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Begonia ×chungii (Begoniaceae), a new natural hybrid in Taiwan

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ABSTRACT. A new natural hybrid, *Begonia ×chungii* C.-I Peng & S. M. Ku, from central Taiwan, is described and illustrated. Based on its morphology, geographical distribution, pollen stainability, seed set, and cytology, and on experimental hybrids, we conclude that *B. ×chungii* is a natural hybrid between *B. palmata* D. Don [sect. *Platycentrum* (Klotzsch) A. DC.] and *B. longifolia* Blume [sect. *Sphenanthera* (Hassk.) Warb.].

Key words: *Begonia*; *Begonia ×chungii*; *Begonia longifolia*; *Begonia palmata*; Hybrids; Meiosis; Natural hybridization; Taiwan; Taxonomy.

INTRODUCTION

A total of 12 species of *Begonia* were recognized by Chen (1993) in the Flora of Taiwan, 2nd edition, with one natural hybrid, *B. ×buimontana* Yamamoto, recognized from southern Taiwan (Peng and Chen, 1991). Subsequently, a second natural hybrid, *B. ×taipeiensis* C.-I Peng, was recognized from northern Taiwan (Peng and Sue, 2000; Peng and Chiang, 2000) and five additional species —*B. bouffordii* C.-I Peng, *B. chuyunshanensis* C.-I Peng & Y. K. Chen, *B. pinglinensis* C.-I Peng, *B. tengchiana* C.-I Peng & Y. K. Chen, and *B. wutaiana* C.-I Peng & Y. K. Chen—were described (Peng et al., 2005). In continuation of our systematic studies of Asian *Begonia* (Fang et al., 2006; Ku et al., 2006; Peng et al., 2006a; Peng et al., 2006b; Gu et al., 2007; Liu et al., 2007; Peng et al., 2007; Ku et al., 2008; Peng et al., 2008a; Peng et al., 2008b), we document here a third natural hybrid, *B. × chungii*, from central Taiwan.

MATERIALS AND METHODS

Materials

Specimens of *Begonia ×chungii*, *B. longifolia* and *B. palmata* were collected from wild populations and cultivated in the experimental greenhouse for morphological comparison, SEM studies, and cytological examination. Vouchers are deposited at HAST.

Chromosome preparations

Meiosis was observed in flower buds fixed in a 3:1 mixture of 95% ethanol and glacial acetic acid and subsequently refrigerated. Prior to staining, the buds were hydrolyzed for 10 minutes at 60°C in a 1:1 mixture of concentrated HCl and 95% ethanol. They were then squashed in FLP orcein (Jackson, 1973).

Cryo scanning electron microscopy

Fresh leaves of *Begonia ×chungii*, *B. longifolia* and *B. palmata* were dissected and mounted on stubs. The samples were frozen with liquid nitrogen slush, and then transferred to a sample preparation chamber at -160°C. After 5 min, when the temperature had risen to -130° C, the samples were fractured and then etched for 10 min at -85°C. After coating at -130°C, the samples were transferred to the SEM chamber and observed at -160°C with a cryo scanning electron microscope (FEI Quanta 200 SEM/Quorum Cryo System PP2000TR FEI).

NEW SPECIES

Begonia ×chungii C.-I Peng & S. M. Ku, *hybr. nov.*— TYPE: TAIWAN. Nantou County, Luku Township, Sitou, National Taiwan University Experimental Forest. *Cryptomeria* plantation by the Tahsuehchih ("University Pond"), 120°46'57" E, 23°44'23" N, elev. ca. 1,200 m, 8 Mar 1994, *Ching-I Peng 17962* (holotype: HAST, here designated; isotypes: A, E, MO, TAIF, TNM). 鍾氏秋海棠 Figures 1, 2

Herba perennis. Caulis erectus, 50-80 cm altus. Folia obliqua, ovata usque anguste ovata, 11-24 cm longa, 5-15 cm lata. Flores masculi: tepala 4; stamina 60-80. Flores foeminei: tepala 5(-6), subaequalia; ovarium triloculare, inaequaliter 3-alatum; placenta axialis; styli 3. Grana pollinis fere in toto abortiva. Ovarium abortivum. Chromosomatum numerus: 2n = 22. Hybrida naturalis e B. longfolia Blume et B. palmata D. Don genita.

