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Three New Species and Three New Records of *Aristolochia* Subgenus *Siphisia* from Vietnam Including a Key to the Asian Species

Truong Van Do,[1,2,4] Truong Hong Luu,[3] Stefan Wanke,[1,4] and Christoph Neinhuis[1]

[1]Institut für Botanik, Technische Universität Dresden, Zellescher Weg 20b, D–01062 Dresden, Germany.
[2]Vietnam National Museum of Nature, Vietnam Academy of Science Technology, 18 Hoang Quoc Viet, Hanoi, Vietnam.
[3]Southern Institute of Ecology, Vietnam Academy of Science Technology, 85 Tran Quoc Toan, Ho Chi Minh, Vietnam.
[4]Authors for correspondence (dovantruong_bttn@yahoo.com, stefan.wanke@tu-dresden.de)

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Abstract*—*Aristolochia* subgenus *Siphisia* comprises about 70 species, with a disjunct East- and South Asian to North- and Central American distribution. Here we describe and illustrate three new species of *Aristolochia* subgenus *Siphisia* from Vietnam: ***Aristolochia faviogonzalezii, ***A. tonkinensis***, and ***A. tadungensis***. The first two species are found in northern Vietnam while the latter occurs in southern Vietnam. Diagnostic characters distinguish the new species from their morphologically close relatives. Their distribution, ecology, phenology, ethnobotany, and conservation status are presented as well. In addition, three species are newly reported for the flora of Vietnam that were until now restricted to China, namely *A. fangchi*, *A. hainanensis*, and *A. utriformis*. An identification key to all Asian species of *Aristolochia* subgenus *Siphisia* is provided.**

***Keywords*—*Aristolochia*, Aristolochiaceae, Asia, China, *Isotrema*, new species, *Siphisia*, taxonomy, Vietnam.**

Aristolochia L. comprises about 500 species representing the largest genus of Aristolochiaceae (Wagner et al. 2012, 2014). Recent phylogenetic studies of Piperales suggest recognition of *Aristolochia* and *Thottea* Rottb. as the sole genera of Aristolochiaceae, separated from Lactoridaceae, Hydnoraceae, and Asaraceae (Naumann et al. 2013). Within *Aristolochia*, morphology and molecular data suggest a subdivision into three monophyletic groups recognized as subgenera. *Aristolochia* subgenus *Aristolochi*a (Schmidt) Ma occurs in the Mediterranean region and in subtropical and tropical areas of America, Africa, and Asia. *Aristolochia* subgenus *Pararistolochia* (Hutchinson & Dalziel) Schmidt is present in tropical Africa and Southeast Asia to tropical Australia, whereas *Aristolochia* subgenus *Siphisia* (Rafinesque) Duchartre shows a disjunct occurrence in eastern and southern Asia as well as Central- and North America (Murata et al. 2001; Ohi-Toma et al. 2006; Wanke et al. 2006; González et al. 2014). The latter subgenus comprises about 70 species, 50 of which occur in East and South Asia while the remaining 20 species are restricted to Central- and North America (Neinhuis et al. 2005; González et al. 2014) and can be distinguished from both remaining subgenera (*Aristolochia* and *Pararistolochia*) by morphological synapomorphies such as a strongly curved perianth with a 3-lobed limb as well as the absence of hairs inside the tube, and especially the gynostemium, which in *Siphisia* has three lobes, each bearing two fused anthers. These 3-lobed gynostemium species have either been recognized at the generic level as *Isotrema* (Rafinesque 1818; Huber 1985, 1993; González and Stevenson 2002; Kelly and González 2003) or *Siphisia* (Klotzsch 1859) or as infrageneric taxa within *Aristolochia* (Duchartre 1854, 1864; Bentham and Hooker 1880; Schmidt 1935; Pfeifer 1966; Phuphathanaphong 1985, 1987; Hwang 1988; Ma 1989a, b; Samanta et al. 1999; Pham 2000; Hwang et al. 2003; Nguyen 2003; Adams et al. 2005; Xu et al. 2011; Huang et al. 2013; Wu et al. 2013).

Key to the Subgenera of *Aristolochia*

1. Perianth strongly curved; utricle and tube not sharply delimited; tube U- or horseshoe shaped; inner surface of tube glabrous; gynostemium 3-lobed ..... subgenus *Siphisia*
1. Perianth slightly curved; utricle and tube clearly and sharply delimited; tube often rectilinear or slightly curved (U or horseshoe-shaped in some species); inner surface of tube with conical trichomes; gynostemium 5, 6, or 9–12-lobed 2
   2. Limb of the perianth at least 3-lobed, the lobes spreading, with a free apex, rarely connate; fruit a berry, sometimes with a leathery pericarp, hexamerous ..... subgenus *Pararistolochia*
   2. Limb of the perianth 1- or 2-lobed, the lobe(s) strongly monosymmetric; fruit a 5 or 6-merous capsule ..... subgenus *Aristolochi*a

Hereafter we shorten *Aristolochia* subgenus *Siphisia* to *Siphisia*; that we incorrectly referred to as subgenus *Isotrema* in previous studies (Wanke et al. 2006; Wagner et al. 2012; González et al. 2014). *Siphisia* is widely distributed in Northeast Asia (Merrill and Chun 1935; Gao 1964; Liang 1975; Chow and Hwang 1975; Hwang 1981, 1988; Ma 1989a, b; Wen 1992; Hwang et al. 2003; Watanabe et al. 2006; Liu and Deng 2009; Xu et al. 2011; Huang et al. 2013; Wu et al. 2013), Southeast Asia (Klotzsch 1859; Lecomte 1909, 1910; Hou 1984; Phuphathanaphong 1985, 1987; Ma 1989b; Hansen and Phuphathanaphong 1999; Pham 2000; Nguyen 2003; Yao 2012; Do et al. 2014), and in Southwest Asia (Wallich 1831; Ma 1989b; Samanta et al. 1999; Hwang et al. 2003; Upson and Brett 2006; Baruah et al. 2012), but is absent from Northwest Asia (north of the Himalayas). Ma (1989b) revised the systematics, geographic distribution, cytotaxonomy, and taxonomy of *Aristolochia* from eastern and southern Asia. He recognized a total of 68 species and one variety, including the 41 species of subgenus *Siphisia* that occur in Japan, Korea, China, Vietnam, Thailand, Myanmar, India, Bhutan, Nepal, and Pakistan. He also estimated that 83% (34 out of 41 species) of the *Siphisia* species occur in China, followed by India and Myanmar (each with 14%; six out of 41 species), and Nepal 12% (five out of 41 species). Later, Hwang et al. (2003) reduced the total number of *Siphisia* species in China to 28, because some species were synonymized. Recently, newly discovered *Siphisia* species from China (Liu and Deng 2009; Xu et al. 2011; Huang et al. 2013; Wu et al. 2013), Vietnam (Do et al. 2014), and Malaysia (Yao 2012), as well as the splitting of the *Aristolochia kaempferi* Willd. complex into three

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distinct species (Watanabe et al. 2006) increased the number of Asian species of *Siphisia* to 47.

Franchet (1898) originally described eight *Aristolochia* species from Indochina, with only one occurring in Vietnam (*A. balansae* Franch.). Later, Lecomte (1909, 1910), reported eight *Aristolochia* species from Vietnam, Laos, and Cambodia including five new species, but none from *Siphisia*. Since then, the species from these regions have not been revised although the number significantly increased with further exploration of the country by local botanists, such as Pham (2000), who reported eleven *Aristolochia* species, and Nguyen (2003), who enumerated the same species as Pham (2000), but listed two additional *Siphisia* species (*A. kwangsiensis* W. Y. Chun & F. C. How ex C. F. Liang and *A. saccata* Wall.). Do et al. (2014) recently described a new *Siphisia* species (*A. quangbinhensis* Do) from Vietnam. These novelties raised the number of *Siphisia* species occurring in Vietnam to six. There are numerous unidentified *Aristolochia* specimens collected from Vietnam and southern China still deposited in herbaria worldwide, but they are difficult to assign to known species or to describe because of the lack of reproductive parts, especially the flower. Furthermore, specimens in Vietnam are mostly collected by local ethnobotanists, who only focus on the use of the species, but overlook the need of complete vouchers for proper identification.

During floristic work on limestone vegetation of northern Vietnam and evergreen broad-leaf forests in the highlands of southern Vietnam, we collected several unusual specimens belonging to *Siphisia* but are not matching known species. Thus, we describe here three new species of *Siphisia* from Vietnam: *Aristolochia faviogonzalezii*, *A. tonkinensis,* and *A. tadungensis*. The first two species are found in northern Vietnam while the latter occurs in southern Vietnam. In addition, three *Siphisia* species (*A. hainanensis* Merr., *A. fangchi* Y. C. Wu ex L. D. Chow & S. M. Hwang, *A. utriformis* S. M. Hwang) previously reported only from southern China (Hainan, Guangxi, Guangdong, and Yunnan) are newly recorded for Vietnam. The new species and new records raise the number of *Siphisia* species occurring in Vietnam to twelve. Vietnam is now one of the centers of diversity after China and Mexico. Remarks on diagnostic characters and their morphological affinities as well as information about distribution, ecology, phenology, ethnobotany, and conservation status are presented. Furthermore, an identification key to the Asian species of *Siphisia* is provided. After acceptance and during proof stage of this manuscript two additional new species were published (Huong et al. 2014, Do et al. 2015) that are not included in this manuscript.

Materials and Methods

Survey of Herbarium Specimens—During the preparation of a taxonomic revision of *Aristolochia* for Vietnam, approximately 200 specimens were examined from the herbaria CPNP, DR, HITBC, HN, HNU, IBK, IBSC, K, KUN, L, MO, NIMM, P, SGN, SING, VNM, and VNMN.

Field Collections and Species Description—Observation of living plants allowed comparison of morphological characters and coloration of the perianth (utricle, tube, and limb) as well as morphology of the inside of the trap flowers including the gynostemium, which are often impossible to observe in dried specimens (characters are reported for field material). Types are exclusively based on material from the field (not from cultivation). In addition, we characterized the vegetation types for each location. The description of new species follows the terminology used by Pfeifer (1966), Harris and Harris (2001), and Hwang et al. (2003) (see Fig. 1 for details about measurements). Conservation status for the new species is presented based on field observation, applying the IUCN red list category criteria of threatened species (IUCN 2013). The identification key to the Asian species of *Siphisia* includes and updates information using new morphological data from field observations, new species recently published, as well as latest species circumscriptions.

Taxonomic Treatment

Description of New Species of Aristolochia Subgenus Siphisia from Vietnam—

Aristolochia faviogonzalezii T. V. Do, S. Wanke & C. Neinhuis sp. nov. —TYPE: VIETNAM. Ha Nam: Kim Bang district, Thanh Son community, on But Son limestone range, near the But Son cement factory, 20°31′387″N, 105°51′306″E, elevation 125 m, 11 Jan 2013, *Do 14* (holotype: VNMN!; isotype: DR!).

Aristolochia faviogonzalezii is morphologically similar to *A. cathcartii* Hook. f. and *A. saccata* but differs from them by the following characters: leaf blade broadly ovate to cordate; inflorescence in clusters of 6–8(–10) cymes, inflorescence axis 5–9 cm long; perianth 3.5–5 cm high, outside with parallel dark purple veins or dots; upper tube uniformly dark purple without visible veins and dots; inner surface of limb lobes densely covered with purple warts; limb nearly rectangular, 2.4–2.6 cm high, 1.8–2 cm wide; upper half of the throat white with dark purple dots, lower half pinkish without visible dots.

