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Arisaema liemiana (Araceae: Arisaemateae), a new species from southern Central of Vietnam

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Abstract

Arisaema liemiana is described and illustrated as a new species from Vietnam. A morphological comparison between the new and other species with yellow spathe limb in the sect. *Attentuata* is discussed.

Introduction

Arisaema Martius (1831: 459) is a genus of the Araceae comprised of around 200 species occurring primarily in temperate regions of Asia, with extended distribution in the Asian tropics, East Africa, and North America (Govaerts *et al*. 2002, Gusman & Gusman 2006, Boyce *et al*. 2012). The most recent phylogenetic study by Ohi-Toma *et al*. (2016) recognized 15 sections in *Arisaema*, in which *Fimbriata* (Engler 1920: 23) Murata (1984: 466) was redefined as a monotypic section and the remaining species of the section *Fimbriata* (*sensu* Gusman & Gusman 2006) belonged to section *Attenuata* (Engler 1920: 23) Li (1979: 127). According to Ma & Li (2017), *Attenuata* has 24 species and is characterized by following characters: deciduous plants with tuberous and subglobose stem, leaves 1 or 2, leaf blades always trifoliolate, spadix-appendix sessile, usually attenuate distally, neuter flowers often present. *Fimbriata* is different from *Attentuata* by having often bisexual spadix and obviously pendulous appendix densely covered with filiform neuter flowers.

In Vietnam, *Arisaema* includes six sections and 24 species (Engler 1920, Gagnepain 1942, Li 1977, 1981, Murata 1984, Mayo *et al.* 1997, Nguyen 1998, 2000, 2002, 2005a, 2005b, 2007, 2017, Pham-hoang 2000, Renner *et al*. 2004, Nguyen & Boyce 2005, Gusman & Gusman 2006, Nguyen & Vu 2009, Li *et al*. 2010, Boyce *et al*. 2012, Hu *et al.* 2012, Bruggeman *et al*. 2013, Luu *et al.* 2013, 2014, Murata *et al*. 2013, Nguyen *et al*. 2014, Hoang *et al.* 2015; Van *et al*. 2016a, Van 2017). Among them, seven species belong to section *Attentuata* (*sensu* Ohi-Toma *et al*. 2016) or *Fimbriata* (*sensu* Gusman & Gusman 2006), namely: *A. averyanovii* Nguyen & Boyce (2005:35), *A. chauvanminhii* Luu *et al.* (2014: 394), *A. condaoense* Nguyen (2000: 23), *A. honbaense* Luu *et al.* (2013: 45), *A. pierreanum* Engler (1920: 159), *A. ramulosum* Alderwerelt van Rosenburgh (1922: 166) and *A. roxburghii* Kunth (1841: 18).

Our surveys of plant diversity in Takou Nature Reserve of Vietnam since 2008 result in collections of a yellow-spathed *Arisaema.* Our careful examination of its morphological characters indicated that the species differed from all the earlier described species of *Arisaema* section *Attentuata* (*sensu* Ohi-Toma *et al*. 2016). In this paper, it is described as *Arisaema liemiana*, a new species from Vietnam.

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Taxonomy

Arisaema liemiana **Luu, H.T.Van, H.C.Nguyen & V.D.Nguyen, *sp.nov.* (Fig. 1)**

Arisaema liemiana is closest to *A. pierreanum* from Vietnam and *A. maxwellii* Hettercheid & Gusman (2003: 33) from Thailand in having white spathe tube and bright yellow spathe limb but differs from *A. pierreanum* by having broad spathe limb (vs. narrow), spadix appendix covered with filiform neuters (vs. naked) and loosely arranged synandria (vs. densely), and from *A. maxwellii* by spathe tube with large auricles at mouth (vs. without auricles), spathe limb without white spot at base (vs. with a large white spot), 3–5-androus synandria (vs. 2–3).

Type:—VIETNAM. Southern Central: Binh Thuan Province, Ham Thuan Nam District, Takou Nature Reserve, Takou Mountain, 10°48'49.38"N, 107°53'43.53"E, 480 m elevation, 5 June 2012, *Luu Hong Truong Luu 887* (holotype SGN!, isotypes SGN!, HN!).

