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Studies of *Begonia* (Begoniaceae) from the Moluccas IV: Two new species from Halmahera, Indonesia

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ABSTRACT: Two new *Begonia* species from the Moluccas, Indonesia, are described: *Begonia fairchildii* and *B. moluccana*, Photo plates, notes on their distributions, habitat preferences, provisional IUCN conservation assessments and a key to Moluccan *Begonia* species are provided. Both species are provisionally assessed as Data Deficient (DD) regarding their conservation status.

KEY WORDS: *Begonia brangbosangensis*, *B. fairchildii*, *B. glabricaulis B. lombokensis*, *B. Moluccana*, Petermannia, Moluccas.

INTRODUCTION

During the 1940s, the American botanist David G. Fairchild led an expedition to Halmahera island in the Moluccas, which was funded by Ann Archbold, a philanthropist and natural historian. They sailed using the floating botanical laboratory called 'Cheng Ho' (Lewis, 2010). They sailed southward from Manila to the Moluccas making several visits to the southern Philippines and some islands near Sulawesi on the way, but before reaching the Moluccas they had to detour to Java due to some problems with the ship. After repair they finally departed from Java and landed in Ambon. Unfortunately, the political situation and security reasons forced them to head back to the Philippines. Sailing northward from Ambon gave them the opportunity to visit some islands such as Bacan, Mandioli, Kasiruta, Halmahera and Makian. They were able to land in Halmahera and make some botanical exploration, particularly in the northern part of the island, which resulted in several important herbarium collections including a new tree species, *Elaeocarpus fairchildii* (Lewis, 2010), and a new species of *Begonia* from Kahatola Island which has not been described until now.

In 2011 and 2012 the Fairchild Tropical Botanic Gardens and Bogor Botanic Gardens collaborated on an expedition commemorating David Farichild's visit to Halmahera. On this expedition, several collections of begonias were made, two of which were described as new species: *B. aketajawensis* Ardi & D.C.Thomas and *B. holosericeoides* Ardi & D.C.Thomas (Ardi *et al*., 2014). Subsequently several new species collected during exploration of the Moluccas by a team from Bali Botanic Gardens were published (Ardi and Thomas, 2015; Ardhaka *et al*., 2016; Unduharta and Ardi, 2016; Ardaka and Ardi, 2019). Here we build on these insights into the *Begonia* flora of the Moluccas, and describe two new species from the island: *B. fairchildii* Ardi & D.C.Thomas and *B. moluccana* Ardi & D.C.Thomas. As with the majority species in the Moluccas, these two new species belong to *Begonia* section *Petermannia*, as they exhibit typical characters of the section: protogynous inflorescences, two-flowered female inflorescences or solitary female flowers, three-locular ovaries with axile placentation and bilamellate placentae, fruits with equal or subequal wings, and anthers with unilaterally positioned slits (Doorenbos *et al*., 1998; Moonlight *et al*., 2018). All available *Begonia* specimens from A, BO, E, K, L and SING have been consulted, and hence it must be assumed, at least until more intensive collecting reveals otherwise, that these species have a restricted range and are endemic to Halmahera.

Identification key to the ***Begonia*** species in Sect. *Petermannia* in the Moluccas (modified from Ardi *et al*., 2014)

1a. Plant erect ……..…… 2
1b. Plant semi-erect or creeping…… 5
2a. Fruit a dry capsule, dehiscent …….. 3
2b. Fruit fleshy, indehiscent …….. 4
3a. Plant small, up to 25 cm tall, many-branched and sparsely hairy; not verruculose at the transition of the petiole and the lamina; female flowers with 5 tepals ……. ***B. moluccana***
3b. Plant up to 1 m tall, less branched but clumped and glabrous; verruculose at the transition of the petiole and lamina; female flowers with 2 tepals ……. ***B. fairchildii***
4a. Leaves broadly ovate; female flowers with 2−5 tepals; male flowers with 2 tepals, anther connective not projecting at the apex …….. ……. ***B. rieckei*** complex
4b. Leaves oblong, elliptic or broadly elliptic; female flowers with 6 tepals; male flowers with 4 tepals, anther connective projecting at apex …….. ***B. aptera***