Perennial, woody liana, 8–10 m high with many fasciculate, cylindrical roots. Stem slightly oval in cross section, young branches densely pubescent, becoming glabrescent, bark corky and furrowed when mature, internodes 15–18 cm long. Petiole 5–8(–10) cm long, twisted, densely pubescent. Leaf blade broadly ovate to cordate, (15–)18–23(–25) cm long, (13–)15–20 cm wide, subcoriaceous, base cordate, sinus 2–3 cm deep, margin entire, apex acuminate or caudate, 1.0–1.2 cm long, both surfaces and margin densely villous when young, then the adaxial surface dark-green and glabrous, basal veins five, palmate, secondary veins four to five pairs, pinnate; tertiary veins coarsely reticulate, slightly sunken adaxially, prominent abaxially. Inflorescence cymose on old woody stems, cymes in clusters of 6–8(–10), each cyme with three or four flowers, clearly separated from each other. Inflorescence axis 5–9 cm long (see Figs. 2E, 3G for details), pubescent. Bracteole clasping the axis, triangular, 2.5–3 mm long, 2–2.5 mm wide, sessile, both surfaces densely brown pubescent. Pedicel 1.2–1.4(–1.6) cm long, pendulous, densely brown villous. Ovary oblong, 1.1–1.3 cm long, 0.4–0.5 cm in diam, densely brown villous. Perianth horseshoe-shaped (in lateral view), 3.5–5 cm high, yellowish-white, outside densely brown hirsute with parallel dark purple veins or dots, inside glabrous. Utricle distinct from the tube, bell-shaped, 1.1–1.2 cm high, 0.6–0.7 cm in diam at base, 1–1.1(–1.3) cm in diam at apex, inside with a dark purple band and densely distributed trichomes. Tube horseshoe-shaped, 5.2–5.5 cm, folded upwards at its middle, lower tube strongly inflated, 1.6–1.8 cm in diam, and upper tube obliquely shortened funnel-shaped, without visible veins and dots, parallel to the utricle, gradually constricted at its base, uniformly dark purple, 1.4–1.5 cm high, narrower at base, 0.6–0.7 cm in diam and broader at apex, 1.5–1.6(–1.8) cm in diam. Limb with three unequal lobes, valvate pre-anthesis: two lateral lobes broadly triangular, each 2–2.2 cm wide, 1–1.1 cm high, middle lobe semicircular, 1.8–2(–2.1) cm wide, 0.4–0.5 cm high, margins of all lobes revolute during anthesis: lateral lobes fused, and middle lobe rib-like, forming a trumpet-shaped limb, nearly rectangular, 2.4–2.5 cm high, 1.8–2 cm wide, warty on

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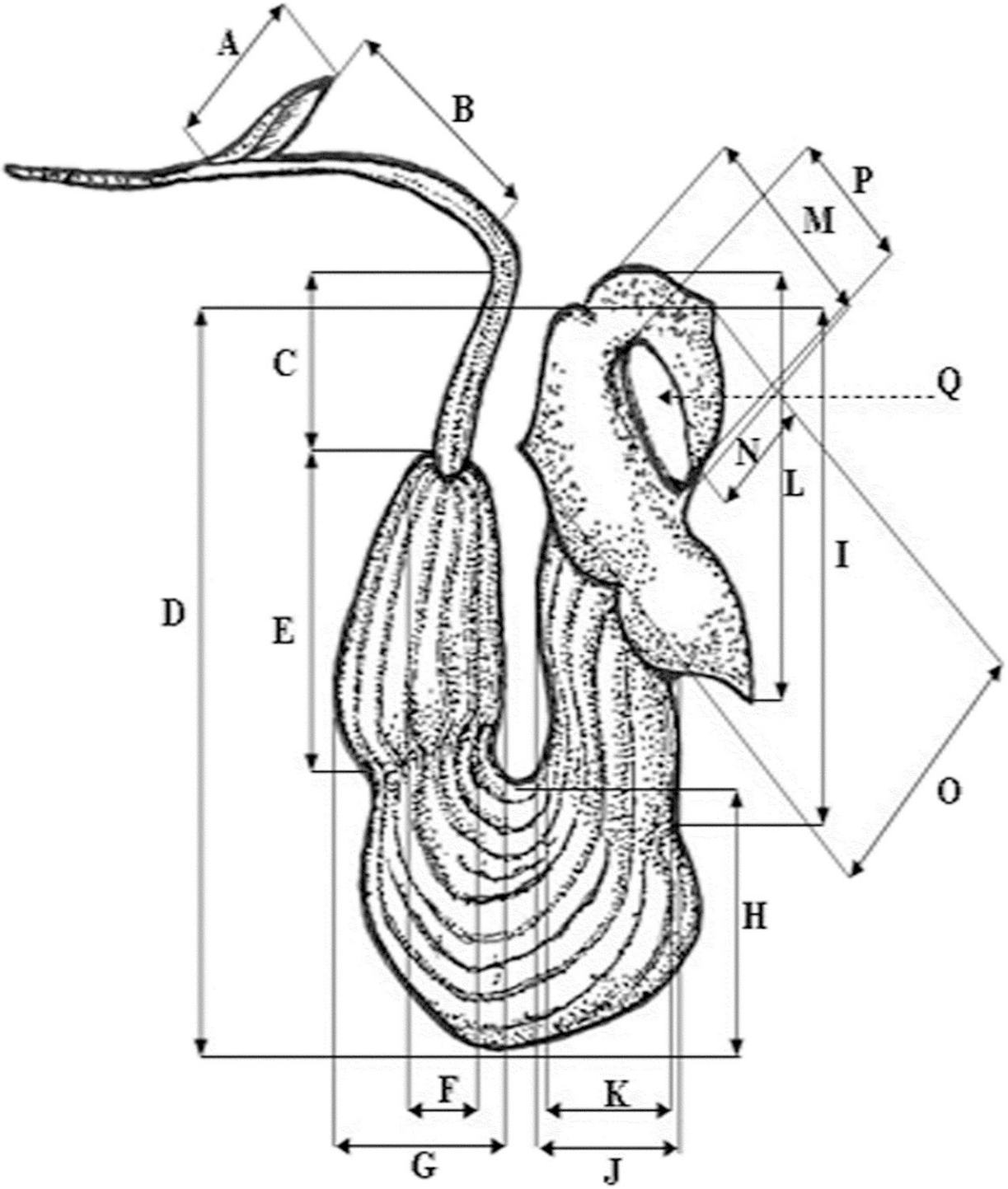


FIG. 1. Simplified overview of a typical *Aristolochia* subgenus *Siphisia* flower illustrating the terminology used and floral characters measured in the present study. A. Length of bracteole. B. Length of pedicel. C. Length of ovary. D. Height of perianth. E. Height of utricle. F. Width of basal part of utricle. G. Width of apical part of utricle. H. Width of lower tube. I. Height of upper tube. J. Width of apical part of upper tube. K. Width of basal part of upper tube. L. Height of limb. M. Width of lateral limb lobes. N. Height of limb. O. Width of limb. P. Width of annulus. Q. Throat.

inner surface of lobes dark purple. Upper half of throat white with dark purple dots, lower half pinkish, without visible dots. Annulus absent. Gynostemium with acute apices, 5–6 mm high, 3–4 mm in diam, smooth; anthers 2.8–3 mm long, 1–1.5 mm wide, yellow. Capsule cylindrical, 5–6 cm long, 1.5–1.8 cm in diam, distinctly 6-angled, dark-brown, the angles villous, becoming glabrescent, basipetally dehiscent. Seeds ovoid, 6–7(–8) mm long, (3–)4–5 mm in diam, not winged, the abaxial surface convex, and the adaxial surface deeply concave, both surfaces smooth. Figures 2, 3.

Vernacular Name—Common names in Vietnamese for this species are "Mộc hýõng Favio" and "Phòng kỷ Favio".

Distribution and Ecology—Known from the type locality, But Son limestone range in Ha Nam province, Kim Bang district, Thanh Son community and a neighboring locality in Ninh Binh province, Hoa Lu district, Ninh Hai community,

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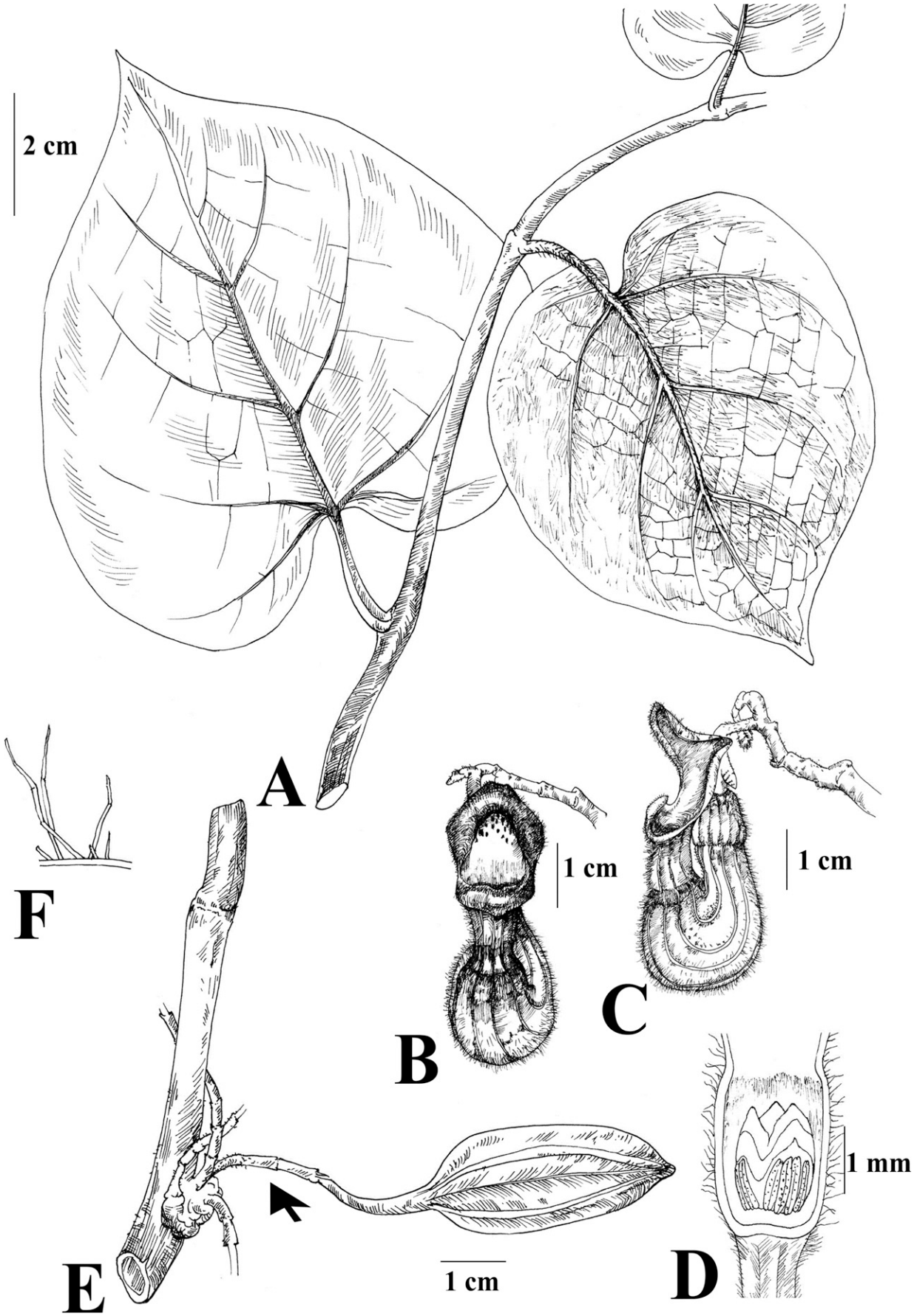


FIG. 2. *Aristolochia faviogonzalezii*. A. Habit. B. Front view of open flower. C. Lateral view of open flower. D. Close up of gynostemium. E. Capsule (Arrowhead indicates the inflorescence axes). F. Multicellular hairs. Drawings by Nguyen Huu Quyet from the type specimen.

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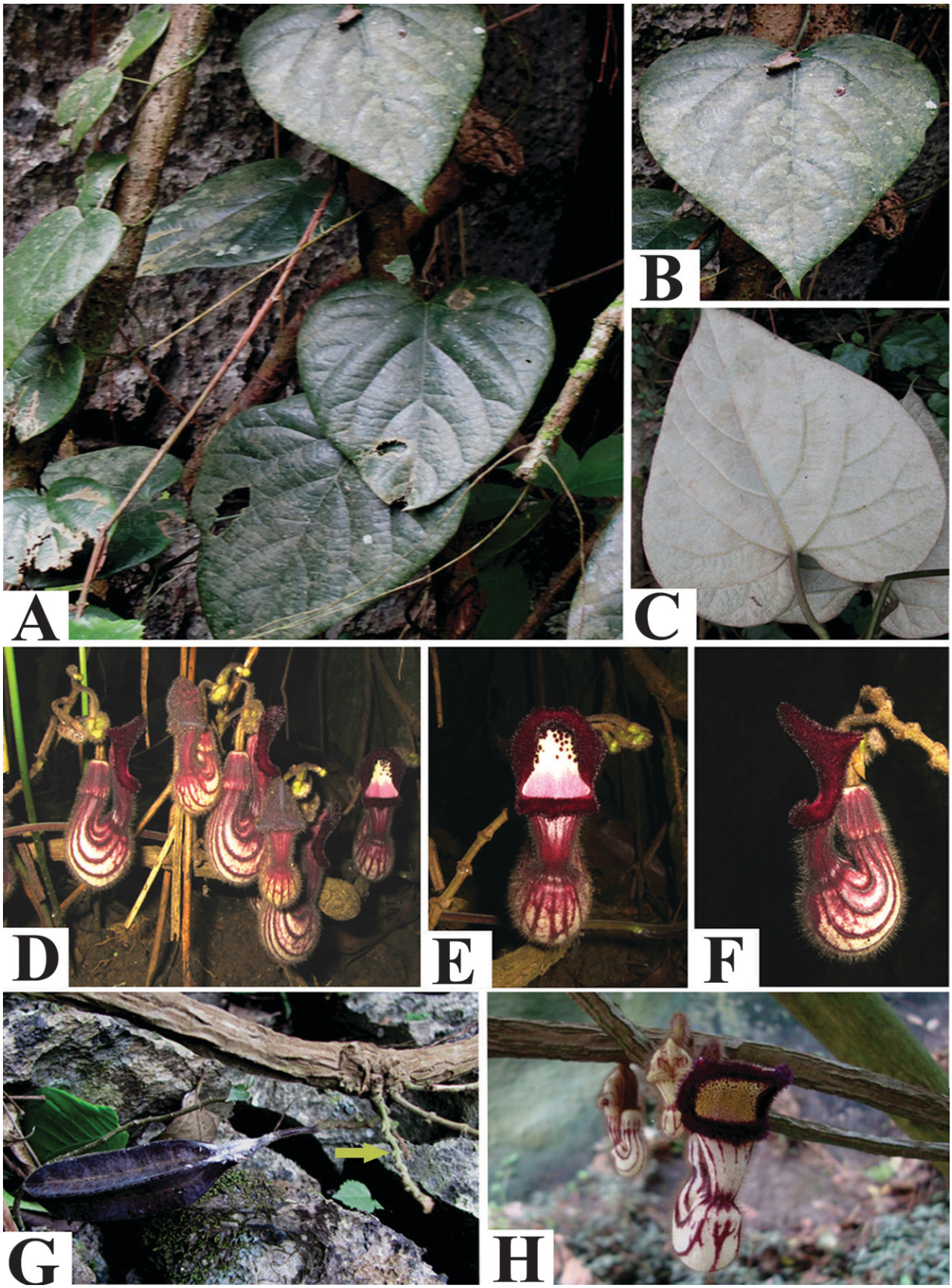


Fig. 3. *Aristolochia faviogonzalezii* (A-G). A. Habit. B. Adaxial leaf surface. C. Abaxial leaf surface. D. Cymes on old woody stems. E. Front view of open flower. F. Lateral view of open flower. G. Capsule (Yellow arrowhead indicates the inflorescence axes) – *Aristolochia cathcartii*. H. Front view of open flower of *A. cathcartii*. A-C & G. Photographs by Do Van Truong. D-F. Photographs by Nghiem Duc Trong from the type population. H. Photographs by Andrew Gavin at Eden Botanic Garden.

