

Research note

## *Aristolochia yujungiana* (Aristolochiaceae): A New Species from Taiwan

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### [ Summary ]

*Aristolochia yujungiana* C.T. Lu & J.C. Wang, a new species from Taiwan is described and illustrated. Compared to its congeners in Taiwan and neighboring areas, *A. yujungiana* is similar to *A. shimadae*, *A. heterophylla*, *A. kaempferi* and *A. liukiensis*. However, it can be differentiated from *A. shimadae* by the perianth color and shape, from *A. heterophylla* by the bracteole shape and limb surface, and from *A. kaempferi* and *A. liukiensis* by the limb-lobe morphology and perianth-tube shape. A morphological description, diagnosis, line drawings, photographs, and conservation status of *A. yujungiana* as well as a key and a comparison table to morphologically similar species are provided to aid in identification.

**Key words:** *Aristolochia yujungiana*, Aristolochiaceae, new species, Taiwan.

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## 研究簡報

## 台灣產馬兜鈴屬植物之一新種—裕榮馬兜鈴

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## 摘 要

本文描述台灣產的新種馬兜鈴屬植物—裕榮馬兜鈴。與台灣及鄰近地區的同屬植物做比較，此新種與台灣馬兜鈴、異葉馬兜鈴、大葉馬兜鈴與琉球馬兜鈴相似。但是，能以花萼筒的顏色與形狀與台灣馬兜鈴區分，以小苞片形狀與花萼筒檐部表面毛被差異與異葉馬兜鈴區別，以及用花萼筒檐部裂片形態與花萼筒形狀與大葉馬兜鈴及琉球馬兜鈴做區分。文中除形態描述及分類特徵摘要外，並提供線描圖、照片、保育等級以及與其近緣之各物種的檢索表與比較表，以助於物種鑒別之用。

關鍵詞：裕榮馬兜鈴、馬兜鈴科、新種、台灣。

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## INTRODUCTION

*Aristolochia* L. *sensu lato*, comprising ca. 450 species distributed in tropical and temperate regions worldwide, is the largest and most diverse genus in the family Aristolochiaceae (Wagner et al. 2014). Recent phylogenetic studies of the genus based on morphological and molecular data suggested a subdivision of *Aristolochia* into 3 subgenera: *Aristolochia*, *Siphisia* (Raf.) Duchartre, and *Pararistolochia* Huteh & Dalz. (Wanke et al. 2006).

In Taiwan, 5~7 *Aristolochia* species (Liu and Lai 1976, Hwang 1981, Ma 1989, Hou 1996, Huang et al. 2003, Yang 2007) have been documented. These species can be sorted into the 2 subgenera of *Aristolochia* and *Siphisia*. *Aristolochia foveolata* and *A. zollingeriana* belong to the subgenus *Aristolochia* based on their slightly curved or rectilinear tube with a sharply distinct utricle and tube, a 1~3-lobed perianth limb, and a gynostemium with more than 3 lobes, each of which carries a single anther on its outer surface. On the other hand, all the other species are placed in

the subgenus *Siphisia* due to their U-shaped perianth without a sharply distinct utricle or tube, a 3-lobed limb, a gynostemium with 3 segments, and paired anthers on the outer surface of each gynostemium segment.

In the species of the subgenus *Siphisia* of Taiwan, *A. shimadae* is a controversial species. This species was first described by Hayata (1916), and some taxonomists (Lai 1973, Liu and Lai 1976) followed Hayata's concept and treated it as an endemic species, but others regarded it as *A. kaempferi* (Hwang 1981, Huang et al. 2003), or as a variety of *A. kaempferi* (Hwang 1988), *A. mollis* (Ma 1989), or *A. heterophylla* (Hou 1996). Recently, Murata (2006) revised the Japanese *Aristolochia*, and considered that *A. kaempferi* was an endemic species of Japan, and *A. shimadae* should be treated as a distinct species, distributed in Taiwan and Japan (central Honshu, Kyushu, and the Ryukyu Islands) (Murata 2006, Watanabe et al. 2006). Based on Murata's concept, *A. shimadae* can be defined as a species in which the floral characters are