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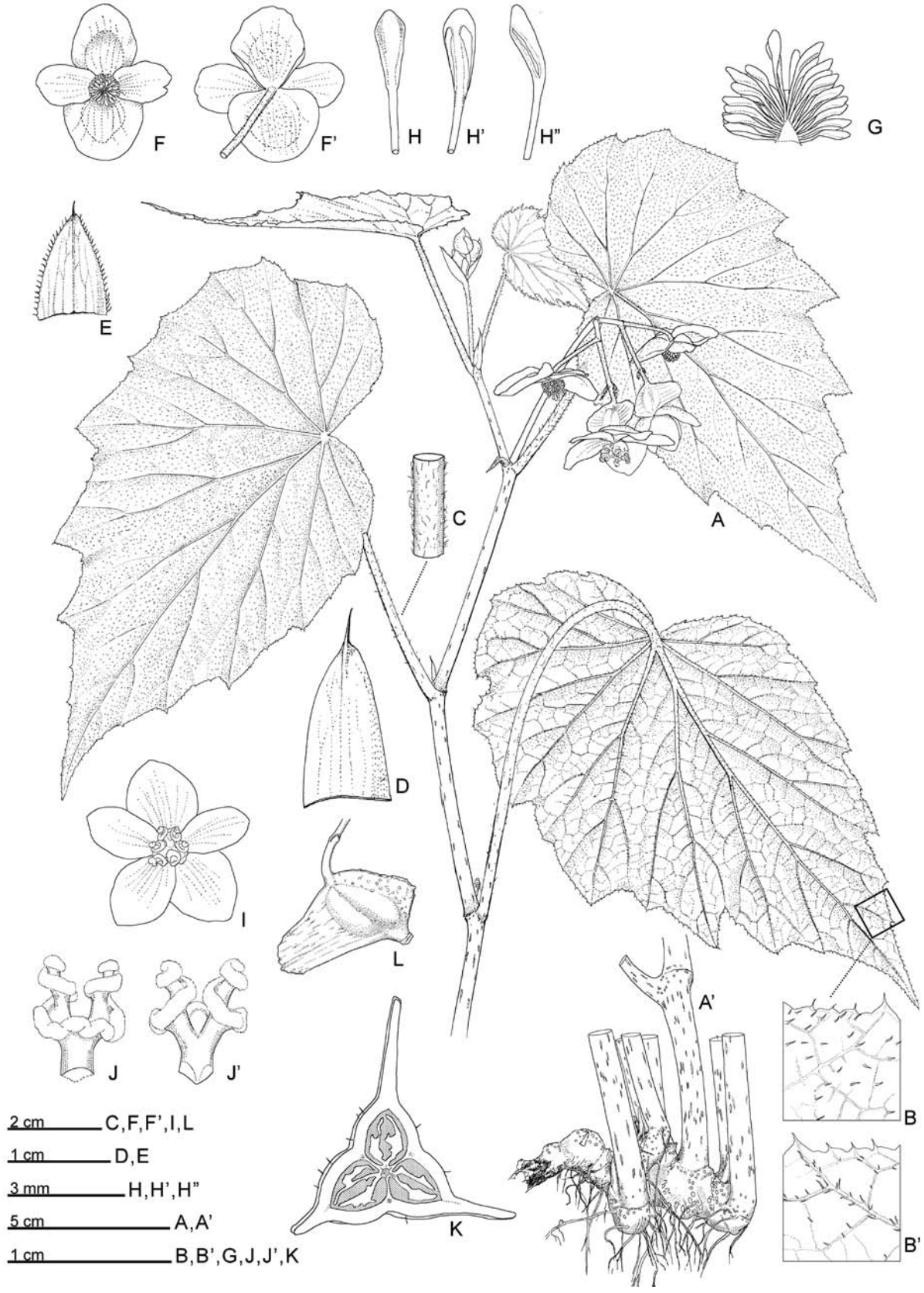

Figure 1. *Begonia ×chungii* C.-I Peng & S. M. Ku. A, Flowering branch, A', Rhizome and base of stems; B, Portion of leaf, adaxial surface, B', abaxial surface; C, Portion of petiole; D, Stipule; E, Bract; F, Staminate flower, face view, F', back view; G., Androecium, longitudinal section, showing filaments fused to a short central column; H, Stamen, dorsal view, H', ventral view, H'', side view; I, Pistillate flower; J, J', Styles and stigmas; K, Cross section of ovary; L, Fruit. (All from *Peng 17962*, HAST).

