



Begonia tui, a new species of *Begonia* sect. *Coelocentrum* from Quang Binh Province, Central Vietnam

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ABSTRACT: *Begonia tui*, a new species of sect. *Coelocentrum*, is described and illustrated here. It was collected during expeditions carried out on a limestone hill in Quang Binh Province, Central Vietnam. The new species is morphologically similar to *B. mollissima* in its rugose, widely ovate lamina. However, the new species can be distinguished by the margin of the stipule which is entire (vs. ciliate), androecium is zygomorphic (vs. actinomorphic), the pistillate flowers with 3 tepals (vs. 2), and the ovary's abaxial wing is triangular (vs. lunate). The conservation status of *B. tui* is assessed as Endangered, according to the IUCN Red List Categories and Criteria.

KEY WORDS: *Begonia mollissima*, *Begonia datii*, biodiversity, endemism, Indochina, limestone, taxonomy, plant conservation.

INTRODUCTION

Begonia sect. *Coelocentrum* exhibits extraordinary species diversity in southwestern China to northern Indochina, with 89 known species almost all narrowly distributed in and endemic to limestone areas (Chung *et al.*, 2014; Hughes *et al.*, 2015–Present). Due to a high proportion of unexplored areas within the Sino-Vietnamese limestone hills, in recent years, there has been a considerable increase in the number of newly discovered species as further field investigations of *Begonia* have been conducted in the area. (Chen *et al.*, 2018; Feng *et al.*, 2023; Hoang and Lin, 2023a,b; Liu *et al.*, 2020; Radbouchoom *et al.*, 2019; Tong *et al.*, 2019; Tu *et al.*, 2020) For instance, Peng *et al.* (2015) recorded approximately 60 species of *B. sect. Coelocentrum* in the area. Less than ten years later, an additional nearly 30 species were listed (Hughes *et al.*, 2015–present), indicating an approximately 50% increase, which clearly demonstrates the high diversity within the section.

While revising the taxonomy of *Begonia* for the limestone flora of Vietnam, the first author conducted several field investigations throughout the country and discovered an unidentified species of *Begonia* in Quang Binh Province, Central Vietnam. This species is identified by its rhizomatous habit, 3-tepaled pistillate flowers, and 1-loculed ovary with parietal placentation, all characters distinct to section *Coelocentrum*. After a detailed examination of the vegetative characters and flower morphology, we confirmed that it is distinct from all species of the section known to date. Therefore, we describe it as a new species, named *Begonia tui*.

TAXONOMIC TREATMENT

Begonia tui T.N.Bon & C.W.Lin, *sp. nov.*

Figs. 1 & 2

§ *Coelocentrum*

Type: VIETNAM. Quang Binh Province: Tuyen Hoa District, Thanh Hoa Commune, 70 m elevation, 20 April 2023, Trinh Ngoc Bon, Nguyen Thanh Tu, Nguyen Hoai Nam, Nguyen Van Su QB 2023-01 (holotype: VAFS).

Diagnosis: *Begonia tui* resembles *B. datii* T.S.Hoang & C.W.Lin in the rhizomatous habit and rugose, widely ovate laminae, but it is different in having elongated (vs. congested) rhizomes, zygomorphic androecium (vs. actinomorphic or subactinomorphic), stamens 38–50 (vs. 65–100) and sparsely red hirsute ovary (vs. glabrous).

Monoecious rhizomatous herb. **Rhizome** stout, dusky greenish-red to crimson, creeping, to 13 mm thick, internodes to 40 mm long, densely white villous. **Stipules** semi-persistent or deciduous, pale green to brownish-red, ovate to ovate-triangular, 10–13 × 8–11 mm, herbaceous, keeled, abaxially sparsely puberulous or tomentose, midrib densely scattered with long hirsute or villous, margin entire, apex aristate, arista *ca.* 2.5 mm long. **Leaves** alternate, petiole terete, dusky red to crimson, 9–26 cm long, 4.5–7 mm diameter, densely recurved white villous; leaf blade asymmetric, oblique, widely ovate to suborbicular, 12.5–20 × 8.4–14.5 cm, broad side 5.7–8.8 cm wide, basal lobes cordate, 4.3–6.2 cm long, apex acute to acuminate, margin denticulate with a line of puberulous hairs; leaf chartaceous, succulent, adaxially emerald green to malachite green, subvelvety with blue iridescence; upper surface densely covered by small

