

## Notes on taxonomy of the genus *Argostemma* (Rubiaceae) from Vietnam

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### ABSTRACT

*Argostemma pictum* (Rubiaceae), a species occurring in Myanmar, Thailand, Laos and Peninsular Malaysia, is newly reported for the flora of Vietnam; a description, photographs, information on ecology and taxonomic notes are also presented. In order to facilitate identification, we provide an identification key and checklist to the 10 known *Argostemma* species in Vietnam.

KEYWORDS: Argostemmateae, checklist, new record, Rubiaceae, Vietnam, Gentianales.

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### INTRODUCTION

The genus *Argostemma* Wall. is the largest genus of the tribe Argostemmateae (Rubiaceae) with about 220 species, distributed mainly in tropical and subtropical Asia, and with two species are endemic to west tropical Africa (Bremer, 1989; Bremer & Manen, 2000). However, the taxonomically complicated genus that has yet to be studied in detail and so knowledge of the genus is still poor. Although several taxonomic treatments of the genus were published for geographical areas, e.g. the Malay peninsula and peninsular Thailand (Ridley, 1923; Sridith, 1999, 2007; Sridith & Puff, 2000), Laos (Lanorsavanh & Chantaranonthai, 2013, 2019), China (Chen *et al.*, 2011), and Vietnam (Pitard, 1923; Pham, 2003), a worldwide monographic study has not yet been attempted. The Malay Peninsula, Peninsular Thailand and Borneo were considered as centres of diversity of *Argostemma*; 31 species were recorded for the flora of Thailand (Sridith, 2007).

During a recent investigation on the flora of Ta Dung National Park in Dak Nong province, southern Vietnam, we collected some flowering specimens belonging to *Argostemma*. Detailed examination of the specimens and studies on the protologues and type specimens of previously known species revealed that the morphological characters of these specimens match with those of *Argostemma pictum* Wall. – a species distributed mainly in Myanmar, Thailand, Peninsular Malaysia, and Laos (Sridith, 2007; Lanorsavanh & Chantaranonthai, 2019), however, this species has not yet been reported for Vietnam in previous treatments (Pitard, 1923; Pham, 2003; Choudhary *et al.*, 2013; Govaerts *et al.*, 2017; Nuraliev *et al.*, 2017; Quang *et al.*, 2019; Do *et al.*, 2020). Therefore, we report here *A. pictum* as a new record for the flora of Vietnam bringing the number of species in the genus to 10, of which, six species, i.e. *A. annamiticum* Ridl., *A. bachmaense* T.V.Do, *A. bariense* Pierre ex Pit., *A. cordatum* Nuraliev, *A. glabra* Joongku Lee, T.B. Tran & R.K. Choudhary

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and *A. vietnamicum* B.H.Quang, Joongku Lee & R.K.Choudhary, are endemic to Vietnam. Moreover, Central and Central Highland Regions of Vietnam are considered as the centres of diversity of *Argostemma*

in the country. In order to facilitate identification, we here provide a key and checklist to *Argostemma* species in Vietnam.

## KEY TO THE SPECIES OF ARGOSTEMMA IN VIETNAM

- |  |                                   |
|--|-----------------------------------|
| 1. Plant glabrous  | <b>1. <i>A. glabra</i></b>        |
| 1. Plant pubescent   |                                   |
| 2. Leaves verticillate   | <b>2. <i>A. verticillatum</i></b> |
| 2. Leaves not verticillate   |                                   |
| 3. Leaves strongly anisophyllous   |                                   |
| 4. Inflorescence exclusively 1-flowered  | <b>3. <i>A. uniflorum</i></b>     |
| 4. Inflorescence 1-many-flowered   |                                   |
| 5. Leaves sessile; inflorescence umbel-like  | <b>4. <i>A. cordatum</i></b>      |
| 5. Leaves petiolate; inflorescence racemose  |                                   |
| 6. Inflorescence axis 4–7 cm long; pedicel 0.8–1.5 cm long   | <b>5. <i>A. bariense</i></b>      |
| 6. Inflorescence axis up to 1.5 cm long; pedicel up to 0.5 cm long   | <b>6. <i>A. annamiticum</i></b>   |
| 3. Leaves isophyllous or slightly anisophyllous  |                                   |
| 7. Large leaves more than 5 cm long; inflorescence umbel-like, 5–10-flowered                               |                                   |
| 8. Leaves ovate; petioles 1–2 cm long  | <b>7. <i>A. borragineum</i></b>   |
| 8. Leaves ovate or triangular; petioles sessile  | <b>8. <i>A. pictum</i></b>        |
| 7. Leaves up to 4 cm long; inflorescence solitary or laxly corymbiform, 1–4-flowered                       |                                   |
| 9. Leaves oblanceolate to spatulate, attenuate at base; inflorescence 1-flowered; bracts absent            | <b>9. <i>A. bachmaense</i></b>    |
| 9. Leaves rounded to obovate, rounded at base; inflorescence 1–4-flowered; bracts triangular to lanceolate | <b>10. <i>A. vietnamicum</i></b>  |