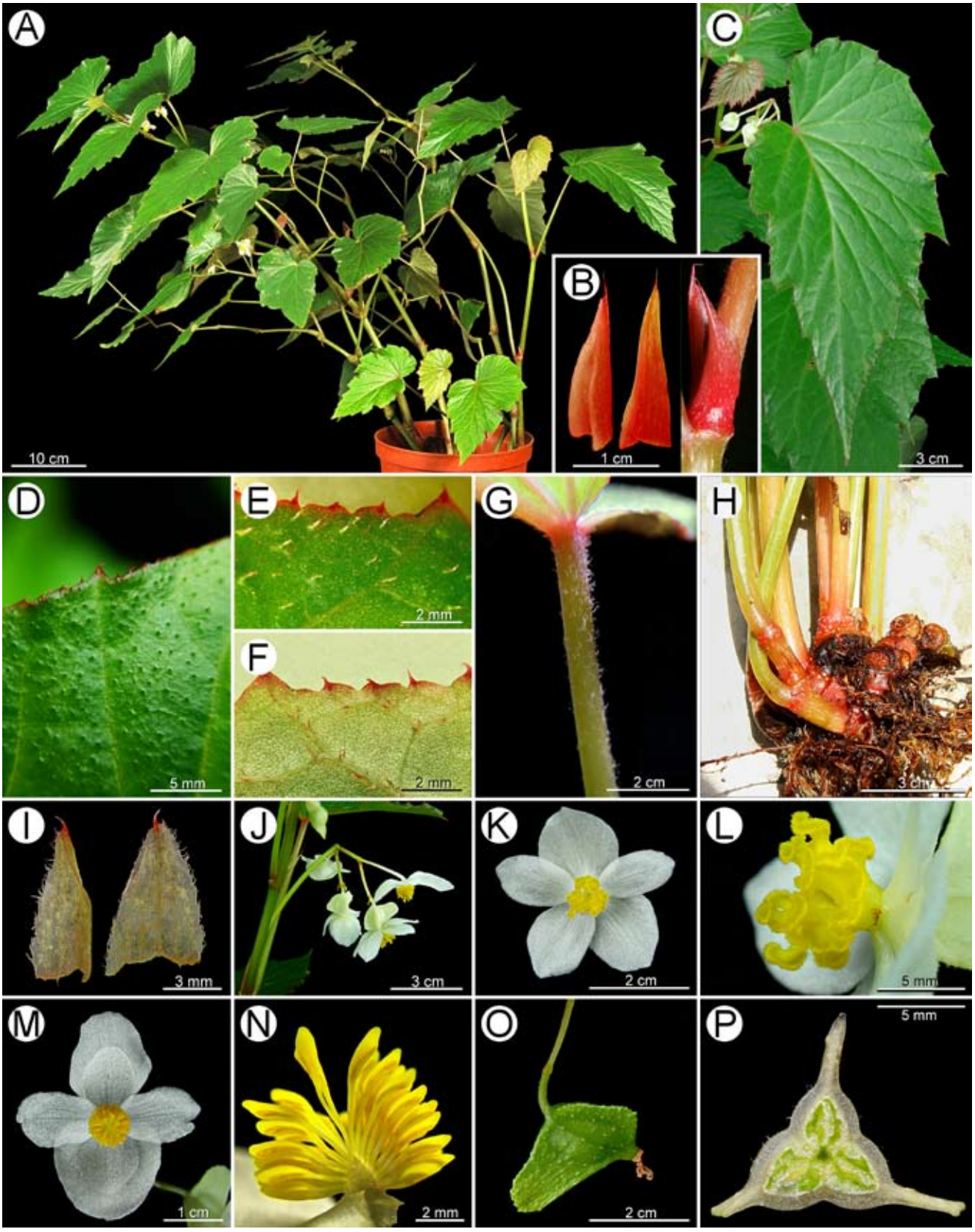

Figure 2. *Begonia ×chungii* C.-I Peng & S. M. Ku. A, Habit; B, Stipule; C, Leaf; D, E, Portion of leaf, adaxial suface; F, Portion of leaf, abaxial suface; G, Petiole; H, Stem bases and rhizome; I, Bracts; J, Inflorescence; K, Pistillate flower; L, Styles and stigmas; M, Staminate flower; N, Androecium, longitudinal section; O, Fruit; P, Ovary, cross section. (All from *Peng 17962*, HAST).

Erect, perennial, succulent herb with poorly developed rhizomes. Stems ±zigzag, pilosulose at first, later glabrescent, 50-80 cm high, to 4-9 mm thick, internodes 7-26 cm long. Stipules glabrous, caducous, triangular-lanceolate, 10-20 mm long, 5-7 mm wide, apex acuminate, margin entire. *Leaves* adaxially sparsely pilosulose or scaberulous, abaxially sparingly pilosulose on major veins, oblique, ovate to narrowly ovate, 11-24 cm long, 5-15 cm wide, apex acuminate to caudate, base obliquely cordate, margins serrate, shallowly lobed and irregularly serrulate or denticulate; venation palmate-pinnate, basal veins 6-7; petioles pilosulose or puberulent, later glabrescent, 10-23 cm long, to 4-7 mm across. Bracts glabrous or near so, caducous, narrowly ovate to narrowly triangular, 5-20 mm long, 2-8 mm wide, apex acuminate, margin ciliate. *Inflorescence* 4-9 cm long, axillary; peduncles ascending, subglabrous or sparsely pilosulose, 3-8 cm long, 2-3.5 mm thick. Tepals white. Staminate flowers: pedicel ca. 2.5 cm, tepals 4, decussate, outer two broadly obovate

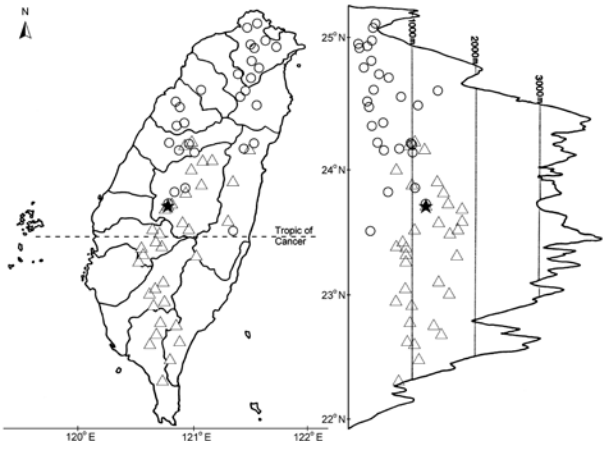

Figure 3. Distribution and altitudinal maps of *Begonia longifolia* (○), *B. palmata* (△) and *B. ×chungii* (★) in Taiwan.

