

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

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(Received August 15, 2007; Accepted November 11, 2007)

ABSTRACT. *Begonia aurantiflora* C.-I Peng, Yan Liu & S. M. Ku, a new species of sect. *Coelocentrum* from Guangxi Zhuangzu Autonomous Region, China, is described and illustrated. Its somatic chromosome number, $2n = 30$, is here reported. *Begonia aurantiflora* is similar to *B. debaoensis*, differing in the tepals orange; leaves adaxially sparsely long-pilose, fully developed mature leaves often with whitish or silver-white ring-shaped belt on upper surface, peduncle, outer tepals and ovaries moderately pilose or glandular hairy. *Begonia aurantiflora* is the only species with orange flowers in sect. *Coelocentrum*. It is also a very rare species with a highly restricted distribution.

Keywords: *Begonia aurantiflora*; *Begonia daxinensis*; *Begonia debaoensis*; Begoniaceae; China; Chromosome number; Guangxi; Limestone flora; New species; sect. *Coelocentrum*; Rare species.

INTRODUCTION

Our field surveys of *Begonia* in southern China in the past several years have resulted in the discovery of a number of new species in sect. *Coelocentrum* (*B. curvicarpa* and *B. luochengensis*, Ku et al., 2004; *B. picturata*, Liu et al., 2005; *B. fangii*, Peng et al., 2005a; *B. liuyanii*, Peng et al., 2005b; *B. ningmingensis*, *B. retinervia*, Fang et al., 2006; *B. debaoensis*, *B. pseudodaxinensis*, *B. pseudoleprosa*, *B. semiparietalis*, Ku et al., 2006; *Begonia bamaensis*, Liu et al., 2007); sect. *Diploclinium* (*B. pulvinifera*, Peng et al., 2006); and sect. *Platycentrum* (*B. coptidifolia*, Ye et al., 2004; *B. rubinea*, Li et al., 2005; *B. crocea*, Peng et al., 2006). In this study we report an additional distinctive new species, *Begonia aurantiflora*, from the limestone areas in Guangxi, China. It is the only species in sect. *Coelocentrum* (comprising over 40 species) with orange tepals. Of the 173 Chinese species of *Begonia* (Gu et al., 2007), only three in sect. *Platycentrum* (*B. crocea*, *B. hekouensis* and *B. cathayana*), previously were known to have orange flowers.

MATERIALS AND METHODS FOR CRYO SCANNING ELECTRON MICROSCOPY

Fresh leaves of *Begonia aurantiflora* and *B. debaoensis* were dissected and loaded onto stubs. The samples were frozen by liquid nitrogen slush, and then transferred to

sample preparation chamber at -160°C . After 5 minutes, when the temperature raised to -130°C , the samples were fractured. The samples were etched 10 min at -85°C . After coating at -130°C , the samples were transferred to SEM chamber and observed at -160°C in cryo scanning electron microscope (FEI Quanta 200 SEM/Quorum Cryo System PP2000TR FEI). All vouchers are deposited at HAST.

NEW SPECIES

Begonia aurantiflora C.-I Peng, Yan Liu & S. M. Ku, sp. nov.—TYPE: CHINA. Guangxi Zhuangzu Autonomous Region, Jingxi Xian, Xinjing Zhen, at a limestone cave, 20 June 2007, *Wei-Bin Xu and Yan Liu 07054* (holotype: IBK; isotype: HAST). 橙花側膜秋海棠

Figures 1, 2

Begonia aurantiflora similis *B. debaoensis*, sed tepalis aurantiacis (in *B. debaoensis* roseis versus marginem, intus albidis), foliis supra sparse longeque pilosis (in *B. debaoensis* sparse vel modice setulosis), eis maturis et perfecte evolutis supra saepe annulatim albido-fasciariis vel argenteo-albo-fasciariis (in *B. debaoensis* pallide viridibus usque argenteo-albis cum venis viridibus vel brunneo-viridibus), pedunculis, tepalis exterioribus et ovariis modice pilosis vel glanduloso-pilosis (in *B. debaoensis* glabris) differt.

