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# Four new species of *Begonia* (Begoniaceae) from Vietnam: *B. abbreviata*, *B. calciphila*, *B. sphenantheroides* and *B. tamdaoensis*

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## Abstract

Four new species of *Begonia*, namely *B. abbreviata* C.-I Peng, *B. calciphila* C.-I Peng, *B. sphenantheroides* C.-I Peng and *B. tamdaoensis* C.-I Peng are documented from northern Vietnam. Detailed descriptions, line drawings, color plates, chromosome data, foliar SEM observations and comparisons with phenetically similar species are provided to aid in identification.

**Key words:** *Begonia*, new species, sect. *Coelocentrum*, sect. *Petermannia*, sect. *Platycentrum*

## Introduction

In the checklist of Southeast Asian *Begonia* Linnaeus (1753: 1056), Hughes (2008) documented 36 species from Vietnam. More recently, 18 new species were reported, bringing the total number to 54 (1 sp.: Nguyen *et al.* 2010; 10 spp.: Averyanov & Nguyen 2012; 1 sp.: Peng *et al.* 2014; 6 spp.: Peng *et al.* 2015). In continuation of our research on Asian *Begonia*, we report four additional new species, i.e. *B. abbreviata*, *B. calciphila*, *B. sphenantheroides* and *B. tamdaoensis* from northern Vietnam which belong to different sections, including sect. *Coelocentrum* Irmscher (1939: 553), *Petermannia* (Klotzsch 1854: 124) de Candolle (1859: 128) and *Platycentrum* (Klotzsch 1854: 243) de Candolle (1859: 134).

## Material and methods

### Chromosome preparations

Somatic chromosomes of the four new species: *Begonia abbreviata* (*Peng 22355*), *B. calciphila* (*Peng et al. 20226*), *B. sphenantheroides* (*Peng et al. 20216*) and *B. tamdaoensis (Peng et al. 16634, 16638)* were examined using root tips. The methods of pretreatment, fixation and staining for chromosome observations followed Peng *et al.* (2014b). Classification of the chromosome complements based on centromere position at mitotic metaphase follows Levan *et al.* (1964). Voucher specimens of all species have been deposited in Herbarium, Biodiversity Research Center, Academia Sinica, Taipei (HAST).

### Cryo-scanning electron microscopy

Fresh leaves of *B. abbreviata*, *B. calciphila*, *B. sphenantheroides* and *B. tamdaoensis* were dissected and attached to a stub. The samples were frozen with liquid nitrogen slush, then transferred to a sample preparation chamber at −160°C and etched for 15 min at −85°C. After etching, the temperature reached −130°C for sample fracturing and coating. After coating, the samples were transferred to the SEM chamber and observed at −190°C with a cryo-scanning electron microscope (FEI Quanta 200 SEM/Quorum Cryo System PP2000TR FEI).

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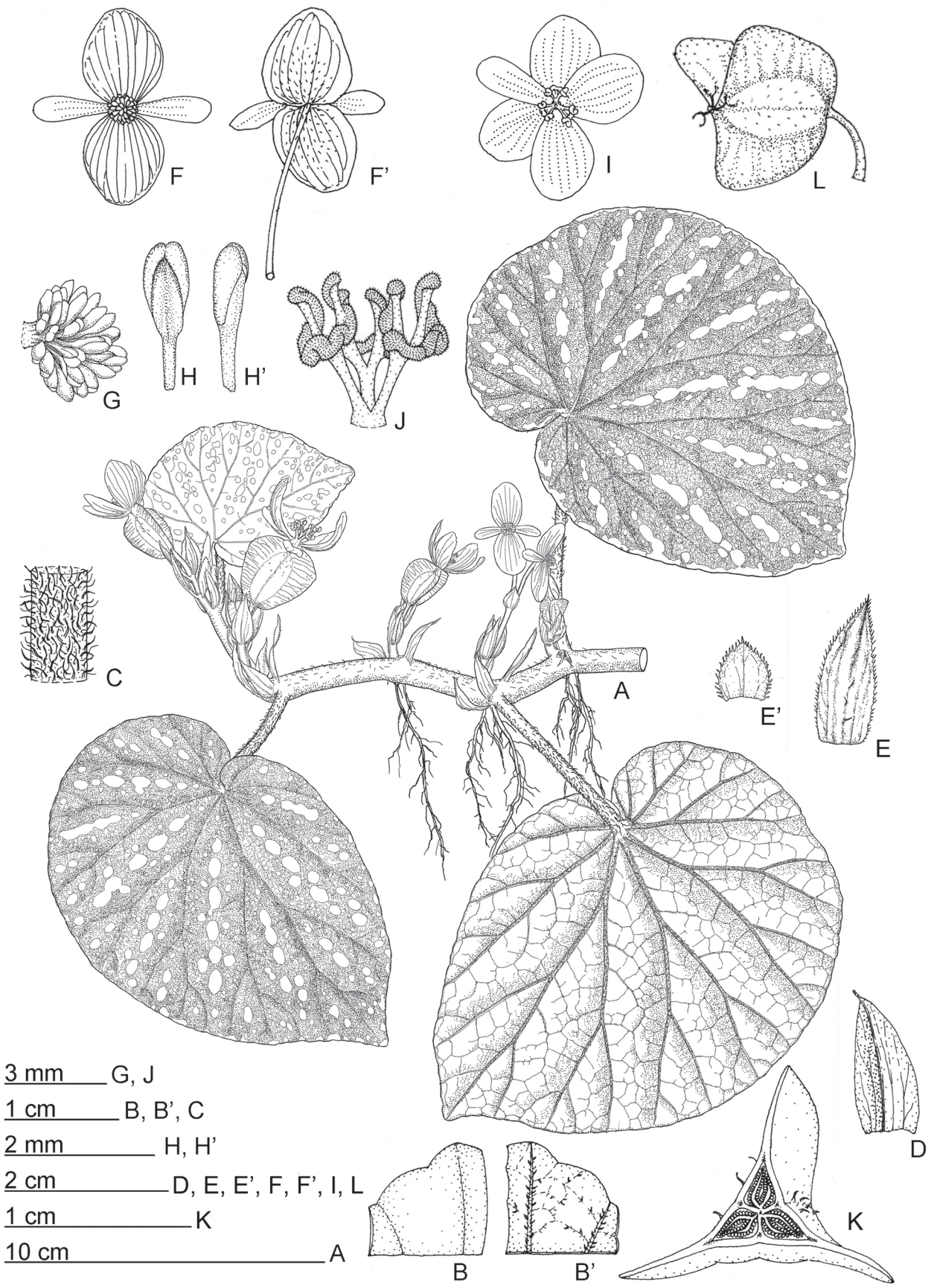


**FIGURE 1.** *Begonia abbreviata* C.-I Peng. A, Habit; B, Leaf adaxial surface; B', Leaf abaxial surface; C, Petiole; D, Stipule; E, E', Bracts; F, Staminate flower, face view; F', Staminate flower, back view; G, Androecium; H, H', Stamen; I, Carpellate flower, face view; J, Style and stigma; K, Cross section of ovary; L, Capsule. All from *C.-I Peng 22355* (HAST). Line drawing by Ya-Wen Hsueh and Ming-Chao Yu.

