



Newly discovered native orchids of Taiwan (XII)

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ABSTRACT: This report presents two new mycoheterotrophic orchids of Taiwan, i.e., *Cyrtosia septentrionalis* (Rchb.f.) Garay and *Gastrodia kaohsiungensis* T.P. Lin. The genus *Cyrtosia* in Taiwan is also reviewed. The pollinia of *Galeola lindleyia* and *G. falconeri* share the same morphology as two species of *Cyrtosia* found in Taiwan. The pollinia may provide new evidence to merge *Galeola* with *Cyrtosia*.

KEY WORDS: *Cyrtosia septentrionalis*, *Gastrodia kaohsiungensis*, Native orchid, Orchidaceae, Taiwan.

INTRODUCTION

The present paper is to update the orchid flora of Taiwan. A complete list of native orchids of Taiwan and their type information was recently published (Lin *et al.*, 2016). However, new orchid species are continually discovered and recorded from different locations due to ongoing orchid hunting activities. A recent field trip resulted in the discovery of two new orchids in Taiwan. All voucher specimens are kept in the herbarium of the National Taiwan University (TAI) (Taipei, Taiwan).

TAXONOMIC TREATMENTS

New species found in Taiwan.

Gastrodia kaohsiungensis T.P. Lin, *sp nov*

高雄赤箭 Figs. 1 & 2A, B

Holotype: Taiwan: Kaohsiung City, June 26, 2018, 210 m, Kuo-Hsiung Wang *s.n.* (TAI 287423).

Diagnosis: *Gastrodia kaohsiungensis* resembles *G. callosa* and *G sui*, also found in Taiwan, in the shape and color of its flowers but it can be easily differentiated from them by the presence of orangish thickened papillae covering a large area inside the perianth tube versus the presence of smooth callosities in *G. callosa* and *G sui*.

Mycoheterophytic orchid. Roots 4 or 5, slender, some longer than 10 cm, arising from apex of rootstock. **Tuberoïds** fusiform, up to 6 cm long, 1.4 cm in diam., brownish. **Flowering** plants 4–6 cm aboveground, or 10–15 cm above rootstock; peduncle whitish, with 3 membranous sheaths, 3 mm in diam. near base; rachis < 5 mm long, 1–4-flowered. Floral bracts membranous, triangular, dark-brownish, 5 × 3.8 mm. Pedicel and ovary 8 mm long. **Flowers** globose, 9–15 mm long, 9–12 mm across, only slightly opened, perianth tube ca. 2.4 cm across when dissected and spread out; sepals united for 70% of their length, succulent, outer surface flesh-

colored, verrucose; free portion of perianth tube ovate-triangular, 4–5 × 4–4.5 mm, reddish-brown or dark-brown; lateral sepal longitudinally ridged; free portions of petals orangish, spreading, ca. 1.5 mm long, apex rounded, hirsute; inner surface of perianth tube glabrous, whitish, covered with orangish thickened papillae in a large area just below apex of lateral sepal, orangish papillae also occur in a small area just below apex of upper sepal. **Lip** succulent, more or less triangular, apex rounded or truncate, whitish, tinged with orangish, reddish-brown near apex, 5.5 (claw included) or 4.5 (not including claw) mm long, 4.3 mm wide near base, no ridge on upper surface, grooved along midrib underneath, with 2 short distinctive ridges near apex, light-blue between ridges; ridges orangish except for basal part (whitish), basal part rounded when viewed from lateral side; claw short, with 2 brownish rectangular calli. **Column** white, more or less compressed, reddish-brown along margin wings, straight, 7 × 4.2 mm, dilated in middle, with a pair of stielidia, stielidia taller than anther; column-foot short. Rostellum semi-orbicular. **Stigma** at a distance from anther and located near base of column. Anther cap oval, white; pollinia 2, white, each with 2 subequal partitions, granulose, usually composed of friable massulae. Capsule ellipsoid, 1.5–2 cm long, stalk greater than 10 cm long.

Flowering time: June and July.

Distribution: Endemic to Taiwan. Only known from the type locality at an elevation of about 200 m.

Note: This species was discovered by the second author in June 18, 2017 in a low-elevation bamboo forest in Kaohsiung City. So far only *Gastrodia callosa* (Hsu and Kuo, 2010) and *G. sui* (Yeh *et al.*, 2011) which exhibit a shape of globose to ellipsoid with a small opening and flesh-colored have been recorded in Taiwan. *Gastrodia kaohsiungensis* can be easily differentiated from these two species by taxonomically informative characters (Table 1).