Herbs, monoecious; epipetric; perennial; rhizomatous. *Rhizomes* slender, 20-60 cm or longer, 3-6 mm thick, internodes (12-)20-30(-50) mm long, villous. Stipules eventually deciduous, ovate-triangular, apex acute, 6-12

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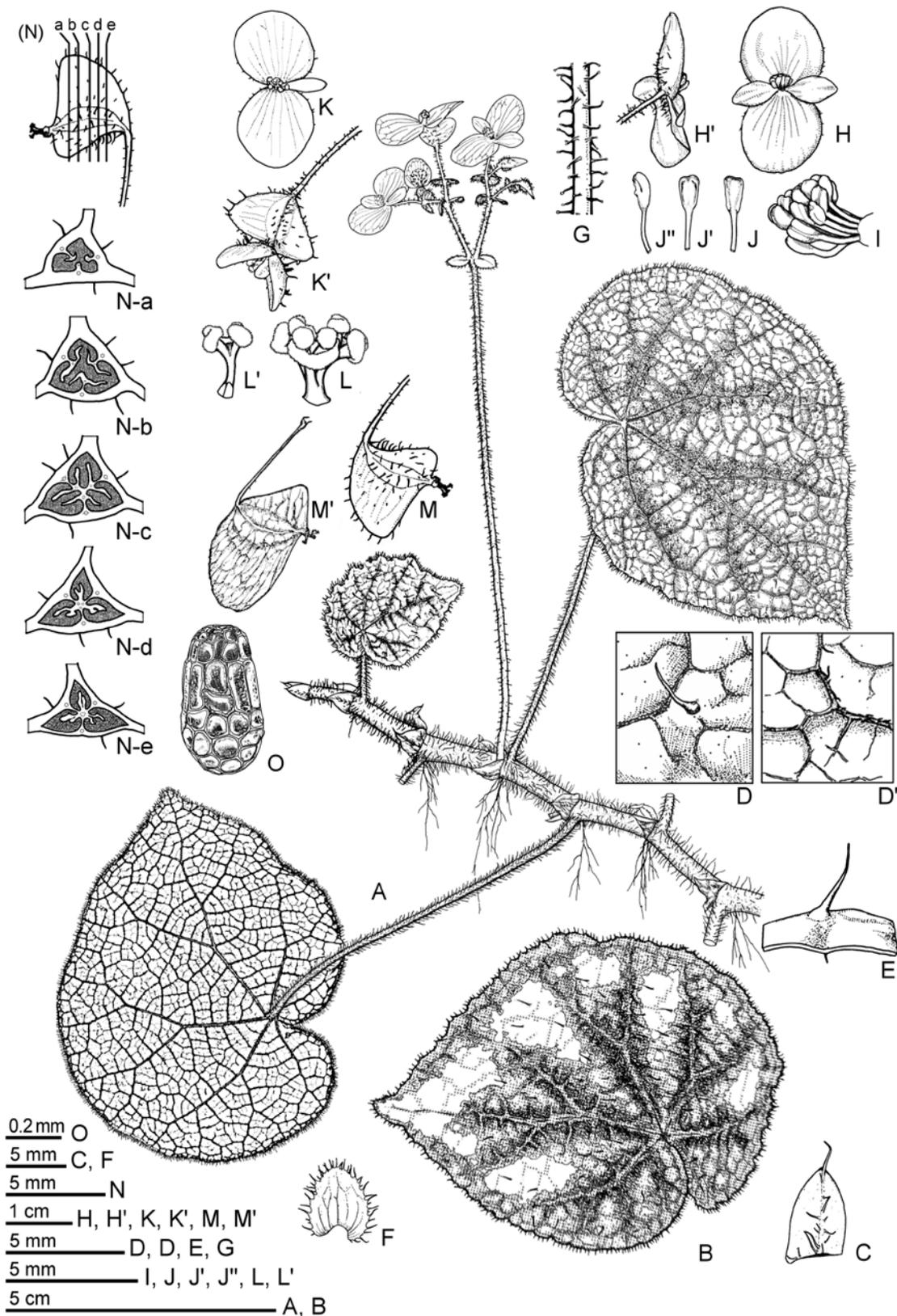


Figure 1. *Begonia aurantiflora* C.-I Peng, Yan Liu, S.M. Ku. A, Habit; B, Leaf, adaxial surface; C, Stipule; D, Portion of leaf, adaxial surface; D', abaxial surface; E, Trichome on adaxial leaf surface; F, Bract; G, Portion of secondary peduncle, showing glandulose hairs; H, Staminate flower, face view, H', side view; I, Androecium; J, Stamen, dorsal view, J', ventral view, J'', side view; K, Carpellate flower, face view, K', side view; L, L', Style and stigmas; M, Capsule, M', Dry capsule; N, Serial cross sections of capsule; O, Seed. All from Peng et al. 21172 (HAST).

