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Two new species of *Hoya* (Apocynaceae, Asclepiadoideae) from Sulawesi, Indonesia

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ABSTRACT: We document the discovery of two new species of *Hoya* from Sulawesi, Indonesia, *H. sulawesiana* S.Rahayu & Rodda and *Hoya surisana* Rodda & S.Rahayu. *Hoya sulawesiana* is similar to *Hoya isabelchanae* Rodda & Simonsson in flower morphology because both species have very pubescent globose corolla but they can be separated based on leaf morphology and corolla indumentum type. *Hoya surisana* is very unusual because its flowers display a combination of large calyx lobes, a white, pubescent, campanulate corolla, and dark purple corona lobes so far not observed in any other species of the genus.

KEY WORDS: Acanthostemma, Celebes, Cystidianthus, *Hoya*, Makalangkan Mountain, Mamuju, Marsdenieae.

INTRODUCTION

In recent years taxonomic research on the genus *Hoya* R.Br. in Indonesia has intensified, with the aim to eventually complete a revision of the genus for Indonesia. First the species of Borneo were investigated in detail by Lamb and Rodda (2016), who recorded 72 species, 34 of which occur in the Indonesian southern part of the Island. Subsequently Rahayu and Rodda (2019) investigated the diversity of *Hoya* of Sumatra, where 43 taxa were found, (41 species and two subspecies). These numbers are far from final and instead are just a starting point for further research: new species from Borneo and Sumatra have in fact already been published since (Rahayu and Rodda, 2017; Rahayu and Astuti, 2019; Rodda *et al*., 2018).

We have recently extended our research to Sulawesi, an island in the centre of the SE Asian ecoregion of Wallacea. Sulawesi, unlike Borneo or New Guinea, has long been separated from the continental region and therefore is characterised by a highly unique array of plants (Monk *et al*. 1997, Irawati and Widyatmoko 2019).

In contrast to the high plant diversity, Sulawesi is one of the most poorly studied islands in Southeast Asia (de Vogel, 1989; Cannon *et al*., 2007). The density of herbarium specimens collected from Sulawesi is relatively low, with 24 specimens per 100 km^2, similar to that of Sumatra (22) but much less than Borneo (35) or New Guinea (46) (Campbell and Hammond, 1989). With an estimated 5972 plant species, 37.3% of which endemic, Sulawesi has a similar number of estimated endemics as Kalimantan in Borneo (39.5%) (KPPN/Bappenas 2016; Middleton *et al*., 2019).

The first species of *Hoya* described from Sulawesi was *Hoya multiflora* Blume (as *Centrostemma micranthum* Blume). The genus *Hoya* in Sulawesi was first revised by Miquel (1856), who listed two species, *Hoya multiflora* Blume (as *Cyrtoceras micranthum* (Blume) Miq.), and *Hoya ariadna* Decne (likely a synonym of *Hoya coronaria* Blume). Subsequently in 1863 *Hoya maxima* Teijsm. & Binn. was added (Teijsmann and Binnendijk 1863) (= *Hoya imbricata* Decne.). Four species were described from Sulawesi by Schlechter (1908, 1916): *Hoya gracilis* Schltr., *Hoya dolichosparte* Schltr., *Hoya incurvula* Schltr. and *Hoya minahassae* Schltr.

The most recent and comprehensive study on *Hoya* of Sulawesi was published by Kleijn and van Donkelaar (2001), who focussed on central Sulawesi, where 13 species were found. They estimated the number of species of *Hoya* for Sulawesi at between 15 and 20. Three new species have since been published (Rodda and Simonsson Juhonewe, 2016). Based on preliminary data, Sulawesi has 15 species of *Hoya*, about 70 % of which are endemic to the island. It is likely that the number of species for Sulawesi will increase steeply as research progresses as has been observed for Borneo, Sumatra and New Guinea (Lamb and Rodda, 2016; Simonsson Juhonewe and Rodda, 2017; Rahayu and Rodda, 2019), and will far exceed the estimate of species given by Kleijn and van Donkelaar (2001).

As noted by Rahayu and Rodda (2019), unidentified *Hoya* species are often posted on social media for identification. In 2018, Indonesian *Hoya* enthusiasts posted on Facebook pictures of two unidentified *Hoya* species from Sulawesi. Later the species became available in the international horticulture market. After the original source of the plants was traced by SR, samples for study were obtained and deposited at BO herbarium allowing the description of the new species.