5a. Stem and petioles with indumentum of simple hairs, fruit pendulous on thin pedicels ..... ***B. mufidahkallae***
5b. Stem and petioles with indumentum of red scales or branched hairs, fruit erect on stiff pedicels 6
6a. Stem and petioles with flattened red scales 7
6b. Stem and petioles with branched hairs 9
7a. Leaves ovate to elliptic, relatively small (4.8–7 × 3–5 cm) ..... ***B. manuselaensis***
7b. Leaves broadly ovate or suborbicular, more than 7 cm wide 8
8a. Leaves broadly ovate or subobicular, 16–23.8 × 12.5–17.2 cm, apex acuminate ..... ***B. galeolepis***
8b. Leaves suborbicular, 5−7 × 8−12 cm, apex shortly acute or rounded ..... ***B. nephrophylla***
9a. Male flower with 4 tepals; leaves obovate to orbicular ..... ***B. aketajawensis***
9b. Male flower with 2 tepals; leaves ovate or broadly ovate to suborbicular 10
10a. Leaves densely hairy on both sides ..... ***B. sageaensis***
10b. Upper leaf lamina surface glabrous 11
11a. Leaves broadly ovate to suborbicular with rounded apex; ovaries densely hairy ..... ***B. holosericea***
11b. Leaves ovate with acuminate apex; ovaries sparsely hairy or glabrous ..... ***B. holosericeoides***

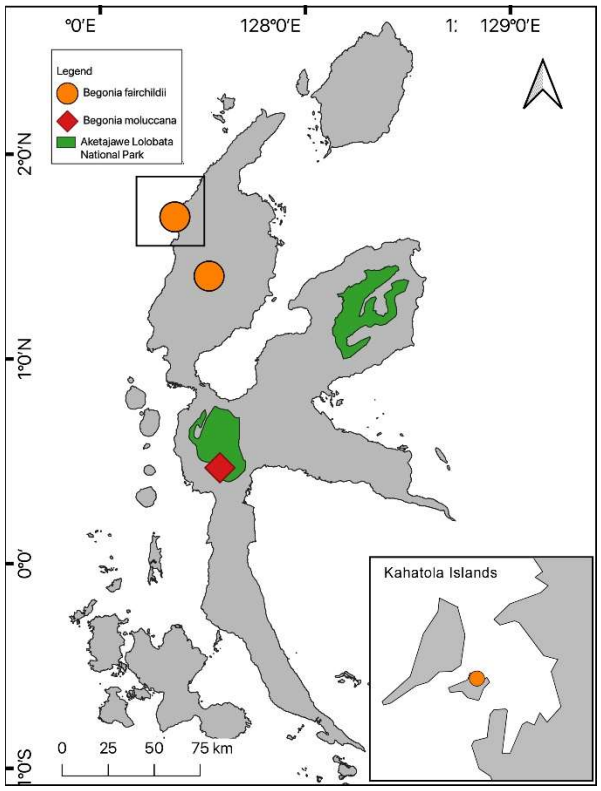

Fig. 1. Distribution of ***Begonia fairchildii*** and ***B. moluccana*** on Kahatola Island (inset) and Halmahera in the North Moluccas Province, Indonesia. Orange circle: ***B. fairchildii***; red rhombus: ***B. moluccana.***

TAXONOMIC TREATMENT

Begonia fairchildii Ardi & D.C.Thomas, ***sp.nov.***
Figs. 1, 2 & 3.

