

Tripterospermum lilungshanensis (Gentianaceae), a new species in Taiwan

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ABSTRACT. A new species *Tripterospermum lilungshanensis* C. H. Chen & J. C. Wang from Taiwan is described. Line drawing, color photos, and SEM micrographs of pollen and seed are also provided to aid in the identification. This species was found at the altitude of ca. 600-1,000 m from Mt. Lilungshan in the southern part of the Central Mountain Range. The new species is most similar to *T. alutaceifolium* (T. S. Liu & C. C. Kuo) J. Murata, which is mainly restricted to northern Taiwan, but differs from the latter by having shorter leaf blades (2-5 cm vs. 4-9 cm), lanceolate to ovate-lanceolate and slightly spreading calyx-lobes (vs. ensiform and straight), and an elongated gynophore which results in fruit exerting from the calyx-tube when mature.

Keywords: Gentianaceae; New species; Taxonomy; Taiwan; *Tripterospermum*; *Tripterospermum lilungshanensis*.

INTRODUCTION

Tripterospermum Blume (Gentianaceae) is a genus of climbing perennials restricted to Asia (Murata, 1989). Twenty-five species have been recognized by Murata (1989) in his worldwide revision. Recently, Hul (2002) described three new species from Vietnam. The genus is the sister group of *Crawfordia* and *Gentiana* based on recent studies from morphology and molecular phylogeny (Ho et al., 1996; Yuan and Küpfer, 1995). Most members of the Taiwanese *Tripterospermum* have been published by early Japanese taxonomists (Hayata, 1911; Yamamoto, 1929; Masamune, 1938). The first revision was made by Satake (1951), who recognized four species. Liu and Kuo (1970) treated Taiwanese *Tripterospermum* as three species. Later, they added two infraspecific taxa (Liu and Kuo, 1974) and subsequently gave it a similar treatment in the Flora of Taiwan, First Edition (Liu and Kuo, 1978). Murata (1989) made a comprehensive revision according to the morphological survey in which six Taiwan species were treated. Basically, later treatments of Taiwanese *Tripterospermum*, e.g. Flora of China (Ho and Pringle, 1995) and Flora of Taiwan, Second Edition (Wang and Chen, 1998), were the same as Murata's.

Recently, in our botanical exploration in southern Taiwan, an unknown species of *Tripterospermum* was found. After further field observations and comparisons with the herbarium specimens in the HAST, NMNS, TAIF, TAI, and TNU herbaria, we concluded that the taxon is a new species.

MATERIALS AND METHODS

Materials used in the present studies were collected from field, pressed and dried for voucher specimens, and deposited in the herbaria NMNS and TNU. Seeds and pollen grains for scanning electron microscope (SEM) study were collected from fresh capsules and flowers of holotype (*Y. C. Chang 21*, NMNS).

Pollen grains were treated by the acetolysis method (Erdtman, 1952) before being dried to the critical point. Seed and pollen were coated with gold and examined under Hitachi S3000N scanning electron microscope.

For the comparison of calyx-lobes, eight individuals of *T. lilungshanensis* in Lilungshan and twelve individuals from four populations of *T. alutaceifolium* in northern Taiwan were measured and plotted. The voucher specimens with geographic information are as follows: *T. lilungshanensis*: Pingtung, Lilungshan, *Y. C. Chang 21* (NMNS), *C. H. Chen 6267* (NMNS), *Lu & Li 1663* (TNU); *T. alutaceifolium*: Taipei, Chihsingshan,