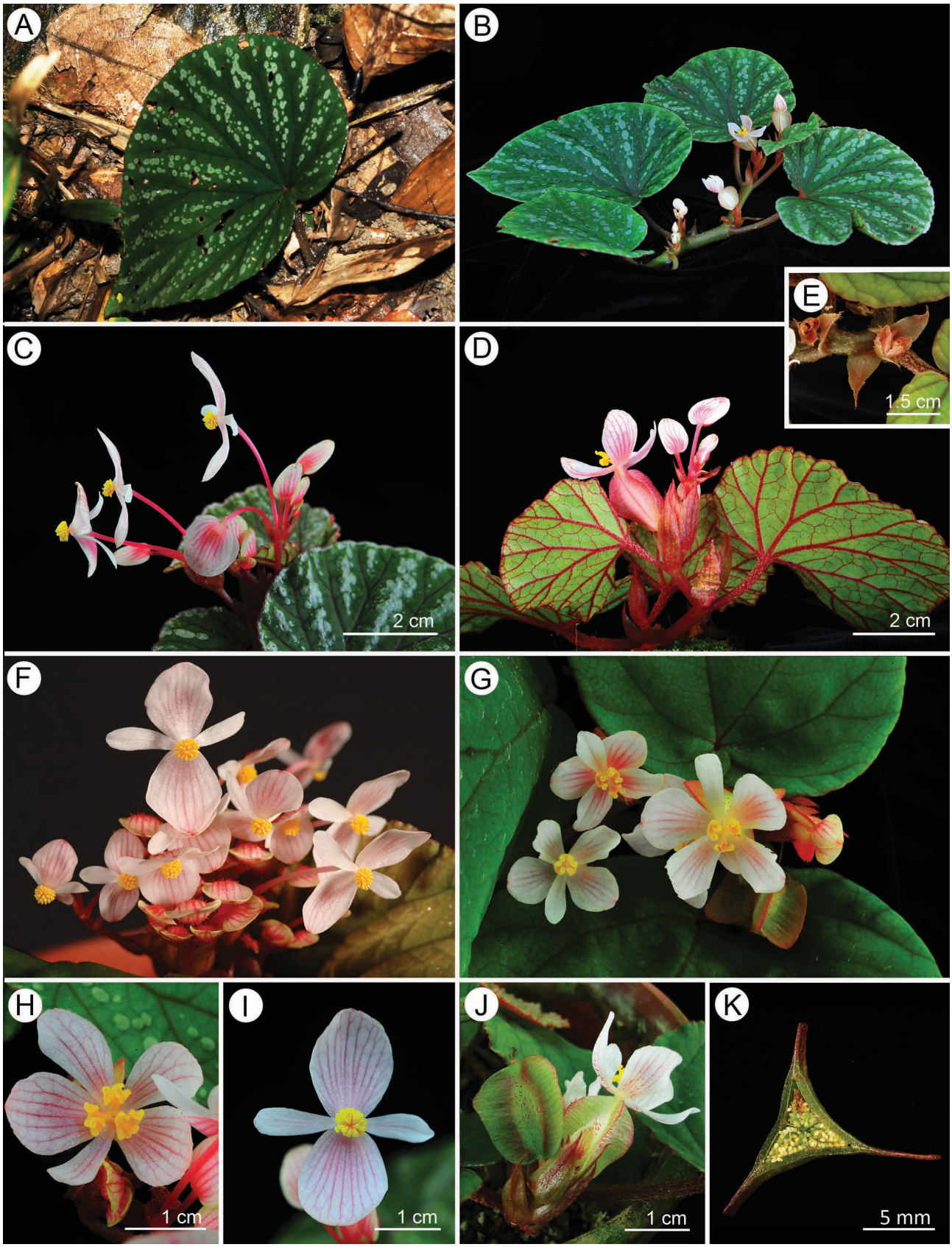


**FIGURE 2.** *Begonia abbreviata* C.-I Peng. A, Habit and habitat; B, Cultivated plant at anthesis; C, Male inflorescence; D, Bisexual inflorescence, also showing leaf abaxial surface; E, Stipules; F, Male inflorescence with numerous staminate flowers; G, Female inflorescence; H, Carpellate flower, face view; I, Staminate flower, face view; J, Carpellate flower (side view), young fruit and bracts; K, Cross section of ovary. [A–D, H–I, K from *C.-I Peng 22355* (HAST); E–G, J from *NTH 5917*(HN)].

## Taxonomy

**1. *Begonia abbreviata*** C.-I Peng, *sp. nov.* (sect. *Petermannia*) (Figs 1, 2)

**Type:**—VIETNAM. Quang Tri Province, Dakrong District, Trieu Nguyen Commune. Sterile plants collected by Pi-Fong Lu on 4 Nov 2009; type specimen made from the collection cultivated in the experimental greenhouse, Academia Sinica, 3 July 2010, *Peng 22355* (holotype: HAST 139792; isotypes: E, HN) 短序秋海棠

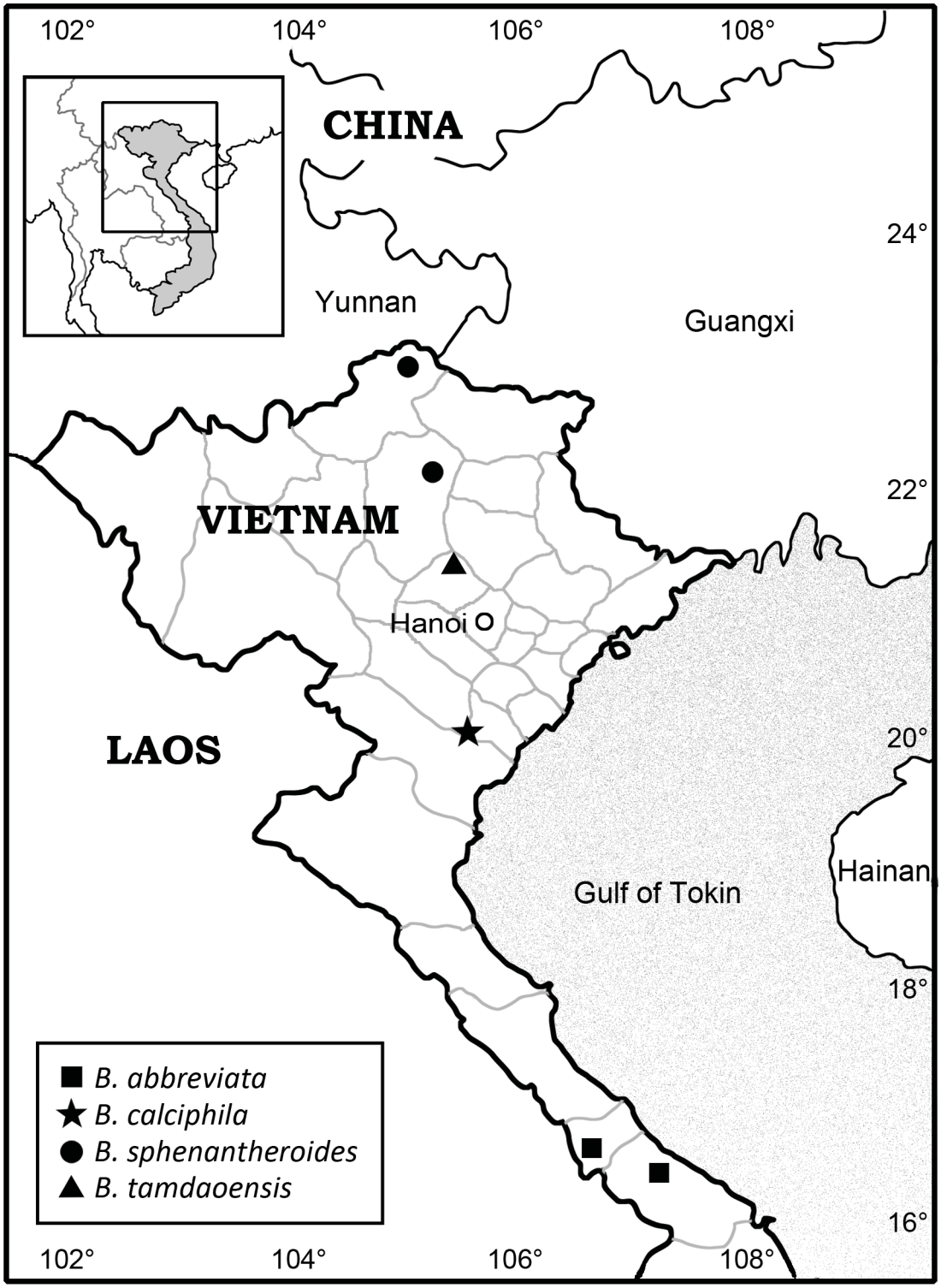


**FIGURE 3.** Distribution map of *Begonia abbreviata* (■), *B. calciphila* (★), *B. sphenantheroides* (●) and *B. tamdaoensis* (▲) in Vietnam.

