

# HYBRIDITY AND PARENTAGE OF *BEGONIA BUIMONTANA* YAMAMOTO (BEGONIACEAE) FROM TAIWAN<sup>1</sup>

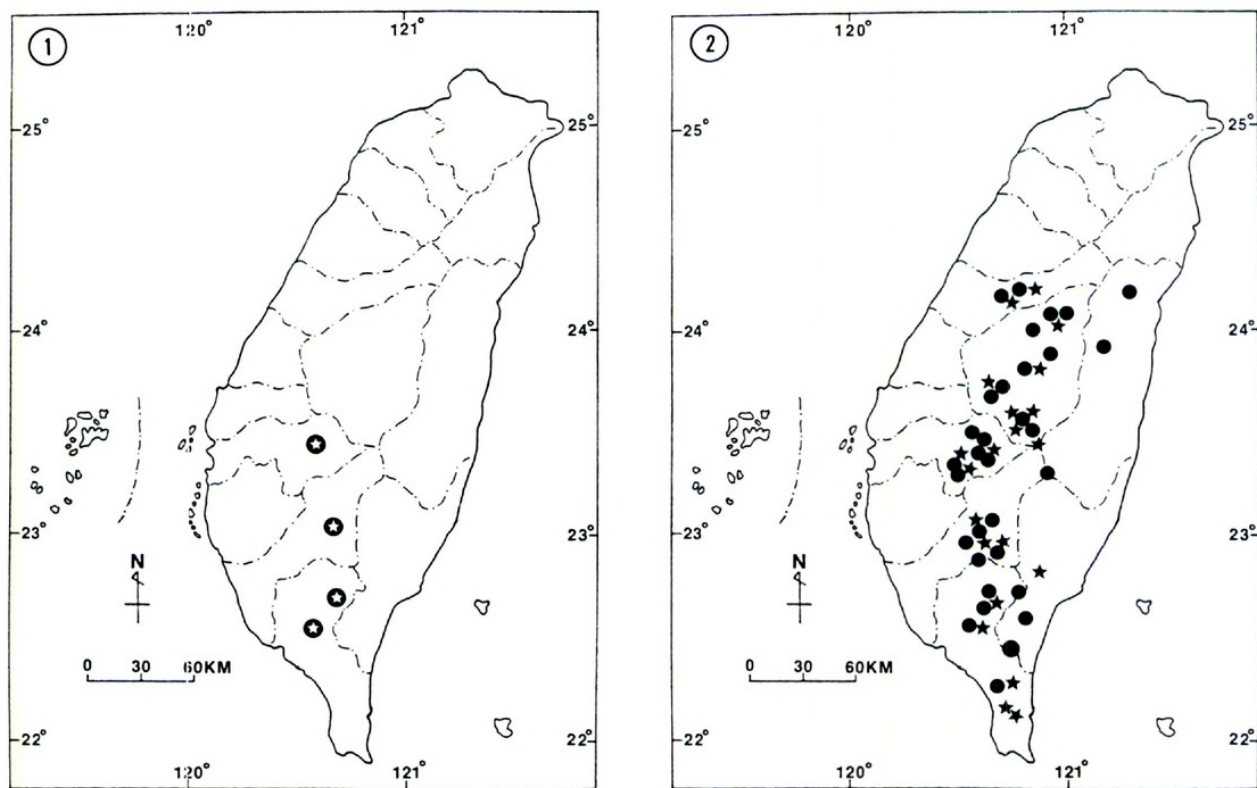
Ching-I Peng<sup>2</sup> and Yung-Kuan Chen<sup>2</sup>

## ABSTRACT

*Begonia buimontana* Yamamoto has been considered an endemic species with a restricted distribution at elevations between 1,000 and 1,600 m in southern Taiwan. Studies of morphology, flowering habit, pollen stainability, and meiotic chromosome behavior suggest a hybrid origin. Morphological comparisons, distribution patterns, chromosome cytology, and experimental hybridization show that *B. buimontana* consists of F<sub>1</sub> hybrids between *B. palmata* D. Don and *B. taiwaniana* Hayata. The hybrid nature and meiotic abnormalities in *B. buimontana* may account for its sterility and explain in part its rarity in nature. A description and line drawing of this hybrid are given.

