

Begonia pengii (sect. *Coelocentrum*, Begoniaceae), a new species from limestone areas in Guangxi, China

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ABSTRACT. *Begonia pengii*, a new species from Guangxi Zhuangzu Autonomous Region, China, is here described and illustrated. Its somatic chromosome number ($2n = 30$) and karyotype are reported. *Begonia pengii* belongs to sect. *Coelocentrum* and somewhat resembles *B. variifolia* Y. M. Shui & W. H. Chen, from which it differs by its much larger size, leaves (11-)15-27 × (6-)8-15 cm, narrowly ovate, peduncle 17-37 cm; anther sacs red margined; and capsules 1.8-2.5 cm long. Like most members of sect. *Coelocentrum*, *B. pengii* is an attractive species and is rare, known only from one steep limestone hill in western Guangxi.

Keywords: *Begonia luochengensis*; *Begonia pengii*; *Begonia picturata*; *Begonia* sect. *Coelocentrum*; *Begonia variifolia*; Begoniaceae; China; Chromosome number; Guangxi; Karyotype; Limestone flora; New species; Rare species.

INTRODUCTION

The spectacular karst limestone landform in Guangxi, China is home to many endemic and rare species. As a result of our continued fieldwork in Guangxi and research on *Begonia*, an attractive new species of sect. *Coelocentrum* was discovered, which is described below.

MATERIALS AND METHODS

Cryo scanning electron microscopy

Fresh leaves of *Begonia pengii* 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. After 5 min, when the temperature rose to -130°C, the samples were fractured. The samples were 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).

Chromosome preparations

Root tips of *Begonia pengii* were pretreated with 2 mM 8-hydroxyquinoline solution at 15-18°C for about 8 h and fixed in ethanol-acetic acid (3:1) at about 4°C for more than 24 h. Chromosome preparations were made

by the enzyme squash method in an enzyme mixture of 4% Cellulase (Onozuka R-10, Yakult) and 2% Pectolyase Y-23 (Kyowa Chemical Products) at about 37°C for 1 h. The preparations were stained with 2% Giemsa solution (Merck). Classification of the chromosome complements based on centromere position at mitotic metaphase follows Levan et al. (1964). The voucher specimen has been deposited in HAST.

NEW SPECIES

Begonia pengii S. M. Ku & Yan Liu, sp. nov. —TYPE: CHINA. Guangxi Zhuangzu Autonomous Region, Bama Xian, Xishan. Sheltered, vertical limestone rock face, ca. 500 m alt. 18 May 2007, *Ching-I Peng, Yan Liu, Kuo-Fang Chung, Ming-Chao Yu & Hai-Shan Gao 21070* (holotype: HAST; isotype: IBK).

彭氏秋海棠

Figures 1, 2, 3A

Begoniae variifoliae Y. M. Shui & W. H. Chen affinis, sed foliis anguste ovatis, antherarum saccis rubromarginatis, habitu multo majore [foliis (11-)17-27 × (6-)8.5-15 cm, pedunculis 17-30 cm longis, capsulis 1.8-2.5 cm longis] differt.

Herbs, monoecious, epipetric, perennial, rhizomatous. *Rhizome* 6-15 cm or longer, (5-)9-12(-18) mm thick, internodes (5-)7-10(-12) mm long, brown or reddish brown, villous near base of petiole and leaf scars. *Stipules* eventually caducous, narrowly triangular-ovate, 12-15 mm long, 5-8 mm wide, reddish hyaline, herbaceous, weakly or not keeled, glabrous, margin eciliate, apex aristate,