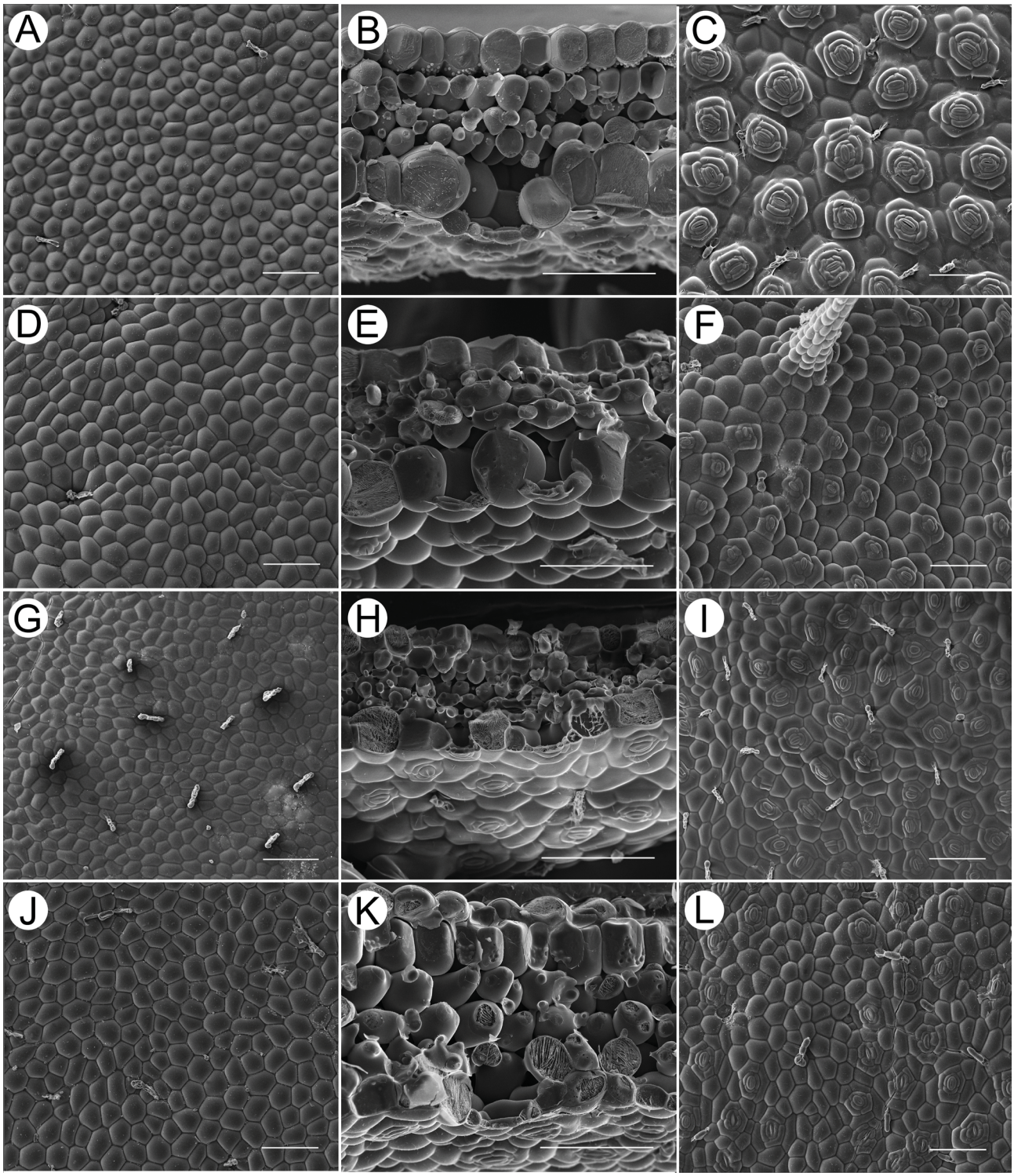


**FIGURE 4.** SEM microphotographs of *Begonia* leaves. A–C, *B. abbreviata*; D–F, *B. calciphila*; G–I, *B. sphenantheroides*; J–L, *B. tamdaoensis*; A, D, G, J, Leaf adaxial surfaces; B, E, H, K, Leaf cross-sections; C, F, I, L, Leaf abaxial surfaces. Scale bars = 200 μm.

Herbs perennial, monoecious. *Rhizomes* green or reddish, terete, 6–8 mm across, to 10 cm or longer, creeping, appressed reddish pubescent, internodes1–4 cm long. *Stipules* triangular, 1.3–1.8 cm long, ca. 7 mm wide, puberulent, apex acuminate and cuspidate, cusp 3 mm long, margin entire. *Leaves* alternate; petiole 2–5 cm long, 3–4 mm across, appressed pubescent; leaf blade ovate to broadly ovate, apex acute to mucronulate, base obliquely cordate, margin entire, 6–17 cm long, 5–12 cm wide; adaxially green or with many silver white patches in intercostal regions; patches elliptic, to 8 mm long, 5 mm wide, minutely puberulent; abaxially reddish tomentulose on red veins and veinlets; primary veins palmate, dichotomous, veinlets reticulate. *Inflorescence* unisexual or bisexual, in cymosely branching panicle, protogynous, axillary and terminal on the rhizome, erect, reddish, subglabrous, peduncles 0.5–1.5 cm long;

female inflorescence 1–3-flowered, male inflorescence single or branched, flowers 5–30. Flowers scented. *Bracts* reddish, persistent, narrowly ovate at base of inflorescence, ca. 13–18 mm long,6 mm wide, apex acute, margin ciliate; widely ovate at summit of inflorescence (with staminate flowers), 6–8 mm long, ca. 6 mm wide, margin ciliate. *Staminate flower*: pedicel 2.5–3 cm long, tepals 4, outer 2 white or pinkish, with apparent red veins, orbicular to ovate, 1.2–1.5 cm long, 1–1.2 cm wide, margin entire, abaxially sparsely reddish-scabrescent or subglabrous; inner 2 white or pinkish, oblanceolate, apex round, base cuneate, 0.9–1.2 cm long, ca. 3 mm wide, glabrous; androecium actinomorphic, stamens 40–52, yellow, filaments free, ca. 0.7 mm long, anthers ca. 1 mm long. *Carpellate flower*: pedicel 0.5–1 cm long, tepals 5, white or pinkish, with apparent red veins, suborbicular to narrowly oblanceolate, outer 3 suborbicular to broadly obovate, ca. 1 cm long, 0.7–1 cm wide, abaxially sparsely reddish-scabrescent; inner 2 unequal, obovate to narrowly so, ca. 1 cm long, 3–6 mm wide, glabrous; ovary trigonous-ellipsoid, sparsely reddish hirsute, 3-locular, 3-winged, wings subequal, ca.5 mm tall, placentation axile; styles 3, ca. 5 mm long, each forked at middle, stigmatic band spiralled. *Capsule* trigonous-ellipsoid, 0.9–1.6 cm long, 5–8 mm across, wings trapeziform with rounded tips and entire margin, 5–7 mm tall.

**Ecology and distribution:—**Endemic to northern Vietnam, Quang Tri Province (Fig. 3).

**Etymology:—**The specific epithet refers to the short peduncle in the new species.

**Additional specimen examined:—**VIETNAM. Thua Thien Hue Province, elev. 500–600 m. Under broad-leaved evergreen forest, on soil, wet place, very common, 7 June 2004, *Nguyen Tien Hiep 5917* (HN).

**Leaf anatomy and vestiture:—**Adaxial surface with sparse glandular trichomes (Fig. 4A); cross section ca.320 µm thick, epidermis single-layered on both surfaces, hypodermis absent (Fig. 4B); abaxial surface with glandular trichomes, stomata complex single, helicocytic, slightly elevated, subsidiary cells (8–)9(–11) (Fig. 4C).

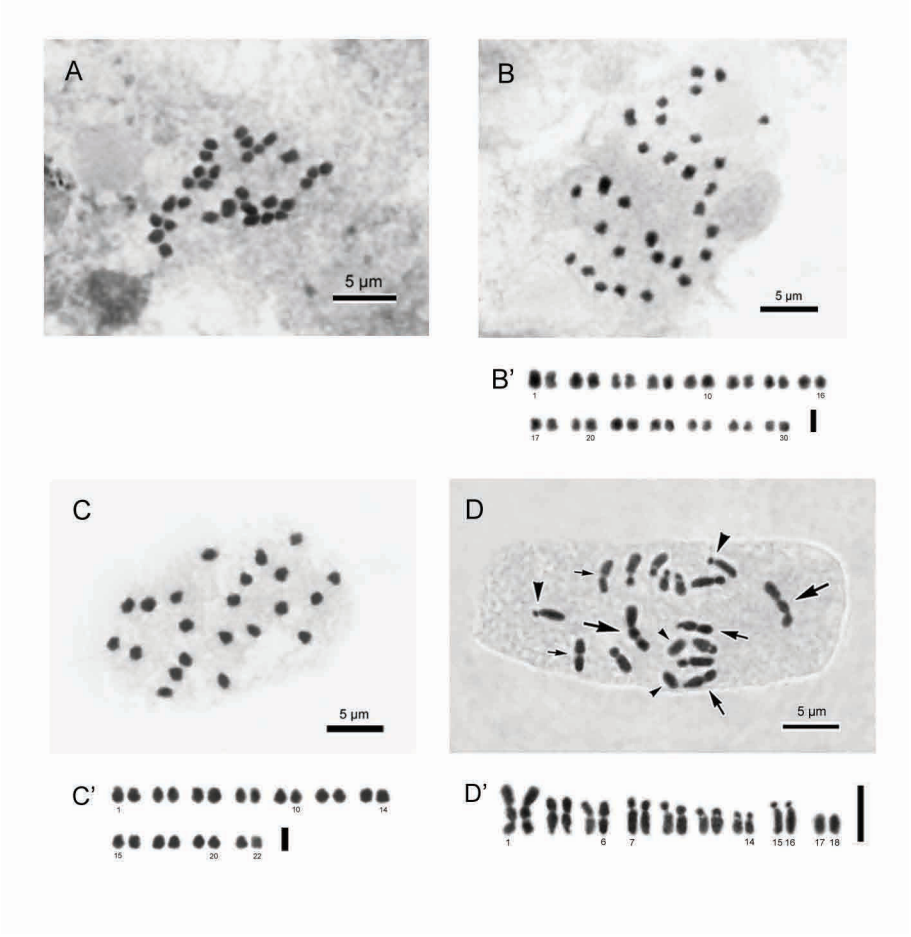


**FIGURE 5.** Somatic chromosomes at metaphase of *Begonia*. A. *B. abbreviata* (2*n* = 30: *NTH 5917*); B. *B. calciphila* (2*n* = 30: *Peng et al. 20226*); C. *B. sphenantheroides* 2*n* = 22: *Peng et al. 20216*); D. *B. tamdaoensis* (2*n* = 18: *Peng et al. 16638*); B', C', D', somatic chromosomes serially arranged by chromosome length and centromere position. Scale bars: B', C'= 2 µm; D' = 5 µm. Large arrows indicate a pair of the largest metacentric chromosomes with secondary constrictions (SC) at interstitial regions of the long arms; medium arrows indicate metacentric chromosomes with SC at distal regions of the long arms. Small arrows, large arrowheads and small arrowheads indicate metacentric chromosomes, subtelocentric chromosomes and telocentric chromosomes, respectively.

**Chromosome cytology:—**Somatic chromosomes at metaphase of *Begonia abbreviata* were determined to be 2*n* = 30 (Fig. 5A). The thirty chromosomes gradually varied from ca. 1.0 to 1.6 µm long. Several longer chromosomes have centromeres at median or submedian positions. Satellites were not observed.

