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Scleromitrion sirayanum (Rubiaceae: Spermacoceae), a new species of the *Hedyotis-Oldenlandia* complex in Taiwan

Tian-Chuan HSU[1,*] and Zhi-Hao CHEN[2]

1. Herbarium of Taiwan Forestry Research Institute, No. 53, Nanhai Rd., Taipei 100, Taiwan.
2. Observer Ecological Consultant Co., Ltd.,Taipei 10088, Taiwan.
[*] *Corresponding author's email: lecanorchis@gmail.com*

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ABSTRACT: The new species *Scleromitrion sirayanum* T.C. Hsu & Z.H. Chen (Rubiaceae) is described and illustrated from Taiwan. *S. sirayanum* is similar to *S. angustifolium* (Cham. & Schltdl.) Benth. but easily distinguished by its constantly solitary flowers, salverform corolla, adaxially basally long villous corolla lobes, spreading to ascending persistent calyx lobes, and obconic capsules dehiscent both septicidally and loculicidally into 4 valves. *S. sirayanum* is so far only found in Nanhua District of Tainan City and evaluated as Vulnerable based on the IUCN Red List criteria. Three new combinations are also proposed for the *Hedyotis-Oldenlandia* complex in Taiwan.

KEY WORDS: *Hedyotis-Oldenlandia* complex, New species, Rubiaceae, *Scleromitrion sirayanun*, Taiwan, Taxonomy.

INTRODUCTION

The *Hedyotis-Oldenlandia* complex (Rubiaceae: Spermacoceae) is one of the main species groups in Rubiaceae with approximately 500–600 species occurring throughout tropical and subtropical regions worldwide (Guo *et al.*, 2013; Neupane *et al.*, 2015). Members within this complex look similar in sharing herbaceous or shrubby habits, relatively small, mostly 4-merous flowers, bilobed stigmas, and dry, usually two-celled capsular fruits with few to many small seeds (Neupane *et al.*, 2009; Guo *et al.*, 2013). Due to its broad geographic distribution, species richness and morphological diversity, the generic circumscription within the *Hedyotis-Oldenlandia* complex has long been controversial. Previous systematic treatments varied from accepting a very broad-sensed *Hedyotis* to partially or completely segregating *Hedyotis s.l.* into different numbers of smaller genera (Guo *et al.*, 2013; Wikström *et al.*, 2013). In the flora of Taiwan, about seventeen species in the *Hedyotis-Oldenandia* complex were recorded (Table 1), including thirteen species placed under *Hedyotis* (Liu and Yang, 1998; Yang *et al.*, 1999; Chen *et al.*, 2010; Huang, 2012; Hsu *et al.*, 2014), two species under *Neanotis* (Chang *et al.*, 2008), one species under *Dentella* (Liu and Yang, 1998; Yang *et al.*, 1999), and a naturalized species in the genus *Oldenlandiopsis* (Jung *et al.*, 2011). Some additional data were also proposed in two recent theses dealing with the taxonomy of *Hedyotis* in Taiwan (Huang, 2010; Su, 2010). However, since main contents of both theses have not been formally published, and they presented some very conflicting taxonomic concepts, their new treatments are tentatively not taken into account.

For presuming the evolutionary history of the *Hedyotis-Oldenlandia* complex and seeking a more stable and consensus taxonomic system, a series of phylogenetic analyses based on multiple chloroplast and nuclear sequences were conducted in recent years (Groeninckx *et al.*, 2009; Guo *et al.*, 2013; Wikström *et al.*, 2013; Wang *et al.*, 2014; Neupane *et al.*, 2015). Their results strongly proved that none of the previous systematic treatments within this complex could fit well with molecular data, and a new systematic framework was thus necessary. In the latest research, Neupane *et al.* (2015) proposed a 13-genera system for Asia-Pacific taxa of the *Hedyotis-Oldenlandia* complex on account of molecular monophyly and morphological synapomorphies. In this article, we follow this new system and provide a summary of taxonomic alterations for the taxa currently recorded in Taiwan (Table 1). Three necessary new combinations (*Dimetia hedyotidea*, *Leptopetalum strigulosum* var. *parvifolium* and *Scleromitrion brachypodum*) are also proposed. Among the *Hedyotis-Oldenlandia* complex in Taiwan, the genera *Dentella* and *Neanotis* are still well-supported, while the former *Hedyotis s.l.* species should be segregated into *Dimetia*, *Exallage*, *Hedyotis s.s.*, *Leptopetalum*, *Oldenlandia* and *Scleromitrion*. Systematic position of *Oldenlandiopsis* is still unclear since it has not been included in any recent phylogeny studies.