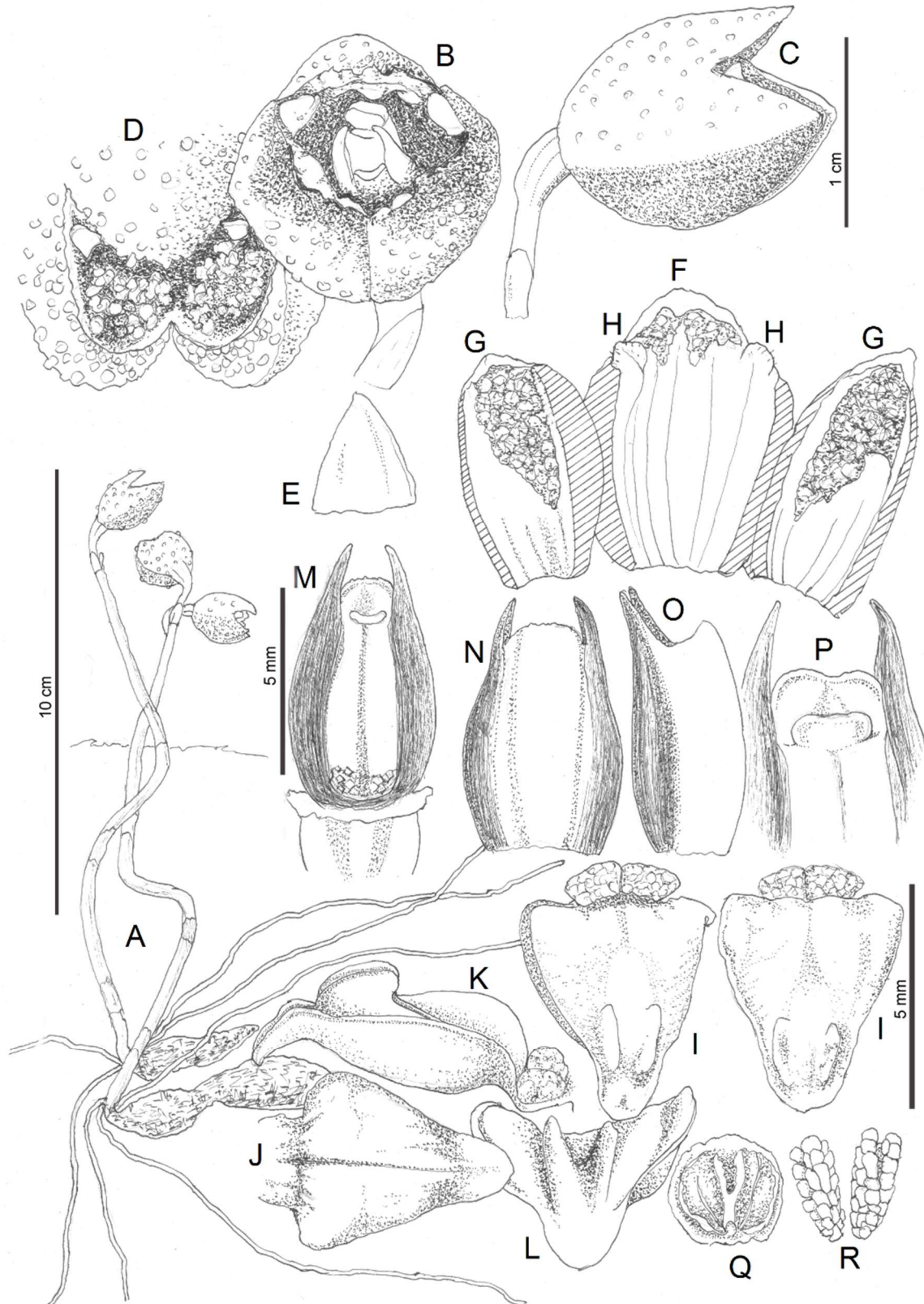


Fig. 1. *Gastrodia kaohsiungensis* T.P. Lin. A: Flowering plant. B: Flower, frontal view. C: Flower, side view. D: Flower, frontal view and slightly from above. E: Floral bract. F: Upper sepal. G: Lateral sepal. H: Petal. I: Lip, view from above. J: Lip, view from below. K: Lip, side view. L: Lip, frontal view. M: Column, view from below. N: Column, view from above. O: Column, side view. P: Enlargement of apical part of column to show the rostellum. Q: Anther cap, view from below. R: Pollinia.