Asian *Begonia* section *Petermannia* comprises ca. 250 species (Doorenbos *et al.* 1998; Hughes 2008). Chromosome numbers of only six of them (ca. 2.4 %) were previously reported: 2*n* = 30 (3 spp.) and 2*n* = 44 (3 spp.) (Legro and Doorenbos 1969, 1971, 1973). We have examined chromosomes of 14 species in sect. *Petermannia* (unpublished data), twelve of which had 2*n* = 30, one had 2*n* = 60 (*B. holttumii* Irmscher (1929: 113)), probably a tetraploid based on *n* =15, and one with 2*n* =44 (*B. bipinnatifida* J. J. Smith (1906: 47)).

**Notes:—***Begonia abbreviata* appears to be allied to *B. eberhardtii* Gagnepain (1919: 198), which was known only from a single collection made about a century ago from Vietnam. Both species are members of sect. *Petermannia* with elongate rhizomes and lacking upright stems. However, they differ markedly in leaf shape. In *B. abbreviata*, leaves are broadly ovate with entire margin and an acute apex. By contrast, leaves of *B. eberhardtii* are ovate, with irregularly and coarsely dentate margin and an acuminate apex.

**2. *Begonia calciphila*** C.-I Peng, *sp. nov.* (sect. *Coelocentrum*) (Figs 6, 7)

**Type:**—VIETNAM. Ninh Binh Province, Nho Quan District, Cuc Phuong National Park, near Khu Thung Tam Park Center (previously Bong Village), 20°21'01"N, 105°35'38"E, elev. ca. 400 m. On surface of steep limestone rocky slope in broadleaf forest, semishaded, occasional. Sterile plants collected on 18 Nov 2004; type specimen (with flowers) pressed from plants cultivated in the experimental greenhouse, 16 Feb 2011. *Ching-I Peng, Wai-Chao Leong, Shin-Ming Ku, Nguyen Tien Hiep & Mai Van Sinh 20226* (holotype: HAST 139793; isotypes: A, CAS, E, K, KEP, HN, MO, P) 喜鈣秋海棠

*Begonia semicava* Irmsch., *in sched.*

Herbs perennial, monoecious, lithophytic. *Rhizomes* creeping, to 30 cm or longer, internodes 1.5–4.5 cm long, 6–8 mm across, reddish or whitish hirsute, hairs 3–3.5 mm long, glabrescent. *Stipules* ovate, 7–12 mm long, 4–7 mm wide, apex caudate, margin entire, abaxially hirsute, hairs 1.5–3.5 mm long. *Leaves* alternate; petiole brownish, 2–7 cm long, villous, hairs 3.5–4 mm long, brownish or reddish; leaf blade orbicular-ovate to ovate, apex acute, base obliquely cordate, 7–10.5 cm long, 5.5–8.5 cm wide, margin undulate, densely ciliate; primary veins 6–8, palmate, veinlets reticulate; adaxially sparsely or densely scabrous, trichomes ca. 1.5 mm long; abaxial surface reddish-hirsute on veins, trichomes multicellular, ca. 1 mm long. *Inflorescence* axillary, with 2–5 flowers in dichasial cymes, peduncle tinged reddish, ca. 8 cm long, glabrous; pedicel 8–9 mm long, glabrous. *Bracts* ovate, margin sparingly reddish ciliate, 3.5–4 mm long, 2.5–3 mm wide. *Staminate flower*: tepals 4, outer 2 orbicular-ovate to ovate, margin entire, white or tinged pinkish, 9–15 mm long, 9–13 mm wide, abaxially sparsely reddish-hirtellous; inner 2 oblanceolate, white, 11–13 mm long, 3.5–4 mm wide; androecium zygomorphic, stamens 20–25, yellow, filaments 0.8–1 mm long, anthers ca. 1.5–1.7 mm long. *Carpellate flower*: tepals 3, glabrous, outer 2 orbicular or suborbicular, tinged pinkish, 12–14 mm long, 12–13 mm wide, margin entire; inner 1 oblanceolate, 8–10 mm long, 3–5 mm wide, white; ovary trigonous-ellipsoid, pinkish, 7–8 mm long, 4–5 mm across, glabrous, 3-winged, abaxial wing crescent-shaped, 3–5 mm tall, lateral wings 2–3 mm tall; styles 3, ca. 4 mm long, fused to 1/3 at base, bifurcating with yellow stigma forming a continuous U-shaped papillose band. *Capsule* trigonous-ellipsoid, 7–8 mm long, 4–5 mm across, abaxial wing crescent-shaped to elliptic, 8–9 mm tall, lateral wings crescent shaped, 3–4 mm tall. *Seeds* many, ellipsoid, truncate at both ends, brownish, 0.4–0.5 mm long, 0.2–0.25 mm thick.

**Ecology and distribution:—**Endemic to limestone karst areas in Cuc Phuong National Park, Ninh Binh Province, Vietnam (Fig. 3), elev. 320–400 m. It grows on steep rocky slope surface or rock crevices in semishaded or shady broad-leaved forest.

**Etymology:—**The epithet *'calciphila'* refers to the new species' definite preference to limestone substrate. Although the name '*Begonia semicava* Irmsch.' has appeared on some specimens in Vietnamese herbaria (CPNP, HNU) and checklists (Frontier Vietnam 1994, 2002; Ho 1991), it was based on unpublished annotations by the late Dr. Edgar Imscher. This unpublished name has been excluded from the checklist of Southeast Asian *Begonia* (Hughes 2008).

**Additional specimen examined:—**VIETNAM. Ninh Binh Province, Cuc Phuong National Park, collected on limestone mountain, Oct 1964, *Ngoc Bich s. n.* (HNU); Bong, Cuc Phuong National Park. 1 December 1969, *Nguyen Huu Hien B442* (CPNP); Ninh Binh Province, Nho Quan District, Cuc Phuong National Park, CP117. Hill southwest of helipad, primary forest on limestone slope, growing on rock crevice under dark forest floor, common, elev. 320–405

m, 20°21'00"N, 105°36'00"E, 18 November, 1999. *D.D. Soejarto, N.T. Hiep, N.M. Cuong, N.Q. Binh, N.X. Tam and M.V. Xinh 11012* (CPNP); Ninh Binh Province, Cuc Phuong National Park, CP213. Dan village, limestone mountain near ranger station, in primary forest, elev. 350 m, 20°18'97"N, 105°37'75"E, 14 August 2000, *N.M. Cuong, D.T. Kien and M.V. Sinh 961* (CPNP); Ninh Binh Province, Cuc Phuong National Park, CP2000. Near Bong, crowded in the herbaceous storey under evergreen broad-leaved forest, creeping herb 20 m long, 20°21'05"N, 105°35'83"E, 13 November, 2000, *N.T. Hiep 4231* (CPNP).