During field expeditions in southern Taiwan, a species of the *Hedyotis-Oldenlandia* complex was discovered by the second author around the upstream valleys of Nanhua Dam. Critical comparative studies of literature and specimens proved it a new species of *Scleromitrion*, which is described and illustrated here as *S. sirayanum*. The newly defined genus *Scleromitrion* differs from other genera in the *Hedyotis-Oldenlandia* complex by the combination of herbaceous habits,

Table 1. Nomenclatural alterations of the ***Hedyotis-Oldenlandia* complex** in Taiwan based on the system of Neupane *et al.* (2015). Specific treatment was mainly adopted from the Flora of Taiwan (Yang and Liu, 1998) and altered by some recent studies (Yang *et al.*, 1999; Dutta and Deb, 2004; Chang *et al.*, 2008; Chen *et al.*, 2010; Jung *et al.*, 2011; Huang, 2012; Hsu *et al.*, 2014; Wang *et al.*, 2014).

Species name under new system	Species name in previous research
Dentella repens (L.) J.R. Forst. & G. Forst.	*Dentella repens* (L.) J.R. Forst. & G. Forst.
Dimetia hedyotidea (DC.) T.C. Hsu, ***comb. nov.*** (basionym: *Spermacoce hedyotidea* DC., Prodr. 4: 555. 1830)	*Hedyotis hedyotidea* (DC.) Merr.
Exallage chrysotricha (Palib.) Neupane & N. Wikstr.	*Hedyotis chrysotricha* (Palib.) Merr.
Hedyotis butensis Masam.	*Hedyotis butensis* Masam.
Hedyotis uncinella Hook. & Arn.	*Hedyotis uncinella* Hook. & Arn.
Leptopetalum biflorum (L.) Neupane & N. Wikstr.	*Hedyotis biflora* (L.) Lam.
Leptopetalum strigulosum (Bartl. ex DC.) Fosberg var. ***parvifolium*** (Hook. & Arn.) T.C. Hsu, ***comb. nov.*** (basionym: *Hedyotis biflora* var. *parvifolia* Hook. &. Arn., Bot. Beechey Voy. 264. 1841)	*Hedyotis strigulosa* (Bartl. ex DC.) Fosberg var. *parvifolia* (Hook. & Arn.) T. Yamaz.
Neanotis formosana (Hayata) W.H. Lewis	*Neanotis formosana* (Hayata) W.H. Lewis
Neanotis hirsuta (L.f.) W.H. Lewis	*Neanotis hirsuta* (L.f.) W.H. Lewis
Oldenlandia corymbosa L.	*Hedyotis corymbosa* (L.) Lam.
Scleromitrion angustifolium (Cham. & Schltdl.) Benth.	*Hedyotis tenelliflora* Blume
Scleromitrion brachypodum (DC.) T.C. Hsu, ***comb. nov.*** (basionym: *Oldenlandia brachypoda* DC., Prodr. 4: 424. 1830)	*Hedyotis brachypoda* (DC.) Sivar. & Biju
Scleromitrion diffusum (Willd.) R.J. Wang	*Hedyotis diffusa* Willd.
Scleromitrion koanum (R.J. Wang) R.J. Wang	*Hedyotis koana* R.J. Wang
Scleromitrion pinifolium (Wall. ex G. Don) R.J. Wang	*Hedyotis pinifolia* Wall. ex G.Don
Scleromitrion verticillatum (L.) R.J. Wang	*Hedyotis verticillata* (L.) Lam.
(unknown)	*Oldenlandiopsis callitrichoides* (Griseb.) Terrel & W.H. Lewis