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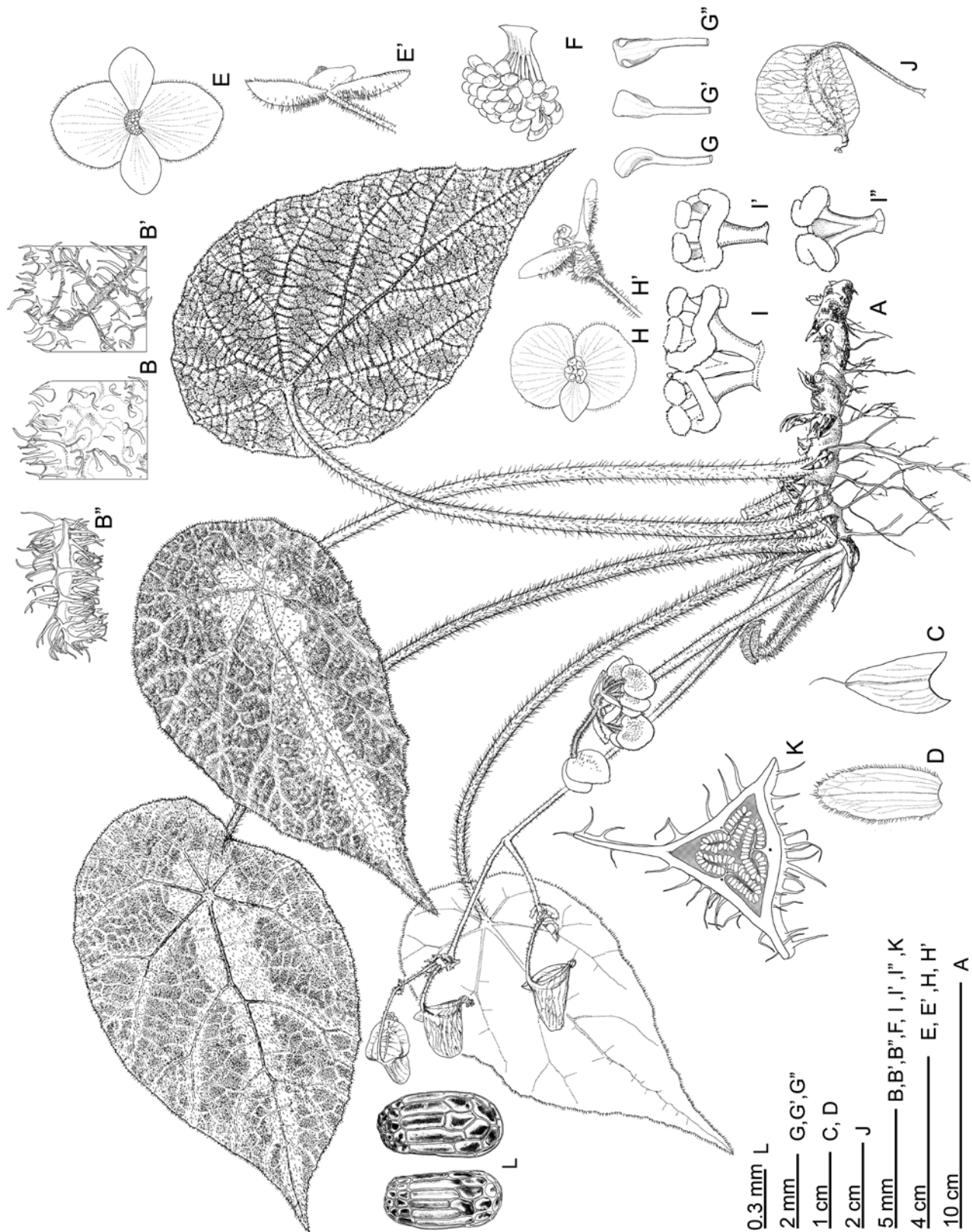


Figure 1. *Begonia pengii* S. M. Ku & Yan Liu. A, Habit; B, Portion of leaf, adaxial surface, showing margin and indumentum, B', abaxial surface, B'', cross section; C, Stipule; D, Bract; E, Staminate flower, face view, E', side view; F, Androecium; G, G', G'', Stamens; H, Carpellate flower, face view, H', side view; I, I', I'', Style and stigma; J, Dry capsule; K, Capsule, cross section; L, Seeds. All but A, J from Peng *et al.* 20724 (HAST); A, J from Peng *et al.* 21070 (HAST).