Herb deciduous, 20–50 cm high. Stem subterranean, sub-globose tuberous, 2.5–3.0 cm in diam. and 2 cm high, covered with stout roots at apex. Cataphylls 4–5, greenish yellow turning to brown with age and up to 9 cm long. Leaves 1–2; petioles sheathing into pseudostem at lower part, free above; pseudostem 10–16 cm long, 1.2–1.4 cm in diam. at base, brown; free part 10–15 cm long, 6–8 mm in diam. at base and 4–7 mm in diam. at apex, apically light green, basally brown to green; leaf blade trifoliolate, 9–22 cm long, 6–10 cm wide, thick, glabrous, pale green adaxially, paler abaxially, margin undulate, apex acuminate with up to 1.5 cm long caudate tip, venation impressed adaxially and prominent abaxially, lateral veins 12–15, prominent abaxially, collective vein at 2–3 mm from the margin; central leaflet ovate to lanceolate, base cuneate, petiolule 1.0–2.5 cm long; lateral leaflets asymmetrical, lanceolate, base obtuse, petiolule 1.0–2.5 cm long. Inflorescence emerging from the pseudostem; peduncle longer (or sometimes shorter) than petiole, 15–25 cm long, 7–8 mm diam., apically light yellow to pale green, basally brown; spathe tube cylindrical, white, sometimes greenish or yellowish with light brownish staining, 1.8–2.0 cm in diam., 3.5–4.0 cm long in male inflorescences and 5.5–8.0 cm long in female inflorescences, mouth margins largely auriculate, bright yellow; spathe limb widely ovate, very bright yellow, occasionally greenish yellow towards apex, with yellow longitudinal veins, curved over the mouth, 8–10 cm long, 5–8 cm wide, spathe tip acute, ending in a 1–2 cm long thread. Male spadix with fertile portion ca. 4.5–5.5 cm long, ca. 0.8–1.5 cm exserted from the tube mouth, synandria loosely arranged; spadix appendix exserted totally from the tube mouth, ca. 3.5–4.5 cm long, 3–4 mm in diameter, bright yellow, filiform, curved forward, non-sinous, basal 1/5 with few short neuters, middle 2/5 with bright yellow and up to 1.7 cm long bristles, apical 2/5 naked. Female spadix with fertile portion conical, 2.5–3.3 cm long, ca. 1.3 mm across at the base and 0.7 cm at the top; pistils densely arranged; female spadix appendix 5–7 cm long, 3–5 cm exserted from the tube mouth, curved forward, 4 mm in diam. at base, basal 1.5–2.0 cm inside the spathe tube, yellowish (often with brownish rhomboid staining pattern) and with a few short light yellow neuters and/or white infertile stamens at base, topped by a naked yellow 1.0–1.5 cm long part, upper ca. 2 cm pale yellow, covered with yellow neuters or bristles up to 1.7 cm long, apical 1 cm naked and yellow. Synandrium of 3–5 stamens, on 0.5 mm stipe; anthers sessile; thecae pale yellow and dehiscent by round pore. Ovaries bottle-shaped, light yellowish green, 2 mm in diameter; stigma penicillate and born on a 0.5 mm long style. Fruiting spike cylindrical, 6–8 cm long, 2.5–2.8 cm diam.; fruits obovoid, truncate, 6–8 mm diam., green when young, orange to red when ripe; seeds 1–2, obovoid, 5–7 mm diam.

Eponymy:—Named after our late friend Vo Thanh Liem, staff of Takou Nature Reserve, for his great contribution to conservation of the reserve.

Vietnamese name:—Nam tinh Liêm.

Distribution:—Southern Central of Vietnam, Binh Thuan Province, Takou Mountain.

Habitat & phenology:—Growing on humus soils on granite in semi-deciduous forest; about 480 m in elevation. Flowering seen in June and fruiting in August to October.

Conservation:—The new species is known only from the type location. The area of discovery is estimated to be less than 1 km^2, which is heavily impacted and open to tourist activities. Less than 100 individuals with less than half in flowering have been observed annually. Our thorough search of Takou Nature Reserve including Takou Mountain, which is isolated some hundred kilometers from other mountainous areas with similar habitat, did not revealed any additional populations. Given this situation, we assess this species as CR B1+B2ab(i, ii, iii)+D (IUCN 2019).

Additional specimens examined (paratypes):—VIETNAM. Southern Central: Binh Thuan Province, Ham Thuan Nam District, Takou Nature Reserve, Takou Mountain, 10°48'49.38"N, 107°53'43.53"E, 480 m elevation, 14 June 2013, *Luu Hong Truong Luu 888* (PHH!, VNMN!); 18 June 2019, *Nguyen Hieu Cuong, Nguyen Thi Luan, Van Thi Thanh Tuyen Pl-BTTN-0811* (SGN!, VNMN!).