conserved with a creamy inside perianth, and a yellow mouth that is rarely purple dotted, but the leaf morphology is polymorphic from triangulate-ovate to lanceolate-ovate (Murata 2006). Recently, Yang (2007) revised the Taiwanese *Aristolochia* again, and accepted Murata's (2006) opinions which treat it as *A. shimadae*. Accordingly, *A. heterophylla* and *A. kaempferi* that are recorded in the *Flora of Taiwan* 2<sup>nd</sup> edition (Hou 1996) should be treated as *A. shimadae* (sensu Murata 2006).

Recently, we received an unknown *Aristolochia* species found in the central part of Taiwan by Mr. Yu-Jung Hung. After a field investigation and comparisons with congeners from Taiwan and neighboring areas, we are certain that this unknown plant should be assigned to the subgenus *Siphisia*, and consider it to be a new species. In this paper, we describe this new species. Besides the diagnosis and morphological description, line drawings, photographs, and a key and a comparison table are provided to aid in the identification of it and its close relatives.

Repositories of specimens examined include the following: HAST, Herbarium, Biodiversity Research Center, Academia Sinica, Taipei, Taiwan; IBSC, South China Botanical Garden, Guangzhou, People's Republic of China; TAI, National Taiwan Univ., Taipei, Taiwan; TAIF, Taiwan Forestry Research Institute, Taipei, Taiwan; TI, Univ. of Tokyo, Tokyo, Japan; TNS, National Museum of Nature and Science, Tsukuba, Japan; TNU, National Taiwan Normal Univ., Taipei, Taiwan.

## TAXONOMIC TREATMENT

*Aristolochia yujungiana* C.T. Lu & J.C. Wang, *sp. nov.*—TYPE: Taiwan. Nantou County, Yuchi Township, Peishankan, *elev. ca.* 400 m, 8.II.2008, *Chang-Tse Lu 1635* (holotype TAIF; isotype TNU) 裕榮馬兜鈴 (Figs. 1, 3B, D, F, H, J, K)

**Diagnosis:** *Species A. shimadae* Hayata *similis*, *sed tubo perianthii ore nigro fauce viridi-flavo et atro-purpureo-maculato, seminibus late ovatis plano-concavis differt.*

Woody, perennial climber. Young branches terete, pubescent. Leaves lamina herbaceous to leathery; petiole 2~5 cm long; lamina 10~20 cm long, 2.5~3 cm wide, linear to lanceolate, rarely 3~5 lobed; base cordate, with 2 small basal lobes directed downward; apex acute to acuminate, adaxially green and glabrescent, abaxially grayish-green with pubescence along the veins, hairs appressed; nerves elevated on abaxial surface. Flower solitary in axils of prophylls of lateral branches; pedicel 4~5 cm long, bracteole ovate, *ca.* 3 mm long, inserted at base of pedicel. Perianth tube U-shaped, 3~4 cm long, upper 1/3 more slender, 5~6 mm wide at utricle, outer surface creamy, pubescent, and inner surface smooth and yellowish-green with dark-purple speckles; mouth subspherical to elliptical, *ca.* 5×8 mm, dark-purple sometimes with yellow dots, annulus distinct; limb obtriangular in front view, *ca.* 2 cm wide, deeply 3-lobed, lobes spread, recurved apically, dark-purple, sparsely pubescent. Stamens 6, adnate to style column, anthers oblong, *ca.* 2 mm long. Gynostemium *ca.* 4 mm long; stigmatic lobes 3, lobe triangular; ovary inferior, cylindrical, *ca.* 8 mm long, pubescent. Capsules hairy, ellipsoid to oblong, with 6 ridges, 4~5 cm long, 2.5~3 cm in diameter, and dehiscent from apex. Seeds flat, widely ovate, plano-concave, 5.2~6 mm long, and 5.2~5.5 mm wide.