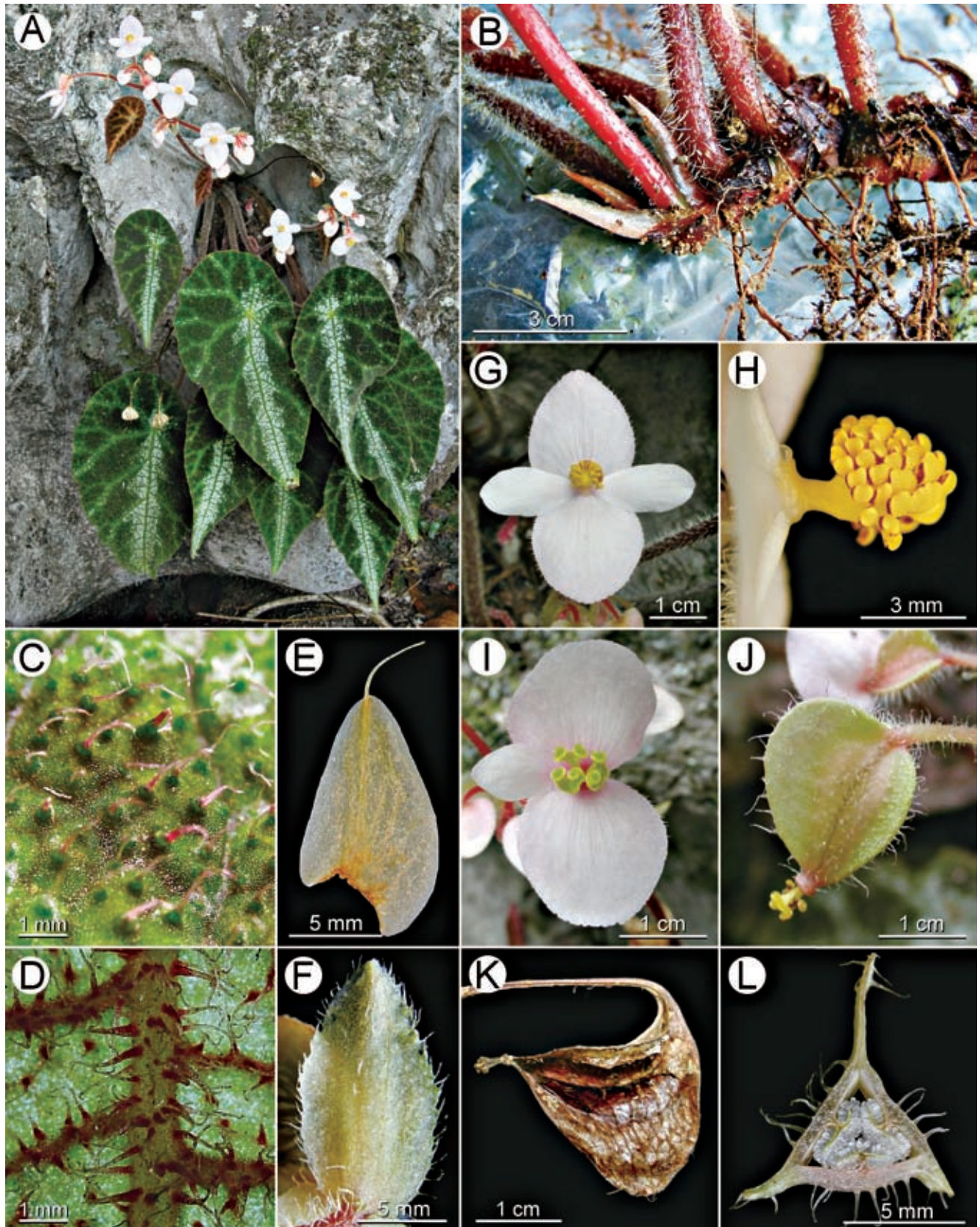


Figure 2. *Begonia pengii* S. M. Ku & Yan Liu. A, Habit; B, Rhizome; C, Leaf adaxial surface; D, Leaf abaxial surface; E, Stipule; F, Bract; G, Staminate flower, face view; H, Androecium, showing red-margined anther sacs; I, Carpellate flower, face view; J, Young capsule; K, Dry capsule; L, Middle cross section of a young fruit. All but C-F, K from Peng *et al.* 21070 (HAST); C-F, K from Peng *et al.* 20724 (HAST).



Figure 3. Holotype specimens. A, *Begonia pengii*, C.-I Peng et al. 21070 (HAST); B, *Begonia variifolia*, Y. M. Shui & W. H. Chen B2004-202 (KUN).

arista 3-5 mm long, hair-like. *Leaves* 2-8, alternate, simple, asymmetric, unlobed, narrowly ovate, base peltate (rarely subpeltate), margin crenate-denticulate and ciliate, apex acuminate to caudate, (11-)17-27 cm long (basal lobes included), (6-)8.5-15 cm wide, surface usually adorned with a wide whitish or pale silvery band (to 2 cm across) along midrib, pale green or whitish along major veins and major lateral veins, dark brownish to purplish red between major veins and major lateral veins, texture papery, surface rugulose, adaxially densely pilose (trichomes 0.7-1.2(-2) mm long, whitish-hyaline or reddish), abaxially villose-pilose, particularly pronounced on veins; venation basally 6-7-palmate, midrib distinct, veins pinnate along midrib, with 1-3 major lateral veins on each side, other primary veins branching dichotomously or nearly so, tertiary veins reticulate and weakly percurrent, forming a divergence angle of 75-100° to major veins, minor veins reticulate, all veins on abaxial surface prominently raised; petiole terete, (10-)15-26 cm long, 3-6.5 mm thick, brownish or brownish