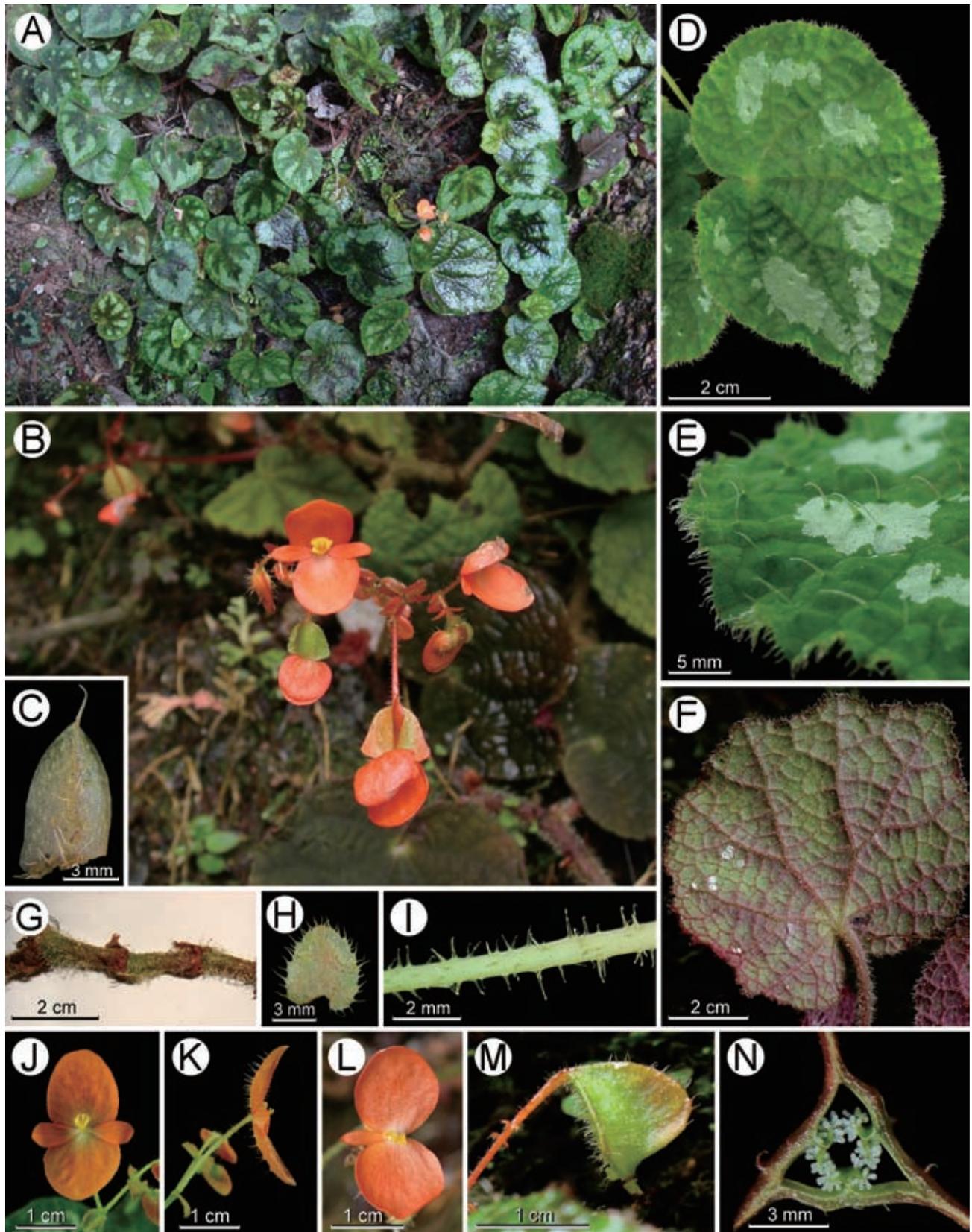


Figure 2. *Begonia aurantiflora* C.-I Peng, Yan Liu & S. M. Ku. A, Habit; B, Inflorescence; C, Stipule; D, Leaf, adaxial surface; E, Leaf, adaxial surface, showing trichomes; F, Leaf, abaxial surface; G, Portion of a rhizome; H, Bract; I, Pedicel of staminate flower, showing glandulose hairs; J, Staminate flower, face view; K, Staminate flower, side view; L, Carpellate flower; M, Fruit; N, Ovary, cross section. All but B, L from Peng et al. 21172 (HAST); B, L from Xu & Liu 07054 (IBK).