**Distribution:** *Aristolochia yujungiana* is endemic to Taiwan and so far found only in the type locality, along the forest edge in low-elevation mountain areas of central Taiwan (Fig. 2).

**Phenology:** *Aristolochia yujungiana* blooms in December to March and fruits in March to August.

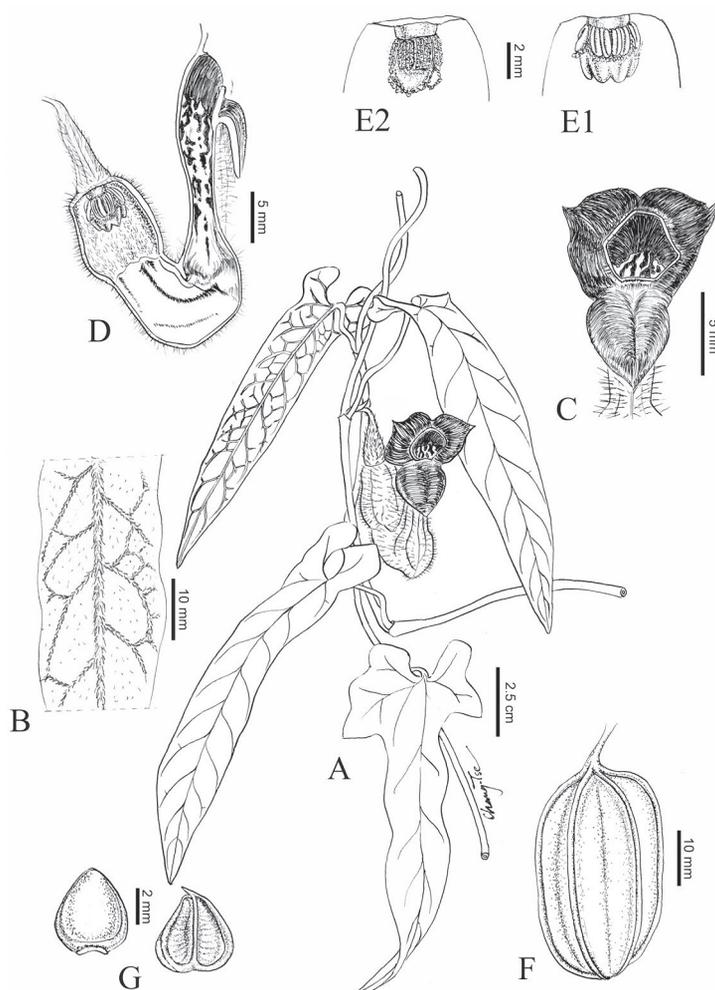


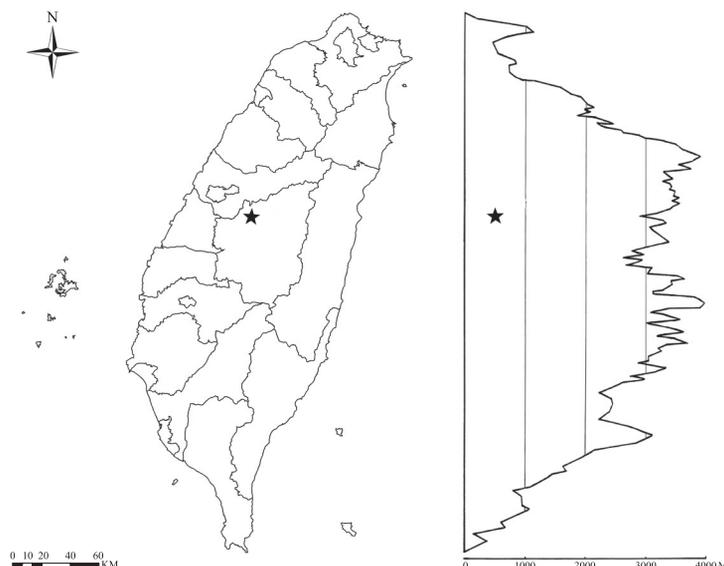
Fig. 1. *Aristolochia yujungiana* (from the holotype). A, habit; B, abaxial surface of the leaf; C, front view of the flower; D, bisection of the perianth tube; E, gynoecium: E1, pistillate stage; E2, staminate stage showing anther dehiscent and stigma folded; F, fruit; G, seeds, adaxial view (left) and abaxial view.