red, hirsute-villous. *Inflorescences* axillary, dichasial cymes 1-3 or more, arising directly from rhizome, branched 2 to 3 times. Flowers 4-12 per inflorescence; staminate flowers 3-9, carpellate flowers 1-3; peduncle well developed, terete, erect or ascending, 17-37 cm long, 1.5-3 mm thick, brownish or reddish

brown, densely pilose or hispid-villous. Bracts caducous, oblong, ovate or broadly ovate, margin denticulate and ciliate, apex obtuse or acute, 4-15 mm long, 3-7 mm wide. *Staminate flowers*: pedicel 1-2 cm long, pilose to hispid; tepals 4, outer 2 broadly ovate or suborbicular, base rounded or slightly cordate, margin usually ciliate, apex rounded, 17-21 mm long, 15-20 mm wide, pinkish or white, abaxially densely pilose (trichomes whitish); inner 2 tepals obovate or elliptic, base cuneate, margin entire, eciliate, apex obtuse or rounded, 13-17 mm long, 7-10.5 mm wide, white, glabrous; androecium zygomorphic, subglobose, stamens 30-75, golf-club-shaped; filaments subequal, 1.5-1.7 mm long, partly fused at base; anthers ± ascending, 2-locular, slightly compressed, obovoid or oblong-obovoid, connective apex slightly emarginate, 1-1.2 mm long, 0.7-0.8 mm wide, yellow with red margins along anther sacs. *Carpellate flowers*: pedicel 15-20 mm long, horizontally spreading to pendent, bracteole absent; tepals 3, caducous, outer 2 tepals suborbicular or obovate, margin ciliate at lower part or sometimes eciliate, 15-18 mm long, 18-20 mm wide, pinkish or white, abaxially densely pilose; inner tepal elliptic or broadly lanceolate, base cuneate, apex obtuse, 9-10 mm long, 6-7 mm wide, white or pinkish, glabrous; ovary trigonous-ellipsoid, ca. 8 mm long, 5-6 mm thick (wings excluded),