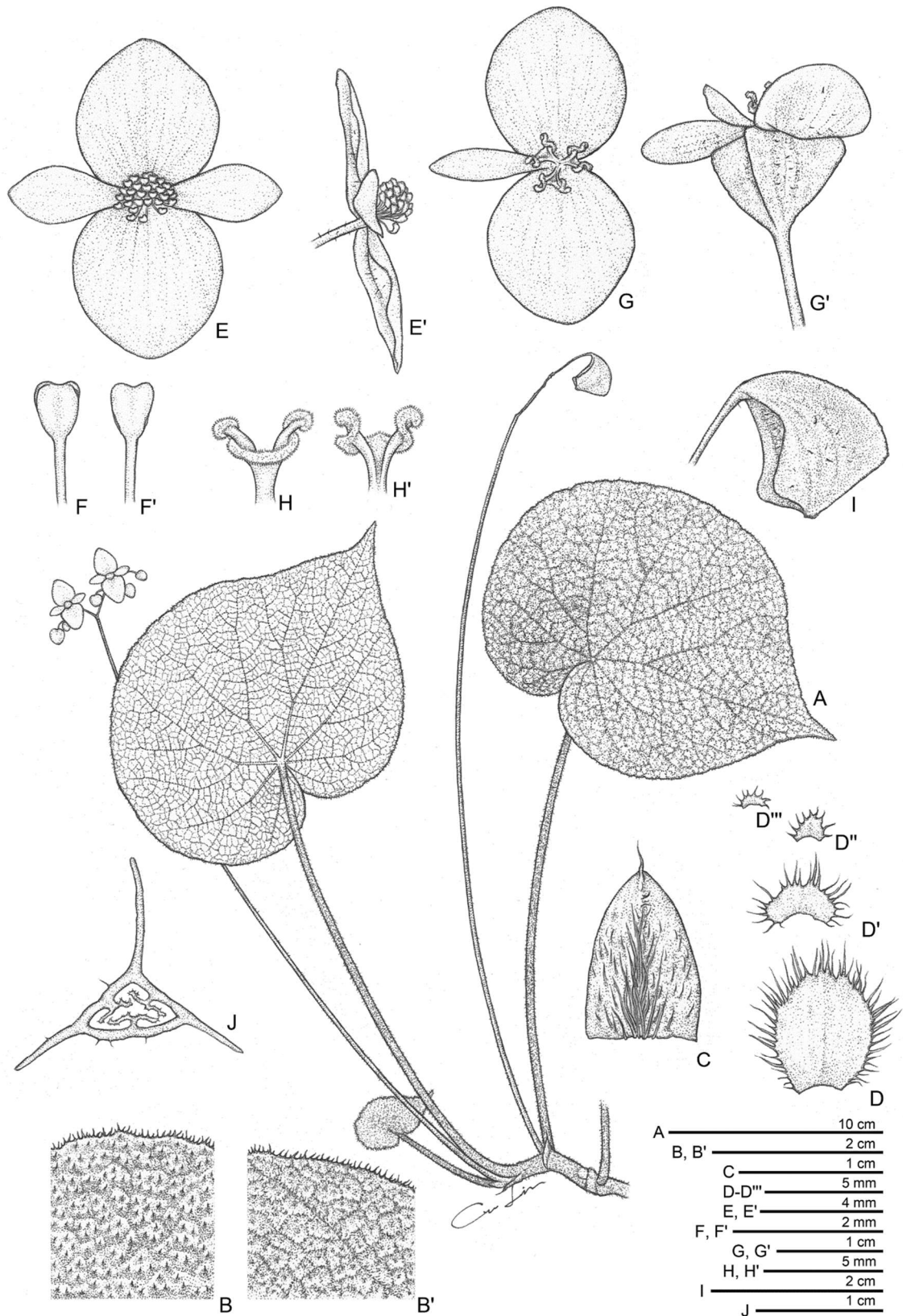


Fig. 1. *Begonia tui* T.N.Bon & C.W.Lin. **A**. Habit; **B, B'**. Portion of leaf adaxial and abaxial surfaces; **C**. Stipule; **D-D'''**. Bracts; **E, E'**. Staminate flower, face and side views; **F, F'**. Stamens, ventral and dorsal views; **G, G'**. Pistillate flower, face and side views; **H, H'**. Style and stigmatic band, dorsal and ventral views; **I**. Capsule; **J**. Cross section of ovary.