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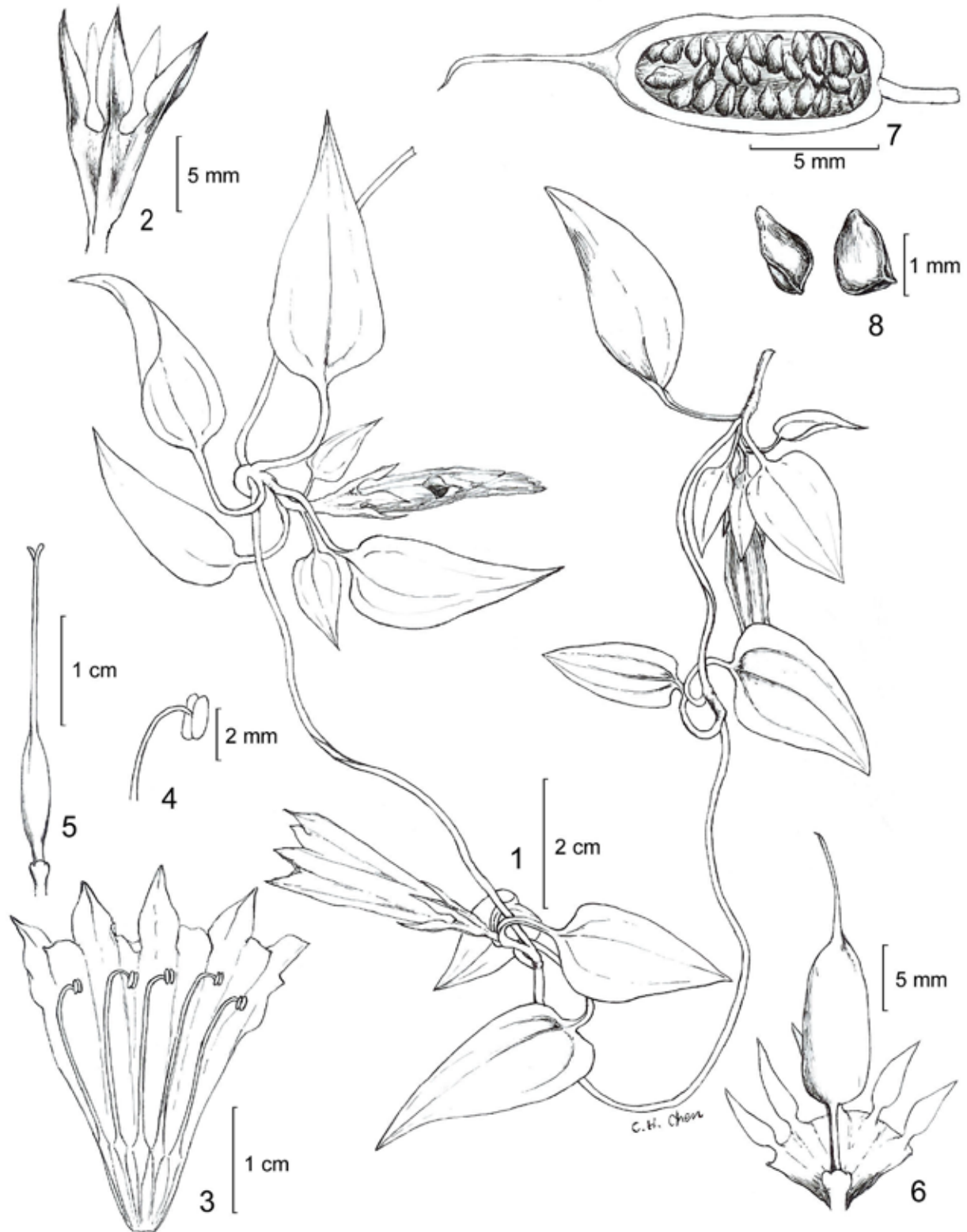


Figure 1. *Tripterospermum lilungshanensis* C. H. Chen & J. C. Wang. 1, Habit; 2, Calyx; 3, Corolla and stamens; 4, Stamens; 5, Pistil; 6, Berry with gynophore and dissected calyx; 7, Longitudinal section of berry; 8, Seeds. (C. H. Chen 6267).