Table 1. Comparison of *Begonia ×chungii* with putative parents, *B. longifolia* and *B. palmata*.

	Begonia palmata (Figure 7)	*Begonia ×chungii* (Figures 1, 2)	*Begonia longifolia* (Figure 8)
Rhizome	Creeping and elongated	Poorly developed	Poorly developed or lacking
Stem	35-90 cm	50-80 cm	45-110 cm
Indumentum	Rusty-lanate to tomentose	Pilosulose	Glabrous
Leaf blade			
Shape	Broadly ovate to orbicular, palmately lobed	Narrowly ovate, serrate, shallowly lobed	Broadly lanceolate to narrowly ovate, almost entire
Indumentum	Adaxially hispidulose-tomentulose; abaxially rusty-lanate to tomentose	Adaxially sparingly pilosulose or scaberulous; abaxially sparingly pilosulose on major veins	Glabrous
Thickness (μm)	130-150	160-180	180-200
Palisade cell size (μm)	15-20(-30) × 12-18	30-35 × 17-23	35-45 × 25-30
Palisade tissue	1-2-layered	2-layered	3-layered
Veinlet on abaxial surface	Raised	Nearly flat	Flat
Stomata complex on abaxial surface	Normal; sometimes heteromorphic	Frequently deformed	Normal; homomorphic
Bract	Abaxially tomentose, margin ciliate	Abaxially glabrous, margin ciliate	Abaxially glabrous, margin eciliate
Peduncle (cm)	6-24	3-8	0.3-2
Androecium			
Shape	Ovoid	Ovoid	Cup- or bowl-shaped
Androphore	Present	Absence	Absence
Anthers	Narrowly obovoid	Narrowly oblong-obovoid	Clavate
Pollen	Fertile; 16-23 × 9-13 μm	Sterile, often deformed; 11-23 × 7-8 μm	Fertile; 11-15 × 5-10 μm
Styles	2	Usually 3	3
Ovary	2-locular, 3-winged	Usually 3-locular, 3-winged	3-locular, wingless
Fruits	Capsule	Capsule	Berry-like
Seeds	Viable	Abortive	Viable