mm long, 4-7 mm wide, reddish-hyaline to brownish, not keeled or weakly keeled, with few hairs along midrib, with sparse minute glandular hairs on abaxial surface, margin eciliate, apex aristate, arista 1-2 mm long, hair-like. *Leaves* 5-10 or more, alternate, simple, asymmetric, unlobed, broadly ovate or suborbicular, base deeply cordate, margin denticulate and ciliate, apex obtuse to acute, (4.5-)7-11 cm long (basal lobes included), (4-)5.5-10 cm wide, fully developed mature leaves often with whitish or silver white ring-shaped belt on upper surface, with white maculation on intercostal area in juvenile plants (occasional on mature plants; rarely without maculation), with brown or brownish-green bands along major vein (forming a palmate mark), usually reddish on abaxial surface, texture thinly herbaceous, surface slightly rugose, adaxially sparsely long-pilose (trichomes 2-4 mm long, whitish-hyaline), abaxially densely pilose to tomentose, pronounced on veins; venation basally palmate, veins (5-)6, midrib distinct, with 1-3 major lateral veins on each side, other primary veins branching dichotomously or nearly so, tertiary veins percurrent and loosely reticulate, forming a divergence angle of 85-110° to major veins, minor veins reticulate, all veins raised on abaxial surface; petiole terete, (3.5-)6-10(-12) cm long, 2-4 mm thick, brownish or brownish red, villous. *Inflorescences* axillary, 1-3, arising directly from rhizome, flowers 5-22, in a dichasial cyme, cyme branched 1-4 times; staminate flowers 4-18, carpellate flowers 1 to 4; peduncle well developed, terete, erect or ascending, (4.5-)6-14(-17) cm long, 1-2 mm thick, glandular-pilose or glandulose-pilose. Bracts caducous, ovate to orbicular, margin denticulate and ciliate, apex obtuse or rounded, 2-5 mm long, 2-4 mm wide, membranaceous. *Staminate flowers*: pedicel 9-25 mm long; tepals 4, orange colored, outer 2 suborbicular, base rounded or slightly cordate, margin eciliate or sparsely ciliate, apex rounded, 9-14 mm long, 8-13 mm wide, pilose or glandular hairy on outer surface, inner 2 tepals oblong or obovate, apex obtuse, 5-8 mm long, 3-4 mm wide; androecium zygomorphic, stamens ca. 15-20, filaments 1.5-2.5 mm long, partly fused at base; anthers ascending, 2-locular, slightly compressed, oblong-obovoid, connective apex slightly emarginate, ca. 1 mm long. *Carpellate flowers*: pedicel 1-2 cm long, sometimes with one or two bracteoles on upper part; tepals 3, orange colored, caducous, outer 2 suborbicular, margin entire, eciliate, 8-13 mm long, 8-13 mm wide, pilose or glandular hairy on outer surface; inner 1 oblong or narrowly obovate, apex obtuse or acute, ca. 7 mm long, 2-3 mm wide, glabrous; ovary trigonous, ellipsoid, ca. 0.5-1 cm long, 4-5 mm thick (wings excluded), pilose or glandular hairy, 3-winged; wings unequal, lateral wings 2-4 mm tall, abaxial wing protruded, crescent-shaped or nearly so, 4-7 mm tall; locule 1; placentation intruded parietal from lower 1/3 to 1/2 of ovary to summit; placentae 3, each 2-branched; styles 3, fused in lower 1/3, yellow, ca. 3-3.5 mm long, apically C-shaped; stigmatic band slightly spiraled. *Capsules* nodding, stipe 1.5-2.5 cm, fruit body ca. 9-12 mm long, 4-6 mm thick (wings excluded), abaxial

wing 7-10 mm tall. Seeds numerous, brown, 0.47-0.53 mm long, 0.28-0.31 mm across, chalazal end rotund; operculum obtuse to subtruncate; collar cells elongated, nearly straight, 10-12 cells in a ring, occupying 1/4-1/2 of seed length, anticlinal boundaries of collar cells and between collar cells and operculum usually channeled; anticlinal boundaries of testa cells consistently channeled. Somatic chromosome number, $2n = 30$ (Figure 3).

Additional specimens examined. **CHINA.** Guangxi Zhuangzu Autonomous Region, Jingxi Xian, Xinjing Zhen, at a limestone cave, 2 Aug 2007, *Ching-I Peng, Minhua Peng, Chien-I Huang, Shan-Ming Cheng and Wei-Bin Xu 21166, 21172* (HAST, IBK).

Ecology. On semi-shady rocky cliff at entrance and inside of limestone caverns.

Distribution. Currently known only from two nearby limestone caves in western Guangxi, China (Figure 4).

Etymology. The specific epithet is derived from the orange flowers.

Leaf anatomy. Epidermis single-layered on both surfaces, hypoderm absent (Figure 5:B); stomata single, heliocytic type, subsidiary cell (5)-6 (Figure 5:C); cystoliths absent.

Chromosome number. As in all other species of *Begonia* sect. *Coelocentrum* for which chromosome numbers are known (Shui et al., 2002; Ku et al., 2004; Peng et al., 2005a, b; Liu et al., 2005; Fang et al., 2006; Ku et al., 2006; Peng et al., 2007), the somatic chromosome number of *B. aurantiflora* is $2n = 30$ (Figure 3).