***Type*:** INDONESIA. Moluccas, Halmahera, Kahatola Island, 1 vi 1940, *David Fairchild 381* (holotype A).

Diagnosis. This species resembles *Begonia lombokensis* Girm. in its erect habit and two-tepaled female flowers, but it differs consistently by the verruculose petiol-lamina transition, distantly dentate to almost entire leaf margins, shorter male flowers pedicels (0.7–1 cm), a rounded anther apex, longer female flower pedicels (17–25 mm) and unequal ovary wings (one wing shorter than the other two). In contrast, in *Begonia lombokensis* the petiole-lamina transition is not verruculose, the leaf lamina margin is scalloped and toothed; the male flower pedicels are longer (1–2 cm), the anther apex is notched, the female flower pedicels are shorter (up to *ca.* 13 mm) and the ovary wings are equal.

Perennial, monoecious herb, stems erect, up to 1 m tall, glabrous except for microscopic glandular hairs on the young shoots. ***Stem*** dark brown with white spots; internodes 3.5–10 cm long. ***Leaves*** alternate; stipules caducous, pale green, midrib slightly prominent, oblong to elliptic, 15–20 × 7–13 mm, apex setose, seta up to 5 mm long. Petiole concolorous with stem, 1–5 cm long, verruculose at the petiole-lamina transition. Lamina basifixed, asymmetric, 13–20 × 5.3–7.5 cm, elliptic to oblong, adaxially smooth, green, abaxially pale green, primary veins 7–9, actinodromous, secondary veins craspedodromous, leaf base cordate, lobes not overlapping, apex acuminate, margin distanly dentate to almost entire. ***Inflorescence*** protogynous; female inflorescence one node basal to male, two-flowered, peduncle 0.3–2.5 cm long, reddish, glabrous, bracts caducous, 18–21 × 8–11 mm, elliptic, fused at base, pale green, adaxially glabrous; male inflorescence a thyrse consisting of 2–3 partial inflorescences, each dichasially branching with 3–15 flowers, peduncle 1.7–9 cm long, bract caducous, 11–21 × 4–11 mm, elliptic, fused at base, pale green, adaxially glabrous; bracteoles caducous, elliptic, 5–7 × 2–3 mm. ***Male flowers***: pedicel 7–10 mm long, glabrous, tepals two, greenish-white to white, 8–13 × 12–16 mm, broadly ovate, adaxially glabrous; androecium of 20–25 stamens, yellow, filaments 0.5–1 mm long, slightly fused at the very base, anthers ca. 1–1.3 mm long, obovate, apex rounded, dehiscing through unilaterally positioned slits ca. ¾ as long as the anthers. ***Female flowers***: pedicels 1–2 cm long, pale green to reddish, tepals 2, white or white tinged with green, 15–19 × 17–25 mm broadly ovate, base cordate, margin entire, apex obtuse, adaxially glabrous; ovary (excluding the wings) 10–12 × 4–6 mm, glabrous, pale green or white, locules 3, placentation axile, placentae bilamellate, wings 3, unequal, one wing shorter than others two, base rounded, apex subtruncate, style basally fused, 3–branched, each stylodium bifurcate in the stigmatic region, stigmatic surface a spirally twisted papillose band, orange. ***Fruits***: peduncle 1– 2.5 cm long, pedicels 2.4–4.6 cm long, seed-bearing part ellipsoid, 12–13 × 8–9 mm (excluding the wings), glabrous, dehiscent, spliting along the wing attachment, wings shape as for ovary, up to 13–14 mm at the widest point (apically). ***Seeds*** unknown.