## A CHECKLIST TO THE SPECIES OF ARGOSTEMMA IN VIETNAM

**1. *Argostemma glabra*** Joongku Lee, T.B.Tran & R.K.Choudhary, *Ann. Bot. Fennici* 50(4): 258. 2013. Type: Vietnam, Khanh Hoa, Hon Ba Nature Reserve, 11 Apr. 2011, *Lee et al. HIKK 285* (holotype **HN!**; isotype **KRIB!**).

Ecology and phenology.— Growing in pristine mixed evergreen and sub-temperate forests on a moss-rich hillock, ca 1,305 m alt. Flowering in April.

Distribution.— Endemic to southern Vietnam (Khanh Hoa).

**2. *Argostemma verticillatum*** Wall., *Fl. Ind.* (Carey & Wallich, ed.), 2: 325. 1824. Type: Nepal, Moreko, July 1821, *Wallich s.n. Numer. List 8394A* (holotype **K-W** [K001125376, image seen]).

— *A. acutum* Wall. ex Hook.f., *Fl. Brit. India* 3(7): 43. 1880. Type: Unknown.

— *A. glaberrimum* Dalzell, Hooker's *J. Bot. Kew Gard. Misc.* 3: 345. 1851. Type: India, Bombay, *Dalzell s.n.* (holotype **K** [K001325261, image seen]).

Ecology and phenology.— Growing on moist

rocks along streams or near small waterfall in evergreen forests, 1,200–1,500 m alt. Flowering June to July.

Distribution.— India, Nepal, Myanmar, Thailand, Laos, southern Vietnam.

**3. *Argostemma uniflorum*** Blume ex DC., *Prodr.* 4: 418. 1830. Type: Indonesia, Java, *Blume s.n.* (holotype **L** [L0063029, image seen]).

Ecology and phenology.— Growing on moist soil near streams in evergreen forest, 900–2,000 m alt. Flowering May to June, fruiting July to August.

Distribution.— Vietnam (Thua Thien Hue, Dak Lak), Indonesia.

**4. *Argostemma cordatum*** Nuraliev, *Phytotaxa* 317(1): 43. 2017. Type: Vietnam, Dak Lak, Lak, Bong Krang, Chu Yang Sin National Park, 11 km South-eastern of Krong Kmar village, 12°24' 53"N, 108°22' 56"E, 22 May 2014, *Nuraliev et al. 960* (holotype **MW** [MW0595623!]).

Ecology and phenology.— Growing on shady stream banks in mixed forests and inhabits vertical granite rock surfaces, 950–1,250 m alt. Flowering May to June.

Distribution.— Endemic to southern Vietnam (Dak Lak).

**5. *Argostemma bariense*** Pierre ex Pit. in Lecomte, Fl. Indo-Chine 3: 79. 1922. Type: Vietnam, in montibus densy ad Baria, 2–300 m alt., 1 Aug. 1866, *Pierre 5480* (holotype **P** [P00077330!]; isotype **P** [P00077331!]).

Ecology and phenology.— Growing on moist soil near streams in evergreen forest, 1,500–1,700 m alt. Flowering August to October, fruiting November to December.

Distribution.— Endemic to Vietnam (Thua Thien Hue, Da Nang, Kon Tum, Ba Ria-Vung Tau).

**6. *Argostemma annamiticum*** Ridl., J. Bot. 65: 40. 1927. Type: Vietnam, Thua Thien Hue (unknown).

Ecology and phenology.— Growing on the moist sites in evergreen forest, 800–1,200 m alt. Flowering April to May.

Distribution.— Endemic to central Vietnam (Thua Thien Hue).

**7. *Argostemma borragineum*** Blume ex DC., Prodr. 4: 417. 1830. Type: Indonesia, Sumatra, 6 Aug. 1921, *Kloss s.n.* (holotype **K** [K000760145!]).

Ecology and phenology.— Growing on moist rocks along streams or near small waterfall in evergreen forests, 1,200–1,600 m alt. Flowering September to October.

Distribution.— India, Nepal, Myanmar, Vietnam (Lao Cai, Ha Tinh, Kon Tum, Dak Lak, Lam Dong), Indonesia, Peninsular Malaysia.