The genus *Begonia* is represented by ten species in Taiwan (Liu & Lai, 1977; Lai, 1979, 1990; Liu & Ou, 1982; Peng et al., 1988; Peng & Chen, 1990). In our systematic revision of *Begonia* of Taiwan, our attention was drawn to a peculiar habit of *B. buimontana*, an endemic with a restricted

distribution at elevations between 1,000 and 1,600 m in southern Taiwan (Fig. 1). We were initially puzzled by not finding any opened staminate flowers in herbarium specimens of this species, although opened pistillate flowers are common. In our field trips to the type locality of *B. buimontana*, we

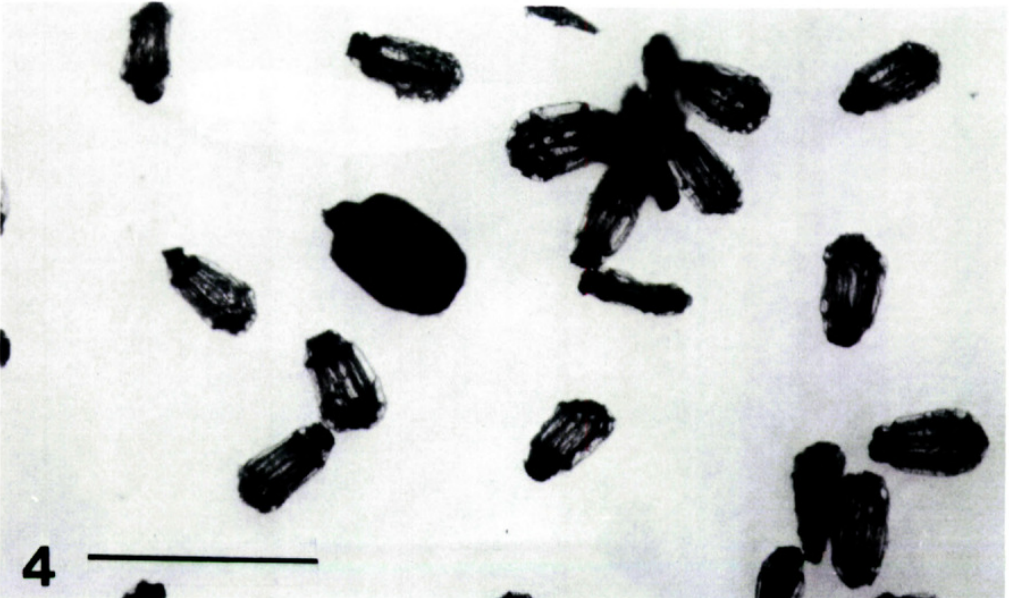


FIGURES 1 & 2. Distribution maps for Taiwan.—1. *Begonia buimontana*.—2. *Begonia taiwaniana* (stars), and *B. palmata* (dots).

<sup>1</sup> Supported in part by a research grant from the Academia Sinica, Taipei. We thank Luc Brouillet for helpful comments on the manuscript and Wen-Pen Leu for technical assistance.

<sup>2</sup> Institute of Botany, Academia Sinica, Nankang, Taipei, Taiwan 11529, Republic of China.