**Table 1.** Morphological Characteristic comparison among *G. kaohsiungensis*, *G. callosa* and *G. sui*.

	<i>G. kaohsiungensis</i>	<i>G. callosa</i>	<i>G. sui</i>
Decoration inside perianth	Orangish thickened papillae in large areas	Smooth calli	Smooth calli
Lip	Deltoid with rounded apex	Deltoid with acute apex	Ovate-oblong with acute apex
Callus number in the perianth tube	2 large reddish calli	Two large reddish calli	Five large reddish calli
Lip disc	Smooth	Two ridges	Smooth
Column, frontal view	Ovate	Strap-like	Strap-like
Calli at apex of lip	Orangish but white for basal part	Green	Reddish-brown



Fig. 2. *Gastrodia kaohsiungensis* and *Cyrtosia septentrionalis* in their natural habitats. **A:** Flowering plant of *G. kaohsiungensis*. **B:** Perianth tube of *G. kaohsiungensis*. **C:** Flowering plant of *C. septentrionalis*. **D:** Flower of *C. septentrionalis* (taken by W.J. Wang). **E:** Fruits of *C. septentrionalis*.



G. oui nom. nud. (Chung and Hsu, 2016) seem to be very similar to *G. kaohsiungensis* but the identity of the former name could not be determined because limited information. From the original publication (in Chinese), it reads: upper sepal, petal and lateral sepals all covered papillae inside the perianth tube. This is in disagreement with *G. kaohsiungensis* which shows orangish thickened papillae in a large area below the apex of the lateral sepals and very little in the upper sepal but not in the petals.

Specimen examined: Taiwan: Kaohsiung City, June 24, 2018, 210 m, Fang-Mei Hsieh and Ching-Hwang Liu s.n. (TAI287424).

Revision of the genus *Cyrtosia* and a new record of *Cyrtosia septentrionalis* in Taiwan

Currently in Taiwan there are several orchid species assigned to two different genera; i.e. *Cyrtosia* and *Galeola*. However, they share several morphologically features which suggest they may belong to the same genus. These species are mostly known as *Galeola falconeri* and *G. lindleyana* (Su, 2000, Pridgeon *et al.*, 2003, Chen and Cribb 2009, the Plant List website; <http://www.theplantlist.org> up to Sept. 2018) and *C. javanica*, but a few authors favored their placement in *Cyrtosia*; i.e. *Cyrtosia falconeri* and *C. lindleyana* (Averyanov, 2011). From these three species, only *C. lindleyana* has been included in phylogenetic studies (Cameron, 2009). In this study *C. lindleyana* groups with *C. septentrionalis* which supports they are closely related. To get a clear picture an extensive investigation using multiple molecular markers and species are required in the future. Meanwhile, we have focused in morphological features and we suggest that the reproductive organs could be a useful source of information. In the recent literature regarding the genus *Cyrtosia*, Chen and Cribb (2009) and Averyanov (2011) both mentioned pollinia “granular-farinaceous, without a caudicle or viscidium” but made no further reference to details of the pollinia. In Taiwan, the genus *Cyrtosia* is represented by two species, *C. javanica* and *C. septentrionalis* (a new record described below). These two species look similar especially in flower appearance. By carefully examining the column structure, we found the pollinia of *Cyrtosia* to be unique as shown in Fig. 3B and 3C: hemicircular, strongly compressed, fully folded, or with a deep cleft. These morphological features have not previously been seen in autotrophic orchids in Taiwan. We also examined other species in the Subtrib. *Vanilleae* including the genera *Erythrorchis*, *Galeola*, *Lecanorchis* and *Vanila*. Morphology of pollinia in genera *Lecanorchis* and *Vanila* are very different from *Cyrtosia* (not shown). The morphology of pollinia of *Erythrorchis* is slightly similar to that of *Cyrtosia* at a first glance, but ultimately they are different (Fig. 3A). They both have compressed and hemicircular-shaped pollinia, but only pollinia of *Erythrorchis* show a shallow cleft and are much thickened. We have

compared the pollinia of these two species with material identified as *G. lindleyana* and *G. falconeri* (Lin *et al.*, 2016, Fig. 3D, E). The pollinia present exactly the same morphology as the two species of *Cyrtosia*. It is evident that *G. lindleyana* and *G. falconeri* should be grouped under *Cyrtosia*. Here, we made the following adjustment of *G. lindleyana* and *G. falconeri* based on the evidence of pollinia morphology.



Fig. 3. Pollinia images of A. *Erythrorchis altissima*, B. *Cyrtosia septentrionalis*, C. *C. javanica*, D. *C. lindleyana*, and E. *C. falconeri*.