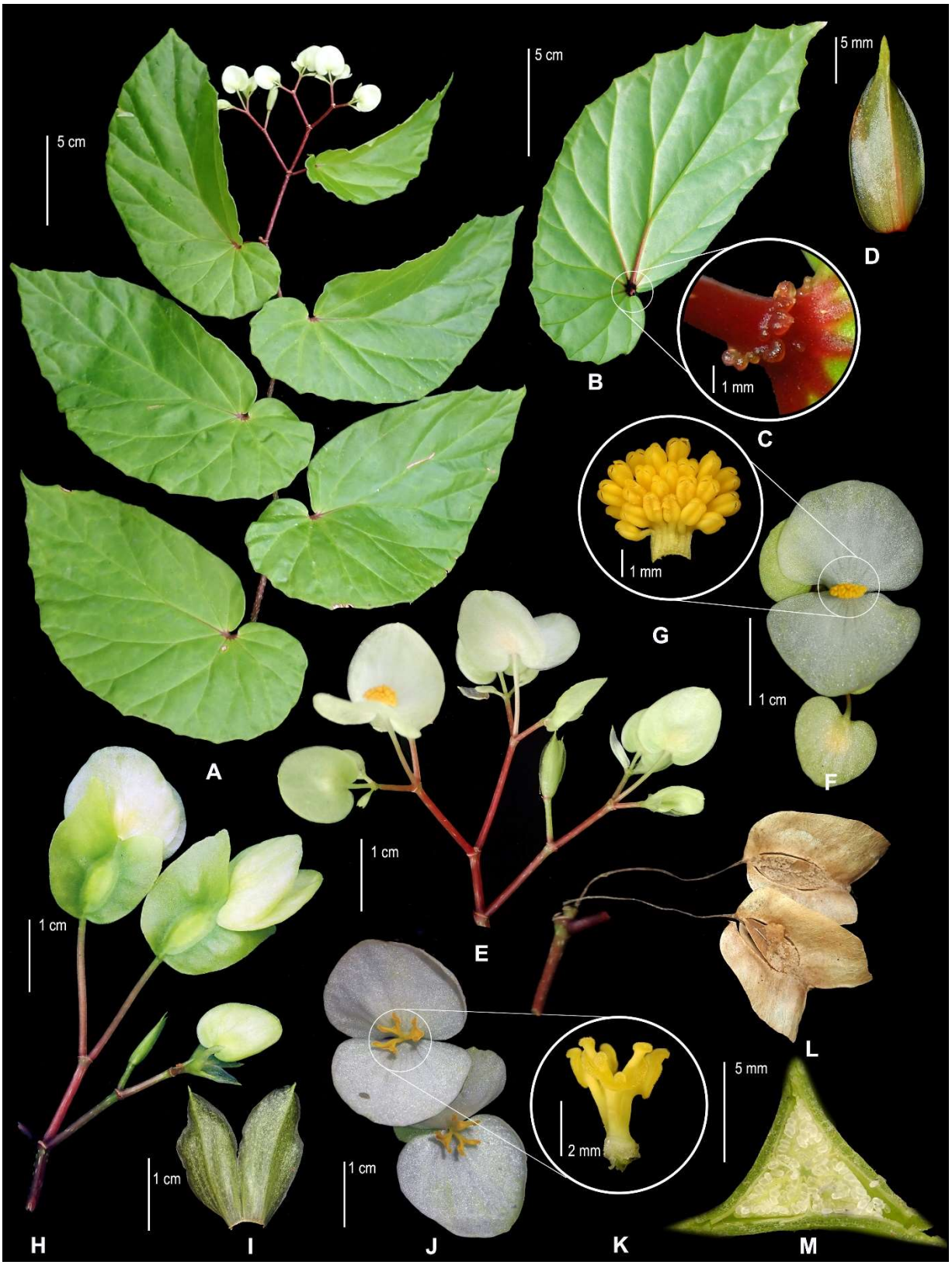

Fig. 2. ***Begonia fairchildii*** Ardi & D.C.Thomas. **A.** Branch with male inflorescence; **B.** Lamina, abaxial surface; **C.** Petiole-lamina transition with verruculose emergences; **D.** Stipule; **E.** Male inflorescence; **F.** Male flower, front view; **G.** Androecium; **H.** Female inflorescence and young male inflorescence; **I.** Bract of female inflorescence; **J.** Female flowers, front view; **K**. Stigma; **L**. Infructescence; **M**. Ovary cross-section, axile placentation and bilamellate placentae;. A–M from *WI 762*. Photos: W.H. Ardi.

Table 1. Morphological comparison of ***B. fairchildii***, ***B. brangbosangensis*** and ***B. lombokensis***.