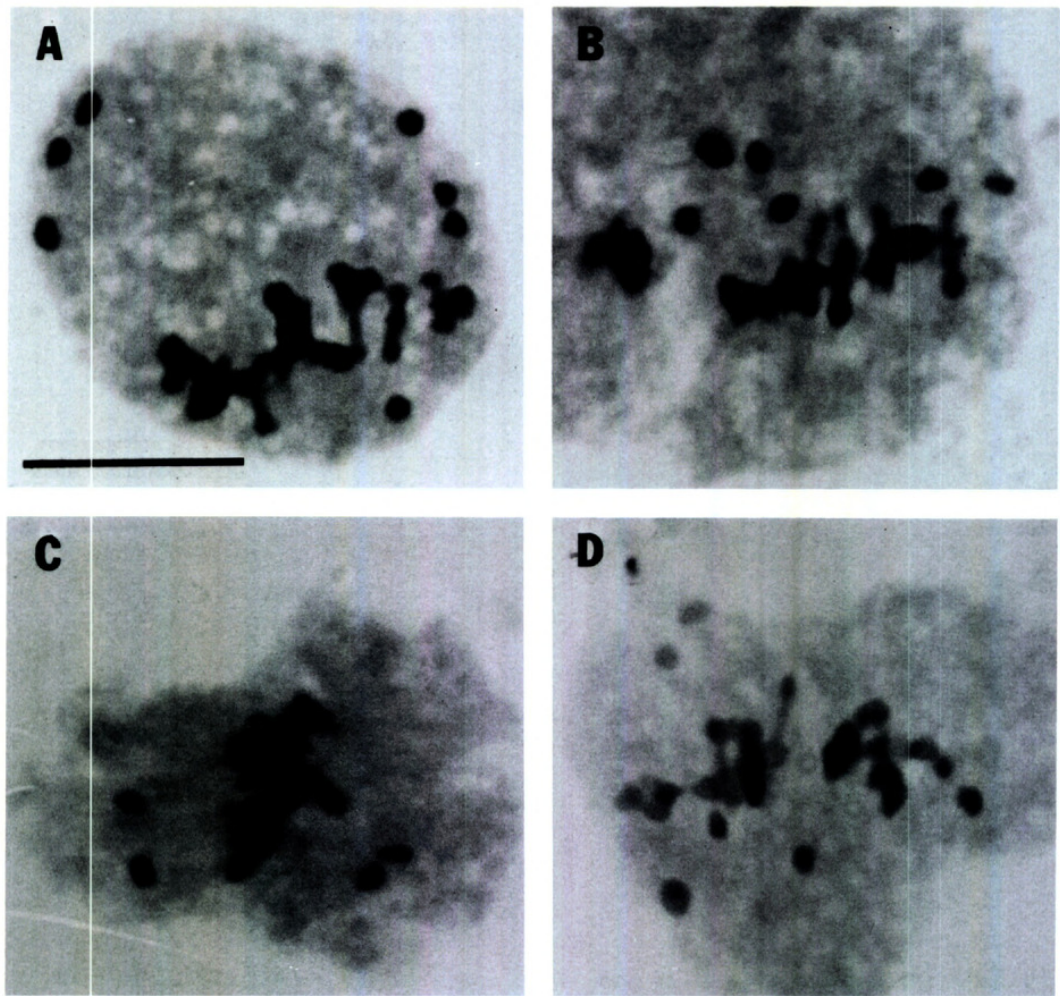


FIGURE 5. Meiotic chromosome spreads of *Begonia buimontana*.—A–D. Metaphase I, showing sticky, often disoriented bivalents, univalents, and multivalent associations. All from *Chen 671* (HAST). Bar equals 10  $\mu$ m.

observed many live plants. Like all other species of *Begonia* in Taiwan, *B. buimontana* is androgynous and produces staminate flowers prior to pistillate flowers. All plants of *B. buimontana* at anthesis produced abundant flowers of both sexes. All staminate flowers observed developed normally up to their late bud stage and dropped off before they were open. By contrast, pistillate flowers were always fully open at anthesis, and bud drop did not occur. Plants brought back from the wild and cultivated in the experimental greenhouse behaved similarly.

Although staminate flowers of *B. buimontana* were shed prematurely, the plants appeared to set abundant fruits. We suspected initially that, in the field, on some plants staminate flowers may open normally to make fruit set possible. An examination

of the pollen fertility of *B. buimontana* estimated by determining the percentage of stainable pollen using the malachite green-acid fuchsin-orange G stain of Alexander (1969), however, revealed nearly complete pollen abortion (Fig. 3). Careful examination of mature capsules of *B. buimontana* revealed that, although the fruits were well formed, they contained very few plump seeds (Fig. 4).

Cytological studies showed that *B. buimontana* has a somatic chromosome number of  $2n = 30$ . Chromosome configurations at meiotic metaphase I typically consisted of some sticky, often disoriented bivalents and up to at least 11 univalents; multivalents are often present (Fig. 5).