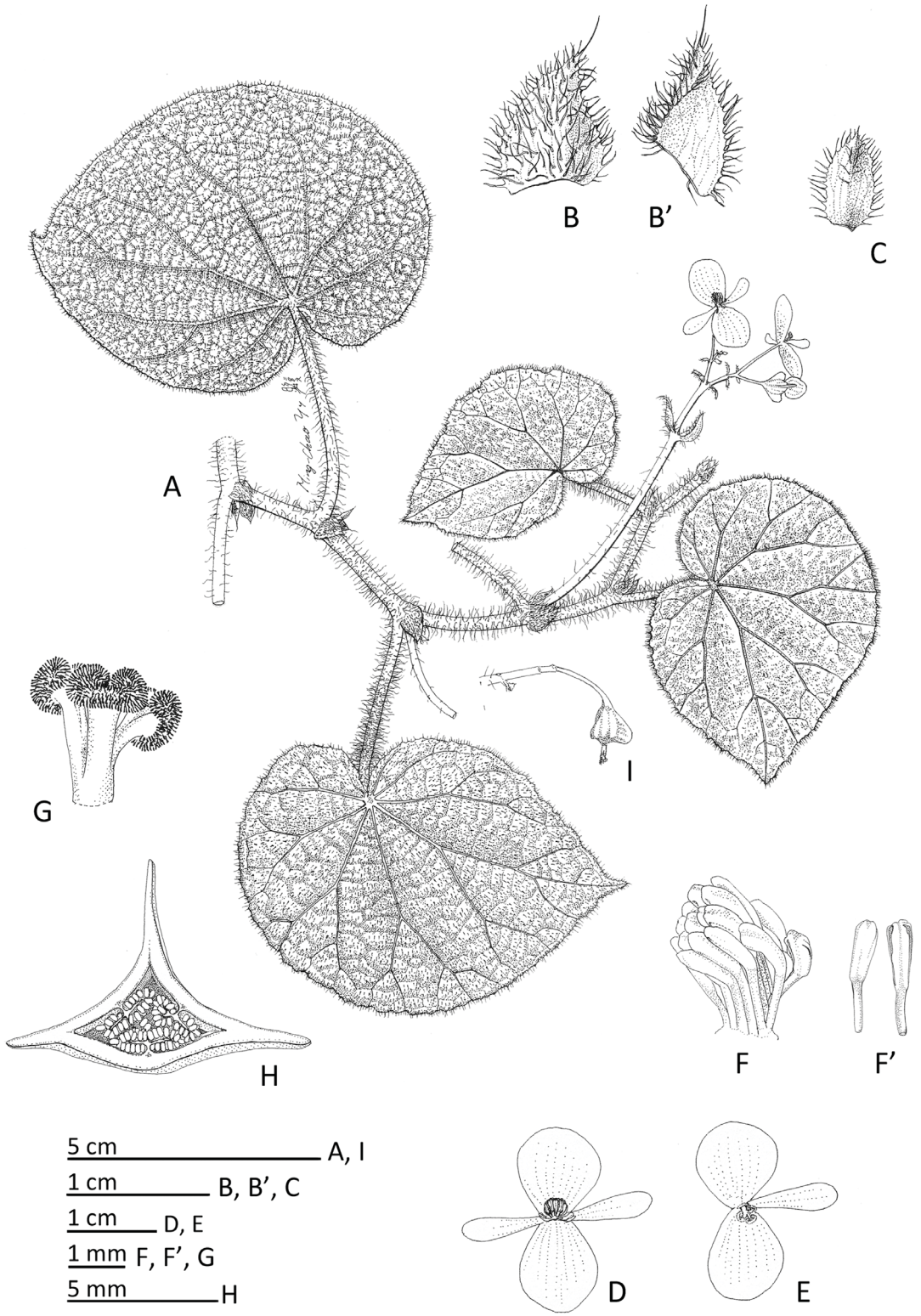


**FIGURE 6.** *Begonia calciphila* C.-I Peng. A, Habit; B, Stipule, abaxial view; B', Stipule, adaxial view; C, Bract; D, Staminate flower; E, Carpellate flower; F, Androecium, F', stamens; G, Style and stigma; H, Cross section of ovary; I, Fruit. All from *C.-I Peng et al. 20226* (HAST). Line drawing by Ming-Chao Yu.

**Leaf anatomy and vestiture:**—Adaxial surface with sparse glandular trichomes (Fig. 4D); cross section ca. 220 µm thick, epidermis single-layered on both surfaces, hypodermis absent (Fig. 4E); abaxial surface with sparse glandular trichomes and multiseriate trichomes on veins, stomata complex single, helicocytic, subsidiary cells (5–)6 (Fig. 4F).

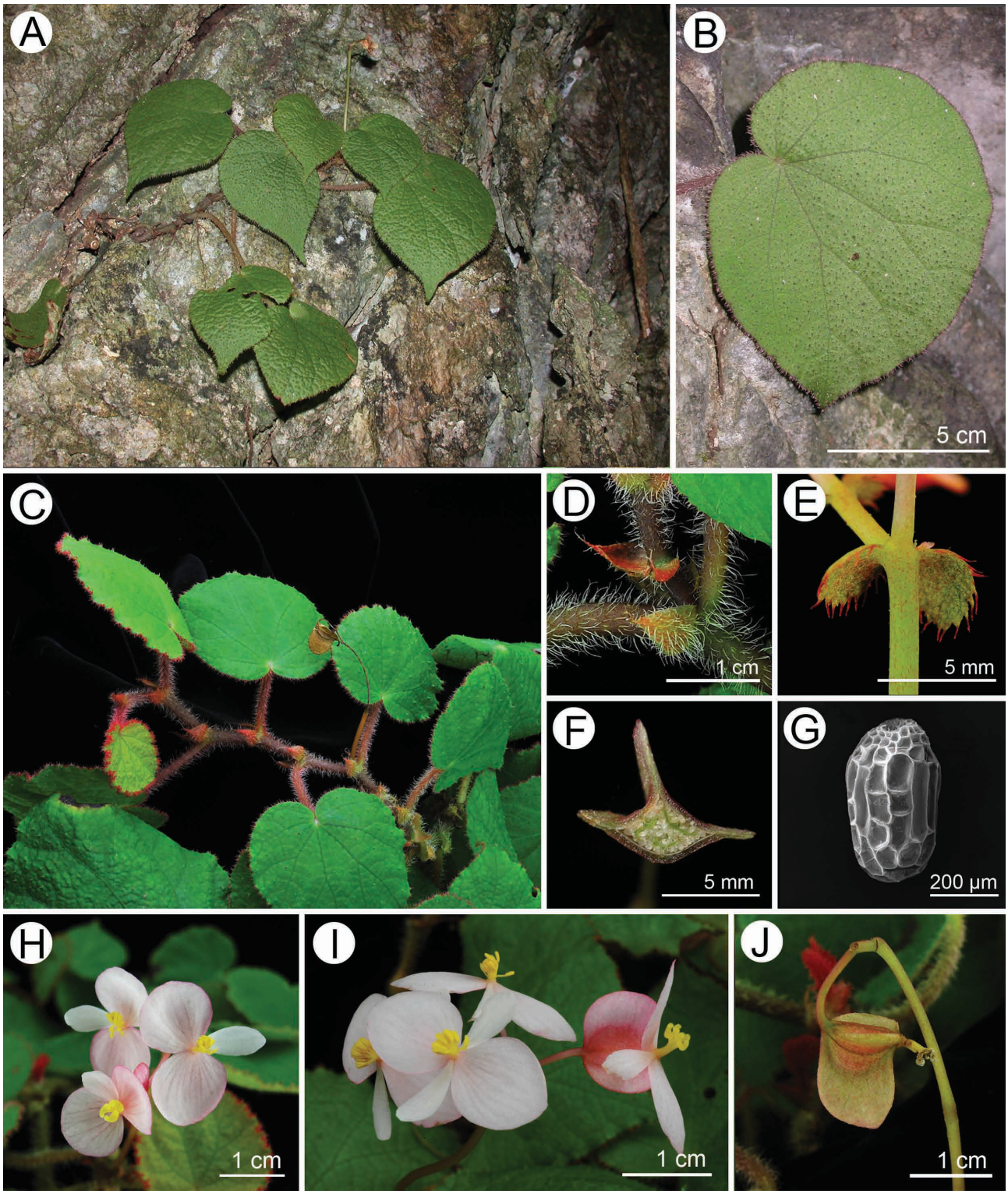


**FIGURE 7.** *Begonia calciphila* C.-I Peng. A, Habit and habitat; B, Leaf, adaxial surface; C, Cultivated plant; D, Portion of rhizome, showing indumentum, petioles and stipules; E, Bracts; F, Cross section of ovary; G, Seed SEM; H, I, Inflorescence; J, Fruit. [All from *C.-I Peng et al. 20226* (HAST)].

**Chromosome cytology:**—The Asian section *Coelocentrum* consistently shows the chromosome number of $2n$ = 30 (Peng *et al.* 2012, 2013, 2014a), with the exception of some probable intraspecific autotriploid individuals with $2n$

= 45 in *B. longgangensis* C.-I Peng & Yan Liu (2013: 54–44: 2) (Peng *et al.* 2013). In this study, the diploid count of 2*n* = 30 was documented for *Begonia calciphila* (Fig. 5B). The 30 chromosomes gradually varied from ca. 1.0 to 2.0 μm long. The centromere positions of most chromosomes were uncertain. However, several chromosomes were clearly metacentric. Satellites were not observed.

**Notes:—***Begonia calciphila* shares the long creeping habit with *B. auritistipula* Y.M. Shui & W.H. Chen (2005: 357), a calciphyte in southwestern Guangxi, China. The new species however differs from the latter in the petioles 2–10 cm long (vs. 9–22 cm); leaves orbicular-ovate with an acuminate apex (vs. ovate with an acute apex); leaf adaxial surface scabrous (vs. rugose and setulose); stipules villous (vs. glabrous); and petioles villous (vs. retrorsely hirsute).