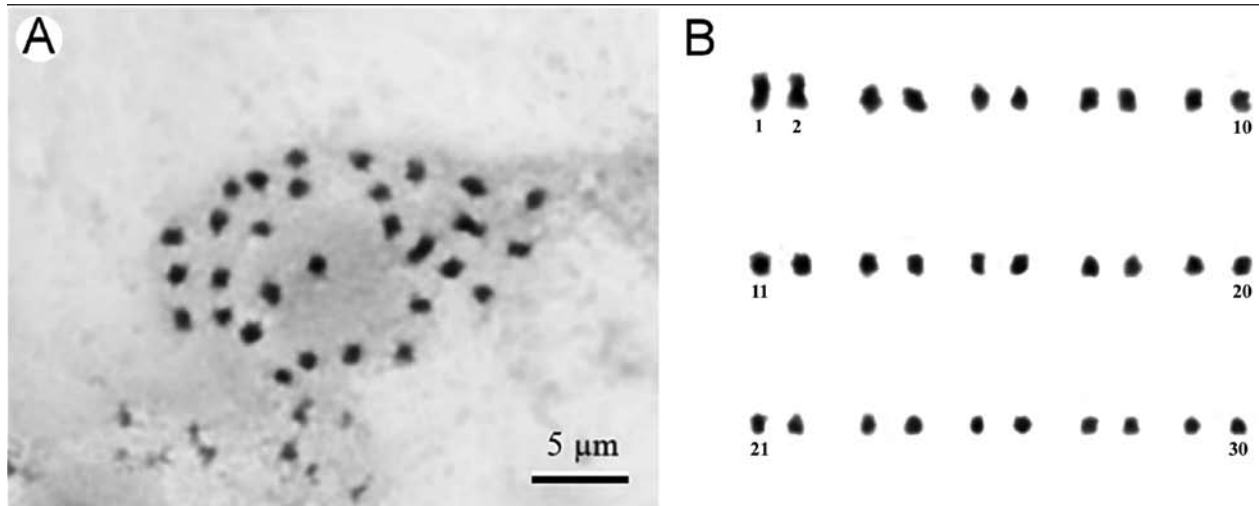


Figure 4. Karyomorphology of *Begonia pengii*. A, Somatic chromosomes at metaphase, $2n = 30$; B, Karyotype: chromosomes pairs arranged by decreasing order of length (from Peng et al. 20724).

pilose or villous-pilose, 3-winged; 1-locular with intruded parietal placentation (axile at base); placentae 3, each 2-branched (T-shaped); styles 3, nearly free, yellow, ca. 4 mm long, apically C-shaped; stigmatic band spiraled. Capsule nodding, trigonous-ellipsoid, somewhat curved, 18-25 mm long, 6-13 mm thick (wings excluded), apex with persistent styles; wings unequal; lateral wings 2-3 mm tall; abaxial wing crescent-shaped or nearly so, 7-11 mm tall. Seeds numerous, brown, ellipsoid or narrowly so, 0.56-0.68 mm long, 0.29-0.32 mm thick, chalazal end rounded, micropylar end obtuse or slightly constricted, outer periclinal walls of mature seeds concave; collar cells elongated, straight, nearly rectangular, 11-14 cells in a ring, occupying 1/4-1/2 of seed length. Somatic chromosome number, $2n = 30$ (Figure 4).

Additional specimens examined. CHINA. Guangxi Zhuangzu Autonomous Region, Bama Xian, Xishan, Limestone rock face, ca. 500 m alt. (same loc. as the type collection), 17 Dec 2005, Ching-I Peng, Shin-Ming Ku, Yan Liu, and Tsung-Han Tsai 20724 (HAST).

Habitat and Ecology. *Begonia pengii* was found in small populations on vertical, usually sheltered, rock faces in evergreen forests on jagged limestone hills.

Distribution. Endemic to western Guangxi, China (Figure 5); rare.

