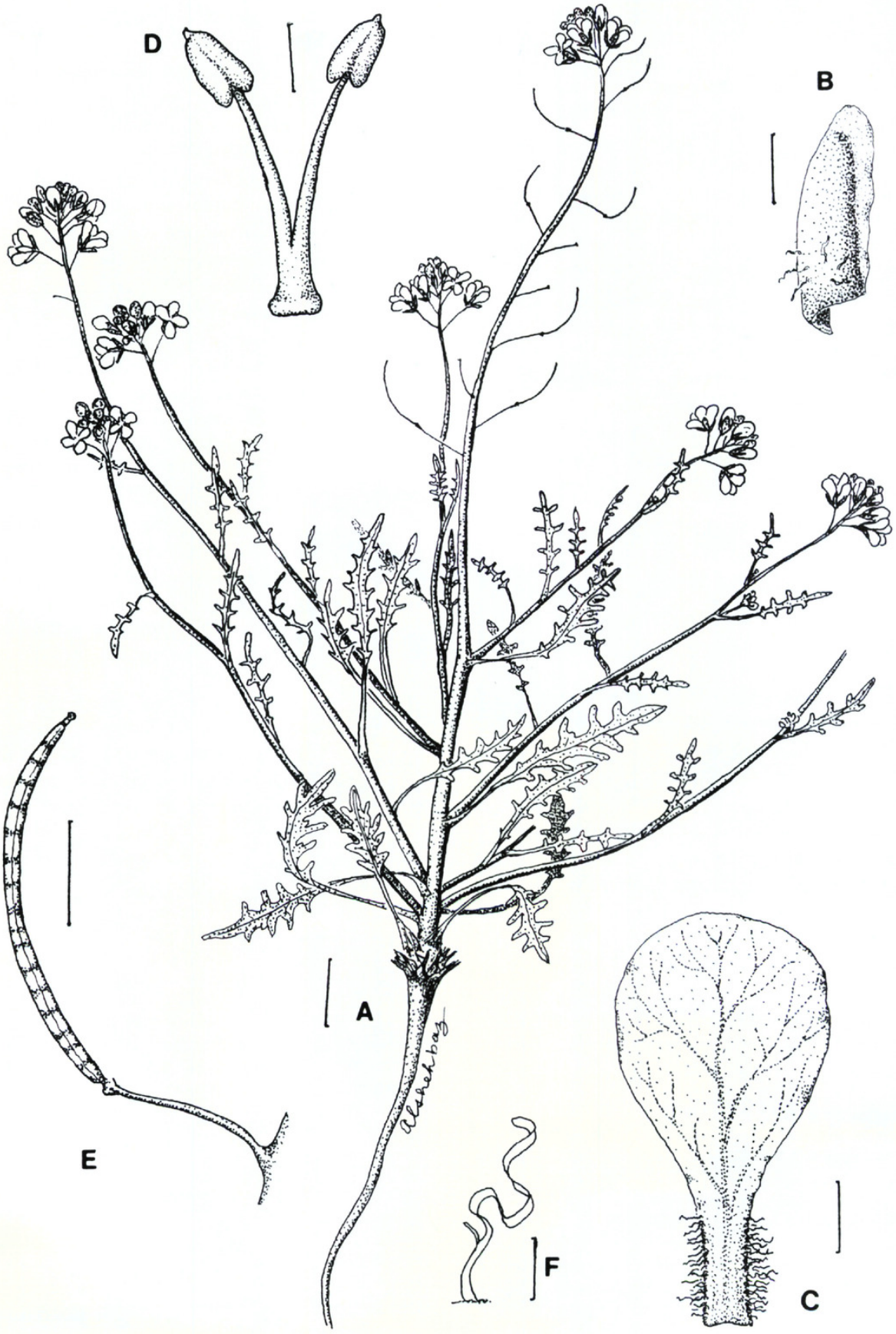

Figure 1. *Synstemon lulianlianus* Al-Shehbaz, T. Y. Cheo & G. Yang. —A. Plant. —B. Sepal. —C. Petal. —D. Median stamens. —E. Fruit and fruiting pedicel. —F. Trichome. Scale: A = 1 cm; B–D = 1 mm; E = 5 mm; F = 0.1 mm. Drawn by Al-Shehbaz from the holotype.

thus far only from the types and the additional collection cited below.