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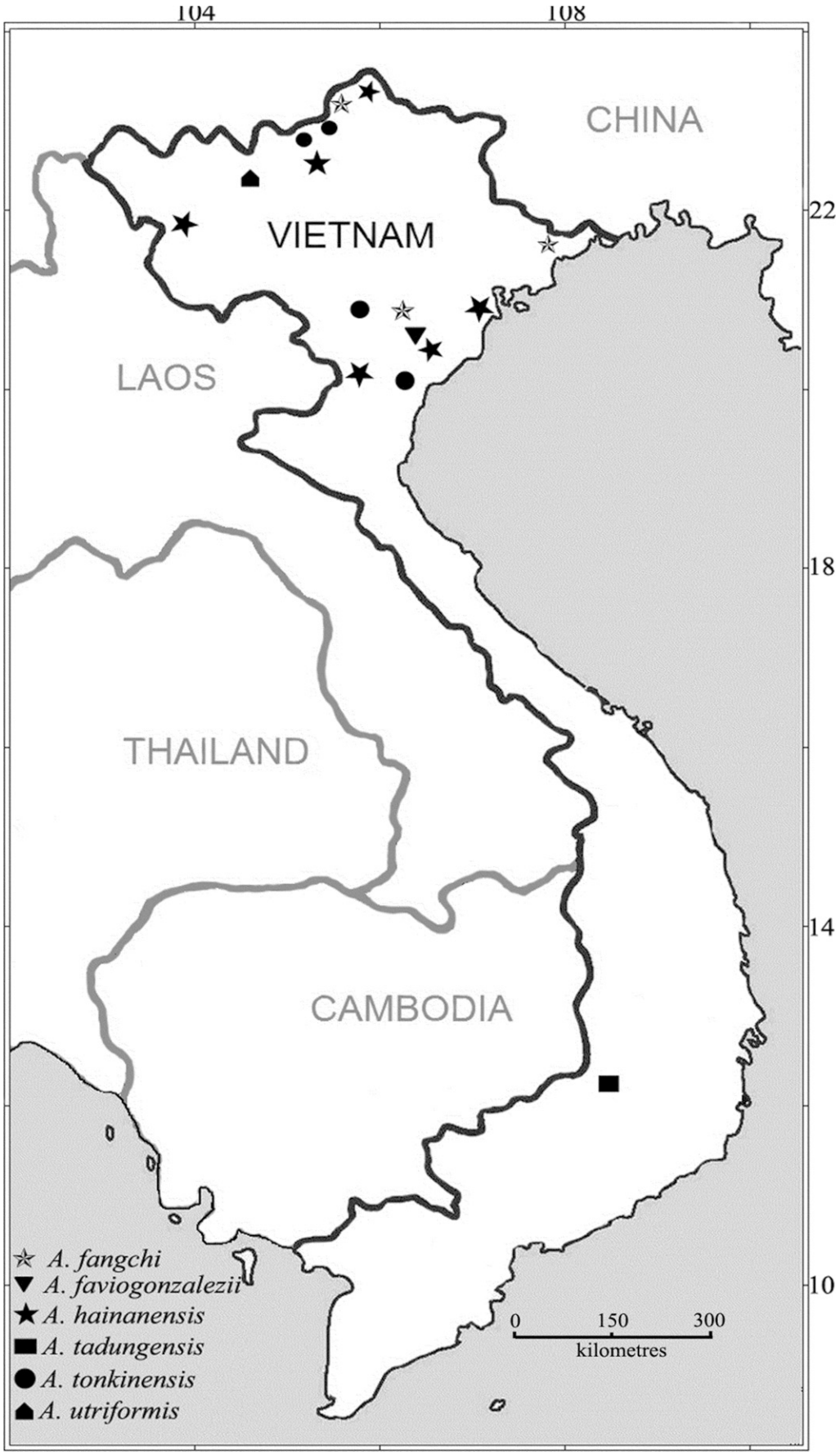


FIG. 4. Map showing the distribution of new species and new records of *Aristolochia* subgenus *Siphisia* from Vietnam.

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Van Lam village, Bui valley (Fig. 4). This species occurs on limestone covered with humus, in open broad-leaf forest and thickets with the following dominant species: Annonaceae (*Desmos chinensis* Lour., *Fissistigma*), Begoniaceae (*Begonia*), Cucurbitaceae (*Gynostemma pentaphyllum* (Thunb.) Makino), Asparagaceae (*Dracaena cambodiana* Pierre ex Gagnepain), Euphorbiaceae (*Mallotus*), Malvaceae (*Byttneria, Sterculia lanceolata* Cavanilles), Moraceae (*Broussonetia*), Pandaceae (*Microdesmis*), Rubiaceae (*Ophiorrizha*, *Psychotria*), Rosaceae (*Rubus*), Urticaceae (*Dendrocnide*, *Elatostema*, *Laportea*), at 120–250 m.

Phenology—*Aristolochia faviogonzalezii* has been observed to flower from August to January while fruits are set from the beginning of December.

Ethnobotany—The whole plant is used for treatment of arthritis and rheumatism.

Etymology—The specific epithet honors Dr. Favio González who contributed extensively to the knowledge of Aristolochiaceae ranging from systematics and morphology to evolutionary biology during the last decades.

Conservation Status—The new species is known from a few populations within the limestone range lying on both Ha Nam and Ninh Binh provinces, northern Vietnam. However, the area has been severely damaged due to exploitation by cement factories. In addition, both populations are outside of protected areas and local people continue to impose strong pressure on the remaining forest patches for medicinal plants, firewood, and converting the vegetation into corn fields. Thus, according to the criteria established by the IUCN (2013), the new species should be considered as endangered (EN) due to the restricted occurrence, small population size, and the possible decline in the quality of habitat.

Morphological affinities—*Aristolochia faviogonzalezii* is morphologically similar to *A. cathcartii* and *A. saccata*, occurring in the eastern Himalayas and southern China. However, *A. faviogonzalezii* can be clearly distinguished from *A. cathcartii* by the leaf blade broadly-ovate to cordate with acuminate or caudate apex (vs. narrowly ovate to lanceolate-ovate with acute to shortly acuminate apex), inflorescence axis 5–9 cm long (vs. 2–4 cm long), perianth 3.5–5 cm high, with parallel dark purple veins or dots (vs. 3.0–3.5 cm, with purple reticulate veins), upper tube uniformly dark purple without visible veins and dots (vs. yellowish-white with purple veins and dots), inner surface of limb lobes densely covered with dark purple warts (vs. dark purple warts and bristle-like papillae), upper half of throat white with dark purple dots, and lower half pinklish without visible dots (vs. uniformly yellow, densely covered with purple dots). *Aristolochia faviogonzalezii* also differs from *A. saccata* by the shape of the leaf blade (broadly-ovate to cordate vs. ovate-oblong to lanceolate), perianth (6.5–7 cm, yellowish-white with parallel dark purple veins and dots vs. 4–4.5 cm, white with purple reticulate veins), throat (upper half white with dark purple dots, and lower half pinkish vs. uniformly yellow) (Table 1).

Additional Specimens Examined—VIETNAM: Ninh Binh. Hoa Lu district, Ninh Hai community, Van Lam village, Bui valley, 27 Feb 2000, *Chien & Hung 4488* (NIMM).

Aristolochia tadungensis T. V. Do & T. H. Luu, sp. nov.—TYPE: VIETNAM. Dac Nong: Ta Dung Nature Reserve, 11°52′147″N, 108°01′218″E, elevation 1,246 m, 11 Jan 2011, *Luu et al. TD 395* (holotype: VNMN!; isotype: SGN!).

Aristolochia tadungensis is morphologically similar to *A. hainanensis* and *A. coadunata* but it differs from them by the following characters: leaf blade coriaceous, abaxial surface densely woolly, hairs subadpressed; cymes solitary on old woody stems, axis 4–10 cm long; perianth yellowish-white; upper tube obliquely oblong funnel-shaped with purple veins, (1.8–)2–2.3(–2.4) cm high; limb nearly rectangular, 1.3–1.5(–1.6) cm high, 1.1–1.2 cm wide; throat yellow densely covered with orange dots.

Perennial woody liana, 15–20 m high with many fasciculate and cylindrical roots. Stem slightly flattened, young branches slender, glabrescent, with a shallowly corky furrowed bark when mature, internodes 18–20 cm long. Petiole (6–)8–10 cm long, twisted, glabrescent. Leaf blade ovate to lanceolate-ovate, (22–)25–27 cm long, 8–10(–12) cm wide, coriaceous, base round to truncate, margin entire, apex acute or shortly acuminate, the adaxial surface dark green and glabrous, the abaxial surface densely subadpressed-woolly, basal veins three, palmate, one pair reaching half the leaf length, secondary veins four to five pairs, pinnate, middle vein and veinlets distinct, parallel or loosely reticulate, prominent abaxially, flattened adaxially. Inflorescence cymose on old woody stems, cymes solitary, each with three or four flowers, clearly separated from each other. Inflorescence axis 4–10 cm long, slightly curved, densely brown

Table 1. Comparison of *A. faviogonzalezii* and its morphological affinities. *Morphological characters following by Upson and Brett (2006) including our own observations from cultivated material at Eden Botanic Garden, U. K. **Morphological characters following the protologue (Wallich 1831) and our own field observations.

Character	*A. faviogonzalezii*	*A. cathcartii* *	*A. saccata* **
Leaf blade	Broadly-ovate to cordate	Narrowly ovate to lanceolate-ovate	Ovate-oblong to lanceolate
Leaf apex	Acuminate or caudate	Acute to shortly acuminate	Acuminate
Inflorescence	Cluster of 6–8(–10) cymes at each node	Cluster of 3–4 cymes at each node	Cluster of 2–3 cymes at each node
Inflorescence axis	5–9 cm	2–4 cm	1.8–2.2 cm
Perianth	Horseshoe–shaped, yellowish-white with parallel dark purple veins or dots	S-shaped, yellowish-white with purple reticulate veins	Horseshoe-shaped, white with purple reticulate veins
Tube	Upper tube exclusively dark purple, vein and dots not visible	Upper tube yellowish-white with purple veins and dots	Upper tube white with purple veins
Limb	Nearly rectangular, 2.4–2.6 cm high, 1.8–2 cm wide, inner surface of limb lobes densely covered with dark purple warts	Nearly rectangular, 2.2–2.5 cm high, 1.6–1.8 cm wide, inner surface of limb lobes densely covered with dark purple warts and bristle-like papillae	Nearly circular, 1.8–2 cm wide, inner surface of limb lobes densely covered with purple warts
Throat	Upper half white with dark purple dots, lower half pinkish, without visible dots	Uniformly yellow, densely covered with purple dots	Uniformly yellow, without visible dots
Distribution	Vietnam	Eastern Himalaya and southern China	Eastern Himalaya and southern China

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pubescent. Bracteole clasping the axis, triangular, (1.6–)1.8–2 mm long, 1.3–1.5 mm wide, sessile, both surfaces densely brown pubescent. Pedicel (2–)2.2–2.4 (–2.5) cm long, pendulous, densely brown pubescent. Ovary 1–1.2 cm long, 0.3–0.4 cm in diam, densely brown villous. Perianth horseshoe-shaped, (4.0–)4.2–4.8 cm high, outside yellowish-white with several longitudinal purple veins (variable in number, usually fewer than 5), sparsely hairy, inside white and glabrous, except for the utricle. Utricle indistinct from the tube, cylindrical, inflated, 0.6–0.7(–0.8) cm high, 1.1–1.2 cm in diam, inside with broad dark purple band and densely glandular pubescent. Lower tube horseshoe-shaped, inflated, narrower than utricle, 1.0–1.1 cm in diam; upper tube obliquely oblong funnel-shaped, (1.8–)2–2.3(–2.4) cm high, constricted at base, 0.6–0.7 cm in diam and slightly broader at apex, (0.8–)0.9–1(–1.1) cm in diam. Limb with three unequal lobes, valvate pre-anthesis: two lateral lobes deltoid, each 1.1–1.2 cm wide, 0.5–0.6 cm high, middle lobe triangular, 0.8–0.9 cm wide, 0.4–0.5 cm high, margins of all lobes revolute during anthesis forming a trumpet-shaped limb, nearly rectangular, 1.3–1.5(–1.6) cm high, 1.1–1.2 cm wide, with two lateral lobes rib-like and narrower than the middle one (1–1.5 mm vs. 2 mm in diam, respectively), acute at apex, inner surface sparsely warty dark purple. Throat yellow, densely covered with orange dots. Annulus absent. Gynostemium with acute apices, bent inward, smooth, 5–6(–8) mm high, 3–4 mm in diam, yellow; anthers (2.2–)2.5–3 mm long, yellow. Capsule cylindrical, 9–10(–12) cm long, (2.5–)2.8–3 cm diam, distinctly 6-ridged, yellowish-green, densely brown villous, basipetally dehiscent. Seeds ovoid, (8–)9–10 mm long, (4–)5–6 cm in diam, not winged, the abaxial surface convex, the adaxial surface deeply concave with a prominent, central, longitudinal funiculus, both surfaces smooth. Figures 5, 6.