corolla without a ring of hairs inside, homostylous flowers with exserted stamens and styles, and loculicidally dehiscent capsules with many obconic seeds (Wang *et al.*, 2014; Neupane *et al.*, 2015). This genus is generally distributed in tropical Asia, tropical Australia and Pacific, but the exact species number is still unknown due to the lack of comprehensive taxonomic revision (Neupane *et al.*, 2015). A key to the seven *Scleromitrion* species so far recorded in Taiwan is provided to aid in their identification.

TAXONOMIC TREATMENTS

Key to the *Scleromitrion* species in Taiwan:

1. Flowers and fruits with distinct peduncles and/or pedicels …….... 2
1a. Flowers and fruits sessile or subsessile ……..……. 4
2. Leaves 1.0–1.5 mm wide; inflorescences terminal and sometimes in uppermost leaf axils; pedicels (3–)10–20 mm ……. ***S. koanum***
2a. Leaves 1–4 mm wide; inflorescences always axillary; pedicels 2–10 mm ……..... 3
3. Stems glabrous; flowers 1(–2) in each axil; peduncles and/or pedicels 2–10 mm ……..…….... ***S. brachypodum***
3a. Stems hirtellous; flowers (1–)2–3 in each axil; peduncles 4–20 mm ……..……. ***S. diffusum***
4. Leaves 0.8–2.0 mm wide; inflorescence terminal and axillary; corolla lobes ascending ……..……. ***S. pinifolium***
4a. Leaves 1.5–13 mm wide; inflorescence always axillary; corolla lobes recurved ...……..…….. 5
5. Flower constantly solitary in each axil; corolla salverform, tube 4–6 × ca. 0.5 mm, lobes adaxially densely long villous at bases; capsules obconic, with spreading to ascending persistent calyx lobes, dehiscent septicidally and loculicidally toward bases ……. ……..……..…… ***S. sirayanum***
5a. Flowers 1–9 in each axil; corolla funnelform, tube 2–3 × ca. 1 mm mm, lobes adaxially glabrous or sparsely pilose; capsules ovoid, with erect persistent calyx lobes erect, dehiscent loculicidally only at apex or above middle …….…… 6
6. Stems, leaves and calyx glabrous or nearly so; leaves 1.5–6 mm wide; flowers 1–5 in each axil; corolla lobes glabrous ……..…… ……..…….. ***S. angustifolium***
6a. Stems, leaves and calyx sparsely to densely scaberulous or hispidulous; leaves 3–20 mm wide; flowers 2–9 in each axil; corolla lobes sparsely pilose adaxially ……..……. ***S. verticillatum***

Scleromitrion sirayanum T.C. Hsu & Z.H. Chen, ***sp. nov.*** **西拉雅蛇舌草 Figs. 1–3.**

Type: TAIWAN. Tainan City, Nanhua District, Tachukeng, 150–250 m elev., 16 April 2016, *T.C. Hsu 8383* (holotype: TAIF; isotype: TNM).

Diagnosis: *Scleromitrion sirayana* is morphologically similar to *S. angustifolium* (Cham. & Schltdl.) Benth. but different from it in having constantly solitary flowers, salverform corollae with 4–6 × ca. 0.5 mm tubes and adaxially basally long villous corolla lobes, spreading to ascending persistent calyx lobes, and obconic capsules dehiscent both septicidally and loculicidally into 4 valves.