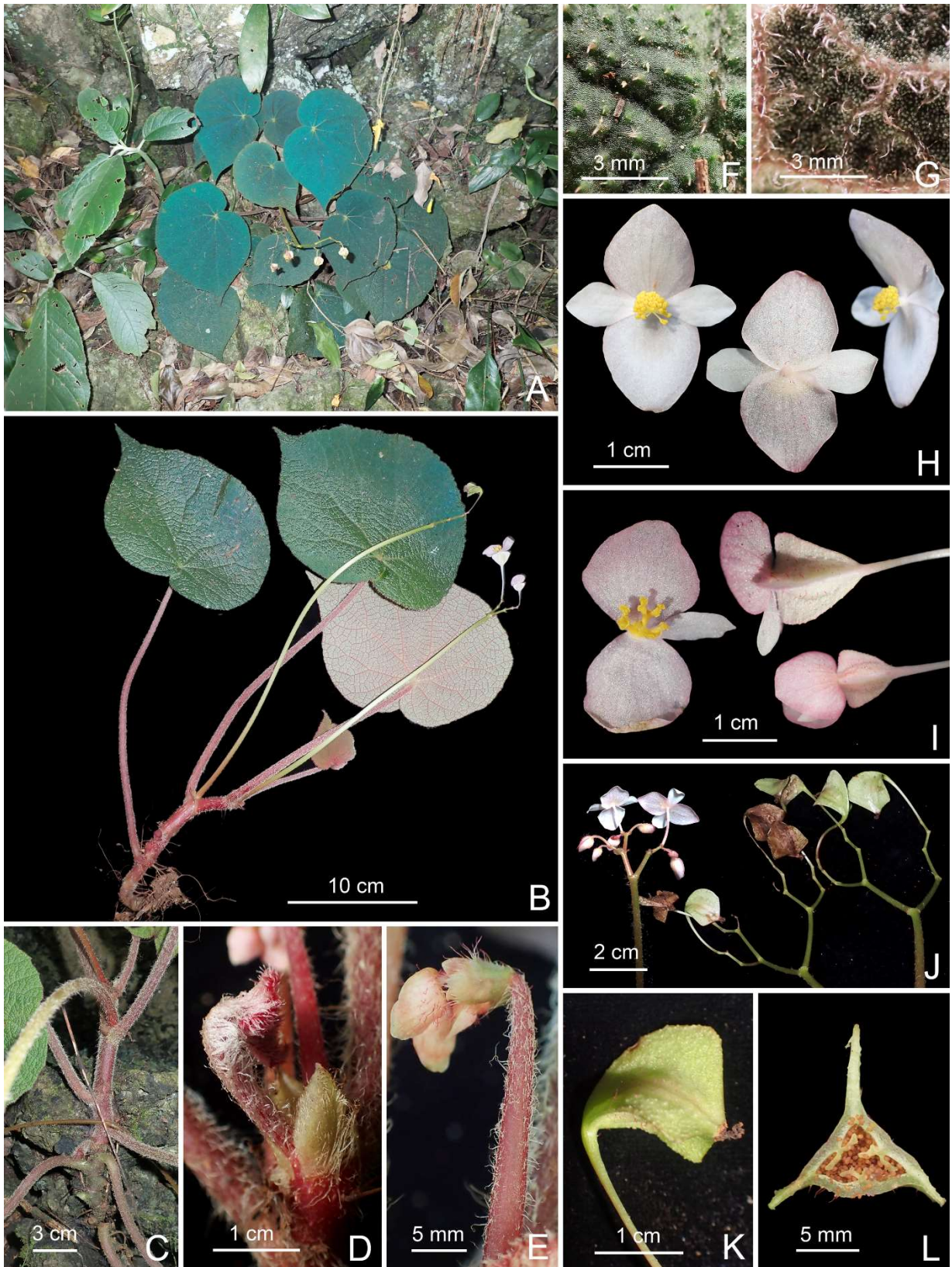


Fig. 2. *Begonia tui* T.N.Bon & C.W.Lin. **A.** Habit and habitat; **B.** Habit; **C.** Rhizome; **D.** Stipule, also showing petioles and juvenile leaf; **E.** Immature inflorescence, also showing bract; **F.** Portion of leaf adaxial surface, **G.** same, abaxial surfaces; **H.** Staminate flowers, face, back and side views; **I.** Pistillate flowers, face and side views; **J.** Inflorescence and infructescence; **K.** Capsule; **L.** Cross section of ovary.