Vernacular Name—Common names in Vietnamese for this species are "Mộc hýõng Tà Đùng" and "Phòng kỷ Tà Đùng".

Distribution and Ecology—Known only from the core-zone of Ta Dung Nature Reserve in Dac Nong province, southern Vietnam (Fig. 4). The species grows on humid soil covering granite rocks in submontane evergreen tropical forest. Dominant plants are Asteraceae, Fagaceae (*Castanopsis*, *Lithocarpus*), Lamiaceae, Lauraceae (*Litsea*, *Machilus*), Myristicaceae (*Knema*, Pentaphylacaceae (*Eurya*), Rubiaceae (*Hedyotis*, *Psychotria*), Theaceae (*Camellia*). A tall dipterocarp tree (cf. *Dipterocarpus*) is also recorded.

Phenology—*Aristolochia tadungensis* has been observed to flower from the middle of the dry season in southern Vietnam through December to January, but mature fruits were also recorded at the same time. Therefore, we believe that flowering may start earlier at the end of the rainy season to the beginning of the dry season through October to November.

Etymology—The specific epithet refers to the only known locality in the Dac Nong province, Ta Dung Nature Reserve.

Conservation Status—The new species is known from a single population within the core-zone of Ta Dung Nature Reserve, a large evergreen forest area. Since the locality has been severely damaged and reduced by deforestation and over-exploitation, the new species should be regarded as threatened with extinction. Following the IUCN red list criteria, a preliminary status of vulnerable (VU D2) is proposed for *A. tadungensis*, because of a restricted area of occupancy (typically less than 20 km^2), the number of locations (typically five or fewer) such that it is prone to the effects of human activities within a short time period in an uncertain future.

Morphological Affinities—*Aristolochia tadungensis* is morphologically similar to *A. hainanensis*, which occurs in southern China and northern Vietnam. But it is distinguishable from the latter as follows: the leaf blade coriaceous (vs. subcoriaceous), abaxial surface densely woolly (vs. villous), inflorescence axis up to 10 cm long (vs. up to 6 cm long), perianth yellowish-white, sparsely hairy with parallel purple veins (vs. yellowish, densely hairy with obscure veins), upper tube obliquely oblong funnel-shaped (1.8–)2–2.3(–2.4) cm high (vs. broadly shortened funnel-shaped, 1.1–1.3 cm high), limb nearly rectangular, 1.3–1.5(–1.6) cm high, 1.1–1.2 cm wide (vs. nearly circular, 2.2–2.5 cm wide), throat yellow, densely covered with orange dots (vs. yellow without visible dots). The new species is also similar to *A. coadunata* Backer, which is restricted to Sumatra and Java, Indonesia. However it is clearly distinguished from the latter by a round to truncate leaf base (vs. cordate), cymes on old woody stems, and inflorescence axis up to 10 cm long (vs. flowering in young branches and up to 2 cm long), perianth yellowish-white with parallel purple veins (vs. dark purple without visible veins), throat yellow, densely covered with orange dots (vs. without visible dots) (Table 2).

Aristolochia tonkinensis T.V. Do & S. Wanke sp. nov.—TYPE: VIETNAM. Ninh Binh: Nho Quan district, Cuc Phuong National Park, Silver cloud top, Bong headquarters 2 km Southeast, 20°21′37″N, 105°36′62″E, plot number CP1046, 21 Sept 2001, *Nguyen 1493* (holotype: MO!; isotype: CPNP!, L!).

Aristolochia tonkinensis is morphologically similar to *A. hainanensis* and *A. saccata* but it is distinguishable from them by the following characters: leaf blade ovate to broadly-ovate, leaf base round to truncate; cymes solitary on old woody stems and young branches; lower tube slightly inflated, upper tube narrowly oblong funnel-shaped, 1.5–1.8 cm high; limb nearly rectangular, 1.2–1.3 cm high, 0.9–1 cm wide; throat white without visible dots.

Perennial, woody liana, 6–8(–10) m high with many fasciculate and cylindrical roots. Stem terete, the young branches densely grey pubescent, becoming glabrescent, with a deeply irregularly longitudinally fissured bark when mature, internodes 15–20 cm long. Petiole 6–10 cm long, twisted, densely villous, becoming glabrescent. Leaf blade ovate to broadly-ovate, rarely deltoid, subcoriaceous, 20–25(–30) cm long, 12–14(–20) cm wide, base round to truncate, margin entire, apex acute to shortly acuminate, the adaxial surface dark-green and glabrous, the abaxial surface densely villous, basal veins three, palmate, one pair reaching one-third of the leaf length, secondary veins five to six pairs, pinnate, venation loosely reticulate, veinlets parallel, prominent abaxially, slightly sunken adaxially. Inflorescence cymose on old woody stems and young branches, solitary, each cyme with three or four flowers, clearly separated from each other. Inflorescence axis 1.5–2.5 cm long, densely villous. Bracteole clasping the axis, ovate, 2–2.2 mm long, 1–1.5 mm wide, sessile, both surfaces densely brown villous, persistent. Pedicel 1.2–1.5 cm long, pendulous, densely brown villous. Ovary 0.6–0.8 cm long, 0.2–0.3 cm in diam, densely brown villous. Perianth horseshoe-shaped, 3.2–3.5 cm high, outside white, densely villous with several longitudinal purple veins (variable in number,

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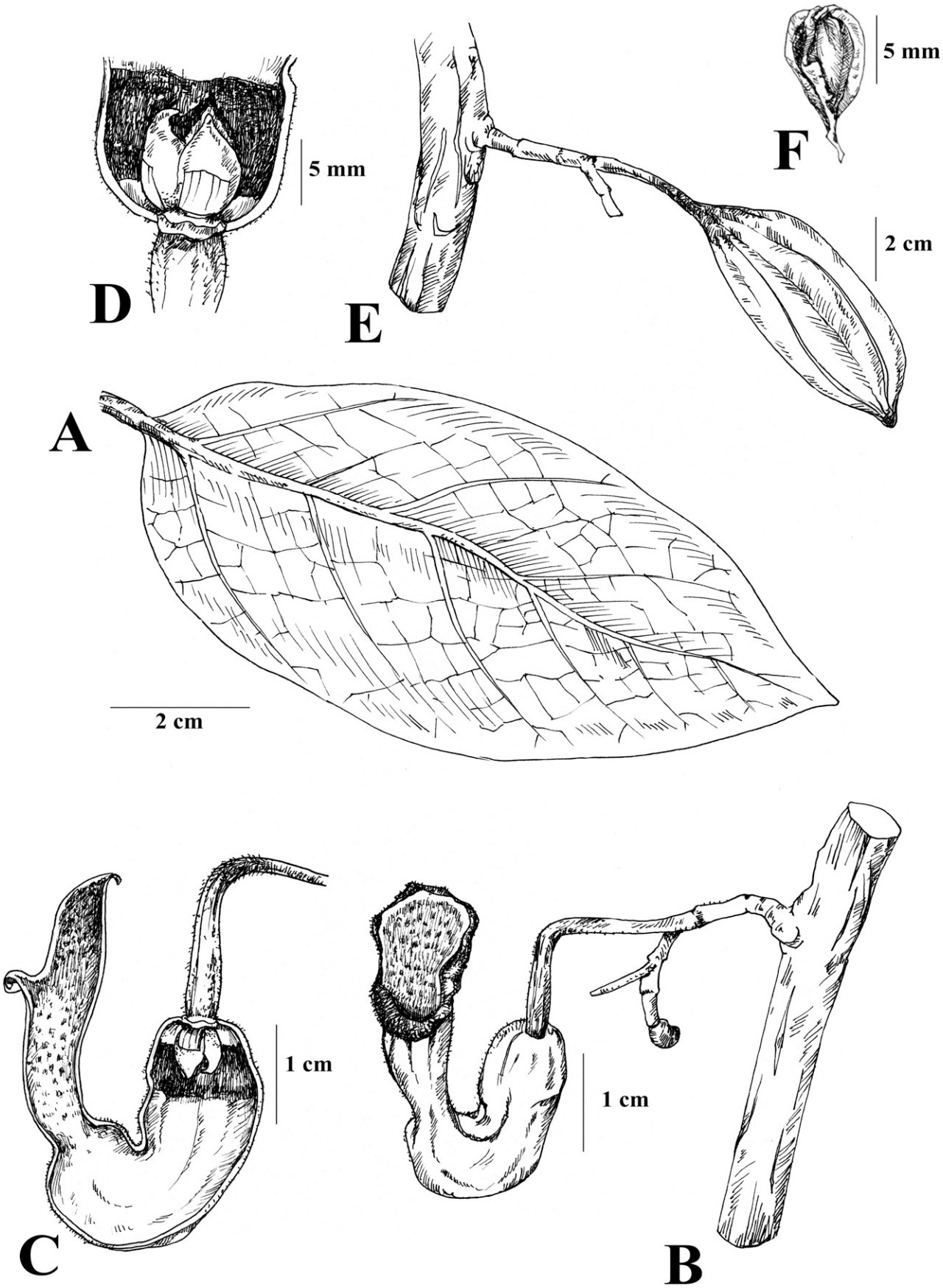


FIG. 5. *Aristolochia tadungensis.* A. Abaxial leaf surface. B. Cyme on old woody stem. C. Longitudinal section of individual flower. D. Close up of gynostemium. E. Capsule. F. Adaxial view of seed. Drawings by Nguyen Huu Quyet from the type specimen.

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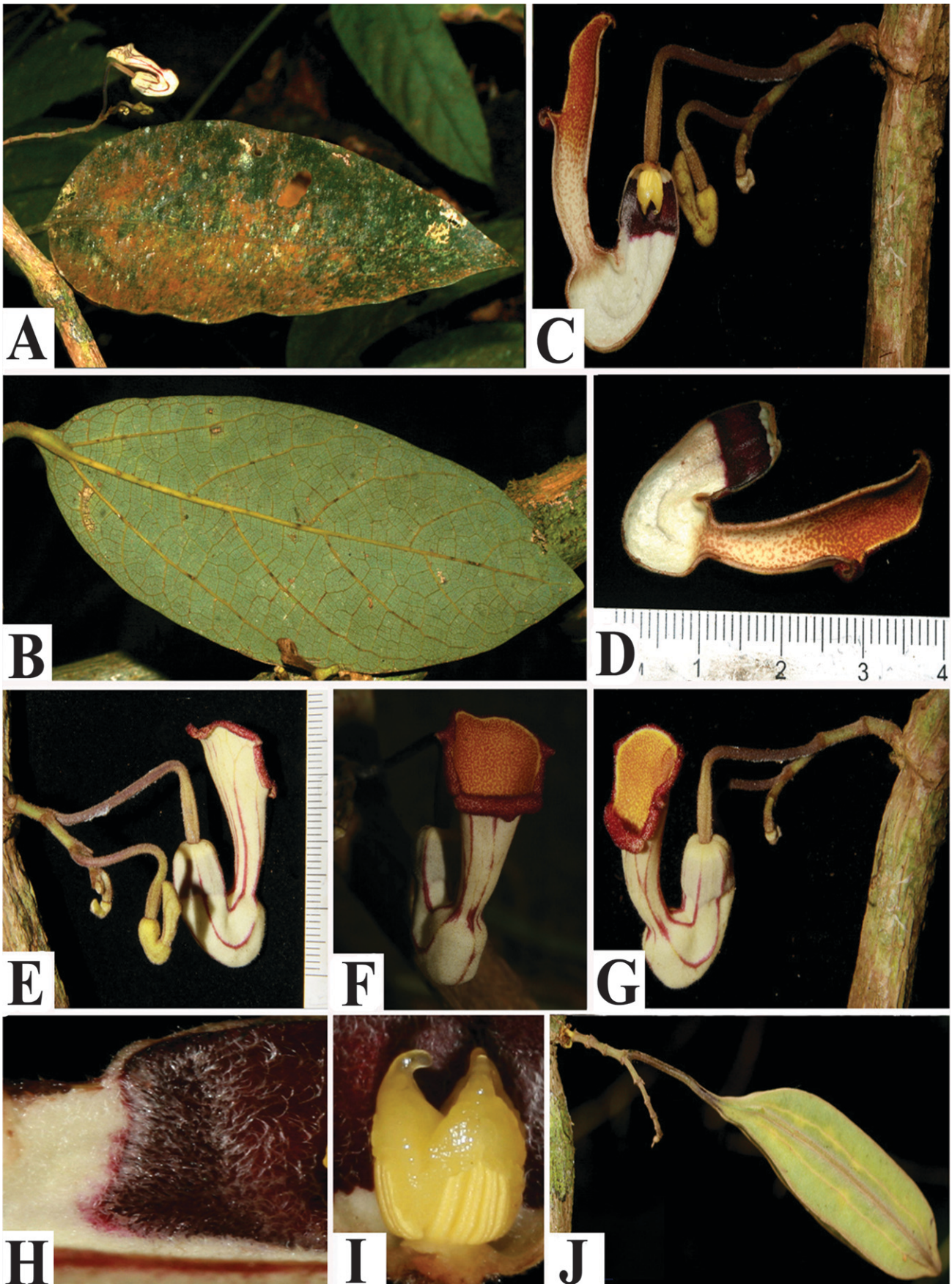


Fig. 6. *Aristolochia tadungensis*. A. Adaxial leaf surface. B. Abaxial leaf surface. C & D. Inflorescence and detailed longitudinal section of the flower. E. Dorsal view of open flower. F. Front view of open flower. G. Lateral view of open flower. H. Inner surface of utricle. I. Close up of gynostemium. J. Capsule. Photographs by Luu Hong Truong from the type population.