Etymology. We dedicate this new, handsome species of *Begonia* to Dr. Ching-I Peng, mentor of the first author. The specific epithet recognizes his emphatic interest and substantial contribution to the study of Asiatic *Begonia*. Heretofore, Dr. Peng and his associates have described 27 new species of *Begonia* (Peng et al., 1988; Peng and Chen, 1990; Peng and Sue, 2000; Ye et al., 2004; Ku et al., 2004; Peng et al., 2005a, b, c; Liu et al., 2005; Li et al., 2005; Peng et al., 2006a, b; Fang et al., 2006; Ku et al., 2006; Peng et al., 2007; Liu et al., 2007; Peng et al., 2008), many of which are of great horticultural potential.



Figure 5. Distribution of *Begonia pengii* (★), *B. variifolia* (●), *B. luochengensis* (■), and *B. picturata* (▲) in Guangxi Zhuangzu Autonomous Region, China.

Leaf anatomy and vestiture. Adaxial surface with multiserial trichomes 0.7-1.2 mm long (Figure 6A, B); upper epidermal cells conoidal; epidermis single-layered on both surfaces, hypoderm absent (Figure 6C). Abaxial surface with intermixed multiserial trichomes and unicellular (globose) or bicellular (upper cell globose) microtrichomes near the veins (Figure 6D, E), a unique character shared only by two other species in sect. *Coelocentrum*: *B. asteropyrifolia* Y. M. Shui & W. H. Chen and *B. variifolia* Y. M. Shui & W. H. Chen (Ching-I Peng, pers. comm.). Stomatal complex single, heliocytic, subsidiary cells (5-)6, moderately elevated (Figure 6F).

Phenology. Flowering from Mar to June; fruiting from June to Dec.