The aberrant phenomena led us to suspect a hybrid origin in *Begonia buimontana*. In our search for putative parents, *B. palmata* D. Don and *B.*

FIGURE 3. Aberrant and aborted pollen of *Begonia buimontana* (A) vs. mostly normal and stainable pollen of other species of *Begonia*, e.g., *B. taiwaniana* (B). Bar equals 20  $\mu$ m.

FIGURE 4. A portion of the seeds from a capsule of *B. buimontana*: all but one aborted. Bar equals 0.5 mm.



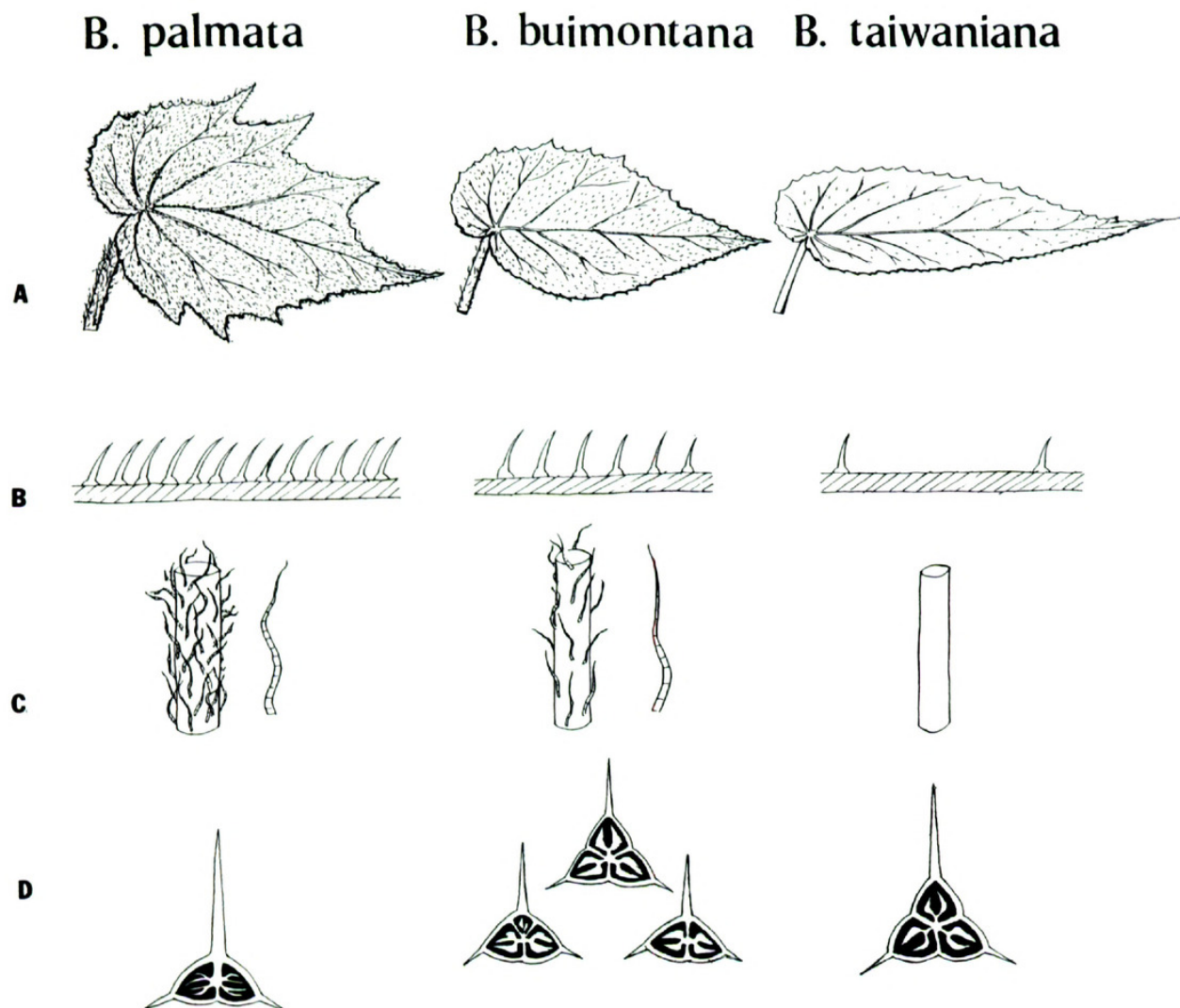


FIGURE 6. Comparison of *Begonia buimontana* with putative parents.—A. Leaf.—B. Leaf, cross section.—C. Petiole and hair type.—D. Fruit, cross section, showing placentation.