TAXONOMIC TREATMENT

Hoya sulawesiana S.Rahayu & Rodda, ***sp. nov.***

Fig 1

Similar to *Hoya isabelchanae* Rodda & Simonsson in inflorescence, corolla and corona morphology, but differing in lamina shape (orbicular-ovate (to elliptic), convex, to 7 cm long in *H. isabelchanae* vs. lanceolate or elliptic in *H. sulawesiana* 7–30 cm long), and in type of corolla inner surface pubescence (hairs straight and pointing outwards in *H. isabelchanae* vs. recurved towards the corona in *H. sulawesiana*).

Type: INDONESIA, Sulawesi, West Sulawesi, Mamuju, 100 m elev., originally collected by Andarias Sambokaraeng, vouchered in cultivation at Bogor Botanic Garden, 17 June 2019, *Rahayu 1215* (holotype, BO).

Epiphytic climber with white latex in all vegetative parts. Stems slender yet stiff, to 10 m long, twining, creeping and hanging on trees and tree branches, internodes (2)5–20(30) cm long, 2–3 mm in diameter, dull green or brown purplish and pubescent when young, dull green to greyish and glabrous when mature, surface rough; adventitious root sparsely produced along the stem and just under the nodes where they are usually paired. Leaves: petiole straight or recurved, cylindrical, 6–12 mm long, 2–4 mm in diameter, pale green, purplish, greyish or brownish, sparsely pubescent to glabrous, surface rough (when dry); lamina of two types , the first lanceolate, very stiff and fleshy, flat, 7.5–30 × 1.5–3.5 cm, up to 3 mm thick, base acute, apex acuminate, abaxially paler green, sometime with reddish or purplish hue, adaxially dark green or purplish, sparsely pubescent when young and glabrous when mature, secondary veins barely visible above, not visible below, 5–8 each side of the midrib, slightly sunken; the second type elliptic, flat to sometime slightly carinate especially when young, fleshy and stiff, 7–9.5 × 2.4–3.5 cm base sub-acute, apex acute, abaxially mid to dark green, glabrous, adaxially pale to mid-green green or sometime reddish, sparsely pubescent turning glabrescent above, secondary veins not visible; colleters 1 or 2 at lamina base, triangular to ovate 0.3–0.5 mm long. Inflorescence positively geotropic, pseudo-umbelliform, flat to slightly concave; peduncle extra axillary, 7–12(–25) cm long, 1.5–2 mm in diameter, dull green to brown, sparsely pubescent when young, turning glabrous, papillose; rachis indeterminate. Flowers (4)6–10(15) per inflorescence; pedicel variable in length, inner ones 1–1.5 cm long, outer ones 2.5–3 cm long, 1.2–1.5 mm in diameter, pinkish cream, pinkish at apex and base, glabrous. Calyx lobes triangular, 1.5–2 × 1–0.8 mm, apex narrow with blunt tips, white or cream, glabrous; basal colleter one at each calyx lobe sinus, ovate, 300–400. × ca. 100 μm. Corolla rotate with strongly reflexed lobes, 10–15 mm in diameter, ca. 20 mm in diameter when flattened; corolla lobes reflexed with revolute tips; tube 2–3 mm long, dark purple, abaxially glabrous, adaxially shortly pubescent, denser towards the centre; lobes ovate, 7–9 × 5–6 mm, apex acuminate, basally dark purple turning pale salmon pink at the tips, abaxially glabrous, adaxially covered with dense long, silvery hair recurved towards the corolla centre (excluding glabrous tip and sparsely pubescent base). Corona staminal, 7–10 mm in diameter, 4–6 mm high; corona lobes broadly ovoid, 3.5–4 × 2–2.5 mm, slightly ridged above, underneath sulcate, inner process apex acuminate, outer process apex divided in an upper round part and a lower bilobed part, inner process and upper part of outer process pale pink, lower outer process bilobed part reddish purple. Anther appendages broadly triangular, c. 1.2 × 1.2 mm. Pollinia oblong, 380–420 × 140–160 μm, base rounded, apex lunate, divergent, pellucid margin all along the outer edge of the pollinium; corpusculum oblong, 120–150 × 50–60 μm; caudicle broad, spathulate, 100–120 × 110 μm at the widest point. Style-head 5 angled in cross section, c. 2.5 mm in diameter, apex conical; ovary conical, 1.2–1.5 mm long, each carpel ca. 0.6 mm wide at the base, pale yellow, glabrous. Fruit and seed not observed.