Morphology: Perennial herb, diffusely branched, to 20 cm tall; stems prostrate, weakly to sharply 4-angled and/or 2-sulcate, glabrous or often scaberulous along grooves and/or near nodes. Leaves sessile or subsessile; petiole to 1 mm; blade thinly leathery, lanceolate-oblong to narrowly elliptic, 1.5–4.2 cm × 3–6(–8) mm, adaxially glabrous or sparsely scaberulous near margins and apices, abaxially glabrous, base cuneate or decurrent, apex acute or acuminate, margins often slightly

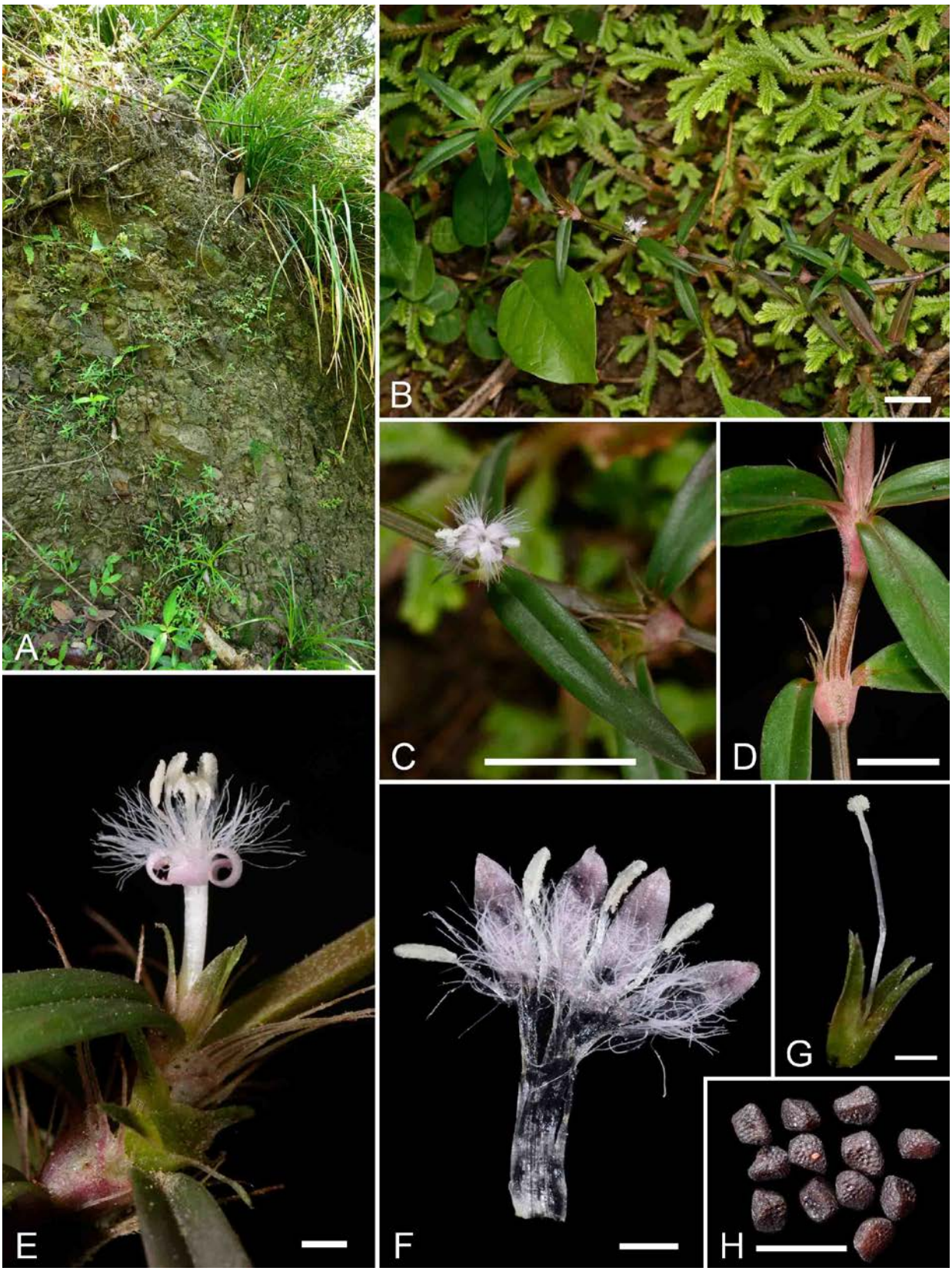

Fig. 1. ***Scleromitrion sirayanum*** T.C. Hsu & Z.H. Chen (from *T.C.Hsu 8383*). **A**. Habitat in Tachukeng, Tainan City, Taiwan. **B–C**. Habit. **D**. Stipules. **E**. Flower and immature capsule. **F**. Expanded and flattened corolla with attached anthers, adaxial view. **G**. Calyx and pistil. **H**. Seeds. Scale bars: B = 1 cm; C–D = 5 mm; E–H = 1 mm. Photographed by T.-C. Hsu.