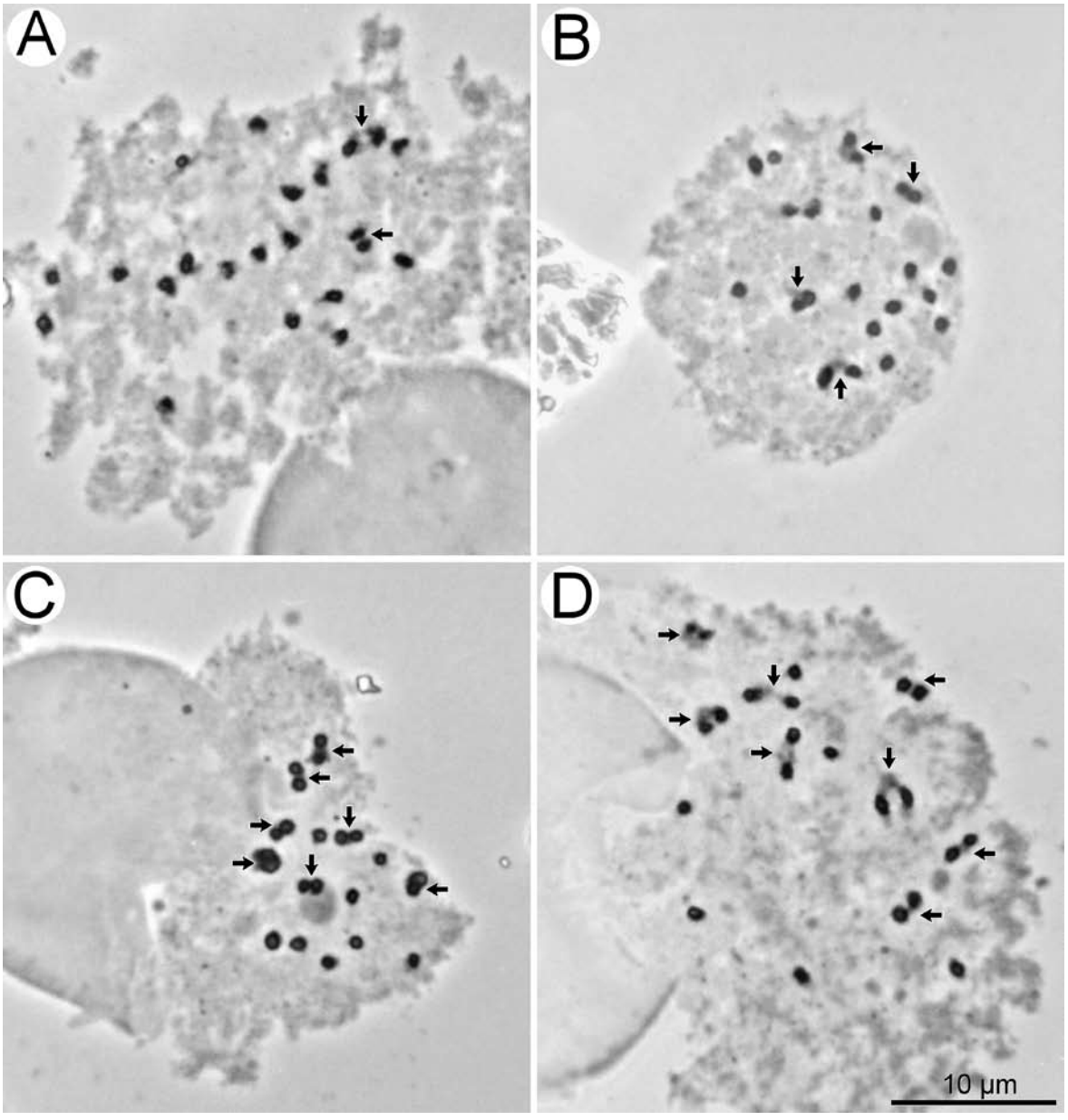

Figure 4. Meiotic chromosomes of *Begonia ×chungii*. A, 2II+ 18I; B, 4II + 14I; C, 7II + 8I; D, 8II + 6I (All from *Peng 15911*, HAST).

to orbicular, 15-25 mm long, 10-18 mm wide, inner two oblanceolate to narrowly obovate, 7-20 mm long, 5-8 mm wide; androecium actinomorphic, ovoid, without androphore, stamens ca. 60-80, golf-club shaped, anthers narrowly obovoid to oblong, yellow, 2-3 mm long, 0.9-1.1 mm across, connective apex protruding, filaments 1.6-2.7 mm long (upper stamems longer), fused to a short central column. Pollen grains irregular, shriveled and unstainable. Carpellate flowers: pedicel 1.3-2 cm long, tepals 5(-6), unequal to subequal, obovate, to oblong, the largest 15-21 mm long, 13-17 mm wide, the smallest 9-15 mm long, 6-9 mm wide; styles 3, yellow, 4.9-5.3 mm long, at their base fused ca. 0.5 mm long, each bifid; ovary nodding or somewhat pendent, trigonous-ellipsoid, 3-locular, longitudinally shallowly grooved between the locules, 3-

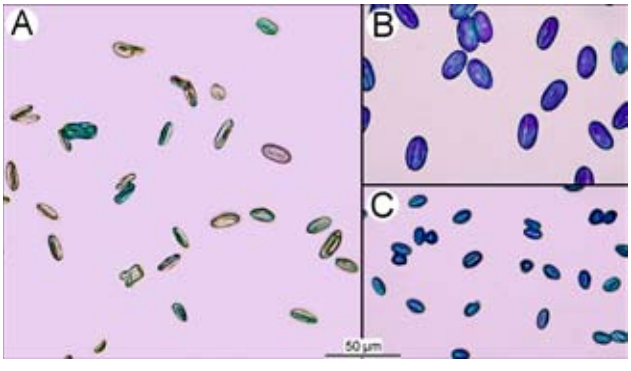

Figure 5. Microphotographs of pollen of *Begonia*. A, *B.* × *chungii* (sterile pollen); B, *B. plamata* (fertile pollen); C, *B. longifolia* (fertile pollen).