**Table 1.** Comparison of *Begonia tui*, *B. datii* and *B. mollissima*

	<i>B. tui</i>	<i>B. datii</i>	<i>B. mollissima</i>
Rhizome internodes	often elongated	always congested	always congested
Stipule margin	entire	entire	ciliate
Leaf			
blue iridescence	present	absent	absent
maculation	absent	white patches between veins	absent
♂ flower			
outer tepals abaxial vestiture	sparsely hirsute	glabrous or villous	villous
androecium	zygomorphic	actinomorphic or subactinomorphic	actinomorphic
number of stamens	38–50	65–100	unknown
♀ flower			
number of tepals	3	3	2
ovary vestiture	hirsute	glabrous	villous
Capsule			
abaxial wing	narrowly triangular	lunate to sub-triangular	lunate
Distribution	Quang Binh Province, Central Vietnam	Quang Binh Province, Central Vietnam	Bac Kan Province, Northern Vietnam

raised cones between veins, giving the lamina a rugose appearance, each cone topped by a tubercular-based puberulous hair; abaxially pale green to dusky purplish-green, densely puberulous-tomentose on veins; venation palmate with 7 primary veins, midrib distinct, with *ca.* 2 secondary veins on each side, secondary veins branching dichotomously or nearly so, tertiary veins weakly percurrent or reticulate. **Inflorescences** axillary, bisexual, cymose arising directly from rhizome, *ca.* 5 orders of branching; peduncle pale yellowish-green to yellowish-pink tinged red basally, 17–31 cm long, tomentose or villous. **Bracts** caducous, pale green to creamy pink, at basal node of inflorescence widely ovate, *ca.* 5 × 5 mm, glabrous, margin fimbriate; bracts on upper nodes ovate to depressed ovate, margin fimbriate, gradually smaller towards the inflorescence apex. **Staminate flower:** pedicel pinkish-white, 10–15 mm long, sparsely red hirsute or subglabrous, tepals 4, white to pink; outer 2 ovate to widely ovate, 10–17 × 10–13 mm, margin entire, apex rounded or obtuse, abaxially sparsely red hirsute, inner 2 obovate, 8–13 × 5–7 mm, apex obtuse or rounded, glabrous; androecium zygomorphic, *ca.* 5 mm across; stamens golden yellow, 38–50; filaments free, *ca.* 1.8 mm long; anthers widely obovate, *ca.* 0.8 mm long, 2-locular, apex retuse. **Pistillate flower:** pedicel pinkish-white, to 22 mm long, glabrous or subglabrous, tepals 3, whitish-pink; outer 2 suborbicular, 12–13 × 12–15 mm, margin entire, apex rounded, abaxially very sparsely red hirsute, inner 1 narrowly obovate or oblanceolate, 10–11 × 3.5–4 mm, apex obtuse; ovary trigonous-ellipsoid, *ca.* 8 mm long, 5 mm thick (wings excluded), creamy to pale yellowish-pink, sparsely red hirsute; 3-winged, wings unequal, pale yellowish-pink, very sparsely red hirsute, margin entire; wings narrowly triangular, *ca.* 11 mm long, lateral wings narrower, 3.5–4.5 mm wide, abaxial wing *ca.* 5 mm wide; ovary 1-locular with intruded parietal placentation, placentae 3, bilamellate; styles 3, free, golden yellow, *ca.* 4.5 mm long, stigma spirally twisted.

Capsule nodding, capsule body trigonous-ellipsoid, 10–12 mm long, 5.5–6.5 mm thick (wings excluded), pale green to pinkish-green when fresh; wings unequal, 15–17 mm long, lateral wings 4–5 mm wide, abaxial wing triangular, 5–8 mm wide, nearly truncate distally, cuneate proximally.