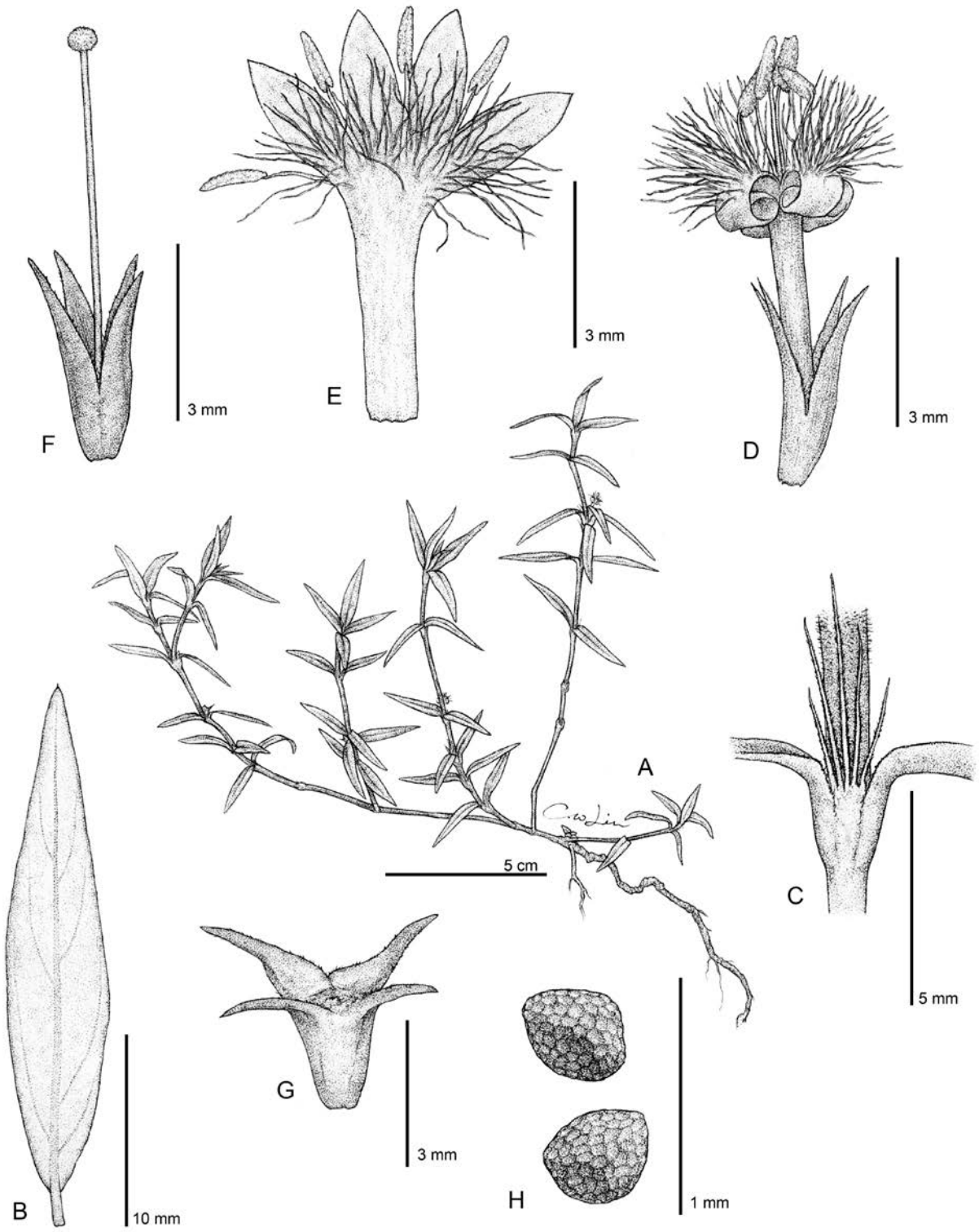

Fig. 2. ***Scleromitrion sirayanum*** T.C. Hsu & Z.H. Chen (from *T.C. Hsu 8383*). **A**. Habit. **B**. Leaf. **C**. Stipule. **D**. Flower, lateral view. **E**. Expanded and flattened corolla with attached anthers, adaxial view. **F**. Calyx and pistil. **G**. Capsule, lateral view. **H**. Seeds. Illustrated by C.-W. Lin.

Table 2. Morphological comparison of ***Scleromitrion sirayanum*** and related taxa. Data of ***S. angustifolium*** and ***S. verticillatum*** are based on previous descriptions [Liu and Yang, 1998 (as *Hedyotis tenelliflora* and *H. verticillata*); Dutta and Deb, 2004 (as *H. angustifolia*); Huang, 2010 (as *H. tenelliflora* and *H. verticillata*); Su, 2010 (as *H. angustifolia* and *H. verticillata*), Chen and Taylor, 2011 (as ***H.*** *tenelliflora* and *H. verticillata*)] and specimens preserved in HAST, TAI and TAIF. Data of ***S. tenelliflorum*** are adopted from the high-resolution image of its holotype (*C.L.Blume s.n.*, preserved in L, with annotations and a detailed line drawing attached on the sheet) available in the JSTOR database (http://plants.jstor.org/stable/10.5555/al.ap.specimen.l0057761, accessed 10 Jan 2017).

Character	*S. sirayana*	*S. angustifolium*	*S. tenelliflorum*	*S. verticillatum*