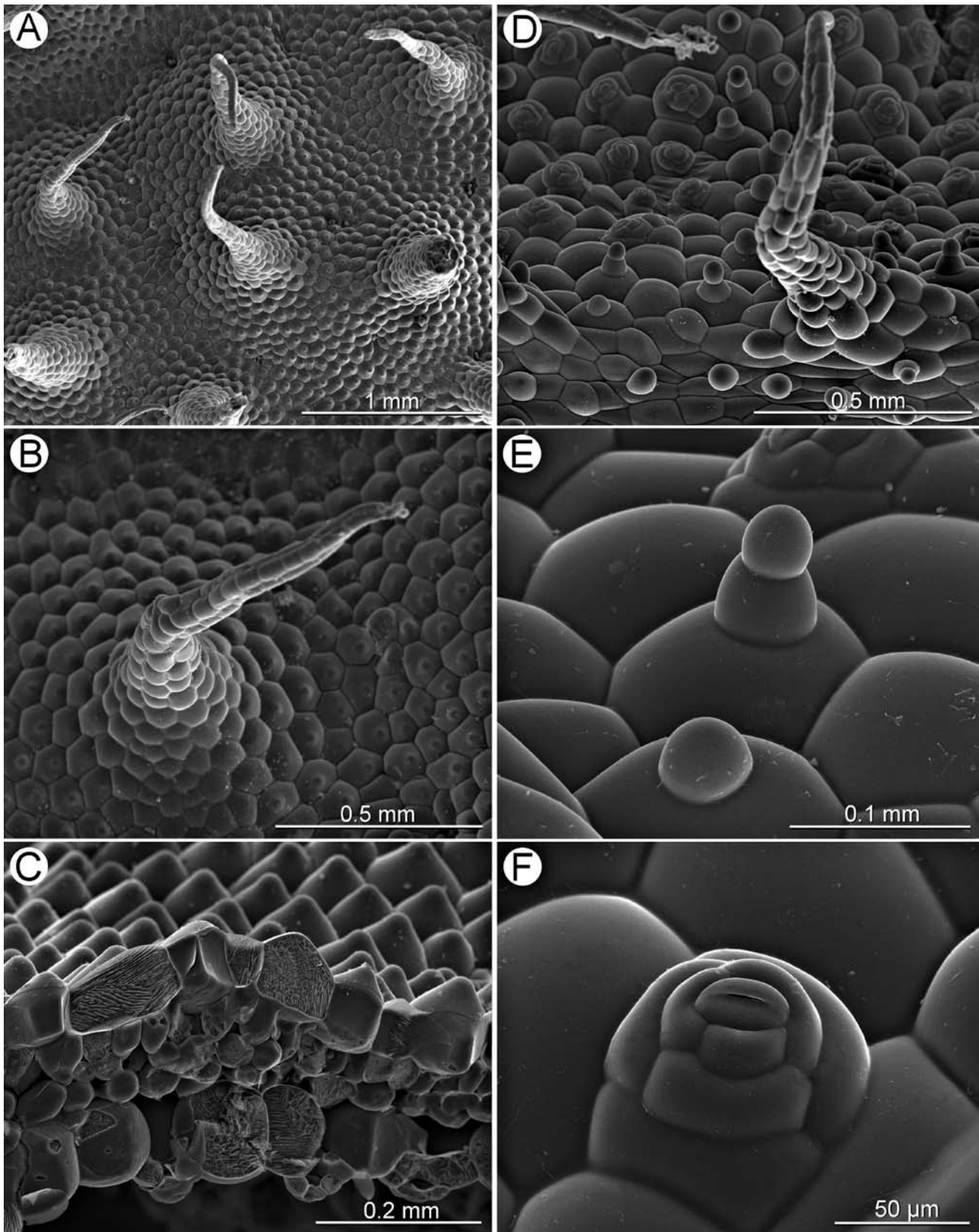


Figure 6. Leaf SEM microphotographs of *Begonia pengii*: A, B, Trichomes on upper epidermis; C, Lamina, cross section; D, Lower epidermis, showing two kinds of trichomes; E, Unicellular and bicellular microtrichomes (lower epidermis); F, Stomatal complex (lower epidermis).

Chromosome cytology. Somatic chromosomes at mitotic metaphase of *Begonia pengii* were determined to be $2n = 30$ (Figure 4). The chromosomes showed a bimodal variation in length. Of the 30 chromosomes, two were about 2 μm long (Figure 4-B: nos. 1 and 2); the

remaining 28 were shorter, ranging from about 0.9-1.4 μm in length. While the position of the centromere of some shorter chromosomes was unclear, the two longest chromosomes had centromere in the median position. Satellite chromosomes were not observed.

Table 1. Comparison of *Begonia pengii*, *B. variifolia*, *B. luochengensis* and *B. picturata*.