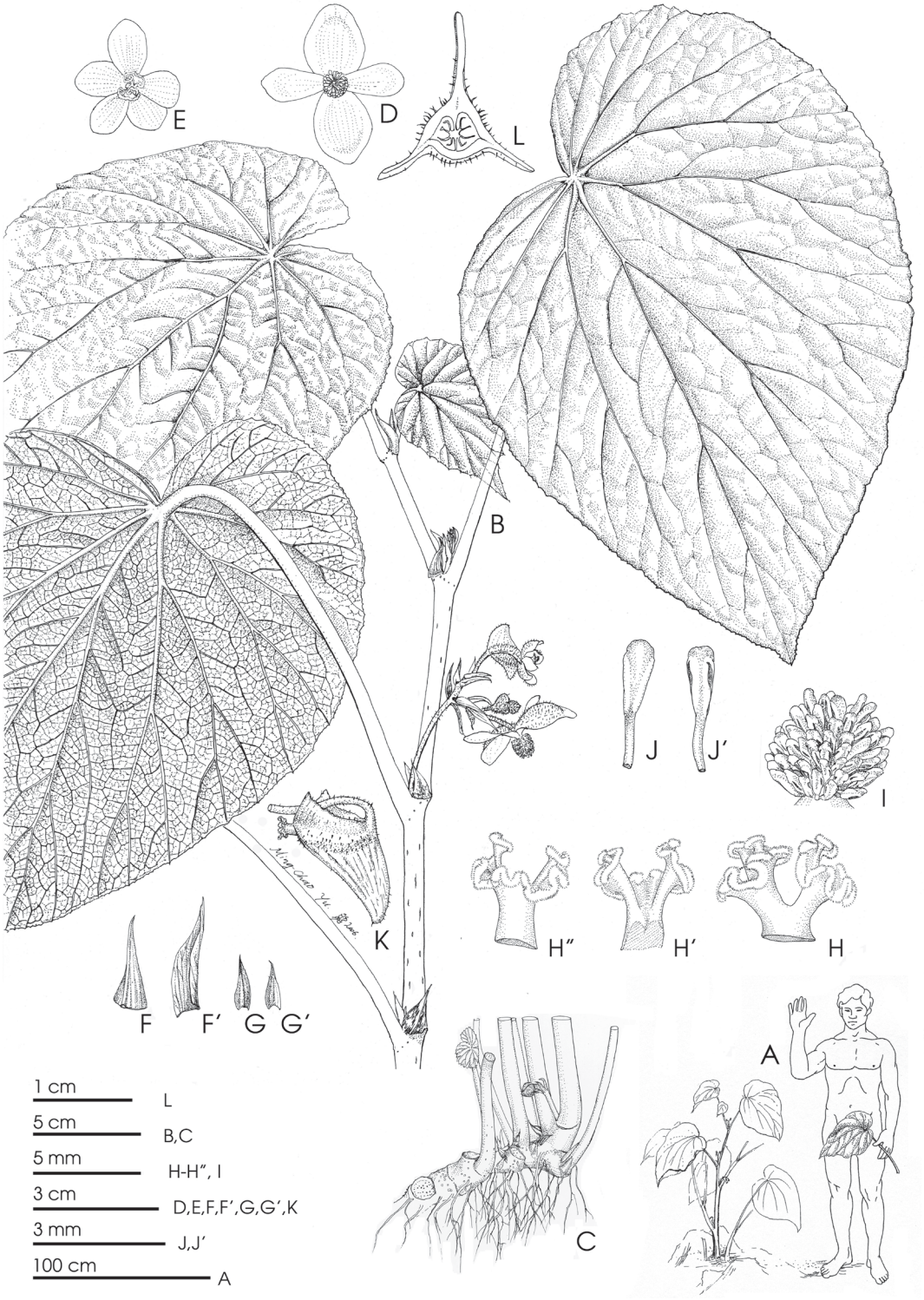


**FIGURE 8.** *Begonia sphenantheroides* C.-I Peng. A, B, Habit; C, Rhizome; D, Staminate flower; E, Carpellate flower; F, F', Stipules; G, G', Bracts; H, H', H'', Style and stigma; I, Androecium; J, J', Stamens; K, Capsule; L, Cross section of ovary. All from *C.-I Peng et al. 20216* (HAST). Line drawing by Ming-Chao Yu.

**3. *Begonia sphenantheroides*** C.-I Peng, *sp. nov.* (sect. *Platycentrum*)
(Figs 8, 9)

**Type:**—VIETNAM. Ha Giang Province, Yen Minh District, Du Gia Community, Lung Dam Village, 22°53’59’’N, 105°14’24’’E, elev. 780 m. On rock on N-facing mossy rocky slope above a running stream, semishaded to shaded, moist, mountain slope in broadleaf forest, occasional. Living collection made on 16 Nov 2004; type specimens pressed from plants cultivated in experimental greenhouse, Academia Sinica on 13 Sep 2012. *Ching-I Peng 20216*, with Wai-Chao Leong, Shin-Ming Ku, Nguyen Tien Hiep, Pham Van The & Nguyen Xuan Tam (holotype: HAST 139794; isotypes: A, E, HN, MO). 高莖秋海棠

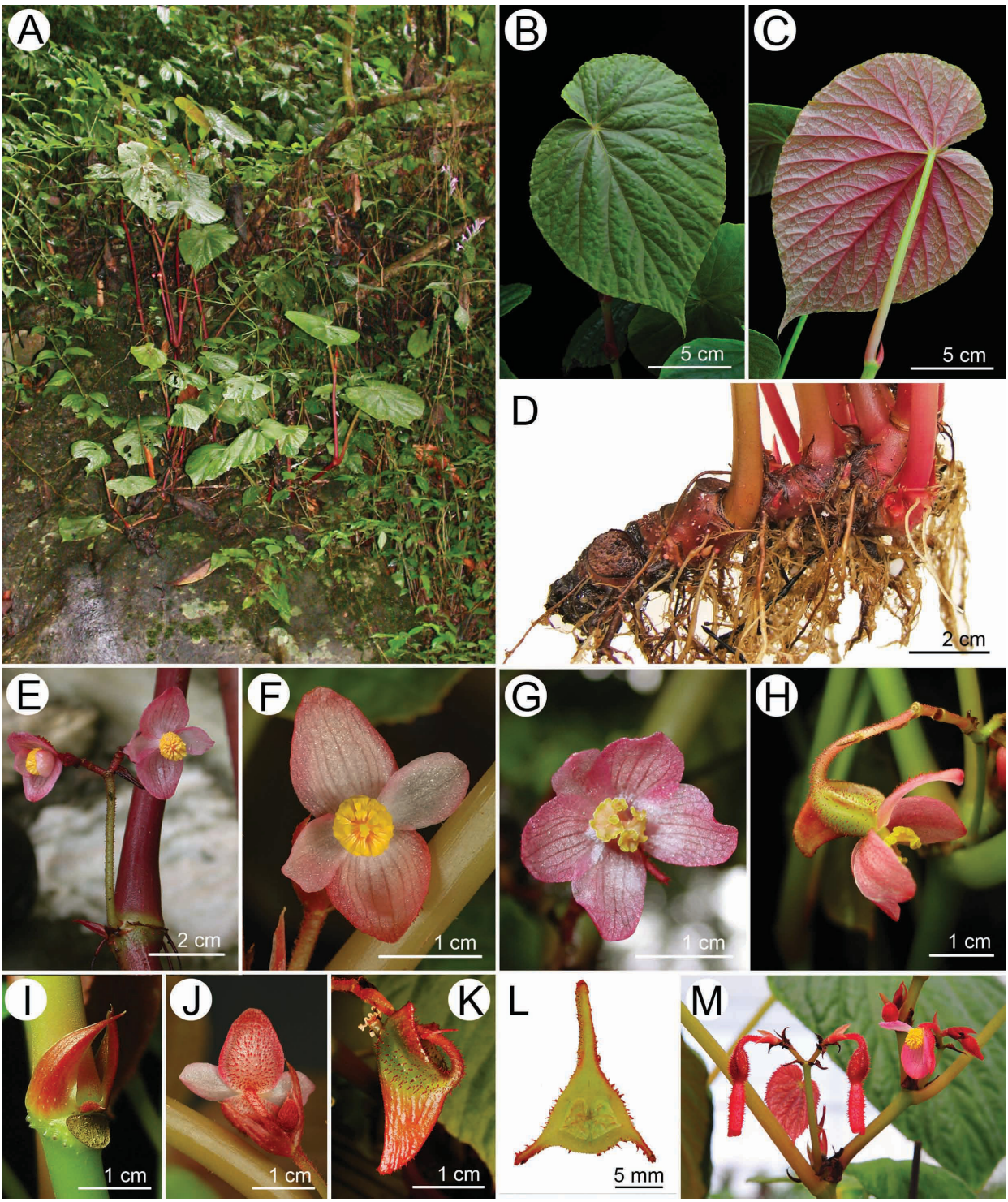


**FIGURE 9.** *Begonia sphenantheroides* C.-I Peng. A, Habit and habitat; B, Leaf adaxial view; C, Leaf abaxial view; D, Rhizome; E, Inflorescence and staminate flowers; F, Staminate flower, face view; G, Carpellate flower, face view; H, Carpellate flower, side view; I, Stipules; J, Staminate flower, back view, showing indumentum; K, Fruit; L, Cross section of ovary; M, Abnormal sympetalous, tubular flowers seen in cultivation. All from *C.-I Peng et al. 20216* (HAST).

Herbs monoecious, perennial, erect, 50–150 cm tall. *Rhizomes* congested, 15–25 mm across, to 9 cm long; erect stem stout, 5–20 mm across, internodes 7–30 cm, glabrous. *Stipules* caducous, triangular or narrowly so, apex aristate or apiculate, margin entire, glabrous. *Leaves* alternate, petiole to 20–30 cm long, glabrescent (puberulent when young); leaf blade herbaceous, asymmetric, ovate to broadly ovate, 21–41 cm long, 15–28 cm wide, glabrous or subglabrous, base obliquely cordate, margin irregularly loosely serrulate or denticulate; apex acute or short acuminate; venation 7- or 8- palmate. *Inflorescences* 2–3 (–7)-flowered, protandrous; peduncle 1–5 cm long, scaberulous; bracts deciduous, narrowly ovate to lanceolate, apex acuminate, margin entire, 0.9–1.8 cm long, subglabrous. *Staminate flower*: pedicel 0.7–1.5 cm long, scabrous; tepals 4, outer 2 reddish, oblong, ovate or orbicular, 0.8–1.9 cm long, 0.5–1.5 cm wide, abaxially scabrous, inner 2 pinkish, broadly oblanceolate to oblong, 0.5–1.7 cm long, 0.3–0.9 cm wide, glabrous; androecium actinomorphic, subglobose, 0.7 cm across, stamens 70–120, yellow, clavate; filaments 0.7–2 mm long, fused to a short central column; anthers 1.5–1.8 mm long, apex truncate. *Carpellate flower*: pedicel 1.5–2.2 cm long, scabrous; ovary green, unequally 3-winged, wings red, scabrous, 2-locular; placentae axile, bilamellate; tepals 5, reddish, unequal, elliptic to obovate, 0.9–1.8 cm long, 0.5–1.5 cm wide, apex obtuse, abaxially scabrous; styles 2, ca. 5 mm long, 2-cleft, fused at base, stigmatic band wavy-twisted and spiralled. *Capsule* nodding, unequally 3-winged, abaxial wing falcate, 5–16 mm tall, ca. 7 mm wide, lateral wings triangular or narrowly so, 3–6 mm tall.