*taiwaniana* Hayata, the only species that commonly associate with *B. buimontana*, came to mind. *Begonia palmata* and *B. taiwaniana* are widespread and sympatric in the mountainous areas of central and southern Taiwan (Fig. 2). An analysis of vegetative and floral characteristics showed that *B. buimontana* is indeed intermediate between *B. palmata* and *B. taiwaniana* (Fig. 6; Table 1). Furthermore, cytological data showed that *B. palmata* has  $n = 11$  and *B. taiwaniana* has  $n = 19$ ; a somatic chromosome number of  $2n = 30$  would be expected in  $F_1$  hybrids of the two species (Fig. 7).

In order to substantiate our hypothesis that *B. buimontana* is derived from natural hybridization between *B. palmata* and *B. taiwaniana*, we crossed the putative parents and obtained artificial  $F_1$  hybrid plants. These plants closely resembled *B. buimontana* in aspect and morphology. Furthermore, as in wild plants of *B. buimontana*, they shed

staminate flowers precociously. They have a somatic chromosome number of  $2n = 30$  and negligible stainable pollen, too.

In conclusion, we consider that *B. buimontana* from Taiwan represents a hybrid, which, as a result of discrepancy in chromosome number and/or disharmony in genomes of the parental species, is pollen sterile and sheds staminate flowers prematurely. Plants of *B. buimontana* brought back from the field flowered in the insect-free experimental greenhouse but failed to set fruit. By contrast, mature fruits with a few seeds were often observed in plants of *B. buimontana* in the field. These were probably derived from back crosses with the putative parental species. Some of these seeds germinated in the experimental greenhouse but died at the cotyledonous stage.

Although both putative parents are widespread and sympatric in the mountainous areas of central and southern Taiwan, (Fig. 2), *B. buimontana* is



TABLE 1. Comparison of *Begonia buimontana* with putative parents.

Characters	<i>B. palmata</i>	<i>B. buimontana</i>	<i>B. taiwaniana</i>
Creeping rhizome	present	lacking	lacking
Plant height (cm)	to 60	to 100	to 200
Leaf width:length ratio	1:1–1.5	1:2–2.5	1:3–4.5
Pubescence	Densely scabrous	Scabrous	Sparingly scabrous to nearly glabrous
Number of styles	2	3	3
Number of ovary cells	2	(2–) 3	3
Length of abaxial wing of capsule (cm)	ca. 2	ca. 1	ca. 1
Chromosome number	$n = 11$	$2n = 30$	$n = 19$

known only from the type locality (Yamamoto, 1933) and three other stations (Fig. 1). Recently, Ying (1988) described *Begonia fenchihuensis*. An examination of his original description and type specimens reveals that it is synonymous with *B. buimontana*. The type locality of *B. fenchihuensis* represents the northernmost station known for *B. buimontana*. In this study we collected *B. buimontana* from two additional localities (Fig. 1 and see below).

Although *B. buimontana* is relatively rare on Taiwan, plants of this hybrid were fairly abundant where found, frequently intermixing with both putative parents, at least in the three localities we visited. The physiological characteristics and ecological tolerances of the putative parents may have recombined in the hybrids in such a way as to limit its distribution range.

*Begonia buimontana* is most likely represented only by  $F_1$  hybrids. Populations are very uniform morphologically, and experimental  $F_1$  hybrids are comparable to wild plants. Although such hybrids are sterile, once established, they are able to persist in a given location due to their perennial habit. The expansion of their populations on the island, however, can only be achieved by recurrent natural hybridizations.

The taxonomic treatment and an illustration of this hybrid species are given below.

***Begonia* × *buimontana*** Yamamoto (pro sp.), J. Soc. Trop. Agric. 5: 353. 1933. Liu & Lai in Li et al., Fl. Taiwan 3: 792. 1977. TYPE: Taiwan. Pingtung County (“Hsien”): Wuweishan. *Matuda* 322 (holotype, TAI). Figure 8.