Characters	***B. fairchildii***	***B. lombokensis***	***B. brangbosangensis***
Petiole and lamina transition	verruculose	not verruculose	not verruculose
Leaf margin	distanly dentate to almost entire	biserrate	biserrulate
Female inflorescences	two-flowered	two-flowered	flowers solitary
Peduncle (cm)	0.5–2.5	up to 0.5	?
Male flowers			
Pedicel length (cm)	0.7–1	1–2	1
Tepals size (mm)	8–13 × 12–16	8–15 × 5–10	8–10 × 6–9
Stamens number	20–25	ca. 24	45
Anthers tip	rounded	notched	notched
Female flowers			
Pedicel	1–2.5 cm long, not recurved	up to 1.3 cm long, not recurved	0.5–1 cm long, recurved
Ovary wings	unequal, one wing shorter than the two others	equal	unequal
Fruits			
Pedicel length (cm)	2.5–4.6	1.2–2.8	1.5

Fig. 3. Holotype of ***B. fairchildii***. (*D. Fairchild 381*)

***Habitat*:** Secondary coastal forest, growing in rocky soil, in half to full shade.

Distribution: Indonesia: Kahatola Island and Halmahera.

Etymology: The species is named in honour of David G. Fairchild (April 7, 1869 – August 6, 1954), American botanist and explorer, who collected the type material of this species.

***Provisional IUCN conservation assessment*:** Data Deficient (DD). This species is known from two localities in the Moluccas, the small island of Kahatola and Halmahera. The forests in the wider area are very poorly explored. Consequently, we assess this species as Data Deficient.

Notes: Two-tepaled female flowers are rare in *Begonia* section *Petermannia*, so far only represented by two species from the Lesser Sunda Islands: *B. lombokensis* Girm. and *B. brangbosangensis* Girm. (Girmansyah, 2009; 2016). Both species show erect and glabrous stems, similar to the condition found in *B. fairchildii*, but otherwise the two species are morphologically dissimilar and *B. fairchildii* can be readily differentiated by the verruculose petiole-lamina transition, separate male and female inflorescences, female inflorescence with two flowers, longer male flower pedicels and fewer stamens. A detailed morphological comparison between *B. fairchildii*, *B. lombokensis* and *B. brangbosangensis* is provided in the Table 1.

***Other specimens examined*:** **Indonesia**: Mollukken, Halmaheira, 12 x 1937, *Nedi 323* (BO); Moluccas, Halmahera, Tasoa, Gn. Sembilan, 24 ix 1951, *Pleyte D.R 242* (BO); Halmahera, Kahatola Island, 18 vii 2012, *Mellisa E. Abdo 4528* (KRB); cultivated at Bogor Botanic Gardens from material collected on Kahatola Isl. 16 iii 2022, *Wisnu H. Ardi WI 762* (BO, FIPIA).

Begonia moluccana D.C.Thomas, Ardaka & Ardi, ***sp. nov.*** **Figs. 1 & 4.**

Type: cultivated at Bali Botanic Gardens from vegetative material collected in the wild (Aketajawe-Lolobata National Park, Halmahera, Indonesia), *Wisnu Ardi WI 97* (holotype BO).

Diagnosis. Species resembling *Begonia glabricaulis* Irmsch. in the low, erect growth habit and many-branched stems, but differs by its longer petioles (3–5 cm), shorter female inflorescence peduncle (1–2 mm) and the straight pedicels of the fruits (vs petioles 0.3–1 cm long, female inflorescence peduncle up to 1.5 cm long, fruit pedicels strongly recurved).