**Etymology:** The specific epithet is derived from the forename of Mr. Yu-Jung Hung, who discovered this new species.

**Conservation state:** Human activities like agriculture and reclamation have largely altered low-elevation mountain areas of Taiwan, especially in western Taiwan. The current population of *A. yujungiana* of fewer than 50 individuals covers an area of about 100 m<sup>2</sup>. We consider the current meager distribution of this new species a likely remnant of a more-

widespread population in the past. According to the International Union for Conservation of Nature (IUCN) threat categories (IUCN 2012), this species should be categorized as critically endangered (CR): B1ab (iii,v).

**Taxonomic notes:** By comparison to the congeners from Taiwan and neighboring areas, we found that *A. yujungiana* most closely resembles *A. shimadae* Hayata, especially the population that is distributed in eastern Taiwan. They both have linear to lanceolate



**Fig. 2. Geographical distribution of *Aristolochia yujungiana* (★).**

laminae, and the base is cordate with 2 small lateral lobes directed downward and acute at the apex. But *A. yujungiana* can be differentiated from *A. shimadae* by the flower color and shape. For example, the color of the mouth of the perianth tube is dark-purple and sometimes with yellow dots in *A. yujungiana*, while it is yellow in *A. shimadae*; and the diameter of tube of *A. yujungiana* is more slender (3~4 mm) than that of *A. shimadae* (5~7 mm) (Fig. 3).

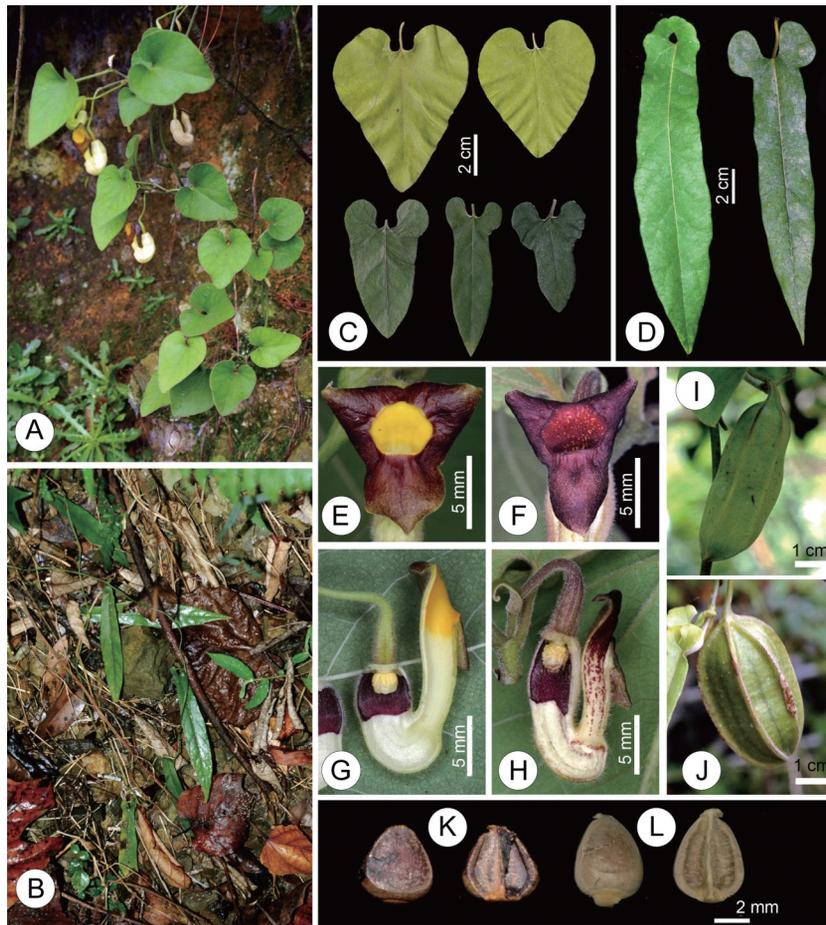
*Aristolochia yujungiana* also resembles *A. heterophylla* from China. Compared to the type specimen and protologue of *A. heterophylla* (see Hemsley 1891), we found that the former can be distinguished from the latter by the bracteole shape (ovate vs. rounded) and limb surface (sparsely pubescent vs. compactly papillose).