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TABLE 2. Comparison of *A. tadungensis* and its morphological affinities. *Morphological characters following the protologue (Merrill 1922), the description of Hwang et al. (2003), and our own field observations from China and Vietnam. **Morphological characters following the protologue (Backer 1919) and the description of Hou (1984).

Character	*A. tadungensis*	*A. hainanensis* *	*A. coadunata* **
Leaf blade	Ovate to lanceolate-ovate, coriaceous	Ovate to lanceolate-ovate, subcoriaceous	Ovate-oblong to lanceolate, subcoriaceous
Leaf base	Round to truncate	Cuneate to round	Cordate
Abaxial leaf surface	Densely woolly, subadpressed	Villous	Densely tomentose
Inflorescence	Cyme solitary on old woody stems	Cluster of 2–3 cymes at each node, on old woody stems and on young branches	Cyme solitary on young branches
Inflorescence axis	4–10 cm	2–6 cm	1–3 cm
Perianth	Outside sparsely hairy, yellowish-white with parallel purple veins	Outside densely hairy, yellowish with obscure purple veins	Outside densely hairy, dark purple with, obscure purple veins
Tube	Upper tube obliquely oblong funnel-shaped, (1.8–)2–2.3(–2.4) cm high	Upper tube broadly shortened funnel-shaped, 1.1–1.3 cm high	Upper tube obliquely oblong cylindrical, 2–2.2 cm high
Limb	Nearly rectangular, 1.3–1.5(–1.6) cm high, 1.1–1.2 wide	Nearly circular, 2.2–2.5 cm wide	Nearly circular, 1.5–3 cm wide
Throat	Yellow, densely covered with orange dots	Yellow, without visible dots	Yellow, without visible dots
Distribution	Vietnam	Vietnam and China	Indonesia (Sumatra and Java)

usually fewer than 6). Utricle poorly developed, sometimes indistinct from the tube, cylindrical, 0.8–0.9 cm high, 0.5–0.6 cm in diam at base, 0.7–0.8 cm in diam at apex, inside with a dark purple band and densely glandular hairs. Tube 3.2–4.5 cm high, lower tube horseshoe-shaped, slightly inflated, 1.1–1.3 cm in diam, upper tube narrowly oblong funnel-shaped, parallel to the utricle, 1.5–1.8 cm high, base constricted, 0.5–0.6 cm in diam, apex slightly broader, 0.8–0.9 cm in diam, inside glabrous. Limb with three unequal lobes valvate pre-anthesis: two lateral lobes triangular, 1.1–1.2 cm wide, 0.5–0.6 cm high, middle lobe broadly triangular, 0.8–0.9 cm wide, 0.4–0.5 cm high, margins of all lobes revolute during anthesis forming a trumpet-shaped limb, nearly rectangular, 1.2–1.3 cm high, 0.9–1 cm wide, two lateral lobes rib-like and narrower than the middle one (1.5 vs. 3–4 mm in diam), inner surface dark purple, densely covered with dark purple bristles. Throat white without visible dots. Annulus absent. Gynostemium with truncated apices, smooth, 3–4 mm high, 2–3 mm in diam, anthers 1.2–1.5 mm long. Capsule cylindrical, (8–)10–12 cm long, 2.5–3 cm in diam, distinctly 6-ridged, greenish-brown, densely pubescent, basipetally dehiscent. Seeds ovoid, 8–9 mm long, 5–6 mm in diam, not winged, the abaxial surface convex, the adaxial surface deeply concave with a prominent, central, longitudinal, funiculus, both surfaces smooth. Figures 7, 8.

***Vernacular Name*—**Common names in Vietnamese for this species are "Mộc hýõng Bắc Bộ" and "Phòng kỷ Bắc Bộ".

Distribution and Ecology*—Aristolochia tonkinensis* is widely distributed in northern Vietnam (Ninh Binh, Hoa Binh, and Ha Giang) (Fig. 4). It was found in primary closed evergreen broad-leaved lowland forest, secondary forest on limestone or granite as well as foggy woodland forest, with the following species: Annonaceae (*Fissistigma*, *Xylopia*), Begoniaceae (*Begonia*), Clusiaceae (*Garcinia*), Fagaceae (*Castanopsis*, *Lithocarpus*), Lauraceae (*Machilus, Neolistsea, Phoebe*), Meliaceae (*Aglaia*, *Toona*), Moraceae (*Streblus*), Myristicaceae (*Horsfieldia, Knema*), Pentaphylacaceae (*Eurya*), Rubiaceae (*Adina, Myrioneuron*, *Pavetta*, *Randia*), Selaginellaceae (*Selaginella*), Theaceae (*Camellia*), Urticaceae (*Elatostema*, *Laportea*), at 450–1,100 m.

Phenology*—Aristolochia tonkinensis* has been observed to flower from August to October and fruit from October to December.

***Etymology*—**The specific epithet refers to the former name of northern Vietnam where it occurs.

Conservation Status*—Aristolochia tonkinensis* has been found in the core-zone of Cuc Phuong National Park, one of the best National Parks in Vietnam as well as other well-protected areas from northern Vietnam. Thus, this species is probably not at risk.

Morphological Affinities*—Aristolochia tonkinensis* was misidentified as *A. saccata* in recent publications of Cuc Phuong National Park (Soejarto et al. 2004; Le and Soejarto 2008; Nguyen et al. 2009). However, *A. tonkinensis* clearly differs from the latter by the following characters: its leaf blade is ovate to broadly-ovate (vs. ovate-oblong to lanceolate), with the leaf base round to truncate (vs. cordate), the cymes solitary on old woody stems and young branches (vs. clusters of several cymes, exclusively on old woody stems), limb nearly rectangular (vs. nearly circular), throat white (vs. yellow). Additionally, *A. tonkinensis* is morphologically similar to *A. hainanensis*, which occurs in southern China and northern Vietnam, but it can be distinguished from the latter by the cyme solitary (vs. clusters of several cymes), upper perianth tube narrowly oblong funnel-shaped, 1.5–1.8 cm high (vs. broadly shortened funnel-shaped, 1.1–1.3 cm high), limb nearly rectangular, 1.2–1.3 cm high, 0.9–1 cm wide (vs. nearly circular, 2.2–2.5 cm wide), throat white (vs. yellow) (Table 3).

***Additional Specimens Examined*—**VIETNAM: Ninh Binh. Nho Quan district, Cuc Phuong National Park, 1 Nov 2012, *Nguyen 1564* (CPNP); Bong headquarters to one thousand years tree, 20°21′244″N, 105°36′108″E, elevation 420 m, 9 Jan 2013, *Do 12* (VNMN, DR); behind the Bong resort, 20°21′110″N, 105°36′006″E, elevation 540 m, 26 Apr 2013, *Do 40* (VNMN, DR): Hoa Binh. Lac Son district, Ngoc Son community, Ngoc Son-Ngo Luong Nature Reserve, 21 Nov 2013, *Lu_NSNL 02* (VNMN): Ha Giang. Vi Xuyen district, Phuong Do community, Lung Vai village, Tay Con Linh Nature Reserve, 22°49′248″N, 104°53′220″E, elevation 1,012 m, 7 Nov 2013, *Do 79* (VNMN, DR). Bac Me district, Khau Ca community, Khau Ca Gibbon Species Protected Area, 22°50′411″N, 105°07′450″E, elevation 1,040 m, 14 Dec 2013, *Lu_KC 01* (VNMN).

New Aristolochia Subgenus Siphisia Records to the Flora of Vietnam—

ARISTOLOCHIA FANGCHI Y. C. Wu ex L. D. Chow & S. M. Hwang, Fl. China 5: 264. 2003.—TYPE: CHINA. Guangdong: Jilong Shan, 22 Apr 1970, *Shi 2* (lectotype: IBSC!) (Fig. 9).

Distribution and Ecology*—Aristolochia fangchi* was considered an endemic species to southern China (Guangdong

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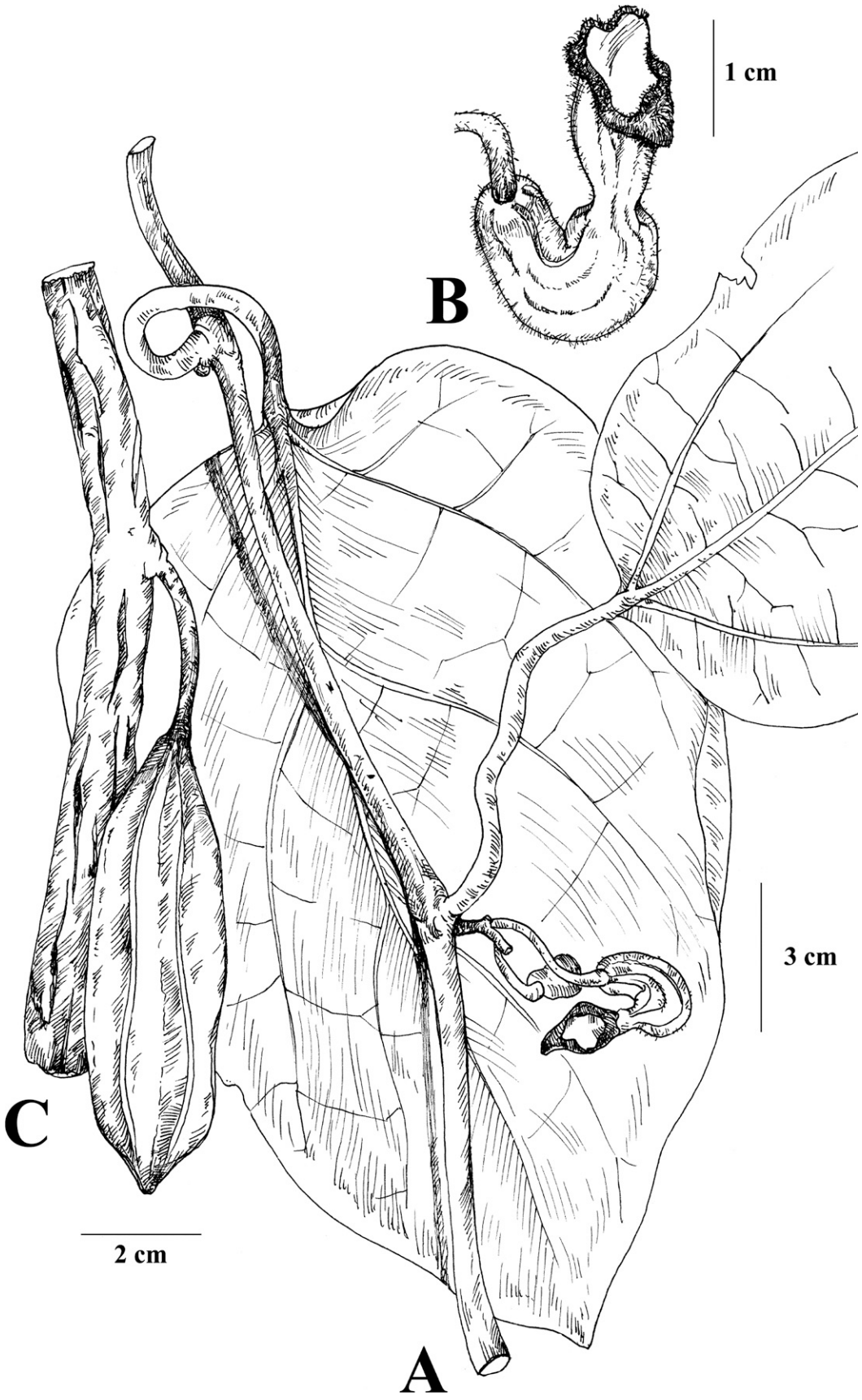


Fig. 7. *Aristolochia tonkinensis*. A. Branch with a cyme. B. Lateral view of open flower. C. Capsule. Drawings by Nguyen Huu Quyet from the type specimen.