Perennial, monoecious herb, stems erect, to c. 25 cm tall, with sparse indumentum of multicellular hairs, and moderately dense indumentum of microscopic, glandular trichomes on the stem. ***Stems*** branched; internodes c.1.5–4.5 cm long, reddish. ***Leaves*** alternate; stipules persistent, 13–15 × 5–7 mm, elliptic to oblong, with an abaxially prominent midrib, apex setose, seta up to 3 mm long; petioles 3–5 cm long, adaxially channelled, glabrescent, red; lamina 8–12 × 5–7.3 cm, asymmetric, elliptic, base

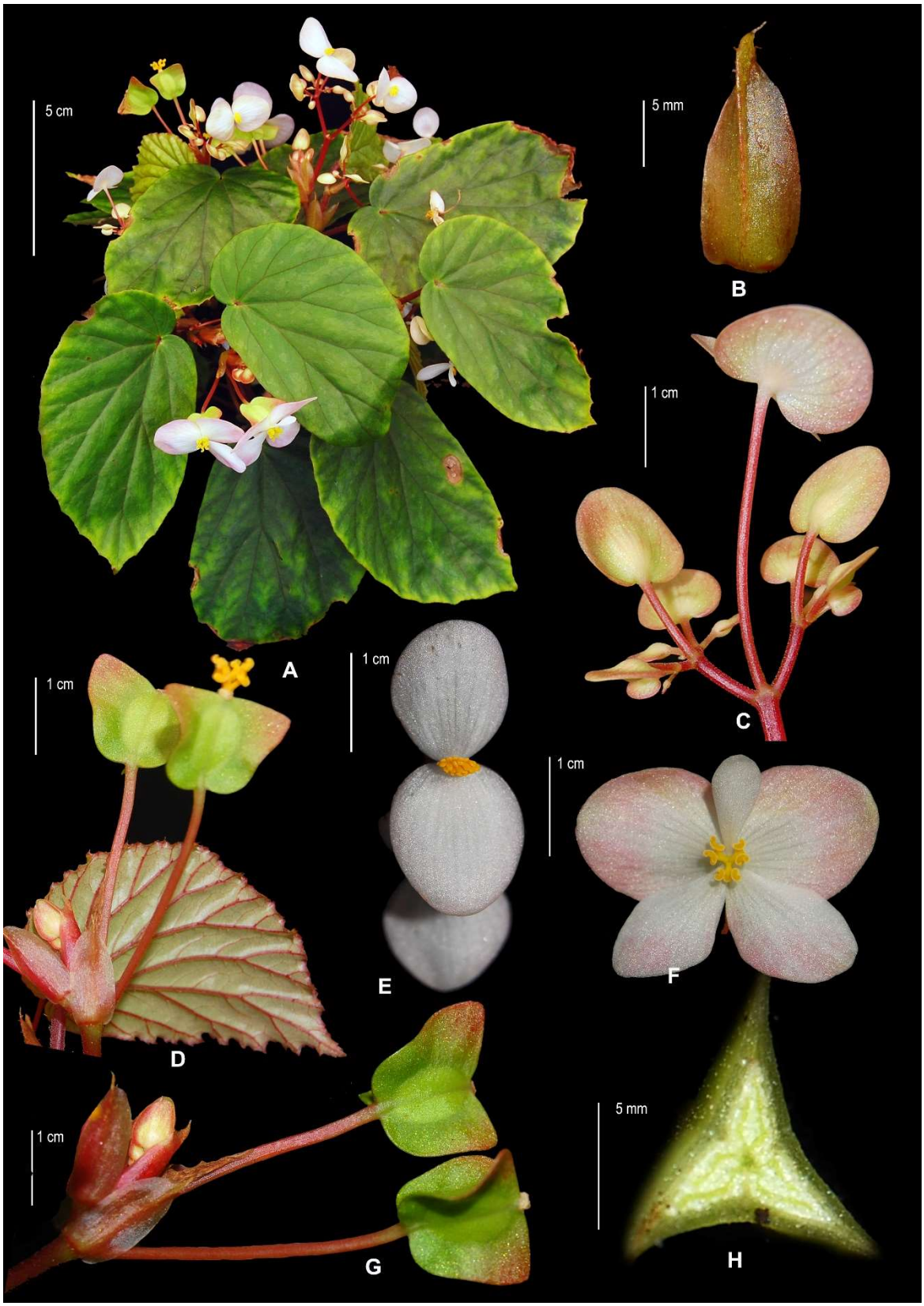

Fig 4. ***Begonia moluccana*** D.C.Thomas, Ardaka & Ardi. **A.** Habit of cultivated plant; **B.** Stipule, abaxial surface; **C.** Male inflorescence; **D.** Female inflorescence; **E.** Male flower, front view; **F.** Female flower, front view; **G.** Infructescence; **H.** Ovary cross-section, axile placentation and bilamellate placentae. A–M from *WI 97*. Photos: W.H. Ardi.