Distribution. Only known from South Sulawesi in Towuti and West Sulawesi in Mamuju at low elevation (100–300 m).

Etymology. *Hoya sulawesiana* is named after the island of Sulawesi, where it is endemic.

Habitat and ecology. Observed in lowland forest at 100–300 m above sea level and above a stream in Towuti, growing epiphytically on small tree trunks about 5 m above ground, growing in about 80% humidity and 50–70% sunlight at the time of collection (Aspar, pers. comm.). *Hoya sulawesiana* can grow in low as well as high light levels, but the leaves develop a purple colour when exposed to intense sunlight. At the type locality in Mamuju, the plants were rooting in ant nests. (Andarias Sambokaraeng, pers.com).

Notes. *Hoya sulawesiana* is most similar to *Hoya ischabelchanae*. Both species belong to *Hoya* section *Acanthostemma* (Blume) Kloppenb. because they have revolute corolla lobes, corona lobes with bilobed outer apices and pollinaria with broad, spathulate caudicles. Both species are endemic to Sulawesi: *Hoya ischabelchanae* is from Gorontalo in the north part of the island, while *Hoya sulawesiana* is from the south and west part of Sulawesi. Their similarities lie in the positively geotropic, convex inflorescences, rotate corollas with revolute pubescent lobes and corona lobes with bilobed outer processes. Further, the coronas of the two species are of similar size: in *H. isabelchanae* the corona is 7–8 mm in diameter, 3–3.5 mm high, while in *H. sulawesiana* it is 7–10 mm in diameter, 4–6 mm high.

Hoya sulawesiana differs from *Hoya isabelchanae* in both vegetative and fertile parts. The leaves of *H. ischabelchanae* are orbicular-ovate (to elliptic), convex,