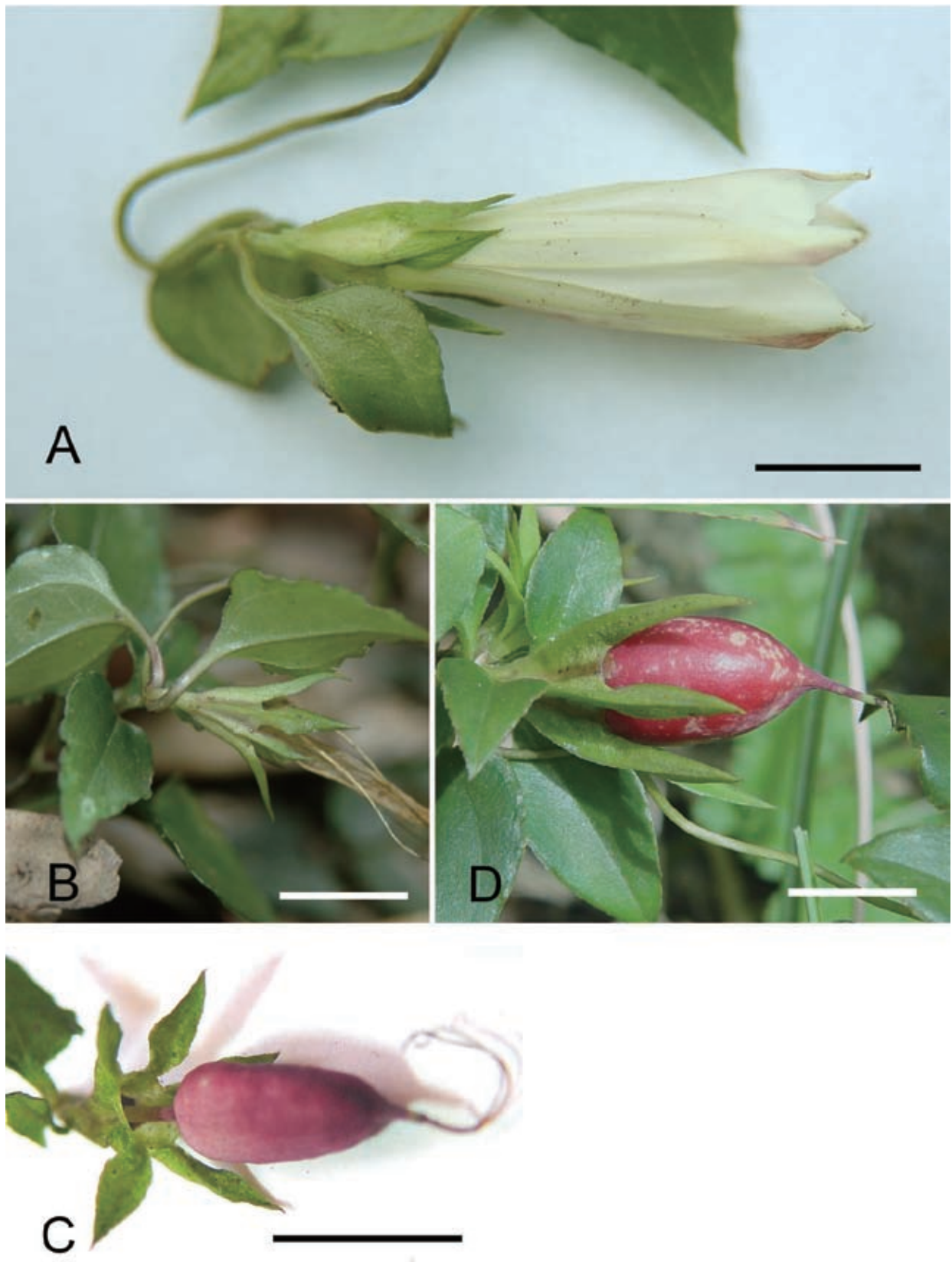


Figure 2. A-C, *Tripterospermum lilungshanensis*. A, Outside view of flower, showing white corolla tinged with purple near apex; B, Calyx remains fresh after corolla withered, compare the slightly spreading calyx-lobes with *T. alutaceifolium* (Figure D); C, Fruit and partially dissected calyx. Notice the gynophore of fruit is longer than calyx-tube; D, Mature fruit of *T. alutaceifolium*, showing the base of fruit included in calyx-tube. Scale bars 1 cm.