Morphological notes. The new species is similar to *B. debaoensis* in aspect, differing in the tepals orange (vs. pink toward margin, whitish toward center); leaves adaxially sparsely long-pilose (Figure 5:A) (vs. sparsely or moderately setulose, Figure 5:D), fully developed mature leaves often with whitish or silver-white ring-shaped belt on the upper surface (vs. pale green to silver-white, and

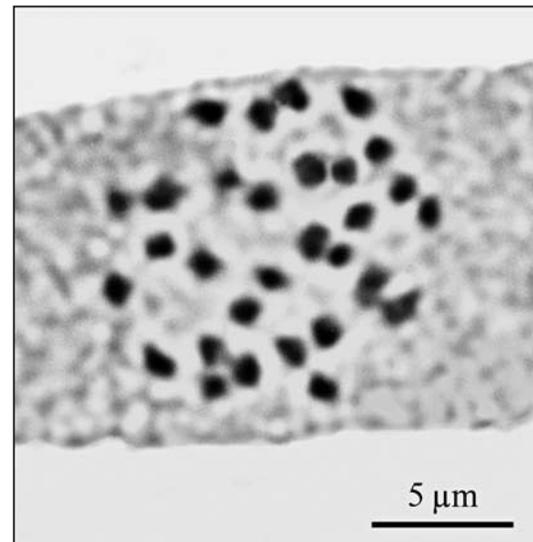


Figure 3. Mitotic chromosome spread of *Begonia aurantiflora* ($2n = 30$, from Peng et al. 21172).



Figure 4. Distribution of *Begonia aurantiflora* (star), *B. debaoensis* (circle), and *B. daxinensis* (triangles) in Guangxi Zhuangzu Autonomous Region, China.

with green or brownish green veins); peduncle, outer tepals and ovaries glandular hairy (vs. glabrous); and the anticlinal boundaries of testa cells channeled (Figure 6: A-D). It also somewhat resembles *B. daxinensis* (Figure 7), differing in the smaller general habit, slender rhizomes, orange tepals, and channeled anticlinal boundaries of testa cells. A detailed morphological comparison of the three species is provided in Table 1.

Acknowledgments. We thank Yoshiko Kono (HAST) for the chromosome spread; Qiner Yang (PE) for the Latin diagnosis; Thomas G. Lammers (OSH) for improving the manuscript; Wei-Bin Xu (IBK), Chien-I Huang, Shan-Ming Cheng, Minhua Peng (HAST) for field assistance; and Ming-Chao Yu for the handsome line drawings. This study was supported in part by the Kadoorie Farm and Botanic Garden, Hong Kong Special Administrative Region, China to Yan Liu (IBK) and grants from the National Science Council and Academia Sinica, Taiwan to Ching-I Peng (HAST).

Table 1. Comparison of *Begonia aurantiflora*, *B. debaoensis*, and *B. daxinensis*.

	<i>B. aurantiflora</i> (Figures 1, 2)	<i>B. debaoensis</i> (Ku et al., 2006: Figures 1, 2)	<i>B. daxinensis</i> (Figure 7; Ku et al., 2004: Figures 9, 10)
Rhizome			
Internode (mm)	12-50	15-35	(8-)10-35(-55)
Diameter (mm)	3-6	2.5-6	8-12
Stipules	Eciliate	Ciliate	Usually ciliate, rarely eciliate
Leaf			
Apex	Obtuse to acute	Acute to shortly acuminate	Acuminate or shortly so
Size (cm)	(4.5-) 7-11×(4-)5.5-10	(4.2-)6-8(-9.5)×(3.5-)4-6(-6.8)	(9.5-)16-24×(6-)11-17
Maculation on adaxial surface	Usually with whitish or silver white ring (sometimes interrupted)	Pale green to silver white, with green or brownish-green veins	Whitish or silver white ring-shaped belt
Indumentum on adaxial surface	Sparsely long-pilose (Figure 5:A)	Sparsely or moderately setulose (Figure 5:D)	Sparsely setose (Figure 7:G)
Surface of upper epidermis cells	Conoidal (Figure 5:B)	Sphaeroid to shallowly conoidal (Figure 5:E)	Sphaeroid to shallowly conoidal
Peduncle and pedicel	Pilose or glandular hairy	Glabrous	Sparsely villous or pilose, rarely subglabrous
Tepals			
Color	Orange	Pink toward margin, whitish inside	Pinkish to white
Indumentum	Outer 2 abaxially pilose or glandular hairy	Glabrous	Outer 2 abaxially sparsely or moderately pilose
Ovary	Pilose or glandular hairy	Glabrous	Subglabrous to pilose
Seeds (Figure 6)			
Anticlinal boundaries of testa cells	Channeled	Not channeled	Not channeled
Sculpture of testa cell	Densely shortly undulately striated and/or bifurcated	Elongately undulately striated and/or bifurcated	Shallowly and somewhat loosely undulately striated