**8. *Argostemma pictum*** Wall. in Roxb., Fl. Ind. (Carey & Wallich, ed.) 2: 327. 1824. Type: Malaysia, Penang, 1822, *Wallich s.n.*, Numer. List 8392 (lectotype **K-Hook**. [K000172892, image seen]; isolecotype **K-Benth**. [K000172894, image seen], **K-W** [K001125373, image seen]), designated by Sridith, 1999)(Fig. 1A–E).

— *A. bifolium* Ridl., Fl. Malay. Penins. 5: 314. 1925. Type: Malaysia, Perak, Maxwell's Hill, Dec. 1892, *Ridley s.n.* (holotype **K** [K000760231, image seen]).

— *A. rotundifolium* E.T.Geddes, Bull. Misc. Inform. Kew 1927(4): 168. 1927. Type: Thailand, Yala,

Betong (formerly in Pattani), 2 Aug. 1923, *Kerr 7470* (lectotype **K** [K000760185, image seen]; isolecotypes **BM** [BM000028699, image seen], **K** [K000760184, image seen], **SING** [SING0058412, image seen]), designated by Sridith, 1999).

Herb, to 9–14 cm tall; stems erect, 6–9 cm long, pubescent. *Stipules* ovate, ca 3 by 3 mm, bifid tip, pubescent. *Petioles* sessile. *Leaves* opposite, 1 pair, rarely 2 pairs, slightly anisophyllous or sometimes isophyllous when young; lamina membranaceous, ovate or triangular, larger one 6–8 by 3–4 cm, smaller one 3–4 by 1–2 cm, base truncate, rounded or occasionally cordate, apex acute or slightly rounded, lower surface light grey, sparsely to densely hairy, upper surface dark green, sparsely hairy; lateral veins 4–5 pairs, venation slightly sunken above and prominent and raised below. *Inflorescences* 6–12-flowered, umbel-like; peduncles 3–5 cm long, sparsely hairy; bracts 4–5, basally fused, forming a cup-like involucre, linear or ovate, 2–3 by 1–2 mm, green, outside pubescent. *Flowers* 5-merous, actinomorphic; pedicels 3–10 mm long, glabrescent to pubescent. *Calyx* green; lobes ovate, triangular, 1–2 by 0.5–1 mm, raphides conspicuous. *Corolla* white, star-shaped, outside densely covered with very short hairs, inside glabrous; tube 0.6–1.1 mm long; lobes triangular, 2–3 by 1–2 mm, strongly recurved and tip very coiled. *Stamens* 5, insert at base of the corolla tube; filament free, ca 1.5 mm long, broad and thick, swollen connective; anthers connivent into an anther cone, pale yellow, basifixed, oblong, 3.8–4.2 mm long, with short appendages, opening by longitudinal slits. *Ovary* pubescent; style filiform, 4–5 mm long, long exerted, glabrous; stigma capitate. *Capsule* not seen.

Ecology and phenology.— Growing on moist sandstone rocks with soil in evergreen forests, 450–500 m alt. Flowering May to June.

Distribution.— Myanmar, Thailand, Peninsular Malaysia, Laos, and new to Vietnam (Dak Nong).

Specimens examined. Vietnam.—Dak Nong [Ta Dung National Park, 23 May 2019, *Nguyen Quang Hung et al. 323 (HN!, VNMN!)*].

Notes.— *Argostemma pictum* is morphologically similar to *A. neurocalyx* Miq. (occurring in Thailand and Laos) by having an ovate or triangular leaves, slightly anisophyllous or sometimes isophyllous when young and umbel-like inflorescence but

it clearly differs by having 1-paired leaves, rarely 2-paired (vs. always 2-paired), conspicuously white veins on upper leaf surface (vs. green veins), sessile petioles (vs. conspicuous, 3–5 mm long), 5-merous flowers with star-shaped corolla (vs. 4-merous with bell-shaped corolla).

**9. *Argostemma bachmaense*** T.V.Do, Nord. J. Bot. 8(7): 02765. 2020. Type: Vietnam, Thua Thien Hue province, Bach Ma National Park, Do Quyen waterfall, 16°11'27.32"N, 107°51'15.62"E, 1 July 2019, Yang *et al.* NWC-201951 (holotype VNMN!; isotype KUN!).