**Ecology and distribution:—***Begonia sphenantheroides* C.-I Peng is distributed in limestone areas in Ha Giang Province and Tuyen Quang Province, northeastern Vietnam (Fig. 3). This species grow on semishaded to shady, moist, mossy rocky slopes in broadleafed forest.

**Etymology:—**The specific epithet refers to its resemblance to some members of *Begonia* sect. *Sphenanthera* in bearing stout rhizomes, upright stems and short, axillary, protandrous inflorescences.

**Additional specimens examined:—**VIETNAM. Tuyen Quang Province, Na Hang Distrct, Xuan Tan Community, Cai village, elev. 124 m, 10 Jan 2007, *NQH 316* (HN).

**Leaf anatomy and vestiture:—**Adaxial surface with glandular trichomes (Fig. 4G); cross section ca. 170–200 μm thick, epidermis single-layered on both surfaces, hypodermis absent (Fig. 4H); abaxial surface with glandular trichomes, stomata complex single, helicocytic, flat, subsidiary cells (5–)6 (Fig. 4I).

**Chromosome cytology:—**Our study of somatic chromosomes at metaphase of *Begonia sphenantheroides* revealed $2n = 22$ (Fig. 5C), which conforms with the predominant chromosome number in species of sect. *Platycentrum*. The 22 chromosomes gradually varied in chromosome length from ca. 1.1 to 1.5 μm long. Most chromosomes have centromeres at median, submedian and subterminal positions, however, some chromosomes could not be determined. Satellites were not observed.

**Notes:—***Begonia sphenantheroides* is assignable to section *Platycentrum*. It bears a superficial resemblance to *B. roxburghii* A. DC. (section *Sphenanthera*) in the erect and branched stems, differing by being monoecious (vs. dioecious) and the broadly ovate leaf blade (vs. triangular-ovate), carpellate flower with 5 tepals (vs. 4 or rarely 3), abaxially scabrous (vs. glabrous) tepals, 2-styled pistil (vs. 4-styled), 2-locular ovary (vs. 4-locular), setose capsule (vs. glabrous or puberulent) and unequally 3-winged (vs. wingless, 4-horned) capsule. Most members of section *Platycentrum* are rhizomatous or with short aerial stems that appear only at anthesis. *Begonia sphenantheroides* has upright stems all year-round, a feature not frequently encountered in sect. *Platycentrum*. In the greenhouse, we observed some abnormally developed tubular pistillate flowers (Fig. 9:M) like those of sect. *Symbegonia* (Warb. 1894: 149) L. L. Forrest & P. M. Hollingsworth (2003: 208), which was probably induced by the cultivated condition.

**4. *Begonia tamdaoensis*** C.-I Peng, *sp. nov.* (sect. *Platycentrum*) (Figs 10, 11)

**Type:**—VIETNAM. Vinh Phuc Province, Tam Dao District. On rock surface along roadside slope, in broadleaf forest, elev. 1050 m, common locally. Living collection made on 21 Mar 1997; type specimens (in flower) pressed from plants cultivated in experimental greenhouse, 25 Oct 2002, *Ching-I Peng 16634* (holotype: HAST 139795; isotype: A, E, HN, K, KEP, MO, P). 三島秋海棠

Herbs monoecious, perennial, rhizomatous. *Rhizomes* 4–7 mm across, to 10 cm long; erect stems seen only at anthesis, to 27 cm tall, ca. 4 mm thick, hispid. *Stipules* narrowly ovate to triangular, ca. 5 mm long, 4 mm wide, margin entire, keeled, apex aristate, arista ca.1 mm long, sparsely hispid. *Leaves* alternate, petiole to 15 cm long, hispid; leaf blade ovate or elliptic, asymmetric, 8–12 cm long, 5–8 cm wide, glabrous or subglabrous above, tomentose along nerves beneath, base slightly obliquely-cordate, margin very shallowly divided, irregularly serrulate and ciliate; apex acute to acuminate; venation palmate-pinnate. *Inflorescences* axillary, protandrous, to 25 cm long, with 4–12 flowers; peduncles 5–21 cm long, hispid; bracts persistent, lanceolate to triangular, apex acuminate, to 5 mm long, margin sparsely fimbriate. *Staminate flower*: pedicel 1.2–2.3 (–2.8) cm long, glandular-hispid; tepals 4, pink, apex

obtuse, outer 2 ovate or narrowly so, 0.8–2 cm long, 0.4–1.2 cm wide, hispid abaxially, inner 2 narrowly oblong or oblanceolate, 0.8–1.8 cm long, 2–6 mm wide; androecium zygomorphic, stamens 12–35, yellow, clavate; filaments 0.5–2.3 mm long, fused at base, anthers 1.6–1.8 mm long. *Carpellate flower*: pedicel 1.5–2.1 cm long, glandular-pilose; ovary unequally 3-winged, glandular-hispid, 2-locular; placentae axile, bilamellate; tepals 5, pink, unequal, oblanceolate, oblong or ovate, 1.5–1.8 cm long, 0.4–1.3 cm wide, hispid outside, apex obtuse; styles 3, fused at base, 2-cleft, stigmas in a spiralled band around style apex. *Capsule* nodding, unequally 3-winged, abaxial wing ligulate or falcate, 11–19 mm tall, lateral wing ca. 3 mm tall.

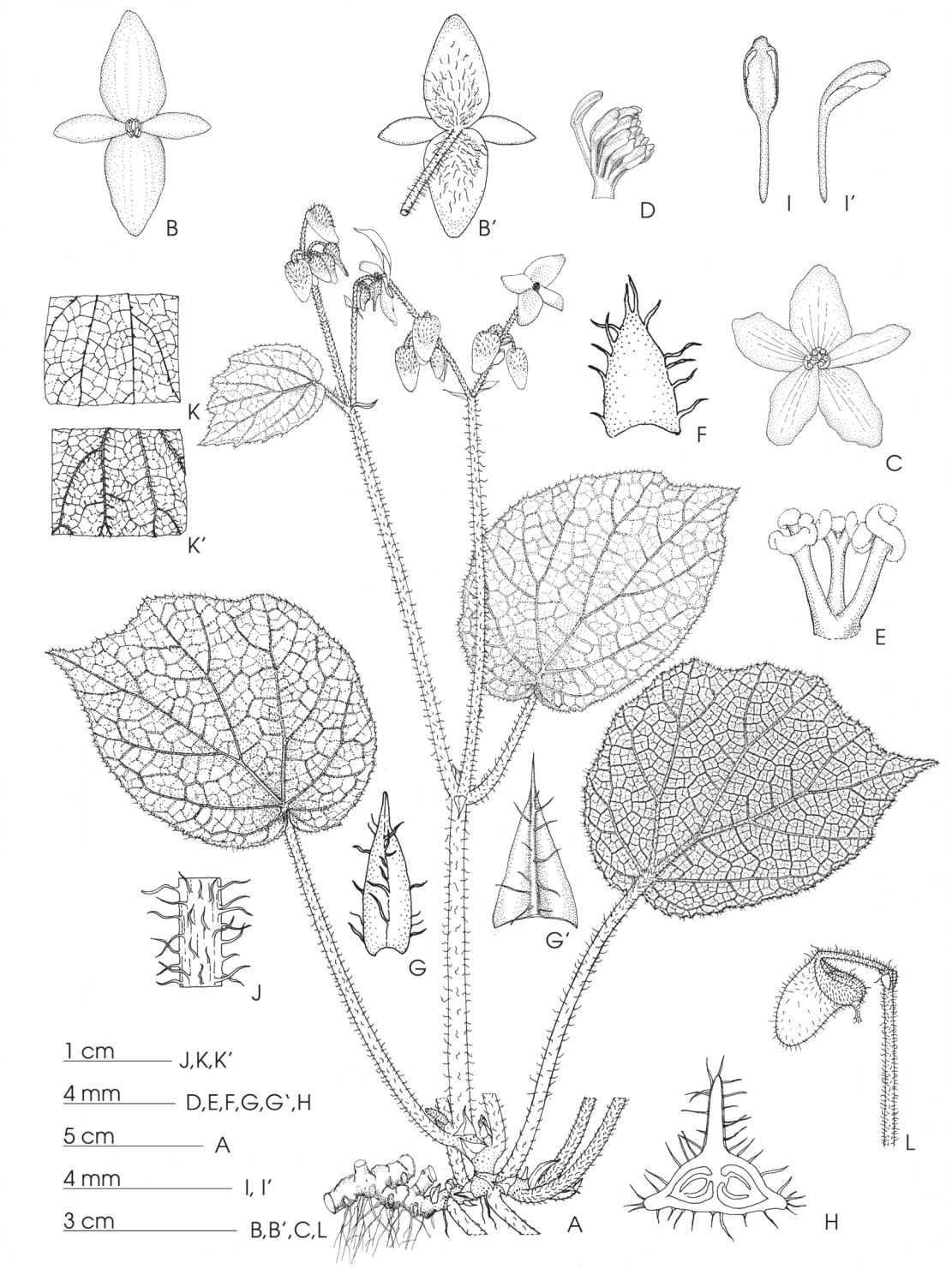


**FIGURE 10.** *Begonia tamdaoensis* C.-I Peng. A, Habit; B, Staminate flower, face view; B', Staminate flower, back view; C, Carpellate flower; D, Androecium; E, Styles and stigma; F, Bract; G, G', stipules; H, Cross section of ovary; I, I', Stamens; J, Showing indumentum on petiole; K, Leaf adaxial surface; K', Leaf abaxial surface; L, Fruit. All from *C.-I Peng16634* (HAST). Line drawing by Ya-Wen Hsueh.