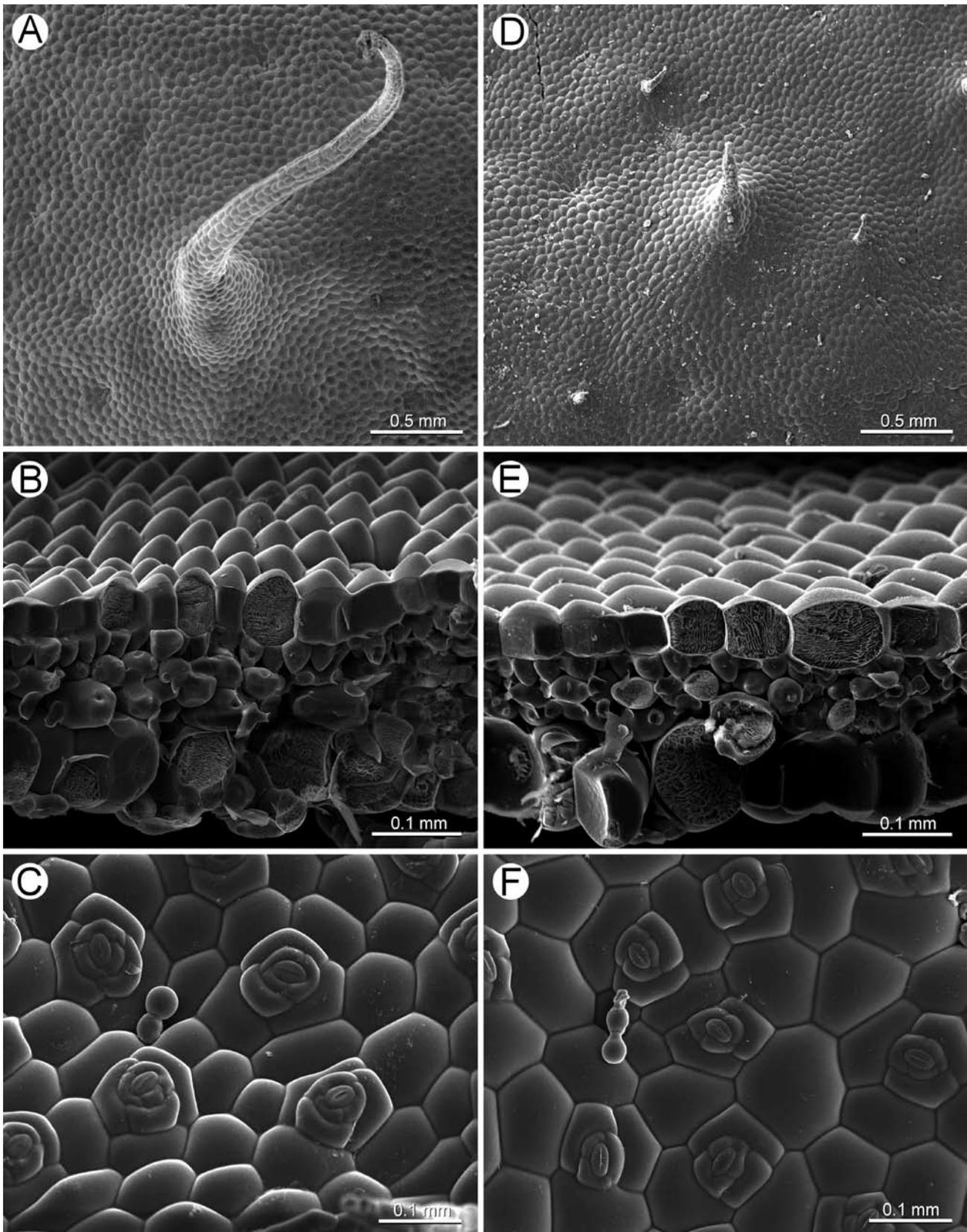


Figure 5. *Begonia* leaf SEM microphotographs. A-C, *Begonia aurantiflora*; D-F, *B. debaoensis*; A, D, Trichome on upper epidermis; B, E, Lamina, cross section; C, F, Lower epidermis, showing single stomatal complex. (A-C from Peng *et al.* 21172, HAST; D-F from Peng *et al.* 21090, HAST).