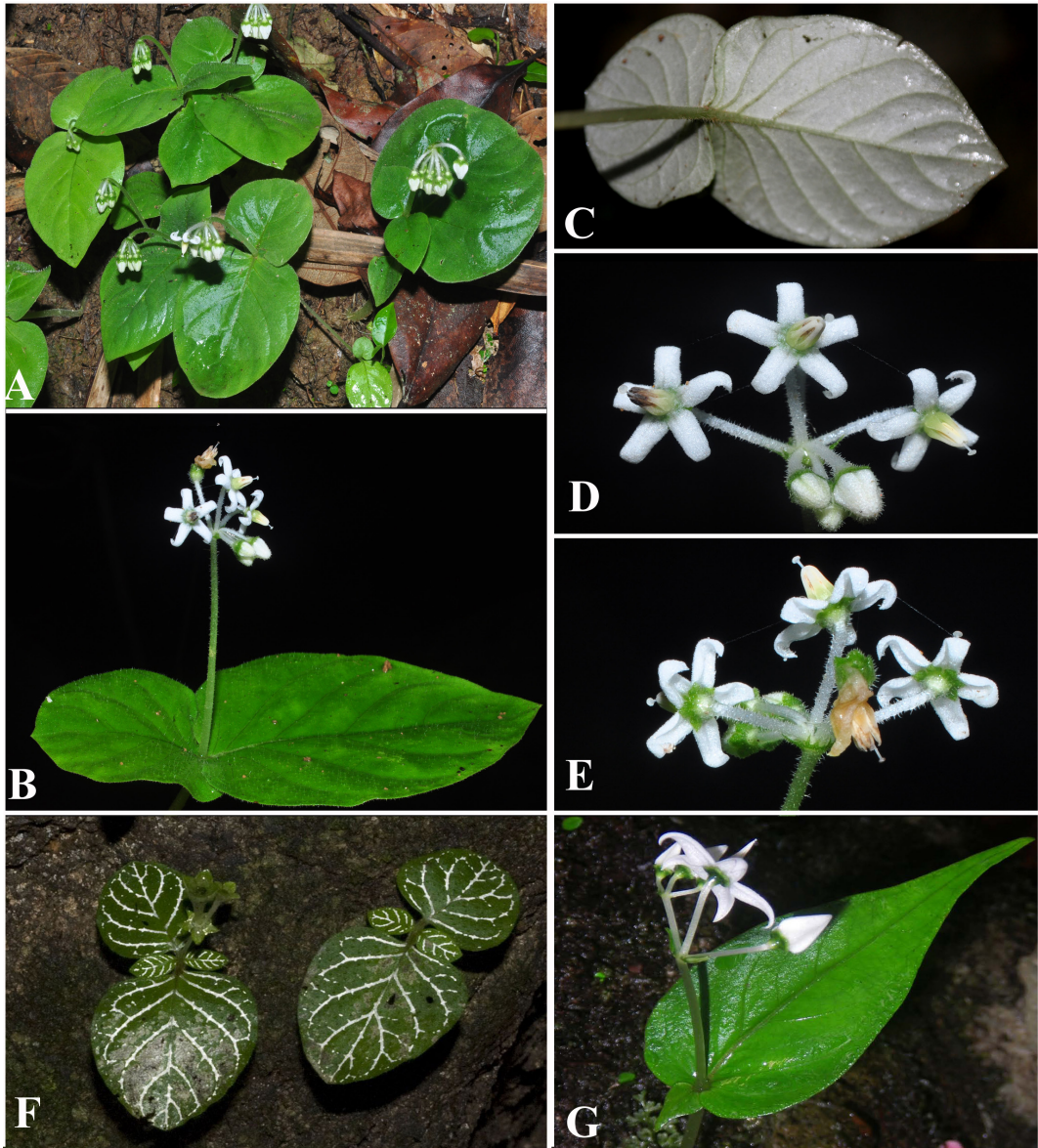


Figure 1. *Argostemma pictum* Wall. (A–E.): A. Habitat; B. Leaves and inflorescence; C. Lower leaf surface; D. Frontal view of flowers; E. Dorsal view of flowers (Nguyen Quang Hung *et al.* 323).— *A. neurocalyx* Miq.: F. Habitat, leaves, and calyx.— *A. cordatum* Nuraliev: G. Habitat, leaves, and inflorescence. A–E. photos by Do Van Truong; F. photo by Tony Rood; G. photo by Maxim Nuraliev.

Ecology and phenology.— Growing on moist rocks near small waterfall or along the rapid stream in evergreen forest, 1,000–1,100 m alt. Flowering June to August.

Distribution.— Endemic to central Vietnam (Thua Thien Hue).

**10. *Argostemma vietnamicum*** B.H.Quang, Joongku Lee & R.K.Choudhary, Ann. Bot. Fennici 56(1–3): 27. 2018. Type: Thua Thien Hue, Bach Ma National Park, 1190 m alt., 16°11'34.4"N, 107°51'16.7"E, 19 Apr. 2013, *Quang 85* (holotype **HN!**; isotype **HN!**).

Ecology and phenology.— Growing on the wetlands (mostly near streams) of the primary and temperate forest, 1,190 m alt. Flowering April to May.

Distribution.— Endemic to central Vietnam (Thua Thien Hue).

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