Cyrtosia falconeri (Hook. f.) Aver., in L.V. Averyanov, Turczaninowia 14(2): 38. Figs. 15, 24c, d. 2011. *Galeola falconeri* J.D. Hooker, Fl. Br. India 6: 88. 1890; King et Pantl., 1898, Ann. Roy. Bot. Gard. Calcutta, 8: 265, tab. 353; H.J. Su, Taiwania 45(3): 244. pl. 2B. 2000. & Fl. Taiwan 5: 882, pl. 376. 2000. **Syntypes:** NE. India: Garhwal, *Falconer s.n.*; Sikkim, *T. Thomson s.n.*

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Cyrtosia lindleyana Hook. f. & Thomson, Ill. Himal. Pl. t. 22. 1855; *Erythrorchis lindleyana* (Hook.f. & Thomson) Rchb.f., Bonplandia (Hannover) 5: 37. 1857. *Galeola lindleyana* (Hook. f. & Thoms.) Rchb. f., Xenia Orchid. 2: 78. 1865; S.S. Ying, Col. Ill. Indign. Orch. Taiwan 1: 456. 1977; Su, Taiwania 45(3): 243. pl. 2A. 2000. & Fl. Taiwan 5: 884, pl. 1596. **Type:** NE. India (“India, Khasia”) 1219 m, *J.D. Hooker* 357 (K000387590); Sikkim: July 7, 1857, 1524~2134 m, *T. Thomson s.n.* (K000387588 fruit only).

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The orchid flora of Taiwan reports only one species of *Cyrtosia*: *Cyrtosia javanica* Bl. (Leou & Chung, 1995). In 2017, the mature fruit of *Cyrtosia septentrionalis* (Rchb.f.) Garay was found in the middle of the Coastal Mountain Range of eastern Taiwan. After 1 year of tracking, *Cyrtosia septentrionalis* (Rchb.f.) Garay is first reported here with a photo and illustration.