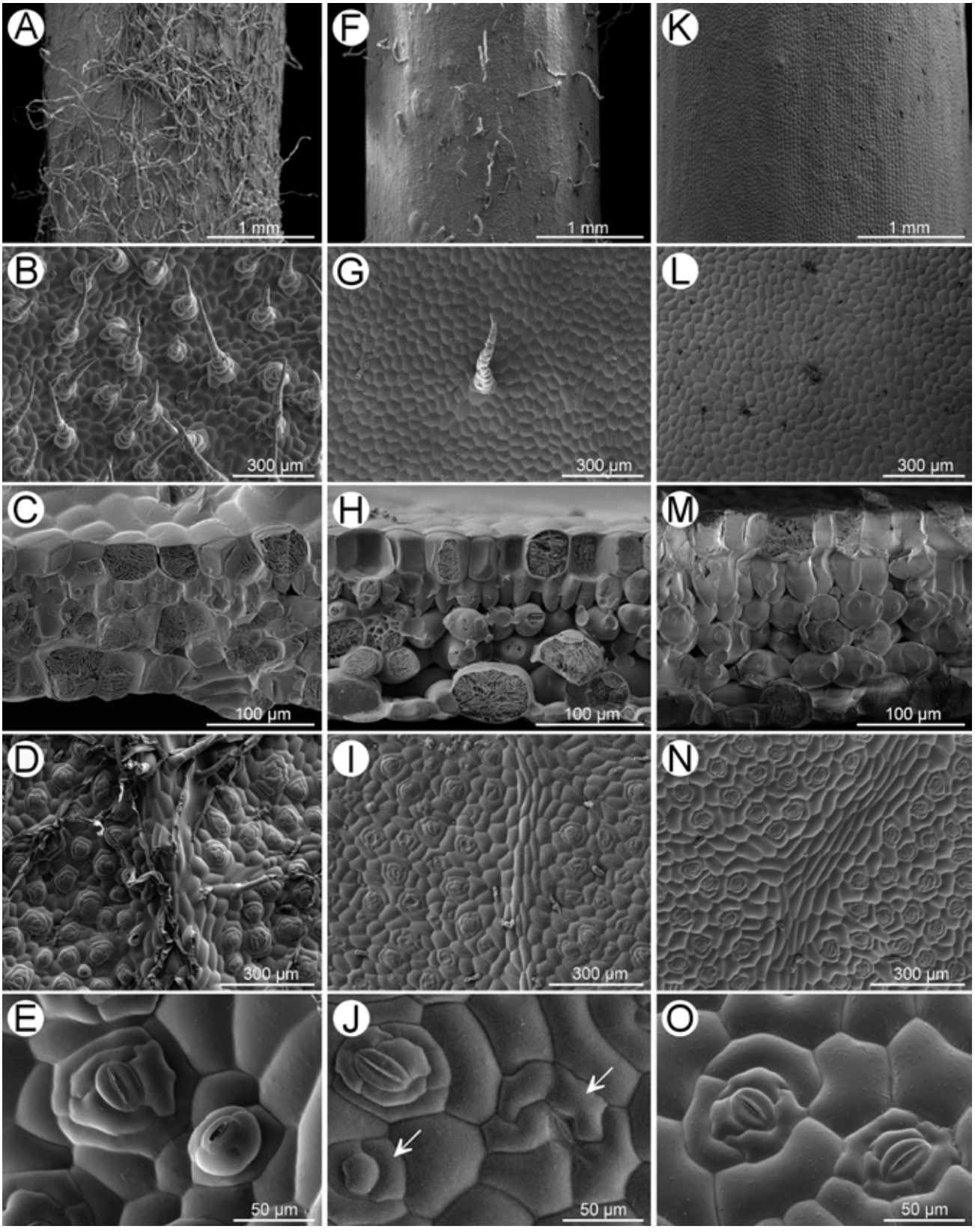

Figure 6. SEM microphotographs of *Begonian palmata* (A-E), *B.* ×*chungii* (F-J), and *B. longifolia* (K-O). A, F, K, Indumentum on petiole; B, G, L, Leaf adaxial surface; C, H, M, Cross section of leaf; D, I, N, Leaf abaxial surface; E, J, O, Stomata on abaxial leaf surface, showing heteromorphic stomatal complex (E), deformed stomatal complex (J, arrows) and homomorphic stomatal complex (O). (A-E from *Peng 15985*; F-J from *Peng 17962*; K-O from *Peng 16792*)