cordate and lobes not or rarely slightly overlapping, apex acuminate, margin toothed to almost entire, teeth long bristle-pointed, adaxial surface green with thin silvery blotches between the veins, abaxial surface pale green, primary veins 6–8, actinodromous, secondary veins craspedodromous. ***Inflorescences***: protogynous; female inflorescences 2-flowered, positioned one node below the male inflorescences, peduncles 1–2 mm long; male inflorescence a thyrse composed of 2–3 partial inflorescences, each dichasially-monochasially branching, each with 5–17 flowers, peduncles 2–3 cm long. ***Male flowers***: pedicels 11–22 mm long, red; tepals 2, white, 10–16 × 11–16 mm, suborbicular, base slightly cordate, apex rounded; androecium of 20–25 stamens, yellow, filaments up to 1 mm long, slightly fused at the very base, anthers up to 2 mm long, obovate, dehiscing through unilaterally positioned slits that are ca. 1/2 as long as the anthers. ***Female flowers***: pedicels 2.5–3.5 cm long, reddish; tepals 5, white tinged with pink, unequal, the smaller 10–11 × 4–5 mm, obovate to elliptic, the two larger 17–19 × 12–15 mm, obovate, two largest 14–20 × 15–18 mm, broadly ovate; ovary (excluding the wings) 9–11 × 5–6 mm, ellipsoid glaborus, locules 3, placentation axile, placentae bilamellate, wings 3, subequal, base rounded, apex truncate, style basally fused, 3-branched, each stylodium bifurcate in the stigmatic region, stigmatic surface a spirally twisted papillose band, orange. ***Fruits***: pedicels 2.7–4.5 cm long; seed-bearing part ellipsoid, 11–13 × 8 mm (excluding the wings), glabrous, dehiscent, spliting along the wing attachment, wing shape as for ovary, up to 10 mm at the widest point (apically). Seeds unknown.

***Habitat*:** Primary lowland forest, growing terrestrially in shade.

***Distribution*:** Endemic to Aketajawe Lolobata National Park, Halmahera, Maluku Province, Indonesia.

***Etymology*:** The specific epithet of moluccana means "of Molucca" and refers to the archipelago.

***Provisional IUCN conservation assessment*:** Data Deficient (DD). This species is known from a single collection from the Aketajawe Lolobata National Park, Halmahera. The forests in the wider area are very poorly explored. Consequently, we assess this species as Data Deficient.

***Notes*:** *Begonia moluccana* is morphologically similar to *Begonia glabricaulis* from Papua, which shares a low, many-branched, erect growth habit and relatively thin stems. *Begonia moluccana* can be easily differentiated from *B. glabricaulis* by its sparsely hairy stems, longer petioles (3–5 cm), shorter female inflorescence peduncles (1–2 mm) and straight fruit pedicels (versus petioles 0.3–1 cm long, female inflorescence peduncle up to 1.5 cm long and strongly recurved fruit pedicels). The growth habit of *B. moluccana* is also similar to the conditions found in *B. didyma* D.C.Thomas & Ardi from South Sulawesi. However, *B. moluccana* can be distinguished by the sparser indumentum on the vegetative parts, a larger leaf size (8–12 × 5–7.3 cm) and the male inflorescence structure with dichasial branching in the basal part (versus densely hairy on vegetative parts, leaf lamina 4.2–6.7 × 2.6–4.7 cm, and male inflorescence subumbellate). This combination of characters also differentiates *B. moluccana* from other Moluccan *Begonia* species.

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