*Begonia fenchihuensis* Ying, syn. nov. Color Ill. Fl. Taiwan 3: 618. 1988. TYPE: Taiwan. Chiayi County (“Hsien”): Fenchihu to Shihcho (as Shi-Chao), elev. 1,400 m, 16 Jan. 1988, S. S. Ying s.n. (holotype, Herb., Dept. Forest., Natl. Taiwan Univ.; isotype, Herb., Dept. Forest., Natl. Taiwan Univ.)

Erect, perennial, succulent herb; horizontal rhizomes lacking. Stems glabrous or sometimes remotely pilose, 40–125 cm high, to 26 mm diam. Stipules glabrous, caducous, ovate to broadly ovate, to 23 mm long, 18 mm wide, the apex acuminate, the margins entire. Leaves densely scabrous or hirsute on both surfaces, obliquely lanceolate to narrowly ovate, 8–22 cm long, 4–8 cm wide, the apex acuminate to cuspidate, the base obliquely cordate, the margins irregularly denticulate or serrulate; venation palmate, the veins 5–8, sometimes

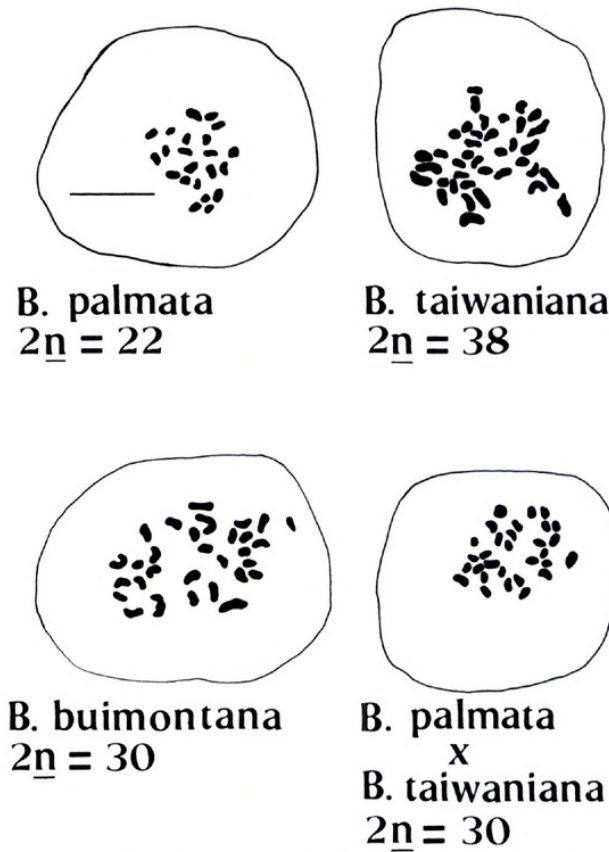


FIGURE 7. Camera lucida drawings of somatic chromosome spreads of *B. palmata*, *B. taiwaniana*, *B. buimontana*, and an experimental hybrid, *B. palmata* × *B. taiwaniana*. Bar equals 10  $\mu$ m.