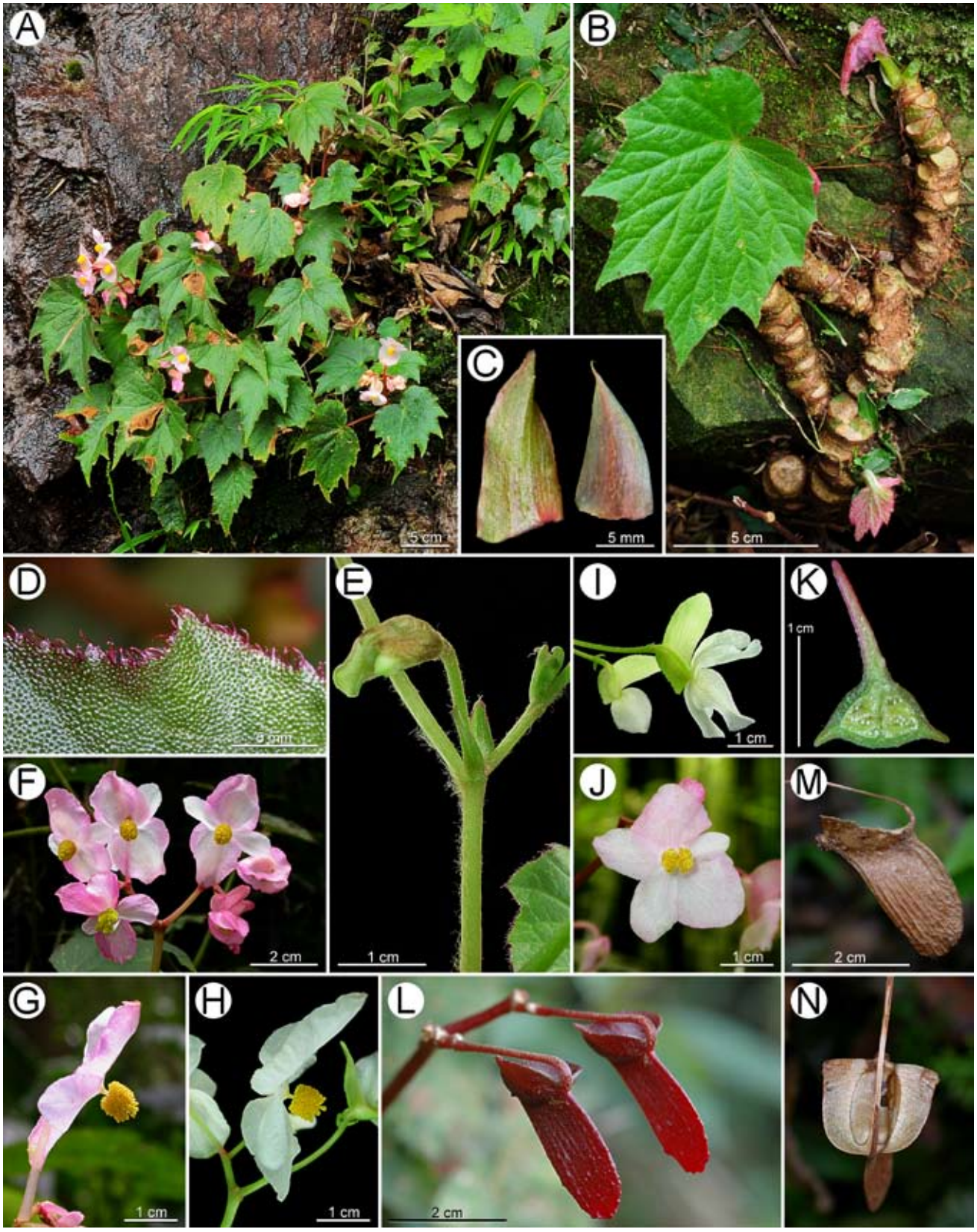

Figure 7. *Begonia palmata* D. Don. A, Habit; B, Habit, sterile plant with exposed creeping rhizomes; C, Stipule from erect stem (left), from rhizome (right); D, Portion of leaf, adaxial suface; E, Developing inflorescence, showing trichomes; F, Inflorescence (pink morph); G, Staminate flower (pinkish morph); H, Staminate flower (white morph); I, Pistillate flower (white morph), side view; J, Pistillate flower (pinkish morph), face view; K, Cross section of a young capsule; L, Capsules; M, N, Dry, dehiscent capsule.