Additionally, *A. yujungiana* is also similar to *A. kaempferi* and *A. liukiensis* of Japan in flower color, but the perianth tube shape and limb morphology differ from those of the latter 2 species. *Aristolochia yujungiana* has a slender tube at 3~4 mm in diameter, while

*A. kaempferi* and *A. liukiensis* has thicker tubes at 5~7 mm in diameter. The limb of *A. yujungiana* is deeply 3-lobed, the lobes are spread, recurved apically, and obtriangular in front view, but those of *A. kaempferi* and *A. liukiensis* are shallowly 3-lobed, the lobes are not spread, are incurved apically, and are widely obovate in front view. Based on these differences, we treated it as a new species. Detailed comparisons between *A. yujungiana* and its close relatives are given in Table 1.

**Key to the *Aristolochia yujungiana* and its close relatives**

- 1. Leaf lamina linear to lanceolate ..... 2
  - 2. Perianth-tube 3~4 mm in diameter; mouth dark-purple, sometimes with yellow dots ..... *A. yujungiana*
  - 2. Perianth-tube 5~7 mm in diameter; mouth yellow ..... *A. shimadae*
- 1. Leaf lamina widely cordate-ovate to narrowly ovate ..... 3
  - 3. Perianth limbs deeply 3-lobed, lobes spread, recurved apically, obtriangular in front view ..... 4



**Fig. 3.** Comparison of the floral morphology of *Aristolochia shimadae* (A, C, E, G, I, L) and *A. yujungiana* (B, D, F, H, J, K). A and B, habitat; C and D, leaf variations; E and F, front view of flower (note the different colors on the mouth of the perianth tube; G and H, bisection of the perianth tube showing the gynostemium and inner surface of the perianth tube; I and J, fruit; K and L, seeds.

4. Limb papillose; bracteole round .....  
 ..... *A. heterophylla*  
 4. Limb sparsely pubescent; bracteole  
 ovate ..... *A. shimadae*  
 3. Perianth limbs shallowly 3-lobed, lobes  
 not spread, incurved apically, widely  
 obovate in front view ..... 5  
 5. Perianth tube mouth > 7 mm in  
 diameter ..... *A. liukiensis*  
 5. Perianth tube mouth < 7 mm in  
 diameter ..... *A. kaempferi*

Additional specimens examined:

*Aristolochia heterophylla* Hemsley. CHI-  
 NA. Hubei, Ichang, October 1887, *A. Henry*  
 3493, Fl. (syntype K photo!), Hupeh, March  
 1889, *A. Henry* 6417, Fr (syntype K photo!),  
 Hupeh, Fang, March 1889, *A. Henry* 6417A,  
 Fr. (syntype K photo!), Hupeh, March 1889,  
*A. Henry* 6490, Fr. (syntype K, photo!), Hu-  
 peh, *A. Henry* 4665, Fl. (syntype NY photo!);  
 Ichang, Patung Dist., fl., March 1886, *A.*  
*Henry* 642 (K photo!).