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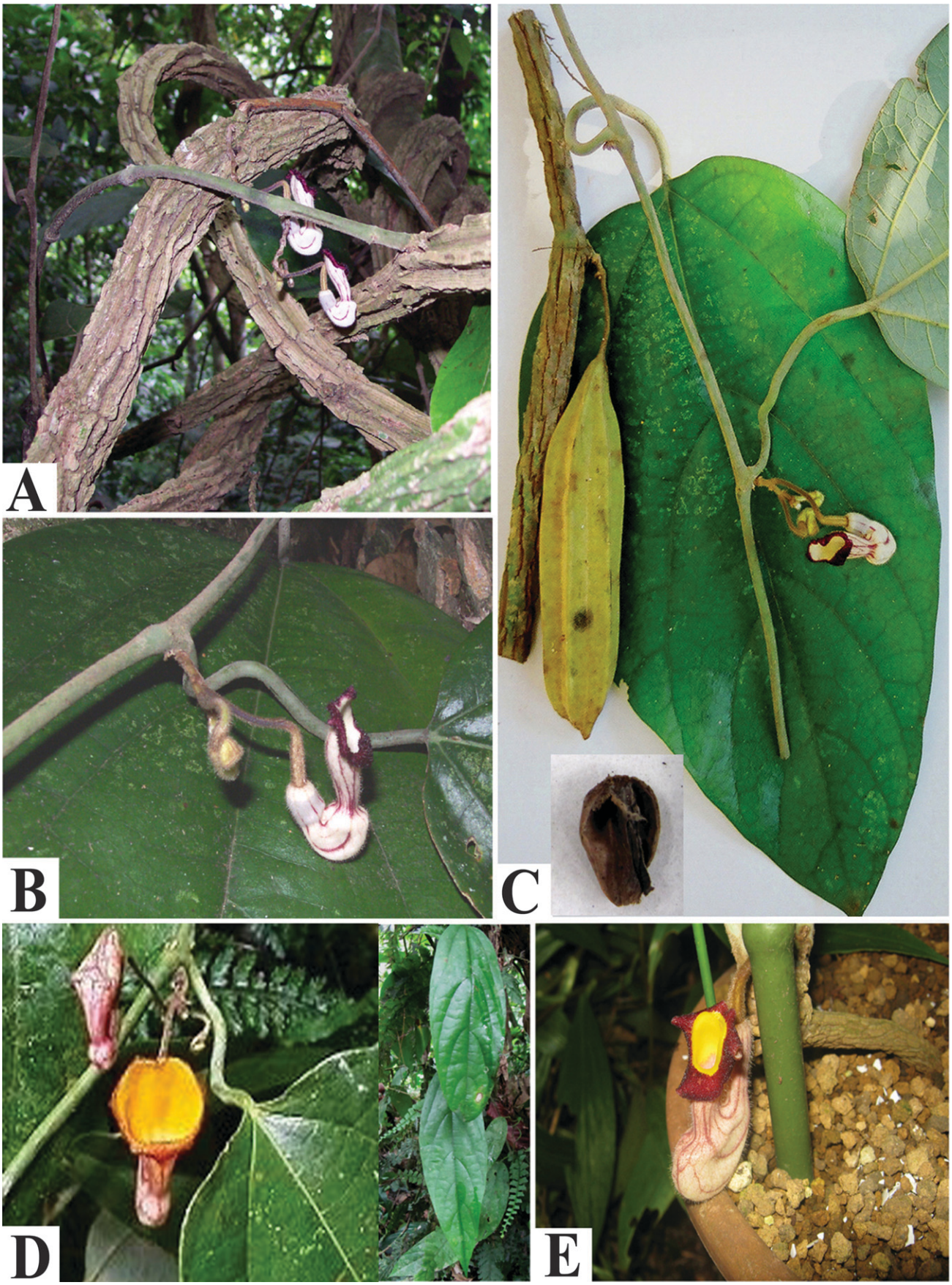


Fig. 8. *Aristolochia tonkinensis* (A-C). A. Habit. B. Cyme on young branch. C. Branch with cyme and capsule, and adaxial surface of seed. D. *Aristolochia hainanensis*. Front view of open flower and habit. E. *Aristolochia saccata*. Front view of open flower. A-C. Photographs by Nguyen Manh Cuong from the type population. D. Photographs by Zhang Rongjing from Hainan Island, China. E. Photographs by Yasushi Yamashita (cultivated).

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TABLE 3. Comparison of *A. tonkinensis* and its morphological affinities. *Morphological characters following the protologue (Merrill 1922), the description of Hwang et al. (2003), and our own field observations from China and Vietnam. **Morphological characters following the protologue (Wallich 1831) and our own field observations.

Characters	*A. tonkinensis*	*A. hainanensis* *	*A. saccata* **
Leaf blade	Ovate to broadly-ovate	Ovate to ovate-lanceolate	Ovate-oblong to lanceolate
Leaf base	Rounded to truncate	Cuneate to rounded	Cordate
Abaxial leaf surface	Densely villous	Villous	Densely adpressed silky villous
Inflorescences	Cyme solitary on old woody stems and young branches	Cluster of 2–3 cymes at each node, on old woody stems and young branches	Cluster of 2–3 cymes at each node, on old woody stems
Inflorescence axis	1.5–2.5 cm	2–6 cm	1.8–2.2 cm
Perianth	White with parallel purple veins	Yellowish with obscure purplish veins	White with purple reticulate veins
Tube	Lower tube slightly inflated; upper tube narrowly long funnel-shaped, 1.5–1.8 cm high, with visible veins	Lower tube less inflated; upper tube broadly shortened funnel-shaped, 1.1–1.3 cm high, with obscure veins	Lower tube strongly inflated; upper tube contractive cylindrical-shaped, 1.2–1.4 cm high, with purple veins
Limb	Nearly rectangular, 1.2–1.3 cm high, 0.9–1.0 cm wide	Nearly circular, 2.2–2.5 cm wide	Nearly circular, 1.8–2 cm wide
Throat	White	Yellow	Yellow
Distribution	Vietnam	China and Vietnam	Eastern Himalaya and southern China

and Guangxi) (Hwang et al. 2003), but this study demonstrates that it also occurs in northern Vietnam (Ha Giang, Hoa Binh, and Quang Ninh) (Fig. 4). This species mostly grows in lowland evergreen forests, bamboo and woody mixed forest, thickets, edges of secondary forests on limestone, at 700–900 m.

Phenology—*Aristolochia fangchi* has been observed to flower from April to May and fruit from June to October.

Conservation Status—Only a few populations of this species were found in non-protected forest areas in northern Vietnam. Furthermore, there are few saplings growing from seeds, thus it might be at high risk of extinction in Vietnam. This species was assessed as critically endangered (CR) according to the IUCN (2013).

Notes—The Vietnamese populations of *Aristolochia fangchi* are identical in vegetative and reproductive characters to the populations found in China. From diagnostic features, *A. fangchi* is similar to *A. petelotii* Schmidt, which also occurs in northern Vietnam and southern China (Pham 2000; Nguyen 2003; Hwang et al. 2003). Inflorescences of both species grow from the old woody stems (each 2–4-flowered), with a U-shaped purple perianth, and evident parallel veins. However, *A. fangchi* differs from the latter by the leaf shape (a round leaf base and an acute to obtuse leaf apex vs. a cordate leaf base and an acuminate leaf apex), the shape of the limb (subrotundate-peltate vs. bell-shaped), and the color of the annulus (white vs. dark purple).

Additional Specimens Examined—VIETNAM. Ha Giang: Bac Me Nature Reserve, 22°42′45″N, 105°15′28″E, elevation 750 m, 30 Oct 2013, *Do 66* (VNMN, DR); Hoa Binh: Da Bac district, Doan Ket community, PuCanh Nature Reserve, 20°55′13″N, 105°04′43″E, 6 May 2013, *Do 31* (VNMN, DR), 22 Sept 2001, *Ngo 5661* (NIMM). Quang Ninh: Uong Bi district, Yen Tu temple, 21°6′32″N, 106°43′23″E, 28 Apr 2013, *Do 35* (VNMN, DR), medicinal plant station, 19 Sept 1976, *Vu 2958* (NIMM).

ARISTOLOCHIA HAINANENSIS Merr., Philipp. Journ. Sc. 21: 341. 1922. *Hocquartia hainanenis* (Merr.) Migo, Journ. Shanghai. Sci. Inst. 14: 334. 1944.—TYPE: CHINA. Hainan: Five Finger Mt., 11 Dec 1921, elevation 1,300 m, *McClure 8630* (holotype: K!, isotypes: A!, US!).

Aristolochia carinata Merr. Chun, Sunyatsenia 2: 219, pl. 42. 1935.—TYPE: CHINA. Hainan: Fanya, Ng Chi Leng, 25 Oct 1932, *Chun & Tso 44161* (holotype: PE, isotypes: IBK!, NY!).

Distribution and Ecology—*Aristolochia hainanensis* was primarily reported from Hainan province, southern China. During recent investigations, we also found this species in northern Vietnam (Ha Giang, Dien Bien, Tuyen Quang, and Hai Phong) (Fig. 4) in closed lowland evergreen forests, valleys or thickets, as well as edges of secondary forests on limestone, dominated by representatives of Fagaceae, Lauraceae, and Sapindaceae, at 600–1,100 m.

Phenology—*Aristolochia hainanensis* has been observed to flower from December to March and fruit from April to July in Vietnam.

Conservation Status—*Aristolochia hainanensis* has been found mostly in well-protected areas in northern Vietnam. The individuals grow and regenerate well. Additionally, many saplings are growing from seed. We propose to assign the species 'near threatened' (NT) although it is currently listed as vulnerable (VU B2ab) according to the IUCN (2013).

Notes—Vietnamese and Chinese populations of *A. hainanensis* are morphologically identical (Fig. 10). This species is morphologically close to *A. saccata*. The latter species is widely distributed in Bhutan, India, Myanmar, Nepal, Vietnam, and China (Samanta et al. 1999; Pham 2000; Nguyen 2003; Hwang et al. 2003). However, *A. hainanensis* differs from the latter by the villous abaxial leaf surface and cuneate to rounded leaf base as well as the acute leaf apex. In contrast, *A. saccata* is characterized by the silky adpressed villous abaxial leaf surface, deeply cordate leaf base and acuminate leaf apex. This species is most similar to *A. tonkinensis*, but it clearly differs from the latter by the characters of inflorescence and perianth (shape, size of upper tube, limb, and color of throat, Table 3).

Additional Specimens Examined—VIETNAM. Ha Giang: Tay Con Linh Nature Reserve, 22°48′17″N, 104°73′15″E, elevation 1,100 m, 7 Nov 2013, *Do 78* (VNMN, DR); Dien Bien: Dien Bien Dong district, Muong Phang community, 4 Jul 1997, *Nguyen 8812* (NIMM). Tuyen Quang: Na Hang district, Thanh Tuong community, Bung village, Na Nieng mountain, 22°16′87″N, 105°26′30″E, elevation 680 m, 15 Jan 2013, *Do 26* (VNMN, DR), 20 Apr 2002, *Nguyen 6490* (NIMM): Chiem Hoa district, Yen Nguyen community, 27 Sept 2002, *Ngo & Nguyen* 6492 (NIMM). Hai Phong: Cat Ba district, Ang Re Bo Da mountain, Ca Ba National Park, 3 Dec 1986, *Nguyen 826* (HN), 6 Jan 1988, *LX-VN 3716* (HN).

ARISTOLOCHIA UTRIFORMIS S. M. Hwang, Acta Phytotax. Sin, 19: 228, Fig. 7: 1–3. 1981.—TYPE: CHINA. Yunnan: Wenshan, elevation 1,900 m, 24 Apr 1962, *Feng 22205* (holotype: KUN!, isotype: IBSC).