Stems	glabrous or scaberulous only along grooves and/or near nodes	glabrous or scaberulous only along grooves and/or near nodes	glabrous or scaberulous only along grooves and/or near nodes	sparsely to densely hirtellous, hispidulous, and/or scaberulous throughout
Leaves	3–6(–8) mm wide	1.5–4(–6) mm wide	10–17 mm wide	(3–)6–13(–20) mm wide
Stipule bristles	5–7, ciliate	1–5, smooth	7–9, ciliate	5–9, ciliate
Inflorescence	constantly 1-flowered	1–5-flowered	few to many flowered	2–9-flowered
Calyx	glabrous	glabrous	glabrous	densely hispidulous
Corolla	salverform	funnelform	funnelform	funnelform
Corolla tube	4–6 × ca. 0.5 mm	2–3 × ca. 1 mm	ca. 2 × 1 mm	2–3 × ca.1 mm
Corolla lobe	adaxially long villous at base, abaxially glabrous	glabrous on both surfaces	adaxially pubescent at base, abaxially glabrous	adaxially pilose at base, abaxially glabrous or sometimes pilose at apex
Capsule (excluding persistant calyx lobes)	obconic, 2.5–3.5 × 2–3 mm, papery, rather soft	ovoid, 2–3 × 1.5–2.3 mm, crustaceous	globose or ovoid, 1.5–2 × 1–2 mm, texture unknown	globose or ovoid, 2–3 × 1.5–2 mm, crustaceous
Persistant calyx lobes on capsule	spreading to ascending	erect and convergent	ascending to erect	erect
Dehiscence of capsule	septicidal from base to apex and then loculicidal	loculicidal from tip to middle	septicidal from base to apex and then loculicidal	loculicidal only at tip
Seeds	22–28 per capsule, 0.4–0.6 mm long	20–30 per capsule, 0.2–0.45 mm long	4–8 per capsule, 0.8–1 mm long	20–30 per capsule, 0.4–0.5 mm long