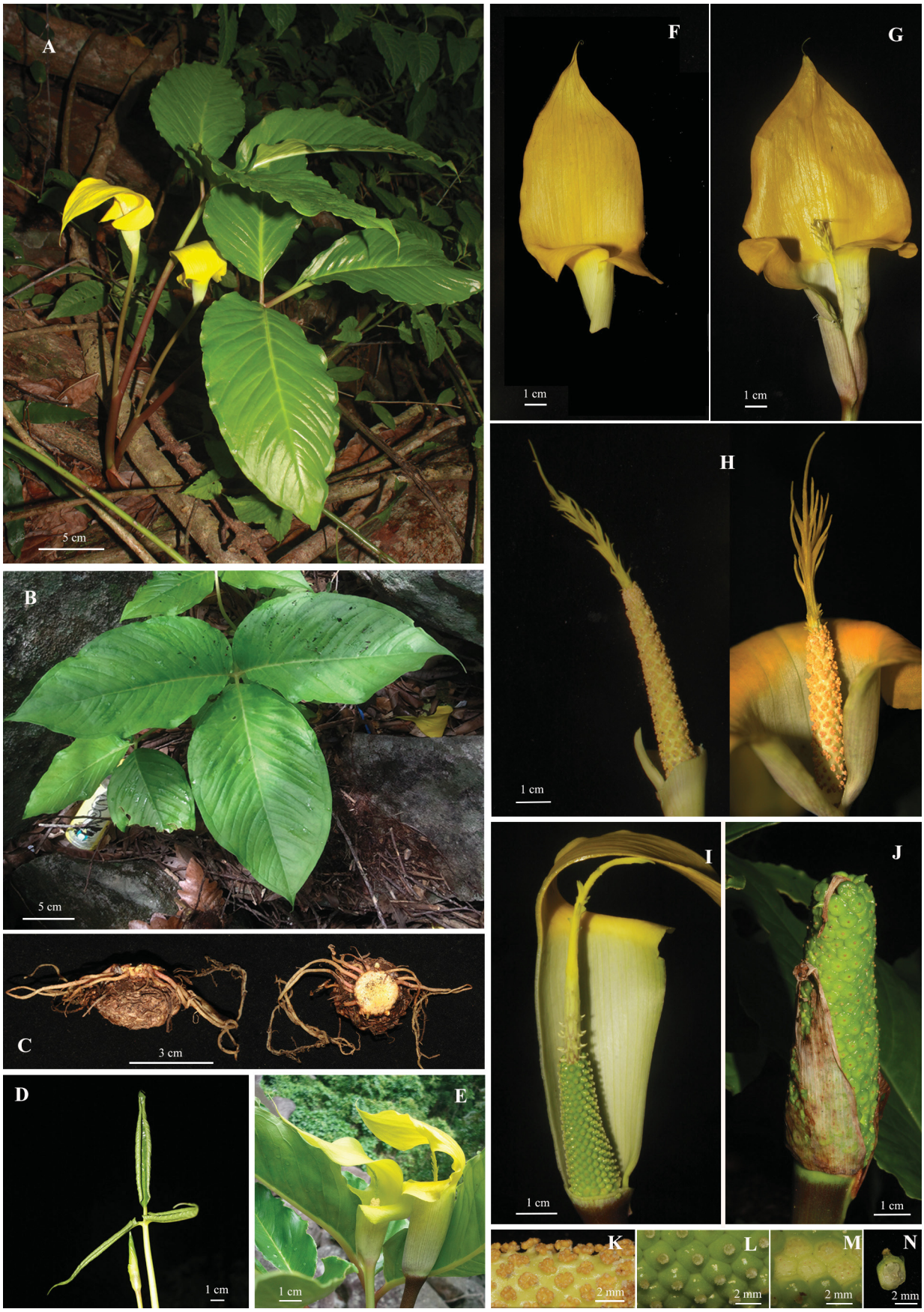

FIGURE 1. *Arisaema liemiana*. A. The species in habitat. B. Leaf blade. C. Tubers. D. Young leaf. E. Male (left) and female (right) spathes. F. Male spathe. G. Female spathe. H. Male spadices. I. Female spadix. J. Infructescence. K. Synandria. L. Ovaries. M. Cross section of ovary. N. Longitudinal section of ovary. Photos by Luu Hong Truong.

TABLE 1. Comparison of *Arisaema liemiana* with its two morphologically closest species.