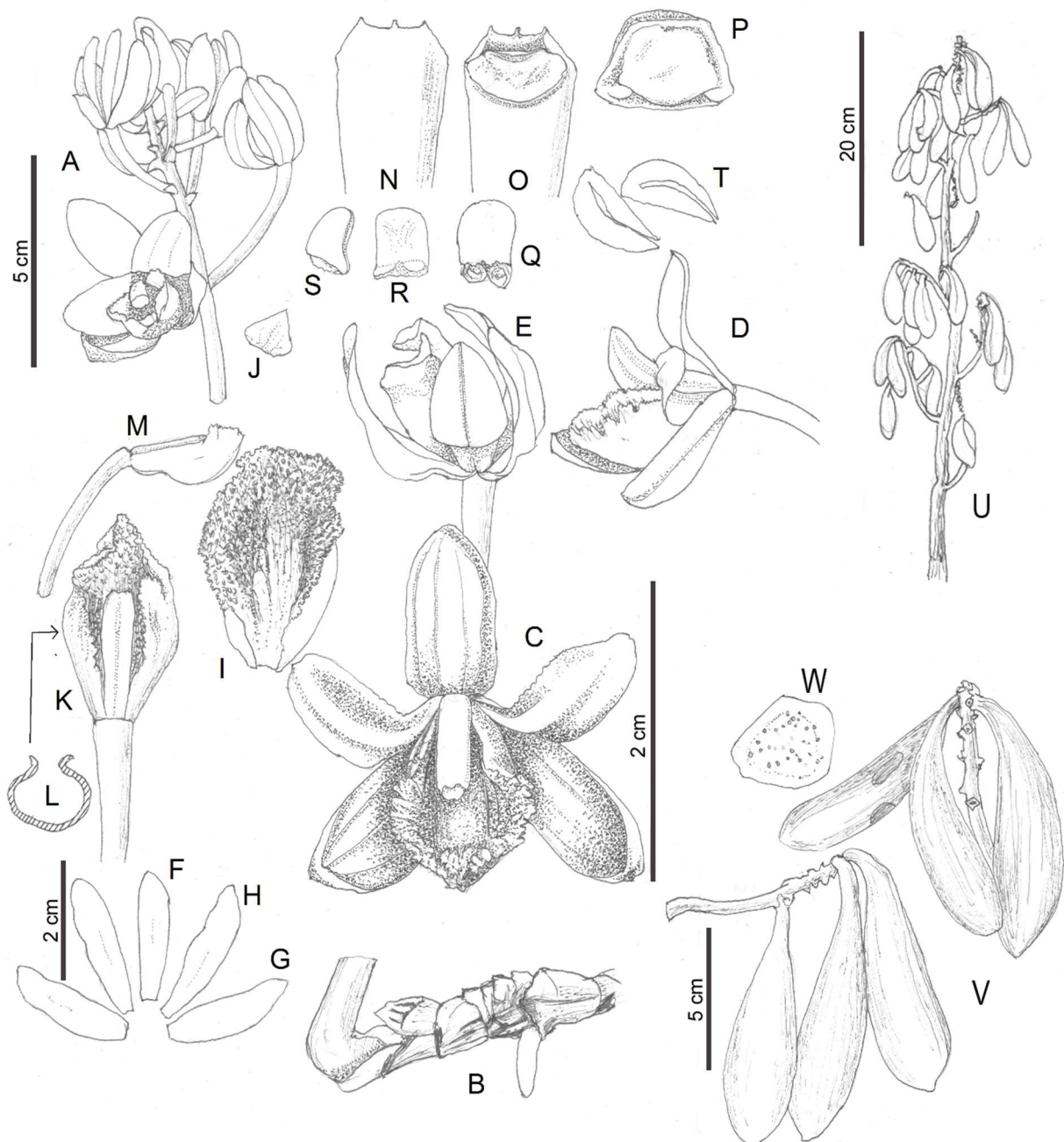


Fig. 4: *Cyrtosia septentrionalis* (Rchb.f.) Garay. **A:** One branch of a flowering plant. **B:** Rhizome. **C:** Flower, frontal view. **D:** Flower, side view. **E:** Flower, view from below. **F:** Upper sepal. **G:** Lateral sepals. **H:** Petal. **I:** Lip. **J:** Floral bract. **K:** Lip and column, view from above. **L:** Lip, cross-section. **M:** Lip and column, side view. **N:** Column, view from above. **O:** Column, view from below to see the stigma. **P:** Column, frontal view to see the clinandrium. **Q:** Anther cap, frontal view. **R:** Anther cap, view from behind. **S:** Anther cap, side view. **T:** Pollinia. **U:** Fruiting stage. **V:** Enlargement of one branch. **W:** Cross-section of one berry fruit.

Cyrtosia septentrionalis (Rchb.f.) Garay, Bot. Mus. Leaflet. 30: 223. 1986. *Galeola septentrionalis* H.G. Reichenbach, Xenia Orchid. 2: 78. 1865. **Type:** From Japan.

血紅肉果蘭 Figs. 2C-E & 4

Mycoheterotrophic orchid. **Rhizome** creeping, stout, with imbricating scales. **Roots** thick. **Flowering** stem erect, reddish-brown, 60–70 cm tall, 2–3 cm in diam.

near base, 1 cm in diam. in upper half, glabrous, 8–10 branches or racemes; rachis shorter than 10 cm, 0.4 cm in diam., ca. 7–10 flowers, base with an ovate-lanceolate glabrous bract. **Floral bracts** ovate, 4.5 mm long and wide; pedicel and ovary 2.5–2.9 cm long, short whitish-tomentose. **Flowers** pale reddish-brown, opening widely, 2.3 cm across; sepals oblong, 2.1–2.3 × 6–8 mm, pale



reddish-brown, glabrous, short whitish-tomentose abaxially; petals similar to sepals, 2.4×0.7 cm, glabrous, recurved or spreading. **Lip** yellow, broadly obovate, 1.6×0.9 cm in natural state, deeply concave, adnate to base of column, adaxially papillose, crested-lamellate near apical half, full of longitudinal cracks, margin irregularly erose, dotted dark-brown near base, not 3-lobed. **Column** white, 1 cm long, 2.6 mm across near apex, terete. Rostellum broad, slightly recurved. **Stigmatic** surface hemicircular. Anther cap yellow, rectangular; pollinia 2, yellowish, mealy, each pollinium hemicircular in outline, highly compressed, fully folded or with a deep cleft. **Fruit** fleshy berry, blood-red, obliquely clavate, $8-11 \times 2.1-2.4$ cm, succulent, glabrous, more or less trigonal in cross-section. Seeds with surrounding wing, ca. 0.6 mm in diam.

Flowering time: May and early June.

Distribution: China, Japan, Korea, and Ryukyu Islands (Japan). Taiwan: So far it is only known from one locality with 2 individuals. This species grows on sunny, grassy slope at an elevation of about 1000 m.

Specimens examined: Taiwan: Hualien Co., in the middle of the Coastal Mountain Range, 1000 m, May 22, 2018, *Wei-Jen Wang s.n.* (TAI 287420); Taiwan: same as above, Aug. 15, 2017. *Hsi-Chi Tsai* and *Mei-Shao Yeh s.n.* (TAI286843, fruit only).

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