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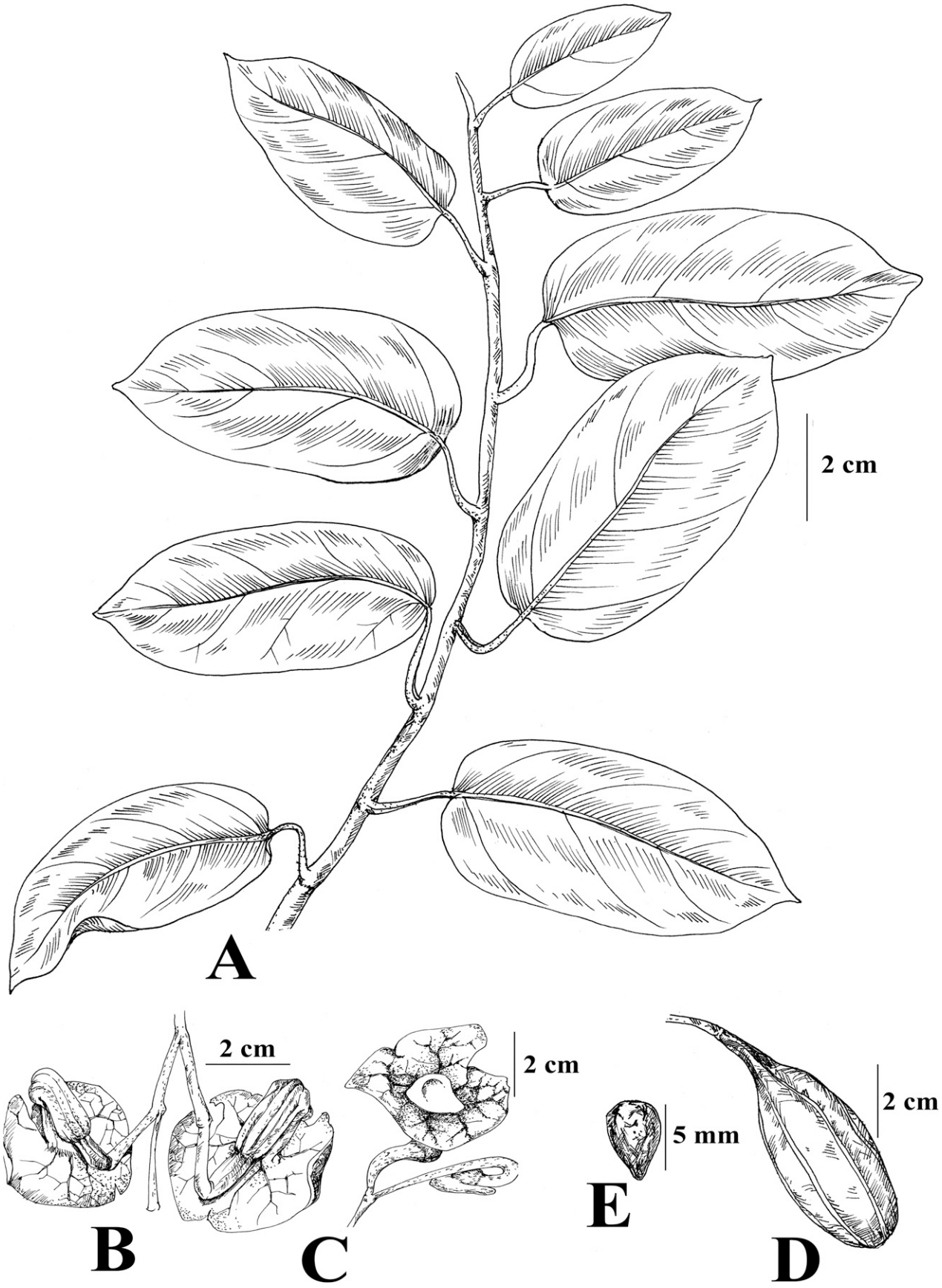


Fig. 9. *Aristolochia fangchi*. A. Branch. B. Dorsal view of open flower. C. Front view of open flower. D. Capsule. E. Adaxial view of seed. Drawings by Nguyen Huu Quyet from the specimens *Do 31* and *Do 35* (VNMN).

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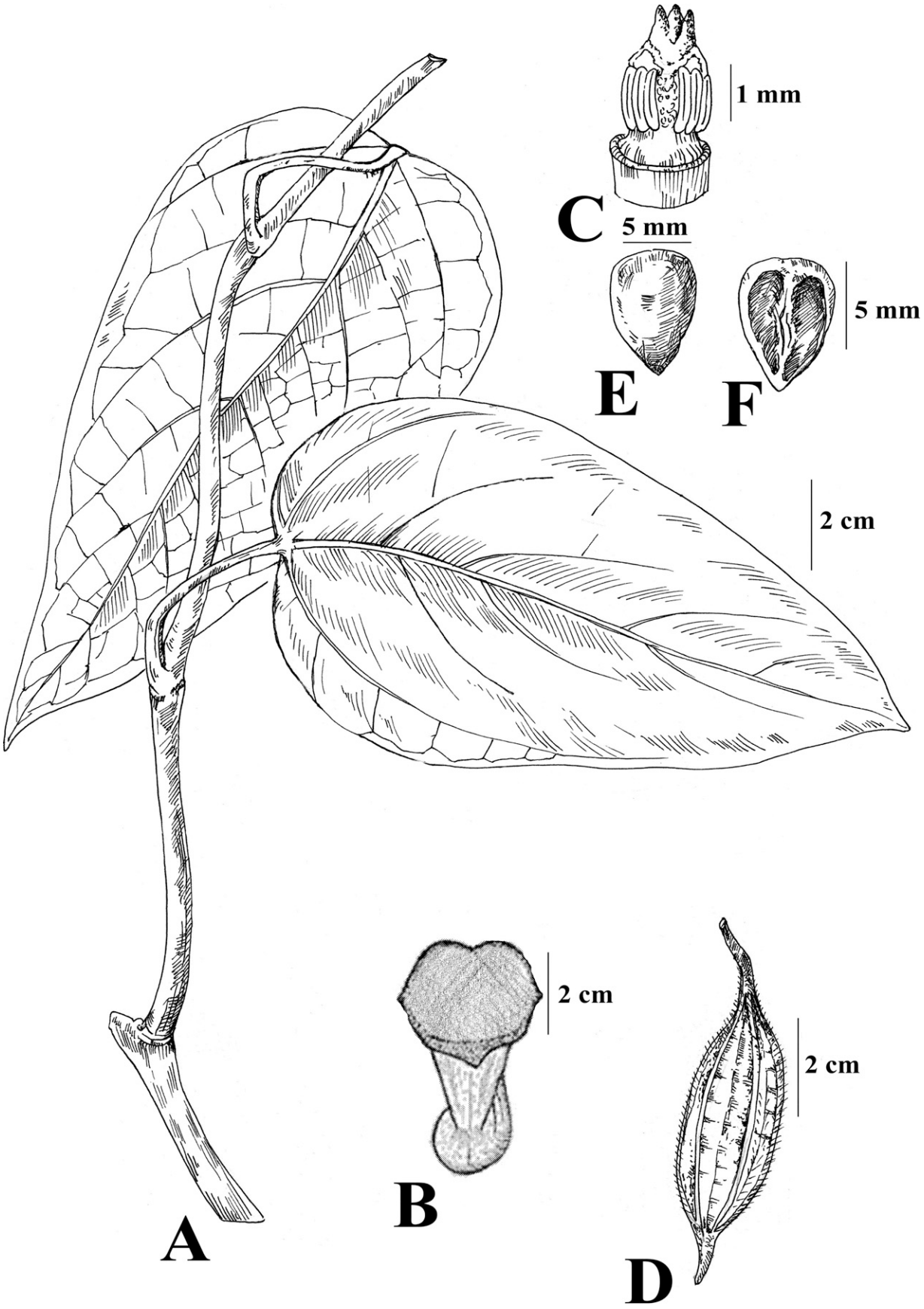


FIG. 10. *Aristolochia hainanensis*. A. Branch. B. Front view of open flower. C. Close up of gynostemium. D. Capsule. E. Abaxial view of seed. F. Adaxial view of seed. Drawings by Nguyen Huu Quyet from the specimens *Do 26* (VNMN, DR) and *LX-VN 3716* (HN).

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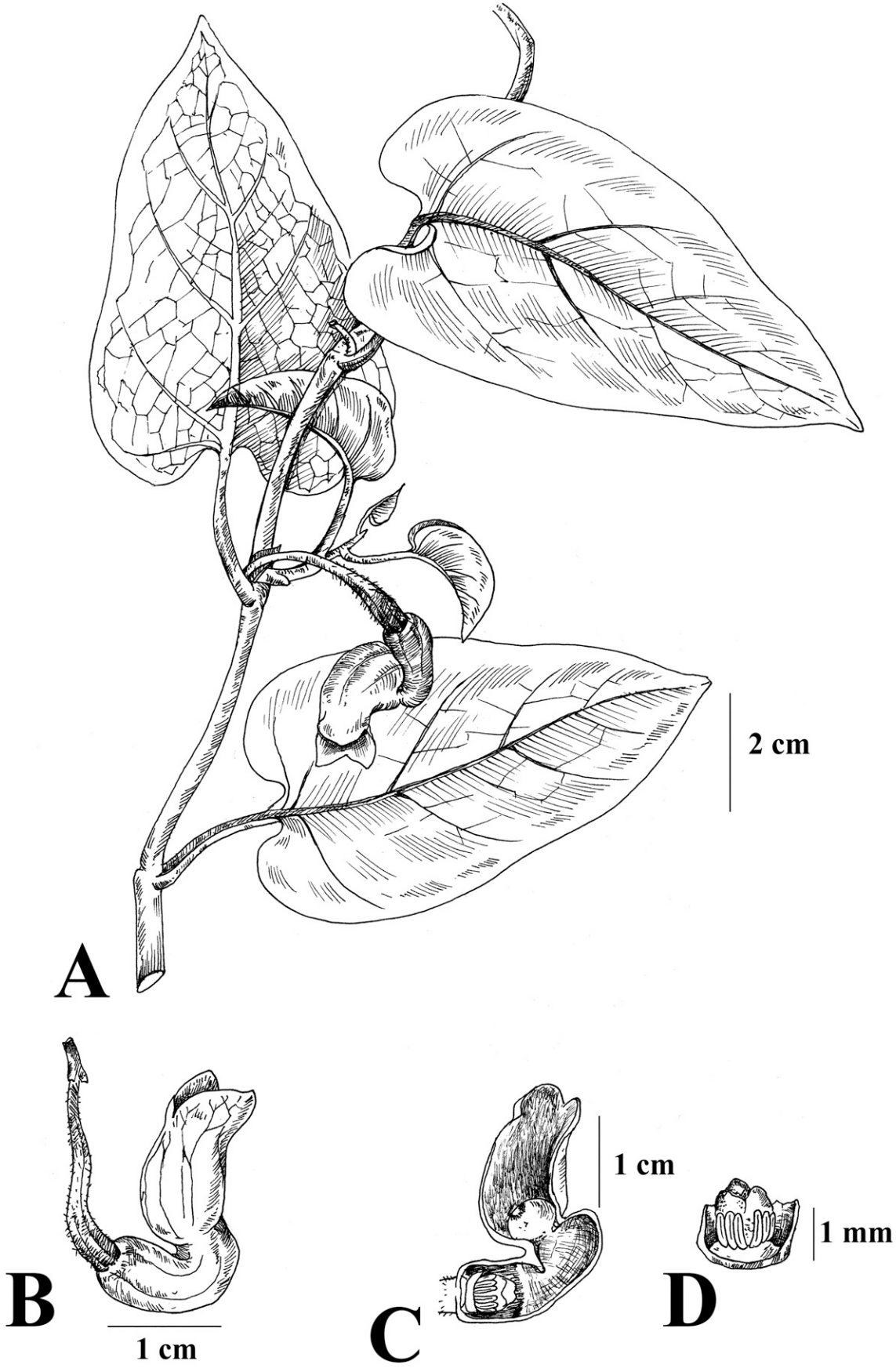


FIG. 11. *Aristolochia utriformis*. A. Branch bearing solitary, terminal flower. B. Lateral view of open flower. C. Longitudinal section of flower. D. Close up of gynostemium. Drawings by Nguyen Huu Quyet from the specimen *Do 38* (VNMN, DR).

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Distribution and Ecology—This species was considered to be endemic to Yunnan, China where borders the northwestern part of Vietnam, including Lao Cai province. Thus, it is not surprising that *A. utriformis* has been discovered and recorded for the flora of Vietnam (Fig. 4). It grows along streams in montane bamboo forest, at 1,800–2,000 m.

Phenology—*Aristolochia utriformis* has been observed to flower in April and May in Vietnam which is the same flowering period as has been reported for the type locality. The fruiting period however remains unknown.

Conservation Status—Only two small populations of *Aristolochia utriformis* were found within the buffer zone of Hoang Lien National Park, but few saplings growing from seeds were observed. Furthermore, the local farmers continue to impose strong pressure on the remaining primary forest patches converting it mostly into Bengal cardamom plantation (*Amomum aromaticum* Roxb.). Thus, it might be at high risk of extinction in Vietnam. This species was primarily assessed as critically endangered (CR) according to the IUCN (2013).

Notes—The Vietnamese populations of *Aristolochia utriformis* slightly vary in shape, size of limb, and limb lobes (Fig. 11). The species is morphologically close to *A. ovatifolia* Hwang. The latter is widely distributed in the provinces of Guizhou, Sichuan, and Yunnan (Hwang et al. 2003). Flowers of both species are solitary on young branches with a saccate-shaped limb that is erectly 3-lobed. However, *A. utriformis* differs from the latter in its ovate-lanceolate leaf blade (vs. ovate), an adaxial leaf surface with scattered hairs (vs. both leaf surfaces densely villous) and a yellowish-green perianth (vs. purple-red).

Additionally *Aristolochia utriformis* is characterized by the presence of a distinct semicircle-like annulus in contrast to a ring-like annulus of other *Siphisia* species from the Old World.

Additional Specimens Examined—VIETNAM. Lao Cai: Sapa district, Hoang Lien National Park, 22°20′03″N, 103°46′47″E, on path from Cat Cat village to 3,143 m peak, 17 Apr 2013, *Do* 38 (VNMN, DR); along third national road to Ton forest station, 10 Dec 1997, *Nguyen & Ngo 8813* (NIMM).