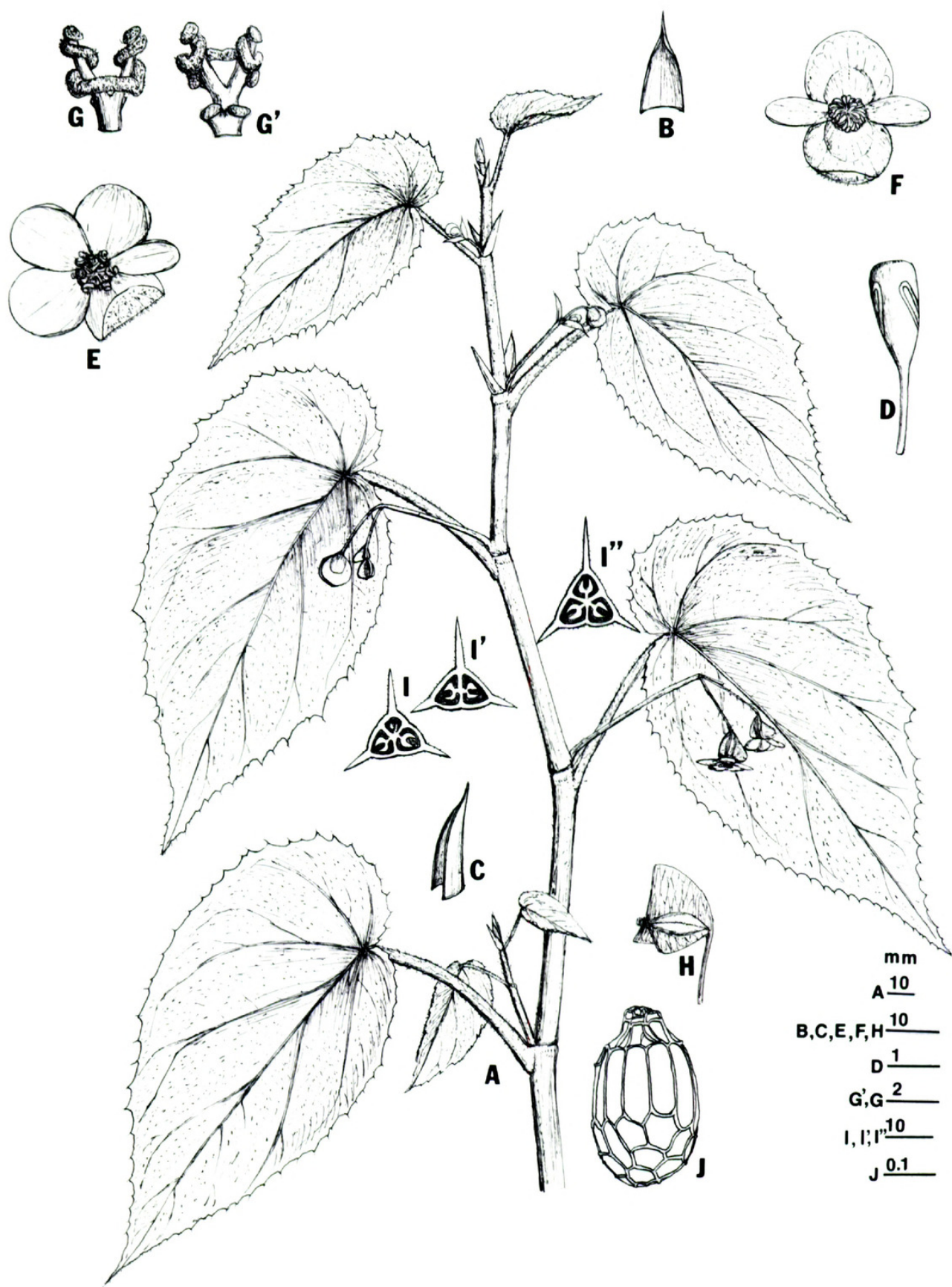


FIGURE 8. *Begonia*  $\times$  *buimontana*. — A. Habit. — B. Bract. — C. Stipule. — D. Stamen. — E. Pistillate flower. — F. Staminate flower, from a bud opened and spread with a forcep. — G, G'. Style. — H. Fruit, external morphology. — I, I', I''. Fruit, cross section, showing placentation. — J. Seed.



villous; petioles rusty villose, 7–16 cm long, to 5 mm diam. Bracts in pairs, thickly papery, glabrous, caducous, narrowly ovate to ovate, to 24 mm long, 17 mm wide, the apex mucronate to acuminate, the margins entire. Inflorescence 6–11 cm long; peduncles erect to pendulous, glabrous or sometimes pilose, to 7 cm long, 2 mm diam. Flowers pink, abaxial surfaces of the outer tepals densely scabrous. Staminate flower: tepals 4, never open, the outer two obovate to orbicular, to 14 mm long, 13 mm wide, the inner two oblanceolate to narrowly obovate, to 13 mm long, 6 mm wide; stamens numerous, to ca. 140, some of which may be reduced, yellow, golf-club-shaped, the anthers narrowly obovoid, 1.8–2.2 mm long, 0.9–1.2 mm across, the filaments 1.5–2.8 mm long. Pistillate flower: tepals 5(–6), unequal to subequal, oblanceolate to orbicular, the largest 11–19 mm long, 9–18 mm wide, the smallest 9–17 mm long, 4–9 mm wide; styles 2–3, yellow, 4.7–5.3 mm long, at their base fused ca. 1.4 mm long, each bifid; ovary inferior, ellipsoid, (2–)3-locular, longitudinally shallowly grooved between the locules, 3-winged; placentae axile, bilamellate. Infructescence to 17 mm long, the fruit-bearing stipes 18–34 mm long; the abaxial wing triangular, 12–19 mm long, 11–16 mm wide, the lateral wings much narrower, 4–6 mm long, 10–14 mm wide. Well-formed seeds few, never exceeding 35 per mature fruit, broadly ellipsoid, 0.35–0.38 mm long, 0.19–0.22 mm thick, the apex rotund, the seed lip nipple-shaped, the micropylar end constricted.