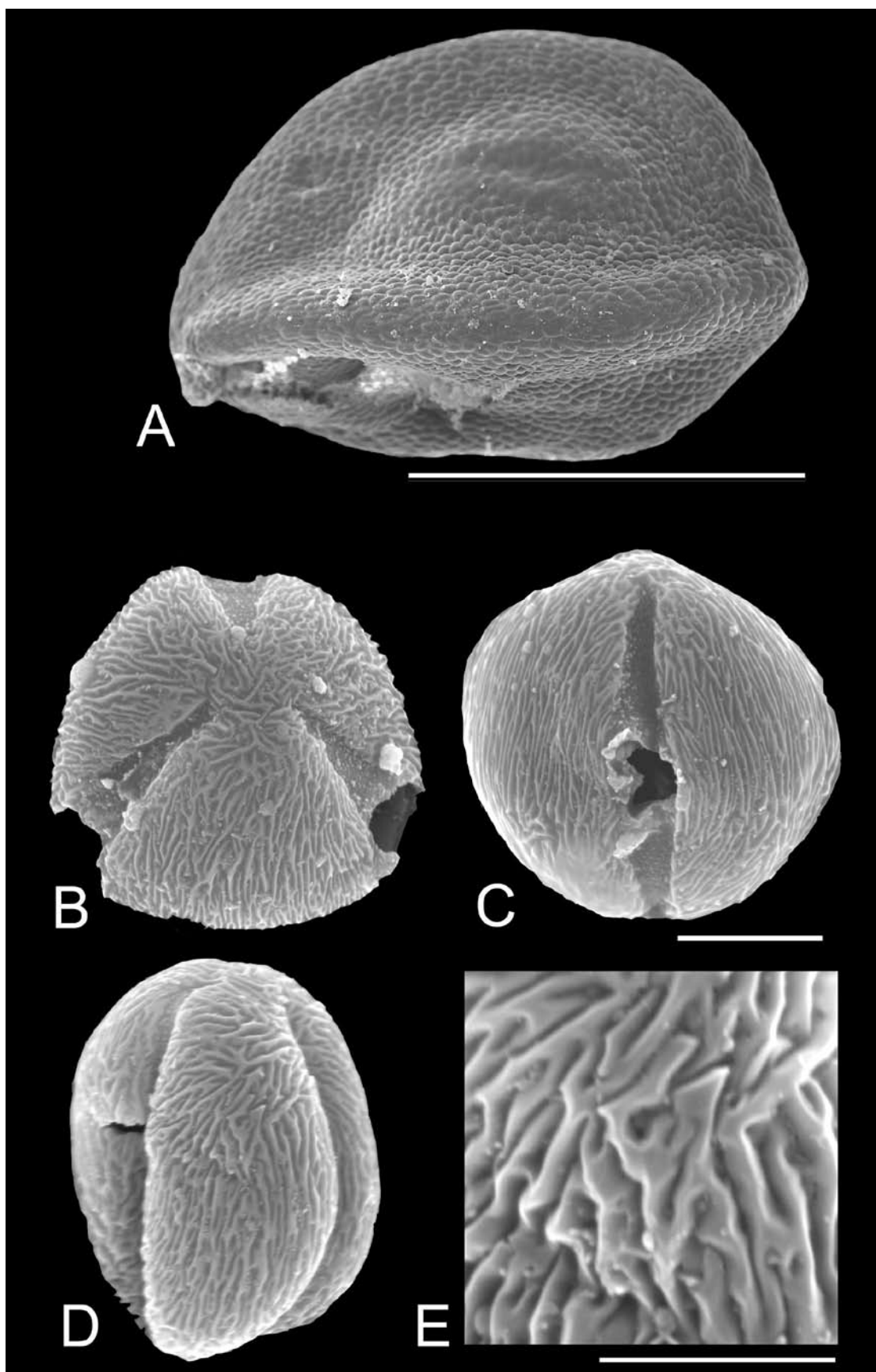


Figure 3. SEM-micrographs of *Tripterospermum lilungshanensis*. A: seed; B: polar view of pollen grain; C, D, E: equatorial view of pollen grain. Scale bars 1 mm (A), 10 μm (B, C, D), 5 μm (E).

Y. C. Chang 19 (NMNS); Taipei, Shihting, Ergeshan, *C. C. Chen 892* (TNU); Taipei, Hsiaoyi, *Z. W. Lee 38* (TNU); Taipei, Wulai, *Y. K. Chen, 280* (HAST); Taipei, Yangmingshan National Park, *C. H. Liu 201* (HAST).

SYSTEMATIC TREATMENT

Tripterosperrum lilungshanensis C. H. Chen & J. C. Wang sp. nov. — TYPE: TAIWAN. Pingtung Hsien: Shihtzu Hsiang, Lilungshan *Y. C. Chang 21*, 20 Nov 2004 (holotype: NMNS; isotype: NMNS, TNU).

里龍山肺形草 (Figures 1, 2)

Species *T. alutaceifolio* affinis sed foliis lamina ovatolanceolata vel cordata minus quam 5 cm longa et calycibus lobis lanceolatis vel ovatolanceolatis circa 6-10 mm longis differens.