Key to the Species of *Aristolochia* Subgenus *Siphisia* in Asia

1. Limb saccate . . . 2
   2. Subshrub erect, stem and branchlet with shortened nodes; limb indistinctly 3-lobed; China . . . *A. thwaitesii* Hooker
   2. Lianas, internodes of stem and branchlet elongated; limb distinctly 3-lobed . . . 3
      3. Limb shallowly 3-lobed, each lobe subround or broadly triangular . . . 4
         4. Limb broad at apex, ca. 1.5 cm wide; China, Myanmar . . . *A. transsecta* (Chatterjee) C. Y. Wu ex S. M. Hwang
         4. Limb constricted at apex, 0.5–1 cm wide . . . 5
            5. Leaf blade ovate, the abaxial surface densely gray villous; pedicel 3–4 cm long, villous; China . . . A. *ovatifolia* S. M. Hwang
            5. Leaf blade lanceolate, the abaxial surface glabrescent; pedicel 1–2.5 cm long, puberulent; Myanmar, India . . . *A. wardiana* J. S. Ma
      3. Limb deeply 3-lobed, each lobe triangular-ovate to acuminate-lanceolate . . . 6
         6. Limb lobes triangular-ovate; China, Vietnam . . . *A. utriformis* S. M. Hwang
         6. Limb lobes acuminate-lanceolate . . . 7.
            7. Limb ca. 6 × 1.5 cm, lobes ca. 2.5 × 1 cm; China . . . *A. forrestiana* J. S. Ma
            7. Limb ca. 2 × 0.2–0.3 cm, lobes ca. 0.5–0.7 × 0.2–0.3 cm; China . . . *A. cucurbitoides* C. F. Liang
1. Limb discoid, subrotundate-peltate, bell- or trumpet-shaped . . . 8
   8. Limb bell- or trumpet-shaped, margins of all lobes distinctly revolute . . . 9
      9. Leaves deeply palmate-lobed; Buhtan, India, Nepal . . . *A. platanifolia* (Klotzsch) Duch.
      9. Leaves entire . . . 10
         10. Limb bell-shaped; Vietnam . . . *A. quangbinhensis* T. V. Do
         10. Limb trumpet-shaped . . . 11
            11. Leaf base slightly to deeply cordate . . . 12
               12. Abaxial leaf surface densely tomentose, leaf base slightly cordate, sinus < 1 cm deep; Indonesia . . . *A. coadunata* Backer
               12. Abaxial leaf surface with densely adpressed silky villous indumentum, leaf base deeply cordate, sinus > 2 cm deep . . . 13
                  13. Leaf blade broadly ovate to cordate; upper half of throat white and lower half pinkish; Vietnam . . . *A. faviogonzalezii* T. V. Do, S. Wanke & C. Neinhuis
                  13. Leaf blade narrowly ovate to lanceolate-ovate; throat uniformly yellow . . . 14
                     14. Limb nearly circular, inner surface of limb lobes covered with purple warts only; throat without visible dots; India, Myanmar, Nepal, Vietnam . . . *A. saccata* Wall.
                     14. Limb nearly rectangular, inner surface of limb lobes covered with purple warts and bristle-like papillae; throat densely covered with purple dots; China, India . . . *A. cathcartii* Hook. f.
            11. Leaf base cuneate to rounded . . . 15
               15. Upper tube obliquely oblong funnel-shaped, > 2 cm high; throat densely covered with orange dots; Vietnam . . . *A. tadungensis* T. V. Do & T. H. Luu
               15. Upper tube shortened funnel-shaped, < 2 cm high; throat without visible dots . . . 16
                  16. Leaf blade ovate, glabrescent abaxially, petiole glabrous; warts on inner surface of limb lobes dark red . . . 17
                     17. Cymes in clusters of 2 or 3, with axes ca. 5 cm long, pedicel 2–2.5 cm long; upper tube 1–1.2 cm high; throat golden-brown; Vietnam . . . *A. balansae* Franch.
                     17. Cymes solitary, with an axis ca. 3 cm long, pedicel 3–7.5 cm long; upper tube 1.4–1.8 cm high; throat fresh-yellow; Thailand . . . *A. grandis* Craib
                  16. Leaf blade ovate-lanceolate to broadly ovate, densely villous abaxially, petiole glabrescent; warts on inner surface of limb lobes dark purple . . . 18
                     18. Upper tube broadly shortened funnel-shaped, 1.1–1.3 cm high; limb nearly circular, 2.2–2.5 cm wide; throat yellow; China, Vietnam . . . *A. hainanensis* Merr.
                     18. Upper tube narrowly oblong funnel-shaped, 1.5–1.8 cm high; limb nearly rectangular, 1.2–1.3 cm high, 0.9–1 cm wide; throat white; Vietnam . . . *A. tonkinensis* T.V. Do & S. Wanke

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8. Limb abruptly expanded discoid, subrotundate-peltate or bell-shaped, margins of limb lobes not revolute . . . 19
19. Limb bell-shaped . . . 20
20. Leaf blade as wide as long, ovate-cordate, leaf base deeply cordate; limb ca. 8 cm wide; Thailand . . . *A. baenzigeri* B. Hansen & Phuph.
20. Leaf blade longer than wide, lanceolate-ovate, leaf base shallowly cordate; limb 3–5 cm wide; China, Vietnam . . . *A. petelotii* O. C. Schmidt
19. Limb abruptly expanded discoid- or subrotundate-peltate-shaped . . . 21
21. Limb oblique, deeply 3-lobed; China . . . *A. obliqua* S. M. Hwang
21. Limb not oblique, sub-symmetrically shallowly 3-lobed . . . 22
22. Inner surface of limb lobes with purple veins; throat densely covered with purple dots . . . 23
23. Flowers solitary or terminal; perianth uniformly dark purple; China . . . *A. huanjiangensis* L. Wu, W. B. Xu, G. F. Wie & Y. Liu
23. Flowers in cyme; perianth whitish-or yellowish-green . . . 24
24. Leaves deeply palmately 3–7- lobed; China, Japan . . . *A. cucurbitifolia* Hayata
24. Leaves entire . . . 25
25. Leaf blade lanceolate; China . . . *A. neolongifolia* J. L. Wu & Z. L. Yang
25. Leaf blade broadly ovate to cordate . . . 26
26. Limb ca. 4 cm wide; annulus ca. 8 mm in diam; China . . . *A. liukiuensis* Hatusima
26. Limb ca. 3 cm wide; annulus ca. 7 mm in diam . . . 27
27. Abaxial leaf surface with adpressed hairs on veins; limb yellow with fine reddish to dark purple veins; throat with reddish to dark purple dots; Japan . . . *A. kaempferi* var. *kaempferi* Willd.
27. Abaxial leaf surface with spreading hairs on veins; limb whitish to greenish with dark purple veins; throat with dark purple band; Japan . . . *A. kaempferi* var. *tanzawana* Kigawa
22. Inner surface of limb lobes smooth or densely purple verrucose; throat without visible dots . . . 28
28. Leaves shallowly 3–5-lobed; Japan . . . *A. shimadai* Hayata
28. Leaves entire . . . 29
29. Leaf blade generally as wide as long, cordate to orbicular; veins palmate . . . 30
30. Abaxial leaf surface glabrescent, leaf base truncate; China . . . *A. caulialata* C. Y. Wu ex J. S. Ma & C. Y. Cheng
30. Abaxial leaf surface villous to hirsute, leaf base cordate or auriculate . . . 31
31. Limb 3.5–12 cm wide . . . 32
32. Stem densely hirsute; limb lobes broadly triangular, deeply lobed . . . 33
33. Pedicel 4–7 cm long; limb pale yellowish-green, inner surface smooth; Indonesia . . . *A. singalangensis* Korth. ex Ding Hou
33. Pedicel 2–3 cm long; limb purple, inner surface densely verrucose or with spinelike protuberances . . . 34
34. Limb ca. 4.5 cm wide, limb lobes triangular, inner surface with acanthoid protuberances and outer surface pale yellow-green; throat yellow; China, Vietnam . . . *A. kwangsiensis* W. Y. Chun & F. C. How ex C. F. Liang
34. Limb ca. 5.5 cm wide, limb lobes broad-triangular, inner surface with verrucose protuberances and outer surface purple; throat purple; China . . . *A. mulunensis* Y. S. Huang, R. C. Peng, W. N. Tan, G. F. Wei & Y. Liu.
32. Stem villous; limb lobes ovate, not deeply lobed . . . 35
35. Limb 4–6 cm wide; seeds deltoid-cordiform or cordiform, 6–7 × 6–7 mm, adaxial surface slightly plano-convex, verrucose; China, Korea, Russia . . . *A. manshuriensis* Komarov
35. Limb 6–12 cm wide; seeds ovoid, 4 × 3 mm, upper surface convex, adaxial surface deeply concave, rugose or smooth; Bhutan, China, India, Myanmar, Nepal . . . *A. griffithii* Hook. f. & Thomson ex Duch.
31. Limb 2–2.5 cm wide . . . 36
36. Abaxial leaf surface densely tomentose, hairs white or gray; limb lobes broadly triangular, deeply lobed . . . 37
37. Stem and adaxial leaf surface densely villous, leaf blade ovate; pedicel 1.5–1.8 cm long; China . . . *A. mollissima* Hance
37. Stem and adaxial leaf surface glabrescent, leaf blade lanceolate-ovate; pedicel 3–4 cm long . . . 38
38. Perianth densely villous; upper tube strongly constricted; inner surface of limb lobes with dense striations; India, Nepal, Pakistan . . . *A. punjabensis* Lace
38. Perianth glabrescent; tube uniformly wide; inner surface of limb lobes without visible striations; India . . . *A. dilatata* N. E. Br.
36. Abaxial leaf surface sparsely to densely villous, hairs yellowish; limb lobes rounded, not deeply lobed . . . 39
39. Leaf blade linear-lanceolate, leaf base shallowly cordate, sinus ca. 1 cm deep; bracteole narrowly lanceolate, 2–3 × 0.5–0.8 cm; China . . . *A. kunmingensis* C. Y. Cheng & J. S. Ma
39. Leaf blade ovate to cordate, round, leaf base deeply cordate or auriculate, sinus 1.5–2.5 cm deep; bracteole ovate, ca. 1.5–2 × 1–2.5 cm . . . 40
40. Leaf blade ovate, adaxial surface densely adpressed pubescent; China . . . *A. salweenensis* C. Y. Cheng & J. S. Ma
40. Leaf blade cordate to round, adaxial surface glabrescent to glabrous . . . 41
41. Lamina 18–24 × 16–20 cm, leaf apex retuse, abaxial leaf surface densely white villous; capsule 11 × 6 cm; China . . . *A. wuana* Zhen W. Liu & Y. F. Deng

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41. Lamina 6–16 × 5–12 cm, leaf apex acute or acuminate, abaxial leaf surface sparsely gray strigose; capsule 6–8 × 2–3.5 cm; China ..... *A. moupinensis* Franch.

29. Leaf blade longer than wide, ovate to narrowly ovate, elliptic, oblong, or lanceolate; veins pinnate 42
42. Leaf base cordate or auriculate 43
43. Limb 4–13 cm wide 44
44. Limb 8–13 cm wide ..... *A. westlandii* Hemsley
44. Limb 4–6 cm wide 45
45. Leaf blade oblanceolate or broadly oblanceolate, petiole 2.5–7 cm long; cymes on old woody stems, the axis 15.5–17 cm long; Malaysia ..... *A. vallisicola* T. L. Yao
45. Leaf blade narrowly elliptic to lanceolate-elliptic, petiole 1–2 cm long; cymes on young branches, the axis 2–3 cm long; China ..... *A. versicolor* S. M. Hwang
43. Limb 2–3 cm 46
46. Leaf base cordate; cymes on old woody stems, each 3–5-flowered; China ..... *A. scytophylla* S. M. Hwang & D. L. Chen
46. Leaf base narrowly auriculate; flowers on young branches, terminal or a 2-flowered cyme 47
47. Leaf blade polymorphic, broadly oblong-oblanceolate, linear, or oblong, margin shallowly 2–3-lobed; limb ca. 3 cm wide; China ..... *A. howii* Merrill & W. Y. Chun
47. Leaf blade uniform, margin entire; limb ca. 2 cm wide 48
48. Leaf blade ovate-elliptic to oblong-elliptic, abaxial surface densely yellowish villous, petiole 1.5–4 cm long; limb purplish-yellow; China ..... *A. fulvicoma* Merrill & W. Y. Chun
48. Leaf blade obovate-oblong, both leaf surfaces grey pilose, petiole 0.5–1 cm long; limb purplish; China ..... *A. thibetica* Franch.
42. Leaf base cuneate to round 49
49. Leaf blade lanceolate or linear-lanceolate; perianth in lateral view V-shaped; inner surface of limb lobes papillate; China ..... *A. championii* Merrill & W. Y. Chun
49. Leaf blade ovate-oblong or ovate; perianth in lateral view U-shaped; inner surface of limb lobes smooth; China, Vietnam ..... *A. fangchi* Y. C. Wu ex L. D. Chow & S. M. Hwang

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