*Distribution.* Southern part of the Central Mountain Range of Taiwan, at elevations between 1,000 and 1,600 m. Known from Pingtung, Kaohsiung, and Chiayi counties.

*Additional specimens examined.* TAIWAN. KAOHSIUNG CO.: Tengchi, *Chen & Peng* 363 (HAST), *Chen* 726 (HAST). PINGTUNG CO.: mountain-hiking entrance of Peitawushan, *Peng* 10617, 13240 (HAST), *Chen* 644, 662 (HAST), *Lai* 9819 (TAI); en route from Peitawushan to Taiwu, *Chen* 671, 672 (HAST).

*Begonia* × *buimontana* consistently has 5(–6) tepals in pistillate flowers. The report of Liu & Lai (1977) of two pistillate tepals in this hybrid species was incorrect. In Taiwan, the only species of *Begonia* with two tepals in pistillate flowers is *B. ravenii* Peng & Chen (Peng et. al., 1988).

#### LITERATURE CITED

- ALEXANDER, M. P. 1969. Differential staining of aborted and nonaborted pollen. *Stain Technol.* 44: 117–122.
- LAI, M. J. 1979. Critical studies on some *Begonia* from Taiwan. *Taiwania* 24: 35–37.
- LAI, M. J. 1990. *Begonia tarokoensis* Lai, a new species from eastern Taiwan. *Landscape Architect. (Taiwan)* 4: 125.
- LIU, T. S. & M. J. LAI. 1977. *Begoniaceae*. Pp. 791–798 in H. L. Li, T. S. Liu, T. C. Huang, T. Koyama & C. E. DeVol (editors), *Flora of Taiwan*, Volume 3. Epoch Publ. Co., Taipei.
- LIU, Y. C. & C. H. OU. 1982. Contributions to the dicotyledonous plants of Taiwan (VII). *Bull. Exp. Forest. Natl. Chung Hsing Univ.* 4: 1–16.
- PENG, C. I. & Y. K. CHEN. 1990. *Begonia austrotaiwanensis* (Begoniaceae), a new species from southern Taiwan. *J. Arnold Arbor.* 71: 567–574.
- , ——— & H. F. YEN. 1988. *Begonia ravenii* (Begoniaceae), a new species from Taiwan. *Bot. Bull. Acad. Sin.* 29: 217–222.
- YAMAMOTO, Y. 1933. Observation ad Floram Formosanum VIII. *J. Soc. Trop. Agric.* 5: 346–354.
- YING, S. S. 1988. *Coloured Illustrated Flora of Taiwan*, with the Introduced Plants. [Published by the author, Taipei.]



Peng, Ching-I and Chen, Yung-Kuan. 1991. "Hybridity and Parentage of *Begonia buimontana* Yamamoto (Begoniaceae) from Taiwan." *Annals of the Missouri Botanical Garden* 78, 995–1001. <https://doi.org/10.2307/2399739>.

**View This Item Online:** <https://www.biodiversitylibrary.org/item/89022>

**DOI:** <https://doi.org/10.2307/2399739>

**Permalink:** <https://www.biodiversitylibrary.org/partpdf/35626>

**Holding Institution**

Missouri Botanical Garden, Peter H. Raven Library

**Sponsored by**

Missouri Botanical Garden

**Copyright & Reuse**

Copyright Status: In copyright. Digitized with the permission of the rights holder.

License: <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Rights: <https://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.