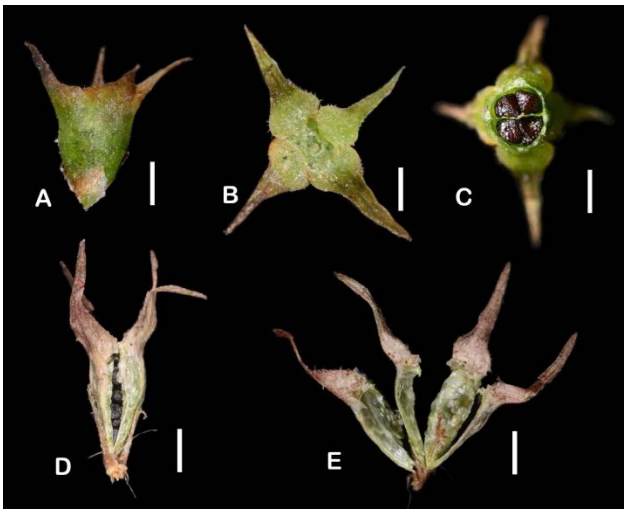

Fig. 3. Fruit morphology of ***Scleromitrion sirayanum*** (from *T.C. Hsu 8675*). **A–C**. Fresh mature capsule; **A**, lateral view, showing spreading to ascending persistent calyx lobes; **B**, apical view, showing the flattened tip; **C**, cross section, showing two locules and placentation. **D**. Capsule starting to dehiscent, showing septicidal dehiscence from base to apex. **E**. Fully dehiscent capsule, showing 4 mostly free valves. Scale bars = 1 mm. Photographed by T.-C. Hsu.

revolute, entire or scaberulous near base; lateral veins invisible; stipules fused to petiole bases, triangular to rounded, 1–2 mm, hispidulous, with 5–7 linear or setiform bristles, bristles 1–5 mm long, cilioate. Inflorescences axillary, constantly 1-flowered, sessile; bracts acicular to lanceolate, 1–2.5 mm, ciliolate. Flowers homostylous. Calyx glabrous, 4-lobed; hypanthium portion obconic, ca. 1 mm; limb lobed nearly to base; lobes lanceolate, 1.5–3 × ca. 1 mm, margin ciliolate at bases, scaberulous toward apices. Corolla 4-merous, white, often flushed with pink, salverform, glabrous abaxially; tube 4–6 mm long, ca. 0.5 mm in diam., glabrous adaxially; lobes narrowly elliptic-oblong, ca. 2.5 × 1.0 mm, strongly reflexed and usually curled, adaxially densely long villous at bases. Stamens 4; anthers exserted, whitish, ca. 1 mm long; filaments 1.5–2 mm long. Stigma bilobed, spheroidal, 0.3–0.4 mm; style glabrous, exserted, 4.5–5.5 mm long. Ovary 2-celled, ovules many in each cell on axile placentas. Fruit capsular, obconic, with flattened tip, 2.5–3.5 × 2–3 mm, papery, dehiscent septicidally from base to apex and then loculicidally from apex to base, eventually divided into 4 mostly free valves; persistent calyx lobes spreading to ascending; seeds ca. 16–28 per capsule, angular, dark brownish, 0.4–0.6 mm long, testa reticulate.

Distribution and habitat: *Scleromitrion sirayanum* is endemic in Taiwan and so far only found in the hilly terrains around Tachukeng village in Nanhua District, Tainan City where it grows on semi-exposed or shaded slopes or cliffs under secondary forests and disused *Dimocarpus longan* Lour. plantation at an elevation of 150–250 m. This new species is found growing along with *Selaginella repanda* (Desv. ex Poir.) Spring, *Adiantum caudatum* L., *Parahemionitis cordata* (Hook. & Grev.) Fraser-Jenk., *Oplismenus hirtellus* (L.) P.Beauv., *Ruellia repens* L., *Lepidagathis formosensis* C.B.Clarke ex Hayata, *Desmodium gangeticum* (L.) DC. and *Carex sp.*

Phenology: Flowering of *Scleromitrion sirayana* are observed from March to October and fruiting from

April to December.