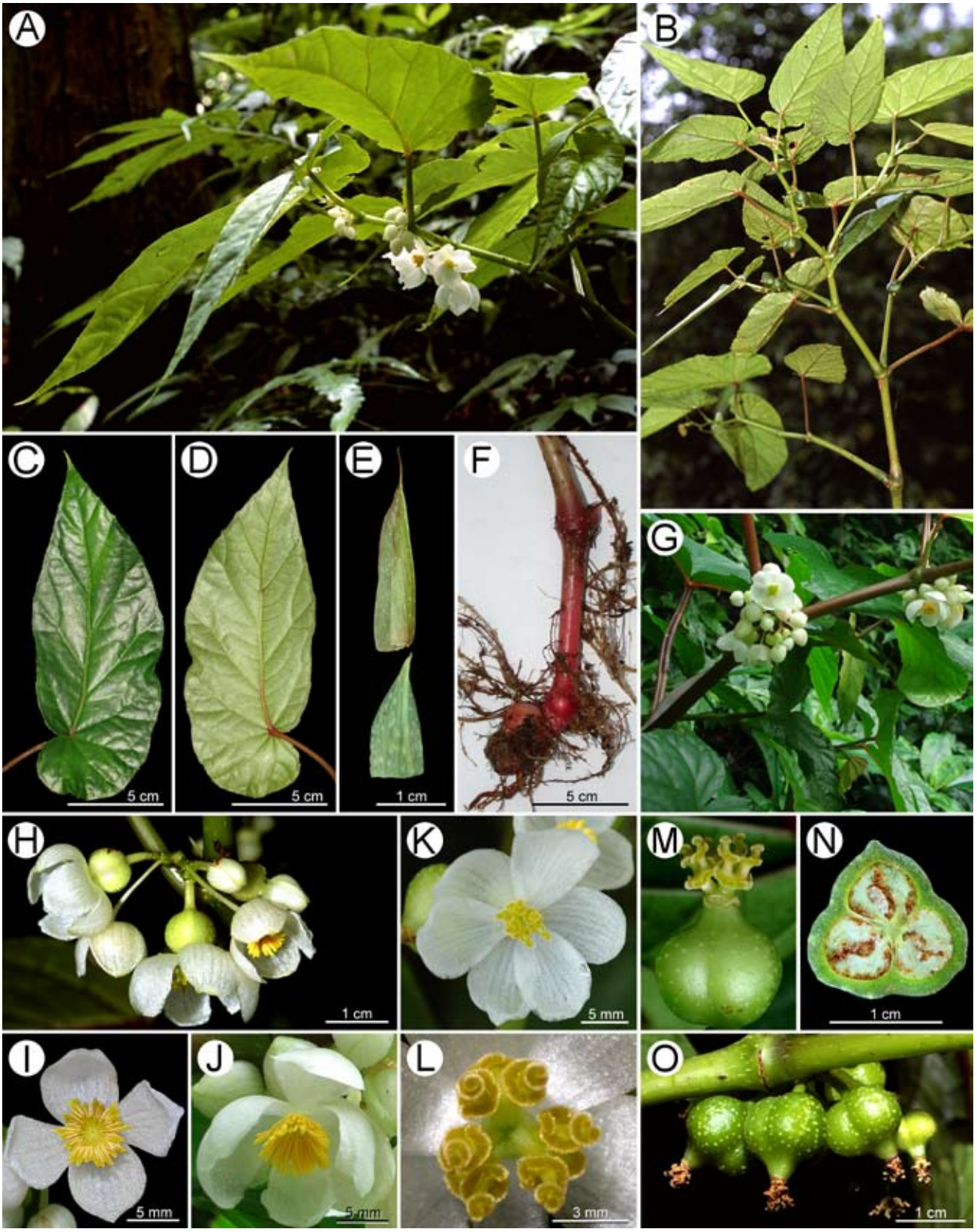

Figure 8. *Begonia longifolia* Blume. A, B, Habit; C, Leaf, adaxial surface; D, Leaf, abaxial surface; E, Stipules; F, Stem base with roots; G, H, Inflorescences; I, J, Staminate flowers, showing bowl-shaped androecium; K, Pistillate flower; L, Three stigmatic bands in a pistillate flower; M, Berry-like fruit; N, Cross section of fruit; O, Berry-like fruits.

winged; placentae axile, bilamellate. Somatic chromosome number, 2*n* = 22.

Additional specimens examined. **TAIWAN.** Nantou County, Luku Township, Hsitou, National Taiwan University Experimental Forest. Grassy floor of *Cryptomeria* plantation by "Vacation Lodge", 120°47' 34" E, 23°40'04" N, elev. ca. 1,200 m, 17 Feb 1994, *Peng 15911* (HAST).

Etymology. The specific epithet commemorates Dr. Nien-June Chung (鍾年鈞), a keen botanist who has accompanied the first author on many field trips and who discovered and called our attention to this unusual *Begonia*.

Notes. Based on morphological comparisons (Table 1), distribution (Figure 3), chromosome cytology (Figure 4), pollen stainability (Figure 5), and comparisons with experimental hybrids, we concluded that the unusual plants from Nantou County are F_1 hybrids between *B. longifolia* [sect. *Sphenanthera*] and *B. plamata* [sect. *Platycentrum*]. The indumentum of the hybrid is intermediate between those of its parents (Figure 6A-B, F-G, K-L). Figure 6C, H, and M compare leaf thickness, palisade cell size, and number of palisade cell layers in the three entities, again showing an intermediate condition in *B.* ×*chungii*. *Begonia palmata* has heteromorphic stomatal complexes, one kind normal and the other with subsidiary cells of different sizes and numbers (Figure 6E); *B. longifolia* has uniform, normal stomatal complexes (Figure 6O); and the hybrid *B.* ×*chungii* has both normal and deformed stomatal complexes (Figure 6J). In *B.* ×*chungii,* the deformed stomatal complexes lack stomata.

Both putative parents, *B. longifolia* and *B. palmata*, have 2*n* = 22 (Oginuma and Peng, 2002). *Begonia* × *chungii* has the same chromosome number as its parents, but exhibits irregular and inconsistent chromosome paring in meiosis, ranging from 2 II + 18 I to 8 II+ 6 I (Figure 4).

Unlike the other two natural hybrids of *Begonia* previously documented in Taiwan (*B.* ×*buimontana*: Peng and Chen, 1991; *B.* ×*taipeiensis*: Peng and Sue, 2000), the staminate flowers of *B.* ×*chungii* are not shed prematurely. *Begonia* ×*chungii* produces capsules, but the seeds are abortive.

Begonia ×*chungii* probably consists of F_1 hybrids only. Local populations are uniform morphologically, and experimental F_1 hybrids are exactly similar to them. Although the hybrids are sterile, the ease of vegetative reproduction by fragments of stem or leaves allows them to spread and persist. The periodic clearing of undergrowth on slopes in the experimental forest may create conditions favorable for their vegetative reproduction. *Begonia* × *chungii* occurs only as scattered clumps at the type locality, where it grows intermixed with its parents. It doubtless occurs elsewhere where the ranges of the parental species overlap.

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台灣產之新天然雜交種：鍾氏秋海棠

彭鏡毅　古訓銘

中央研究院生物多樣性研究中心 植物標本館 (HAST)

本文報導台灣一新天然雜交種 ： 鍾氏秋海棠 (*Begonia* ×*chungii* C.-I Peng & S. M. Ku)，提供線繪圖與彩色照片以資識別。根據形態特徵、地理分布、花粉可染率、結籽性、細胞學研究，以及人工雜交試驗等，我們推斷鍾氏秋海棠為一天然雜交種，其親本為二室組 [sect. *Platycentrum* (Klotzsch) A. DC] 之裂葉秋海棠 (*B. palmata* D. Don) 與無翅組 [sect. *Sphenanthera* (Hassk.) Warb.] 之圓果秋海棠 (*B. longifolia* Blume)，為一組間雜交之案例。

關鍵詞 ： 秋海棠屬 ； 鍾氏秋海棠 ； 圓果秋海棠 ； 裂葉秋海棠 ； 雜交種 ； 減數分裂 ； 天然雜交 ； 分類學。

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