| | <i>B. pengii</i> (Figures 1, 2, 3A) | <i>B. variifolia</i> (Figure 3B) | <i>B. luochengensis</i> (Ku et al., 2004: Figures 4, 5) | <i>B. picturata</i> (Liu et al., 2005: Figures 1, 2) |
|------------------------|--|---|---|---|
| Rhizome diam. (mm) | (5-)9-12(-18) | (3-)4-6 | (5-)8-15(-20) | (5-)6-12 |
| Stipule | | | | |
| Indumentum | Glabrous | Glabrous | Glabrous | Abaxially villous |
| Margin | Eciliate | Eciliate or remotely ciliolate | Ciliate | Ciliate |
| Size (mm) | 12-15 \times 5-8 | 5-6 \times 3-5 | 7-10 \times 7-9 | 5.5-23 \times 6-10 |
| Shape | Narrowly triangular-ovate | Ovate | Triangular-ovate to semicircle | Ovate-triangular to lanceolate-triangular |
| Leaf | | | | |
| Size (cm) | (11-)15-23(-27) \times (6-)8-15 | 5-10 \times 3.5-7.2 | 5-20 \times 7-12 | (7-)10-15(-20) \times (5.5-)7-10(-14) |
| Base | Peltate (rarely subpeltate) | Peltate, subpeltate to basifixed | Basifixed | Basifixed |
| Maculation | With a prominent white band along midrib; pale green or white along major veins and lateral veins; usually dark brownish to purplish red between major veins | With or without a narrow white band along midrib, pale green along major veins and major lateral veins; green or brownish between major veins | With a prominent white band along midrib, pale green along major veins and lateral veins, dark brownish to purplish red between major veins | With a wide white, greenish-white, or pale green ring in the middle or with digitate dark brown bands along main veins and at leaf margin, pale green, yellowish green to whitish elsewhere |
| Tertiary venation | Reticulate and percurrent | Reticulate and percurrent | Ramified or loosely reticulate, not percurrent | Reticulate and percurrent |
| Peduncle | | | | |
| Indumentum | Densely pilose or hispid-villous | Pilose to hirsute-villous | Glabrous | Villous |
| Length (cm) | 17-37 | 7.5-21 | 8-22 | 10-16 |
| Outer staminate tepals | Densely pilose, usually ciliate | Densely pilose, usually eciliate | Glabrous, eciliate | Hirsute, eciliate |
| Anther sac | Yellow with red margins | Yellow throughout | Yellow throughout | Yellow with red margins |
| Capsule | | | | |
| Size (mm) | 18-25 \times 6-13 | 8-14 \times 4-6 | 11-17 \times 6-7 | 10-15 \times 6-8 |
| Indumentum | Pilose or villous-pilose | Pilose or villous-pilose | Glabrous | Villous-setose or hispid-setose |

The chromosome number of all 14 taxa of *Begonia* in sect. *Coelocentrum* reported earlier are uniformly $2n = 30$ (Fang et al., 2006; Ku et al., 2004, 2006; Liu et al., 2005, 2007; Peng et al., 2005a, 2005b, 2007, 2008). Two taxa, *B. ningmingensis* var. *bella* and *B. kui*, clearly showed bimodal variation in chromosome length (Fang et al., 2006; Peng et al., 2007).

Morphological notes. *Begonia pengii* is similar to *B. variifolia* (Shui and Chen, 2005), differing in the much larger size, leaves (11-)15-27 × (6-)8-15 cm (vs. 5-10 × 3.5-7.2 cm), narrowly ovate (vs. broadly ovate to ovate), peduncle 17-30 cm (vs. 7.5-21 cm); margin of the anther sacs red; and capsules 1.8-2.5 cm (vs. 0.8-1.4 cm). *Begonia* sect. *Coelocentrum* comprises more than 40 species. Red-margined anther sacs are known only in *B. pengii* and *B. picturata*. Detailed comparison of *B. pengii* with related species is presented in Table 1.

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中國廣西石灰岩地區秋海棠屬側膜組新種：彭氏秋海棠

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本文報導中國廣西壯族自治區的秋海棠屬側膜組 (*Begonia* sect. *Coelocentrum*) 一新種：彭氏秋海棠 (*Begonia pengii*)。本研究除提供線繪圖與彩色照片以資辨識外，並報導其染色體數 ($2n = 30$) 與核型。彭氏秋海棠與多變秋海棠 (*B. variifolia*) 略似，但植株明顯碩大：葉片大小為 (11-)15-27 × (6-)8-15 cm (後者 5-10 × 3.5-7.2 cm)，總花梗長 17-37 cm (後者 7.5-21 cm)，蒴果長 1.8-2.5 cm (後者 0.8-1.4 cm)；此外，葉片常呈狹卵形 (非廣卵形至卵形)、雄蕊之藥囊邊緣為紅色 (非黃色)，明顯與多變秋海棠有別。彭氏秋海棠之體態及葉片斑紋皆美，目前僅知其族群分布於廣西西部一個陡峭的石灰岩山，為稀有植物。

關鍵詞：羅城秋海棠；彭氏秋海棠；一口血秋海棠；多變秋海棠；秋海棠屬側膜組；秋海棠科；中國；染色體數；廣西；核型；石灰岩植物；新種；稀有植物。