**Table 1. Comparisons of *Aristolochia yujungiana* with its 4 morphologically close relatives**

Character	<i>A. yujungiana</i>	<i>A. shimadae</i>	<i>A. heterophylla</i> <sup>1)</sup>	<i>A. kaempferi</i> <sup>1)</sup>	<i>A. liukiensis</i> <sup>1)</sup>
Leaf	linear to lanceolate, 10~20×2.5~3 cm	cordate-ovate, ovate, to lanceolate or 5~7 lobed, 6~18×2~14 cm	cordate, ovate to ovate-lanceolate, 6~15×4~8 cm	cordate-ovate to narrowly ovate, 13×11 cm	cordate-ovate to widely cordate-ovate, 5~13×5.5~12 cm
Bracteole	ovate	ovate	round	ovate	ovate
Limb					
Limb shape	obtriangular in front view; deeply 3-lobed, lobes spread, recurved apically	obtriangular in front view; deeply 3-lobed, lobes spread, recurved apically	obtriangular in front view; deeply 3-lobed, lobes spread, recurved apically	widely obovate in front view; shallowly 3-lobed, lobes not spread, incurved apically	widely obovate in front view; shallowly 3-lobed, lobes not spread, incurved apically
Limb color	dark-purple	dark-purple	dark-purple	yellowish-green with fine reddish-purple lines	yellowish-green with fine reddish-purple lines
Limb surface	sparsely pubescent	sparsely pubescent	compactly papillose	sparsely pubescent	sparsely pubescent
Mouth	dark-purple, sometimes with yellow dots	yellow	yellow	yellowish-green with dark-purple reticulum or entirely dark-purple	yellow or dark-purple
Inner surface of perianth-tube	yellowish-green with dark-purple speckles	yellow to creamy	— <sup>2)</sup>	yellowish-green with dark-purple speckles	— <sup>2)</sup>
Fruit	ellipsoid to oblong, 4~5×2.5~3 cm	cylindrical to narrowly ellipsoid, 4~7 cm long	cylindrical or ovoid, 6~7×2.5~4 cm	cylindrical to narrowly ellipsoid, 3.5~5 cm long	cylindrical to narrowly ellipsoid, 4~6 cm long
Seeds	widely ovate, plano-concave, 5.2~6×5.2~5.5 mm	ovoid, concave-convex, 5×3.7~4.3 mm	obovoid, ca. 3.4×2.3 mm	narrowly elliptic, ca. 5 mm long	obovate, ca. 5~6 mm long
Distribution	central Taiwan	Taiwan and Japan (Ryukyu Islands, Kyushu, Honshu)	China (Hubei, Sichuan)	Japan (Honshu)	Japan (northern Ryukyu islands)

<sup>1)</sup> Comparison characters of *A. heterophylla* were extracted from the protologue of *A. heterophylla* (Hemslay 1891), and those of *A. kaempferi* and *A. liukiensis* were extracted from the *Flora of Japan* (Murata 2006).

<sup>2)</sup> —, Information unavailable.

*Aristolochia kaempferi* Willd. JAPAN. HONSHU: Manatsuru Peninsula, Manatsurumachi, Ashigara-shimo-gun, elev. ca. 70 m, fr., June 1958, *T. Kawasaki 6499* (HAST); Shizuoka Pref., Numazu-shi, elev. ca. 80 m, fl., 29 April 1991, *F. Konta & K. Okada 69* (TNS); Numazu-shi, elev. ca. 150 m, fl., 5 June 1991, *F. Konta et al. 225* (TNS); Shimizu City, elev. ca. 250 m, 17 June 1988, *F. Konta 17046* (TNS); Shimoda City, elev. ca. 30 m, 28 May 2003, *F. Konta et al. 23090* (TNS); Chiba Pref., Kanto Distr., Amatsukominato-machi, Mt. Kiyosumi, fr., 5 June 1990, *Y. Tateishi et al. 15787* (IBSC); Miyazaki Pref., Koyu-gun, Kawanami-machi, elev. ca. 200 m, fr., 27 May 1983, *Idzumi & Togashi s.n.* (TI); Prov. Ohsumi, Ohdomari, Satacho, fl., 29 April 1962, *Hatusima & Sako 26891* (TI); Prov. Satsuma, Kawashiri, near Mt. Kaimon, fr., 18 May 1946, *Togashi s.n.* (TI).