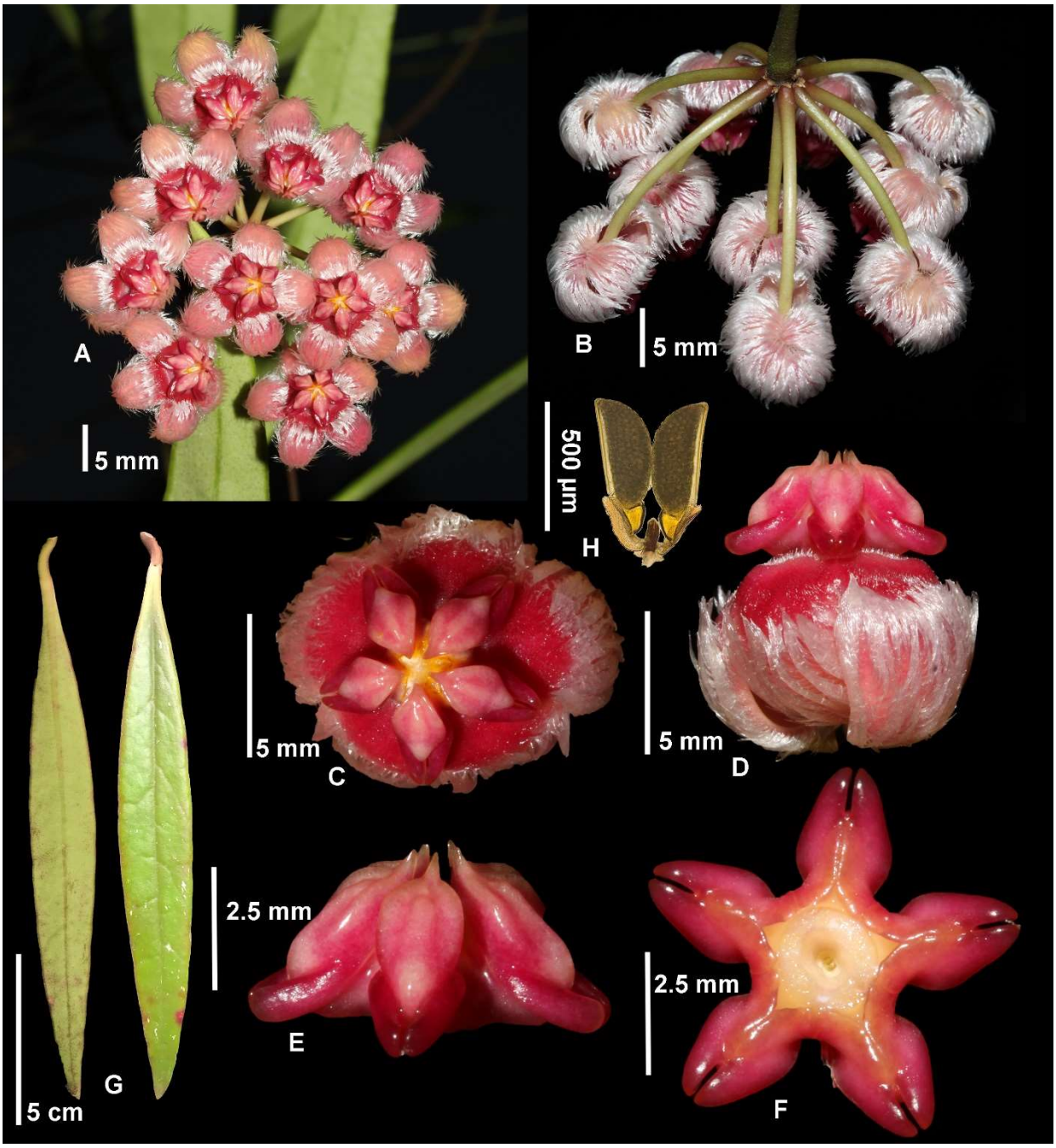

Fig. 1. ***Hoya sulawesiana*** S.Rahayu & Rodda. **A**, inflorescence; **B**, inflorescence, side view; **C**, flower, top view; **D**, flower, side view; **E**, corona, side view; **F**, corona, from underneath; **G**, leaves: right, from above; left, from underneath; **H**, pollinarium. photos, A-G by Surisa Somadee; H by Michele Rodda.

(1.5–)2–4(–7) × (1–)1.5–2.5 cm, with a cuneate (round) base, and an obtuse (round) apex, while the leaves of *H. sulawesiana* are much larger, lanceolate or elliptic, flat or slightly carinate, 7–30 × 1.5–3.5 cm, with an acute base, and an acute or acuminate apex. The corolla lobes of *H. sulawesiana* are covered on the outside with dense long hair recurved towards the corona inside while the hairs on the corolla lobes of *H. isabelchanae* are straight and point outwards.

Proposed IUCN category. Known from only two localities at Mamuju – West Sulawesi and Towuti – South Sulawesi with unknown population size, the preliminary conservation status of *Hoya sulawesiana* is Data Deficient (IUCN 2012). *Ex situ* collections are present in Bogor Botanic Gardens (from the type locality).

Additional specimen examined. Cultivated in Thailand, Nakhorn Si Thammarat, May 2019, *S. Somadee in M. Rodda MR1956* (SING).

Hoya surisana Rodda & S.Rahayu, ***sp. nov.***

Figs 2 & 3

Similar to *Hoya mappigera* in corolla and corona shape and colour, but differing in number of flowers, size and shape of the calyx and in corolla pubescence.

Type: INDONESIA, Sulawesi, West Sulawesi, Mamasa, Pebassian, Makalangkan mountain, ca 500 m elev., originally collected by Andarias Sambokaraeng, vouchered in cultivation at Bogor Botanic Garden, 5 August 2019, *Rahayu 1221* (holotype, BO).