Perennial herbs. Stems usually spirally twining. Petiole 2-3 cm; leaf blade ovate-lanceolate, ovate to cordate, 2-5 cm long, 1-3 cm wide, base rounded to cordate, margin entire, apex acute to acuminate. Inflorescences 1-flowered or cymous; bracts 1-3 pairs. Calyx campanulate; tube 7-9 mm, winged; lobes lanceolate to ovate-lanceolate, 6-10 mm long, 2-3 mm wide; apex acute to acuminate. Corolla narrowly campanulate, 2.5-3.5 cm long; lobes triangular, 3-4 mm long, apex acuminate; plicae obliquely triangular, 1-2 mm long. Filaments linear, 1-2 cm long; anthers ellipsoid, ca. 1 mm long. Disc 1-1.5 mm long; ovary narrowly ellipsoid, 7-10 mm long; gynophore 2-3 mm long; style linear, ca. 2 cm long. Berries red-purple, subglobose to long-ovoid, 8-12 mm long, 4-6 mm across; fruit gynophore 8-12 mm long (including disc). Seeds dark purple, ellipsoid to ovoid, triquetrous, ca. 1.5 mm long, wingless or somewhat winged (Figure 3: A).

Flowering and fruiting Sep.-Feb.

Paratypes. PINGTUNG HSIEN: Shihtzu Hsiang, Lilungshan, 600-1,000 m, *Lu & Li 1663* (TNU, TAI); same loc., 1,062 m, *Huang et al. 16247* (TAI); same loc., 650-950 m, *C. H. Chen 6267* (NMNS).

Distribution. Endemic to Taiwan, presently known from 700 to 1,000 m in the southern part of the Central Mountain Range. Found on forest floor or semi-shady grasslands.

Palynology. Pollen grain (Figure 3: B-E) tricolporate, isopolar, spheroidal to prolate spheroidal in equatorial view, 23-28 × 21-28 μm (P × E); semiangular in polar view. Colpi long, crassimarginate, ends acuminate, colpus membranes finely granulate. Ora circular. Sexine striate; striae meridinally distributed, forking or anastomosing, 0.5-0.7 μm wide.

The pollen morphology of Gentianaceae has been studied extensively by Nilsson (1967), in which only one species of *Tripterosperrum*, *T. microphylla*, was from Taiwan. He concisely pointed out the interspecific differences in the sexine sculpture of this genus. Huang (1972) observed three Taiwan species (under the genus

name “*Crawfordia*”) using LM and also reported little interspecific difference. SEM study of pollen morphology for the Taiwan taxa has been known for *T. lanceolatum* only (Chen and Wang, 1999b). Our palynological observation revealed some similarities with *T. lanceolatum*. However, the latter is characterized by the subprolate to prolate pollen grains with constricted colpi. Sexine sculpture seems also to display minute differences between them when compared with the photographs of Chen and Wang (1999b). However, their description indicated a wide range of sexine sculpture. Therefore, its implications for the systematics of this genus call for an extensively comparative study.

Notes. Based on Murata’s system (Murata, 1989), the new species belongs to the *Tripterosperrum* sect. *Tripterosperrum* because of the baccate fruits. The characters of elongated gynophore and fruit exerted from calyx-tube occurred also in *T. championii* Gardner of SE Asia (Hul, 2003) and *T. japonicum* (Sieb. & Zucc.) Maxim. of NE Asia (Murata, 1989), suggesting that they are allied taxa.

Morphologically, *T. lilungshanensis* is most similar to *T. alutaceifolium* (T. S. Liu & C. C. Kuo) J. Murata.