Distribution and ecology: *Begonia tui* currently is only known from a secondary evergreen forest in Tuyen Hoa district, and grows on limestone rocks in shady, moist areas, at an altitude of 40–80 m (fig. 3). Co-occurring taxa include: *Asplenium belangeri*, *A. falcatum* (Aspleniaceae), *Athyrium asplenioides* (Athyriaceae), *Selaginella* sp. (Selaginellaceae), *Thelypteris petelotii* (Thelypteridaceae), *Orophea multiflora* (Annonaceae), *Hoya acuminata*, *H. parasitica* (Apocynaceae), *Vernonia* sp. (Asteraceae), *Impatiens albo-rosea*, *I. eberhardtii* (Balsaminaceae), *Radermachera hainanensis* (Bignoniaceae), *Bursera tonkinensis* (Burseraceae), *Capparis henryi* (Capparaceae), *Combretum indicum* (Combretaceae), *Hopea vietnamensis*, *Vatica odorata* (Dipterocarpaceae), *Diospyros frutescens* (Ebenaceae), *Acalypha siamensis*, *Cleidion spiciflorum*, *Deutzianthus tonkinensis* (Euphorbiaceae), *Derris trifoliata* (Fabaceae), *Ornithoboea wildeana* (Gesneriaceae), *Illigera dunniana* (Hernandiaceae), *Walsura bonii* (Meliaceae), *Ficus benjamina*, *F. tinctoria* subsp. *gibbosa* (Moraceae), *Cleistanthus acuminatus* (Phyllanthaceae), *Canthium umbellatum* (Rubiaceae), *Pilea notata*, *Urtica fissa* (Urticaceae), *Pothos repens*, *Rhaphidophora hookeri* (Araceae), *Dracaena cambodiana* (Asparagaceae), *Pollia hasskarlii* (Commelinaceae), and *Axonopus compressus* (Poaceae).

Etymology: The species is named in honor of Nguyen Thanh Tu, who has made an outstanding contribution to the conservation of the Ha Tinh langur (*Trachypithecus hatinhensis*) population in Tuyen Hoa district, Quang Binh province.

Conservation: *Begonia tui* is considered Endangered (EN B1b(iii)+c(i)) based on the IUCN Red List Categories and Criteria (2020). It is known only from the

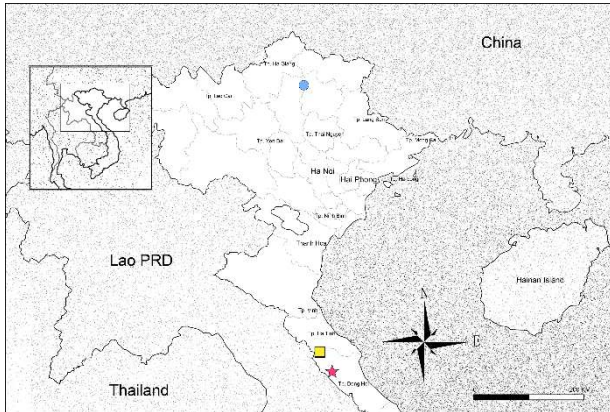


Fig. 3. Distribution map of *Begonia tui* (yellow square), *B. datii* (red star) and *B. mollissima* (blue circle) in Vietnam.

type locality, with one population of about 2,500 adults. In the 14 survey lines conducted in April 2023, we encountered a population (70 m altitude) of 9 individuals scattered over an area of 1,000 square meters along the survey route. The limestone forest where this species is distributed is fragmented by rice paddies and is not a protected area. In addition the habitat of this species is likely to be vulnerable to unforeseen events such as agriculture expansion and drought.

Notes: In Quang Binh Province, only four *Begonia* species of sect. *Coelocentrum* have been collected: *B. cavaleriei* H.Lév. (Léveillé, 1909), *B. datii* T.S.Hoang & C.W.Lin (Hoang and Lin, 2023b), and two new species, one of which is described in this study. The new species, *Begonia tui* is similar in overall appearance to *B. mollissima* Y.M.Shui, H.Q.Nguyen & W.H.Chen (Chen *et al.*, 2018) and *B. datii*, but is distinguishable by its elongated (vs. congested in both of *B. datii* and *B. mollissima*) rhizomes, the zygomorphic androecium (vs. actinomorphic or subactinomorphic in both of *B. datii* and *B. mollissima*), stamens 38–50 (vs. 65–100 in *B. datii*), 3-tepaled pistillate flowers (vs. 2 tepals in *B. mollissima*), and an ovary with a sparsely red hirsute (vs. glabrous in *B. datii*) and triangular abaxial wing (vs. lunate in *B. mollissima*). A comparison of the salient characters of the three species is shown in Table 1.