Terrestrial climber with white latex in all vegetative parts. Roots fibrous, basal; adventitious roots absent, unless in direct contact with substrate. Stems terete, 1.5–3 mm in diameter, mid green when young, later dark green or greyish brown pubescent turning glabrescent; internodes (2–)5–15(–25) cm long. Petiole cylindrical, slightly channelled above, 4–10 mm long, 2–3 mm in diameter; lamina coriaceous, oblong or elliptic-lanceolate, (5–)8–12 × (1.5–)3–6 cm, base round (cuneate), apex acuminate, abaxially pale green, adaxially mid green, venation pinnate, main vein depressed on adaxial surface, evident on abaxial surface, secondary veins, 5–10 each side, more evident abaxially, anastomosing; tertiary venation reticulate, adaxially prominent on immature leaves only; colleters at lamina base 3–6, conical, 0.5–0.8 mm long. Inflorescence umbelliform, convex, positively geotropic, up to 10-flowered; peduncle extra-axillary, terete, persistent, 1.5–2.5 cm long, c. 3 mm in diameter, glabrous, rachis indeterminate; pedicel terete, 1.8–2.8 cm long, 1–1.2 mm in diameter, sparsely pubescent. Calyx lobes ovate-lanceolate, spatulate, 14–17 × 7–9 mm, apex acuminate, greenish white, outside glabrous, inside very sparsely pubescent, margins ciliate. Basal colleter 1(0) at each calyx lobe sinus, oblong, 0.2–0.3 × c. 0.1 mm. Corolla broadly campanulate, membranous, 1.5–2 cm in diameter, with lobes sharply bent outwards; tube broadly campanulate, 7–9 mm long, white, outside glabrous, inside very finely pubescent; lobes triangular, sharply bent outwards, 7–9 × 9–10 mm, white, abaxially glabrous, adaxially very finely pubescent. Corona stipitate, stipe ca 1 mm long, ca 2.5 mm in diameter; corona lobes with a basal, spreading globose process ca 2 mm in diameter with basal revolute margins, dark purple, and an apical lunate process 3–3.5 mm long, apically acute, dark purple. Guide rails ca 3 mm long, yellow. Style head conical ca 2 mm in diameter, ca 1.5 mm high, covered by the anther appendages. Pollinia, oblong, 900–1100 × 150–200 μm, without pellucid margin, corpusculum ovate, 700–750 × 480–520 μm, caudicles triangular c. 120 μm long. Anther appendages ovate, ca 2.5 × 1.5 mm, membranous, hyaline, apically acuminate. Ovary oblong, ca 3 × 1 mm, glabrous. Fruit a single follicle, fusiform, 15–18 × 1–1.5 cm, base with pedicel laterally attached, apex acuminate, seeds 3.5–4.5 × c. 1.5 mm, long comose.

Distribution. only known from West Sulawesi, Makalangkan mountain, at about 500 m elev.

Etymology. *Hoya surisana* is named after Surisa Somadee, Thai *Hoya* expert and grower.

Habitat and ecology. *Hoya surisana* is found in pine forest on steep slopes. This species was seen rooted in the ground and then producing long climbing stems growing onto the nearby trees.

Notes. *Hoya surisana* is an unusual species of *Hoya* that combines characters so far not observed in such a combination in any other species of the genus. It is therefore extremely difficult to pinpoint a similar species for morphological comparison. The leaves are similar to these of *Hoya thuathienhuensis* T.B.Tran *et al*., a species endemic to Vietnam. The similarities are particularly evident in the very visible venation of the young leaves, that are paler than the rest of the lamina, and become darker as the leaf matures. Both species are also terrestrial climbers. The mature plain mid green glabrous leaves are also comparable to these of *Hoya ischnopus* Schltr. from New Guinea, which are almost indistinguishable. Both *H. thuathienhuensis* and *H. ischnopus* have corollas with reflexed lobes, while *H. surisana* has campanulate corollas.

The most prominent feature of the flower of *H. surisana* is the rather large, broadly campanulate, white corolla. This has been observed in numerous species such as *Hoya campanulata* Blume, *Hoya danumensis* Rodda & Nyhuus, *H. mappigera* Rodda & Simonsson and *Hoya wallichii* (Wight) C.M.Burton from Sundaland. All these species have glabrous corolla, while the corolla of *H. surisana* is very finely pubescent inside. Additionally, these species have small calyx lobes that do not extend beyond the corolla lobe sinuses while in *H. surisana* the calyx lobes are very prominent and extend beyond the corolla lobe sinus. Very conspicuous and large calyx lobes have been observed in *Hoya griffithii* Hook.f. and *Hoya thailandica* Thaithong from continental Southeast Asia and some forms of *Hoya calycina* Schltr. from New Guinea. However, none of these species have a campanulate corolla. The corona of *H. surisana* is somewhat similar to that of *Hoya mappigera* from peninsular Malaysia and Borneo. In both species the corona lobes have a distinct swollen basal process and an erect elongated process. As mentioned above the two species can be separated based on the corolla pubescence and the vastly different size of the calyx. Further, *H. mappigera* produces inflorescences that produce only one flower at a time while *H. surisana* inflorescences produce up to 10 flowers opening concurrently.