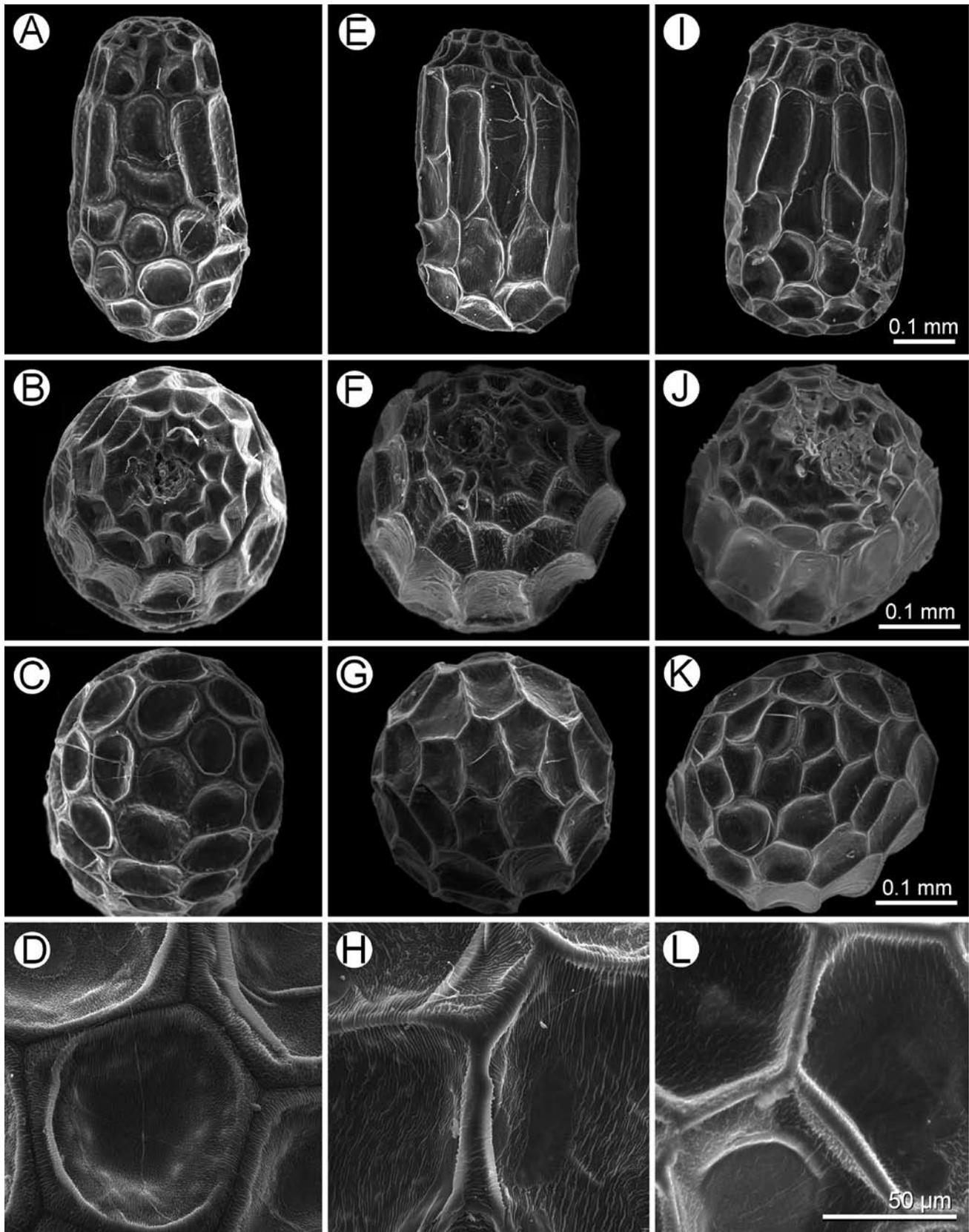


Figure 6. *Begonia* seed SEM microphotographs. A-D, *Begonia aurantiflora*; E-H, *B. debaoensis*; I-L, *B. daxinensis*; A, E, I, Side view; B, F, J, Micropylar end, showing operculum; C, G, K, Chalazal end; D, H, L, Testa cells. (A-D from Peng et al. 21172; E-H from Peng et al. 21089; I-L from Peng et al. 19695. All at HAST).