Although we have not examined the type of *Synstemon deserticola*, the detailed description and illustration leave no doubt that it is a synonym of *S. petrovii*. The trichome density on leaves, stems, and sepals of *S. petrovii* exhibits continuous variation and, therefore, variety *pilosus* (with densely pubescent sepals) and variety *xinglongnicus* (with glabrous leaves and stems) do not merit recognition. The type of *S. petrovii* has glabrous sepals, but the additional collection cited above has sparsely pubescent sepals and leaves. *Synstemon petrovii* also varies in the density of trichomes on the filaments. A closer examination of the type shows, contrary to the original illustration, that the median filaments are very sparsely pilose instead of being glabrous at the base.

Additional collection. CHINA. **Gansu:** 60 km N of Unchang, E of Begashan, 29 June 1958, *Petrov s.n.* (LE).

The illustration of *Synstemon petrovii* in Ying et al. (1993) belongs to some other species, and we have not seen the specimen on which that illustration was based. Neither the petals nor the stamens were illustrated, and if the voucher of that illustration is indeed a *Synstemon*, then it must be *S. lulianlianus* because of its pinnatisect cauline leaves and curved fruits. It is possible, however, that a species of *Dontostemon* was instead illustrated because *S. lulianlianus* is a biennial with petiolar remains of the preceding year, and the illustration in Ying et al. (1993) clearly represents an annual plant.

2. Synstemon lulianlianus Al-Shehbaz, T. Y. Cheo & G. Yang, sp. nov. TYPE: China. N Gansu: Tam-zhi, near railroad station, 22 Apr. 1909, *F. Dushendenko 156* (holotype, LE). Figure 1.

Herba biennis, 7–15 cm alta, pilis crispatis; folia basalia et caulina inferiora petiolata, pinnatisecta vel pinnatifida, 1–2.5 cm × 4–10 mm; folia caulina anguste lanceolata, pinnatisecta, 4–25 × 5–10 mm, petiolis 1–4 mm longis, lobis lateralibus oblongis, 1–5 × 0.5–1 mm; pedicelli fructiferi divaricati, glabri, 6–10 mm longi; petala lilacina, obovata, 4.5–6 × 2–3 mm; unguibus dense pilosis, 2–2.5 mm longis; filamenta mediana ad basim connata et glabra, 2.5–3 mm longa; fructus lineari, compressi, arcuati, 2–2.5 cm × ca. 1.2 mm.

Herbs biennial, 7–15 cm tall, sparsely covered with crisped trichomes to 0.5 mm long. Stems branched basally, unbranched above, sparsely pilose or glabrescent. Basal and lowermost stem leaves petiolate; petiole 0.5–1.5 cm long; leaf blade lanceolate, pinnatisect to pinnatifid, 1–2.5 × 0.4–1 cm, apex acute. Stem leaves with petioles 1–4 mm long, blades narrowly lanceolate, 0.4–2.5 × 0.5–1 cm, glabrescent to pilose, pinnatisect, apex acute; lateral lobes oblong, 1–5 × 0.5–1 mm. Fruiting pedicels divaricate, slender, glabrous, 6–10 mm long. Sepals oblong, 2.5–3 × 1.2–1.5 mm, sparsely pilose to glabrescent. Petals lilac, obovate, 4.5–6 × 2–3 mm, apex rounded; claw 2–2.5 mm, pilose. Filaments of median stamens 2.5–3 mm long, united at base, glabrous; lateral stamens 1.5–2.5 mm long, glabrous; anthers oblong, 1–1.1 mm long. Ovules 14 to 16 per locule. Fruit linear, compressed, 2–2.5 cm × ca. 1.2 mm, arcuate; valves sparsely pubescent basally when young, soon glabrescent, with a distinct midvein; gynophore obsolete; style ca. 0.5 mm long. Seeds oblong, ca. 1.3 × 0.7 mm. Flowering and fruiting in April.

Synstemon lulianlianus, which is named in honor of our colleague Lu Lianli (NAS), an expert on Chinese Brassicaceae, is known thus far only from the type collection. The species is readily distinguished from *S. petrovii* by its pinnatisect lanceolate leaves instead of narrowly linear entire leaves. Other differences are given in the key above.

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