Additional specimen examined. Cultivated in Thailand, Nakhorn Si Thammarat, May 2019, *S. Somadee in M. Rodda MR1955* (SING).

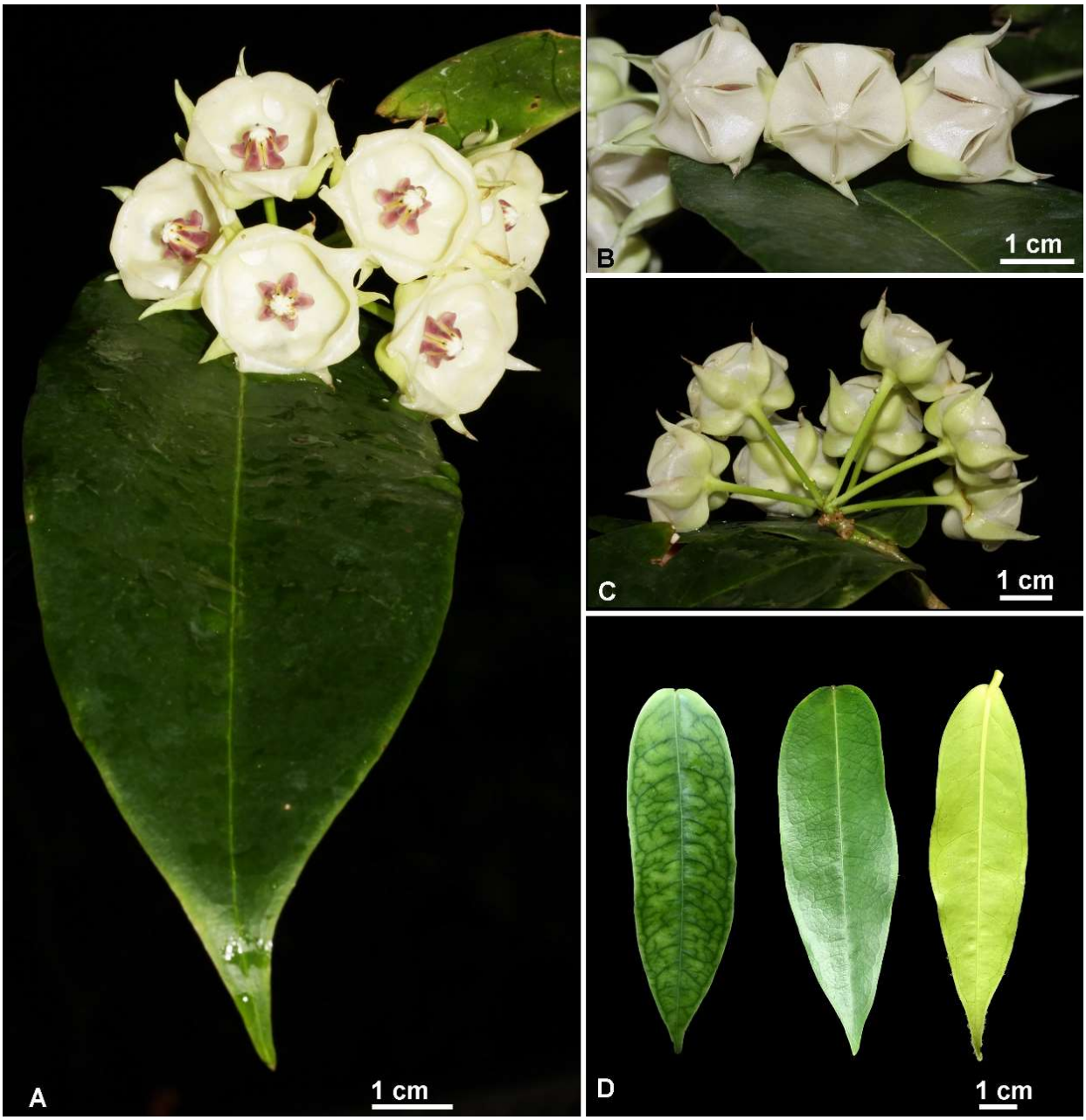

Fig. 2. ***Hoya surisana*** Rodda & S.Rahayu. **A**, inflorescence; **B**, buds, almost ready to open; **C**, inflorescence back view, showing the large calices; **D**, leaves: right, from underneath; middle, from above; left, from above and immature; photos, A-C by Surisa Somadee; D by Michele Rodda.