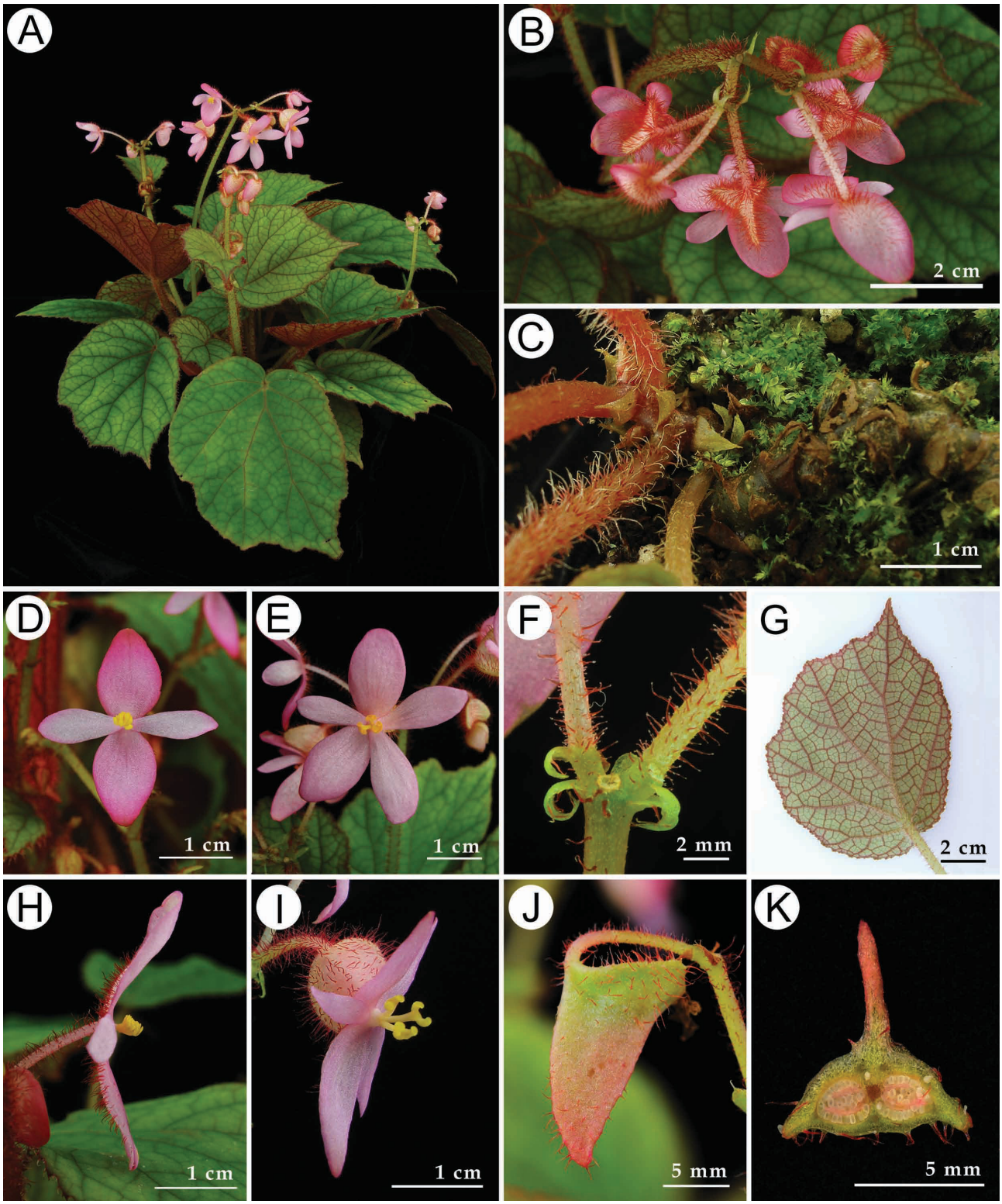


**FIGURE 11.** *Begonia tamdaoensis* C.-I Peng. A, Habit; B, Inflorescence, showing indumentum on pedicels and tepals; C, Rhizome, showing indumentum on petioles; D, Staminate flower, face view; E, Carpellate flower, face view; F, Bracts and pedicels, showing glandular trichomes; G, Leaf abaxial surface; H, Staminate flower, side view; I, Carpellate flower, side view; J, Fruit; K, Cross section of ovary. All from *C.-I Peng 16634* (HAST).

**Ecology & Distribution:**—Known only from Tam Dao, Vinh Phuc Province, Vietnam (Fig. 3). On rock face on roadside slope, in broadleaf forest, elev. 1050 m, locally common.

**Etymology:**—The specific epithet refers to the type locality, Tam Dao.

**Additional specimen examined:**—VIETNAM. Vinh Phuc Province, Tam Dao District. On rock face along

roadside slope, in broadleaf forest, elev. 1050 m, common locally, 21 Mar 1997, *Ching-I Peng 16634* (HAST); Vinh Phuc Province, Tam Dao District. Near base of rocky slope, elev. ca. 1000 m. Living collection made on 22 Mar 1997, specimens pressed from plant cultivated in experimental greenhouse, 29 Oct 2007, *Ching-I Peng 16638* (HAST); Approximately 100 km NNW of Hanoi, Tam Dao Forest Reserve, on trail approximately 0.5 km S of bridge over Suoi B'ac River. Along trail on rocky soil, 21°27'09"N, 105°39'09"E, elev. 990 m. 9 Sep 1993. *D. K. Harder et al. 1805* (HAST); Vinh Phuc Province, Tam Dao National Park, 6 Nov 2009, Pi-Fong Lu s. n., specimens pressed from plant cultivated in experimental greenhouse, 15 May 2015, *Ching-I Peng 22285* (HAST).

**Leaf anatomy and vestiture:—**Adaxial surface with glandular trichomes (Fig. 4J); cross section ca. 450 μm thick, upper epidermis biseriate, with a layer of thick hypodermis under upper epidermis, lower epidermis single-layered (Fig. 4K); abaxial surface with glandular trichomes, stomata complex single, helicocytic, flat, subsidiary cell (5–)6 (Fig. 4L).

**Chromosome cytology:—**Chromosomes of most species of *Begonia* are small (< 2 μm), difficult to stain, and karyotypes are mostly impossible to determine (Peng *et al.* 2014b). The somatic chromosome number of *B. tamdaoensis* was determined as $2n = 18$ (Fig. 5D). The chromosomes are large and clearly analyzable. Among the 18 chromosomes, six were metacentric (m) and about 3.0–4.5 μm in length (Nos. 1–6 in Fig. 5D'), eight were submetacentric (sm) and 2.0–3.4 μm in length (Nos. 7–14 in Fig. 5D'), two were subtelocentric (st) and about 3 μm in length (Nos. 15 and 16 in Fig. 5D') and the remaining two were telocentric chromosomes (t) and about 1.8 μm in length (Nos. 17 and 18 in Fig. 5D'). Secondary constrictions (SC) were observed at the interstitial regions of the long arms of the largest two median chromosomes (Large arrows in Fig. 5D) and at the distal regions of long arms of two median chromosomes (Middle arrows in Fig. 5D). The karyotypic formula of *B. tamdaoensis* is $2n = 18 = 6m (4SC)+8sm+2st+2t$.

As noted above, the predominant chromosome number in sect. *Platycentrum* (including *B. sphenantheroides*, the new species documented in this paper) is $2n = 22$. Our observation of $2n = 18$ in *B. tamdaoensis* is exceptional, which however corresponds to that of *B. purpureofolia* S.H. Huang & Y.M. Shui reported by Nakata *et al.* (2007). *Begonia wui-senioris* C.-I Peng (2014: 55-13: 2), another member of sect. *Platycentrum*, has the lowest chromosome number, $2n = 14$, for the genus (Peng *et al.* 2014b).

**Notes:—***Begonia tamdaoensis* is assignable to sect. *Platycentrum* by being rhizomatous, protandrous, staminate flowers basal and pistillate flowers distal, ovaries 2-locular and placentas with two branches, capsules pendulous, 2-loculate and wings very unequal (Doorenbos *et al.* 1998). The capsules are recurved, which is likely an adaptation for rain splash dispersal (Tebbit *et al.* 2006). However, it is unusual in having 3-styled carpellate flowers. *Begonia versicolor* Irmscher (1939: 546) is the only other species in sect. *Platycentrum* that is known to have 3-styled carpellate flowers and 2-loculed ovaries (Shui *et al.* 2002; Gu *et al.* 2007).

*Begonia tamdaoensis* resembles *B. oreodoxa* Chun & F. Chun ex C.Y. Wu & T.C. Ku (1995: 274) in SE Yunnan (China) and northern Vietnam in aspect and being very pubescent, but is distinguished by the very shallowly cordate leaves (vs. cordate), bracts fimbriate (vs. incised), carpellate flower with 5 tepals (vs. 4 or rarely 3) and 3 styles (vs. 2), placentas axile throughout (vs. axile for the most part, but parietal near summit of ovary).

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