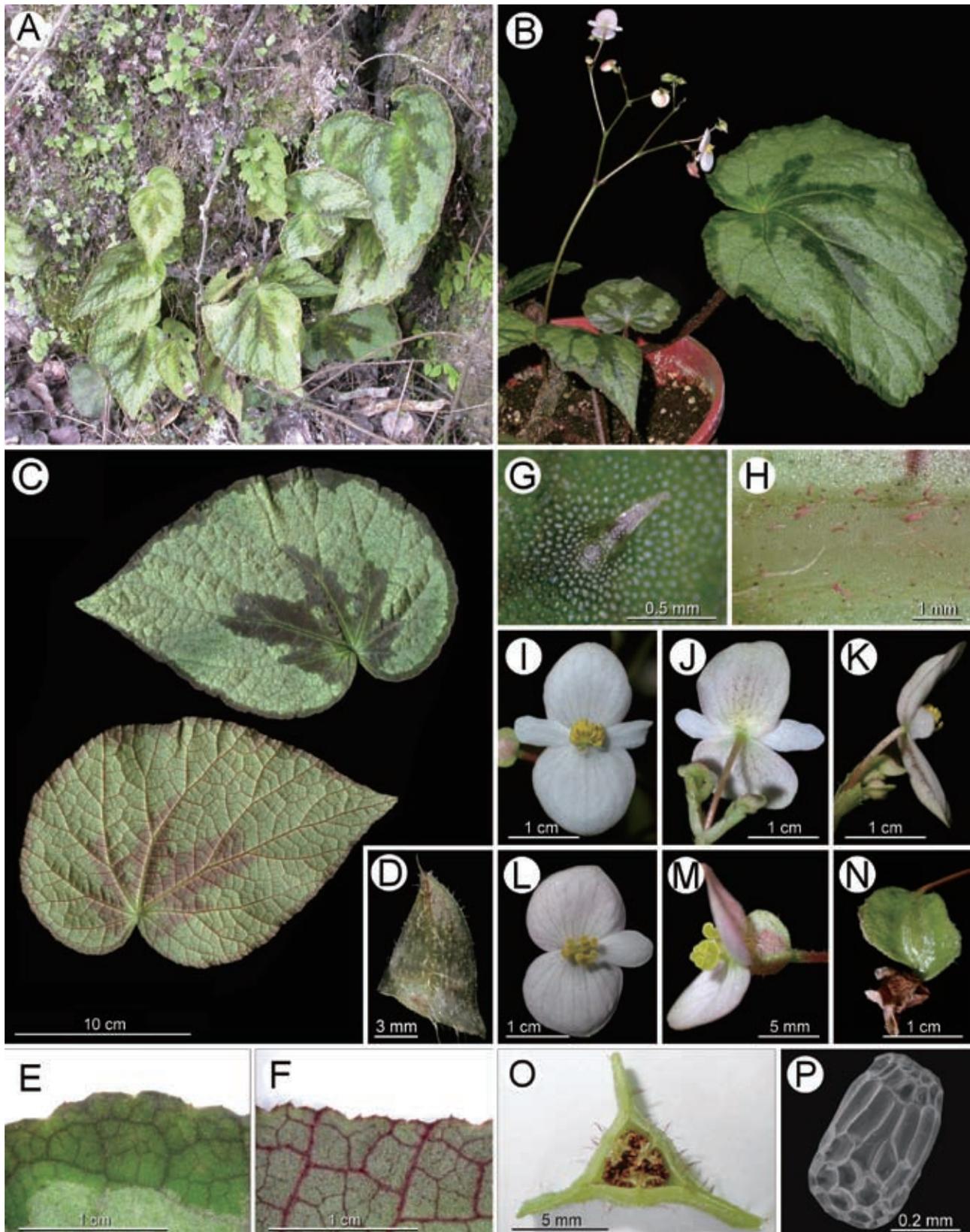


Figure 7. *Begonia daxinensis* T. C. Ku. A, Habitat; B, Habit; C, Leaves, adaxial (upper) and abaxial (lower) surfaces; D, Stipule; E, Leaf margin, adaxial surface; F, Leaf margin, abaxial surface; G, Leaf adaxial surface, showing a trichome; H, Leaf abaxial surface, showing trichomes; I, J, K, Staminate flower, face, back and side views; L, M, Carpellate flower, face and side view; N, Capsule; O, Capsule, cross section; P, Seed SEM micrograph. All from Peng *et al.* 19695 (HAST).

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中國廣西石灰岩地區秋海棠屬側膜組新種：橙花側膜秋海棠

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本文報導中國廣西壯族自治區西部石灰岩地區的秋海棠屬側膜組 (*Begonia* sect. *Coelocentrum*) 新種：橙花側膜秋海棠 (*B. aurantiflora*)，提供線繪圖與彩色照片以資辨識，並報導其染色體數 ($2n = 30$)。橙花側膜秋海棠與德保秋海棠 (*B. debaoensis*) 相似，但前者花被片橙色，葉上表面疏被長柔毛，成熟植株發育良好的葉表面常具有銀灰色環紋，花序梗、雌雄外花被外側與子房（果實）被柔毛，可資區別。此外，橙花側膜秋海棠的種皮細胞之垂周壁的邊界凹陷呈溝狀，與其他側膜組秋海棠明顯不同。中國產的 170 餘種秋海棠屬植物僅 4 種開橙色的花，其他 3 種都屬於二室組 (sect. *Platycentrum*)，分別為橙花秋海棠 (*Begonia crocea*)、花葉秋海棠 (*B. cathayana*) 以及河口秋海棠 (*B. hekouensis*)，但後二種亦見開粉紅花的個體。

關鍵詞：橙花側膜秋海棠；大新秋海棠；德保秋海棠；秋海棠科；中國；染色體數；廣西；石灰岩植物；新種；側膜組；稀有植物。