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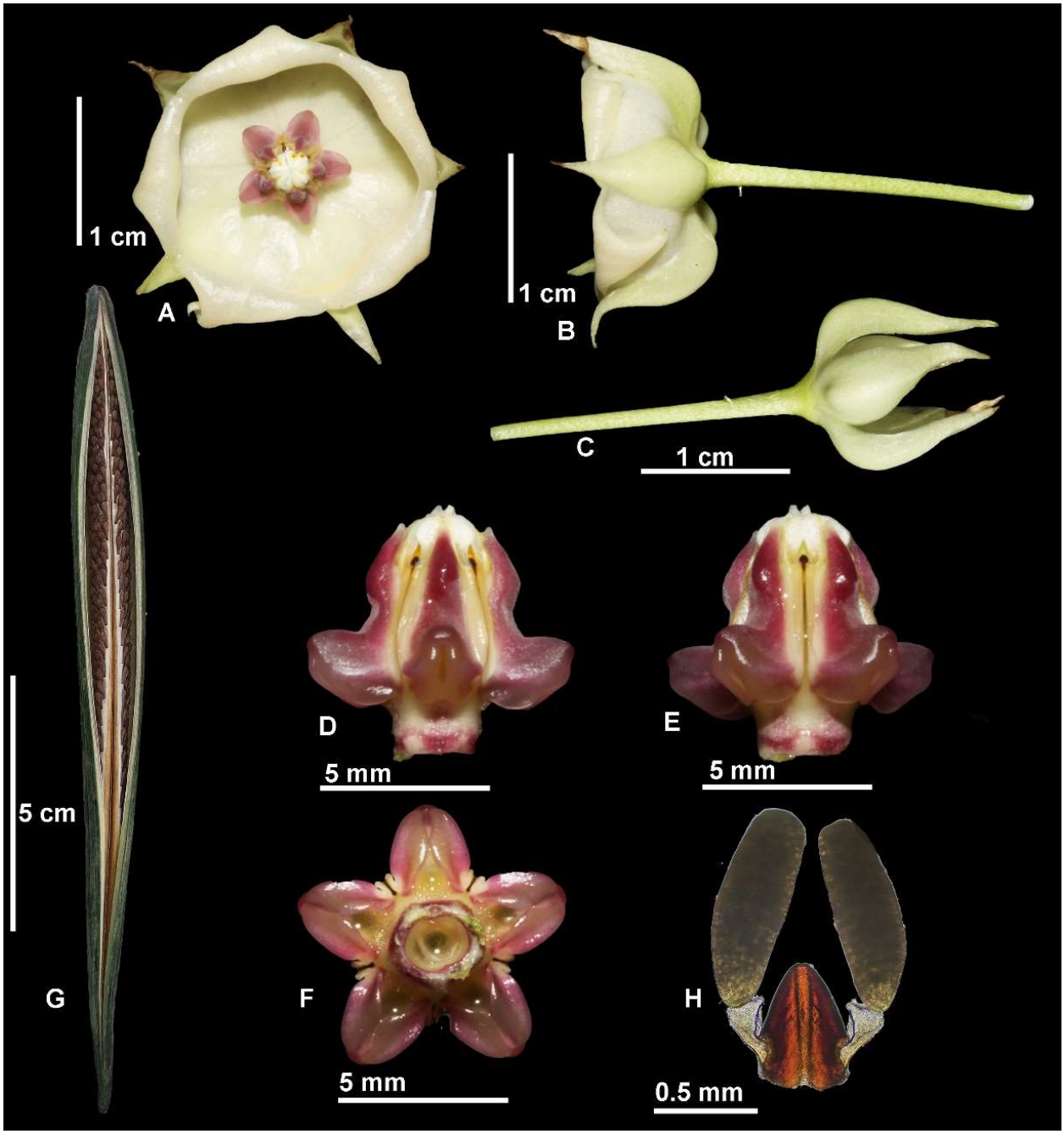

Fig. 3. ***Hoya surisana*** Rodda & S.Rahayu. **A**, flower; **B**, flower, side view; **C**, calyx; **D**, **E**, corona, side view; **F**, corona, from underneath; **G**, follicle showing seeds within; **H**, pollinarium. photos, A-G by Surisa Somadee; H by Michele Rodda.

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