Characters	*A. liemiana*	*A. pierreanum*	*A. maxwellii*
Spathe limb	widely ovate, 8–10 cm long, 5–8 cm wide, plain yellow	lanceolate, 9–11 cm long, 4.5–5.0 cm wide, plain yellow	ovate, 4–6 cm long, 4 cm wide, yellow with a white spot
Spathe tube	1.8–2.0 cm in diam., 3.5–4.0 cm long in male inflorescences, 5.5–8.0 cm long in female inflorescences, mouth largely auriculate	2.5–3.0 cm in diam., 5–3 cm long, mouth auriculate	c. 2 cm in diam., 3.4–5.5 cm long, mouth non-auriculate
Male spadix appendix	non-sinous, basal part with few short neuters, middle part with long bristles, apical part naked	slightly sinous, naked	non-sinous, basal and apical parts naked, middle part with neuters
Female spadix appendix	non-sinous, basal part with neuters and/or white infertile stamens topped by a naked part, middle part with neuters or bristles, apical part naked	slightly sinous, naked	non-sinous, basal part with neuters, middle and apical parts naked
Fertile part in male inflorescence	exserted from the tube mouth	completely inside the spathe tube	completely inside the spathe tube
Synandria	3–5 androus	1-androus	2–3-androus

Notes:—In *Arisaema* sect. *Attenuata* (*sensu* Ohi-Toma *et al*. 2016), the following species have been known to have yellow spathe limb: *A. condaoense*, *A. maxwellii, A. pierreanum* and *A. sizemoreae* Hetterscheid & Gusman (2003: 39) (Gusman & Gusman 2006, Nguyen *et al*. 2014, Van *et al*. 2016b, Van 2017). Among them, *A. liemiana* is closest to *A. pierreanum* as both species have bright yellow spathe limb, white spathe tube, male spathe limb almost twice to thrice as long as spathe tube and male spadix with 4.5–5.5 cm long fertile part and appendix exserted totally from the tube mouth. However, the later has narrower spathe limb (4–11 cm x 1.5–5.0 cm), slightly sinous, naked male and female spadix appendices and male spadix with dense stamens. *Arisaema condaoense* is different from the new species in having smaller spathe limb (5–6 cm long, 2.5–3.0 cm wide), slender male spathe tube (4.5–5.0 cm long, ca. 1 cm in diam.) that is almost as long as spathe limb, naked and sinous spadix appendix and male spadix with fertile portion completely inside the spathe tube. Meanwhile, *A. maxwellii* is distinguishable from *A. liemiana* in having the spathe with a white spot, smaller limb (4–6 cm long, 4 cm wide) and non-auriculate tube mouth, 2–3-androus synandria and naked base of spadix appendices. Finally, *A. sizemoreae* differs from *A. liemiana* in having pale greenish yellow spathe, paler spot in the middle of lower internal surface of spathe limb, non-auriculate tube mouth with widely recurved margins and fleshy bristles covering the whole male spadix appendix. Key morphological differences between the *A. liemiana* and its two closest species are presented in Table 1.

It should be noticed that in the section *Attenuata*, *A. roxburghii*, which is widely distributed in Indochina, Malaysia and Thailand, has variable spathe colors ranging from pale green to yellow. In Vietnam, the yellow form is common in low mountains in the Mekong Delta. However, *A. roxburghii* is readily distinguished from our new species in having small and translucent spathe with narrow limb (1.5–3.0 cm wide) and tube of equal size (2.5–5.0 cm long), 2–3-androus synandria and naked spadix appendices sometimes with a few minute neuters near apex or at base of spadix appendices.

Key to species of *Arisaema* section *Attenuata* in Vietnam

According to the authors' field observations and the previous studies (Pham-hoang 2000, Gusman & Gusman 2006, Nguyen *et al*. 2014, Nguyen 2017, Van *et al*. 2016b, Van 2017, Van *et al*. 2017), the species of section *Attenuata* in Vietnam can be distinguished by the following key:

1. Spathe tube shorter than spathe limb 2
– Spathe tube as long as or longer than spathe limb 4
2. Spadix appendix sinous; thecae purple or cream with purple top ..... *A. condaoense*
– Spadix appendix not sinous; thecae pale yellow 3
3. Spadix appendix naked; synandria dense ..... *A. pierreanum*
– Spadix appendix covered with neuters; synandria loose ..... *A. liemiana*
4. Spathe dark brown with white area at middle ..... *A. averyanovii*
– Spathe not above 5
5. Spathe limb with dark brown staining and white spot at base ..... *A. chauvanminhii*
– Spathe limb not above 6
6. Spadix appendix strongly fluted and ending in a backward bent brush ..... *A. honbaense*
– Spadix appendix not above 7
7. Spathe limb green or yellow, translucent; anthers stipitate; pollen cream ..... *A. roxburghii*
– Spathe limb green with dark purplish cross-band at the base, not translucent; anthers sessile; pollen pale green ..... *A. ramulosum*

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