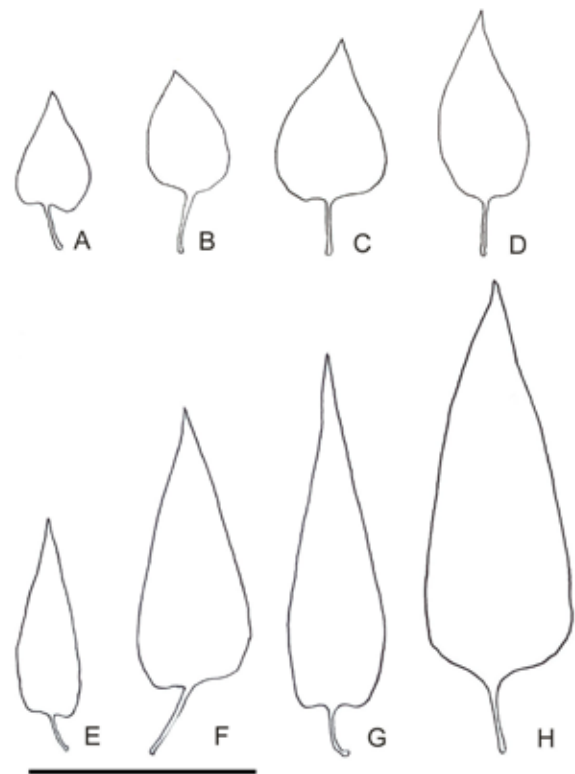


Figure 4. Leaf-blades of *Tripterosperrum lilungshanensis* (A-D) and *T. alutaceifolium* (E-H). A-D and E-H are traced from mature leaves of different specimens and show the infraspecific variation of both species respectively. Scale bars 5 cm.

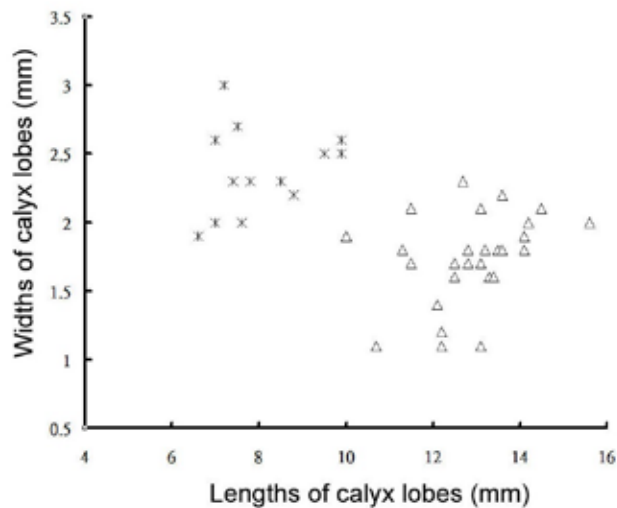


Figure 5. Scatter plotting of calyx lobes length (X axis) and width (Y axis) of *Tripterospermum lilungshanensis* (star) and *T. alutaceifolium* (triangle).

The new species has smaller and shorter leaf blades than the latter (2-5×1-3 cm vs. 4-9 × 1.5-3.5 cm) (Figure 4). The flowers look very much alike. Both species have white corollas sometimes tinged with purple abaxially near the apex (Figure 2A). However, they are easily distinguishable in calyx morphology. Calyx morphology is an important character in discriminating species within the genus *Tripterospermum* (Murata, 1989) and also in the closely related genus *Gentiana* (Chen and Wang, 1999a). *Tripterospermum lilungshanensis* and *T. alutaceifolium* share relatively broad calyx-lobes that retain their fresh condition even when the corolla is withered or the fruits have matured and dropped (Figure 2, B-D). However, the slightly spreading calyx-lobes in the new species (Figure 2B) differ from the erect form in *T. alutaceifolium* (Figure 2D). The scatter diagram of calyx lobes length and width (Figure 5) also clearly shows that *T. lilungshanensis* has shorter and wider calyx-lobes than *T. alutaceifolium*. In addition, the gynophore of *T. lilungshanensis* is usually elongated and becomes longer than the calyx-tube. Consequently, the fruit is exerted from the calyx-tube when mature (Figure 2C), in contrast to *T. alutaceifolium*, in which the gynophore is slightly shorter than the calyx-tube, and the base of fruit is included within the calyx-tube (Figure 2D). Their distribution is allopatric, respectively being restricted to the southern and northern parts of Taiwan.

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台灣產龍膽科新種—里龍山肺形草

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本文發表台灣的龍膽科（*Gentianaceae*）肺形草屬一新種—里龍山肺形草（*Tripterospermum lilungshanensis* C. H. Chen & J. C. Wang），並提供形態描述、繪圖、花果照片及花粉和種子的掃描電子顯微鏡照片以供辨識；至目前為止，本種類僅發現於台灣南部的里龍山區（分布海拔約從 600 至 1,000 公尺）。此新種與另一侷限分布於台灣北部的台北肺形草（*T. alutaceifolium*）較為相似，但里龍山肺形草的葉片明顯較短，花萼裂片也較寬短，呈披針形至卵狀披針形且略微開展，而且雌蕊柄伸長以致果實成熟時突出於萼筒之外。

關鍵詞：龍膽科；新種；分類；台灣；肺形草屬；里龍山肺形草。