*Aristolochia liukiuensis* Hatusima. JAPAN. Kagoshima Pref., Uken-Son (Uken Village), Ooshima-gun (Ooshima District), elev. ca. 330 m, fl., 12 March 2002, *Noshiro et al. D488* (TI); Kagoshima Pref., Is. Tokunoshima, Oshima-gun, Isen-machi, Kozima, fl., elev. ca. 100 m, 10 February 1982, *Murata & Endo 79* (TI); Isl. Amami-Oshima, near Kosyuku, fl. & fr., elev. ca. 100 m, 22 March 1958, *Hatusima & Sako 21728* (TI); Isl. Okinawa, fl., 5 March 1998, *Takushi s.n.* (TI); Okinawa Pref., Mt. Yonaha, Kunigami-son, Kunigami-gun, fl., 13 December 1992, *Kobayashi 1895* (TI); Kanna, Ginoza-son, Kunigami-gun, Okinawa-jima, fl., March 1983, *Nishi & Ishizuka 158* (TI).

*Aristolochia shimadae* Hayata. JAPAN. OKINAWA: Miyako-jima: Gusukube-cho W. of Aragusuku, elev. ca. 50 m, fl. & fr., 10 March 1978, *Tateishi 4012* (TI); Isl. Ishigaki, upper stream of Miyara-gawa, E. foot of Mt. Omoto-dake, elev. 50~100 m, fl. & fr., 28 March 1973, *H. Koyama et al. 349, 350* (TNS);

Yaeyama-gun, Taketomi-cho, Isl. Itiomote, Funaura, elev. 10~20 m, fl., 16 April 1998, *K. Yonekura et al. 98051* (HAST). TAIWAN. TAIPEI: Yangmingshan, Chingshan Rd., elev. ca. 240 m, 3 May 1996, *S. C. Wu 977* (TAIF); Kuanyinshan, elev. ca. 616 m, 4 February 1973, *J. F. Wang s.n.* (TNU). HSINCHU: Shimpo, Shinchikucho, 15 December 1915, *Y. Shimada s.n.* (holotype: TI, photo!; merotype: TAIF!); Shintiku, Shinpo, fr., 20 September 1917, *Shimada s.n.* (TI, fruit voucher of *A. shimadae* in Icon. Pl. Form. 8: 110, 1919); Kuanhsi Town, No. 16 County Rd. 6.3 km, Minan Bridge-Nanho, elev. ca. 102 m, 28 June 2003, *C. M. Wang 7005* (TNM); Paoshan Reservoir, elev. ca. 150 m, 26 March 2002, *S. C. Wu 2438* (HAST); Kuanwu, elev. 1950~2000 m, 16 May 2000, *S. W. Chung 2371* (TAIF). MIAOLI: Kungkuan, elev. ca. 120 m, 4 April 1973, *I. S. Chen 2929* (TAI); Hsihu Hsiang, Chinshih Village, elev. ca. 138 m, 21 February 2007, *C. L. Yang 460* (TNU). TAICHUNG: en route from Chungshing Ling to Takeng, elev. ca. 570 m, 2 November 1986, *C.-I Peng 9981, 9966* (HAST); Ssuyuan, elev. ca. 1900 m, 19 April 1997, *S. Y. Lu s.n.* (TAIF); Wuling Farm, elev. ca. 2000 m, 4 July 2000, *S. W. Chung 2645* (TAIF); Hohuanshan Tunnel to Lishan, elev. ca. 2482 m, 7 June 2002, *C. K. Yang 92* (TNM). NANTOU: Meifeng to Tsuifeng, elev. 2000~2300 m, 21 May 2005, *J. H. Lii 1181* (TAI); Tunyuan, elev. 1900~2100 m, 22 April 2000, *C. H. Chen 3201* (TAIF); Hohuanshan, elev. ca. 3000 m, 19 May 1997, *C. C. Hsu 254* (TAIF). HUALIEN: Chingshuishan, elev. 1500~2400 m, 25 July 1986, *K. C. Yang 12861* (TAI). TAITUNG: Tulanshan, elev. ca. 1100 m, 8 May 2002, *S. W. Chung 5245* (TAIF).

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