Other specimens examined: *Begonia datii* T.S.Hoang & C.W.Lin: VIETNAM. Quang Binh Province, Minh Hoa district, Thuong Hoa commune, 495 m elev., grows on limestone mountains under secondary forests, 20 April 2022, *Hoang Son 4435* (VAFS, VNMN). *Begonia mollissima* Y.M.Shui, H.Q.Nguyen & W.H.Chen: VIETNAM. Bac Kan Province, Cho Ra county, Ba Be National Park, 22°24'56"N, 105°37'48"E, 235 m a.s.l., 18 April 2016, *Y.M. Shui, W.H. Chen, C. Liu, H.Q. Nguyen, H.T. Nguyen, N.Q. Chuong CK1183* (KUN)

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LITERATURE CITED

- Chen, W.H., Radbouchoom, S., Nguyen, H.Q., Nguyen, H.T., Nguyen, K.S., Shui, Y.M. 2018 Seven new species of *Begonia* (Begoniaceae) in Northern Vietnam and Southern China. *Phytokeys* **94**: 65–85.
- Chung, K.F., Leong, W.C., Rubite, R.R., Repin, R., Kiew, R., Liu, Y., Peng, C.-I 2014 Phylogenetic analyses of *Begonia* sect. *Coelocentrum* and allied limestone species of China shed light on the evolution of Sino-Vietnamese karst flora. *Bot. Stud.* **55**:e1.
- Feng, X.-X., Chen, Y.-M., Liu, J.-X., Huang, Y.-N., Liu, Z.-X., Li, R.-K., Zhao, T., Guo, W. 2023 *Begonia barosma*, a new species in *Begonia* sect. *Coelocentrum* (Begoniaceae) from limestone karsts across Sino-Vietnamese Border. *Taiwania* **68**(3): 349–354.
- Hoang, T.S., Lin, C.W. 2023a *Begonia wiformis*, a new species, and a new record of *B.* sect. *Coelocentrum* (Begoniaceae) from North Vietnam. *Phytotaxa* **591**(4): 292–300.
- Hoang, T.S., Lin, C.W. 2023b *Begonia datii* (sect. *Coelocentrum* Begoniaceae), a new species from Quang Binh Province, Central Vietnam. *Phytotaxa* **609**(4): 282–288.
- Hughes, M., Moonlight, P.W., Jara-Muñoz, A., Tebbitt, M.C., Wilson, H.P., Pullan, M. 2015–Present. *Begonia* Resource Center. Online database available from: <http://padme.rbge.org.uk/begonia/> (accessed 2 October 2023)
- IUCN 2020 Standards and Petitions Committee. 2019 Guidelines for Using the IUCN Red List Categories and Criteria. Version 15 (January 2022). Prepared by the Standards and Petitions Committee. Available from: <http://www.iucnredlist.org/> (accessed 10 May 2023)
- Léveillé, H. 1909 Decades plantarum novarum XVI. *Repert. Spec. Nov. Regni Veg.* **7**(1–3): 20–23.
- Liu, Y., Tseng, Y.H., Yang, H.A., Hu, A.Q., Xu, W.B., Lin, C.W., Kono, Y. C., Chang, C., Peng, C.-I, Chung, K.F. 2020 Six new species of *Begonia* from Guangxi, China. *Bot. Stud.* **61**:e21.
- Peng, C.-I, Lin, C.W., Yang, H.A., Kono, Y., Nguyen, H.Q. 2015 Six new species of *Begonia* (Begoniaceae) from limestone areas in Northern Vietnam. *Bot. Stud.* **56**:e9.
- Radbouchoom, S., Chen, W.H., Guo, S.W., Nguyen, H.Q., Nguyen, S.K., Nguyen, H.T., Shui, Y.M. 2019 Two new peltate-leaved species of *Begonia* L. (Begoniaceae) from northern Vietnam. *Phytotaxa* **407**(1): 71–78.
- Tong, Y., Tian, D.K., Shu, J.P., Xiao, Y., Wang, B.M., Fu, N.F. 2019 *Begonia yizhouensis*, a new species in *Begonia* sect. *Coelocentrum* (Begoniaceae) from Guangxi, China. *Phytotaxa* **407**(1): 59–70.
- Tu, W.H., Wang, B.M., Huang, Y., Yao, G., Huang, J.X., Li, Y.L. 2020 *Begonia guangdongensis*, a new species of *Begonia* (Begoniaceae) from Guangdong, China. *Phytokeys* **162**: 29–36.