Conservation status: Only one population with fewer than 1000 mature individuals and less than 10 km^2 area of occupancy is so far discovered for *Sclerom*itrion *sirayanum*. Since no population decline or immediate threat were observed so far, *P. sirayanum* is evaluated as Vulnerable (VU D1+2) according to the IUCN Red List criteria (IUCN, 2012).

Etymology: The new specific epithet commemorates the Siraya ethnicity, a group of indigenous people mainly settled coastal plains and low hills in southwest and eastern Taiwan including the type locality of *Sclerom*itrion *sirayanum*.

Additional specimens examined: **TAIWAN**. Tainan City, Nanhua District, Tachukeng, *T.C. Hsu 8519, 8675* (TAIF).

Taxonomic remarks: *Sclerom*itrion *sirayanun* is characterized by the constantly solitary axillary flowers, salverform corollae with narrow tubes and strongly reflexed, adaxially basally long villous lobes, spreading to ascending persistent calyx lobes and obconic capsules dehiscent both septicidally and loculicidally into 4 mostly free valves. In gross morphology, this new species could be grouped with *S. angustifolium* (Cham. & Schltdl.) Benth. [often synonymized under *Hedyotis tenelliflora* Blume (Liu and Yang, 1998; Huang, 2010; Chen and Taylor, 2011) but actually a distinct species as discussed by Su (2010) and Wang *et al.* (2014)], *S. tenelliflorum* (Blume) Korth and *S. verticillatum* which share perennial habits, diffusely branched stems, rather narrow subsessile leaves, constantly axillary inflorescences, sessile or subsessile flowers, and strongly recurved corolla lobes. A detailed comparison of these species are presented in Table 2. The dehiscence pattern of *S. sirayanum* capsules (Fig. 3) is somewhat remarkable and disagree with the definition of *Sclerom*itrion by Neupane *et al.* (2015). However, similar pattern is actually also seen in *S. tenelliflorum* (Wang *et al.*, 2014; Table 2) which is well nested within the *Sclerom*itrion clade (Neupane *et al.*, 2015). Due to the great similarity in other morphologically characters, we still place our new species under *Sclerom*itrion. Further molecular study might be necessary to reconfirm its systematic position and clarify the evolution of fruit morphology in the genus *Sclerom*itrion.

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LITERATURE CITED

Chang, K.-C., Y.-H. Tseng, C.-C. Wang, S.-L. Deng and C.-M. Wang. 2008. Notes on *Neanotis* (Rubiaceae) in Taiwan. Taiwan J. Forest Sci. **23**: 271–277.

Chen, S.-H., J.-Y. Su and M.-J. Wu 2010. *Hedyotis pinifolia* Wall. ex G. Don (Rubiaceae), a New Record to the Flora of Taiwan. Taiwania **55(1)**: 86–89.

Chen, T. and C.M. Taylor. 2011. *Hedyotis* L. In: Wu, Z.Y. & Raven, P. (eds.) Flora of China. **19**: 147–174. Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Dutta, R. and D.B. Deb. 2004. Taxonomic Revision of *Hedyotis* L. (Rubiaceae) in Indian Subcontinent. Botanical Survey of India, Kolkata. 211 pp.

Groeninckx, I., S. Dessein, H. Ochoterena, C. Persson, T.J. Motley, J. Kårehed, B. Bremer, S. Huysmans and E. Smets. 2009. Phylogeny of the herbaceous tribe Spermacoceae (Rubiaceae) based on plastid DNA data. Ann. Missouri Bot. Gard. **96(1)**: 109–132.

Guo, X., R.J. Wang, M.P. Simmons, P.P.H. But and J. Yu 2013. Phylogeny of the Asian *Hedyotis-Oldenlandia* complex (Spermacoceae, Rubiaceae): Evidence for high levels of polyphyly and the parallel evolution of diplophragmous capsules. Molec. Phylogen. Evol. **67(1)**: 110–122.

Hsu, T.-C., Z.-H. Chen and S.-W. Chung 2014. *Hedyotis koana* Wang (Rubiaceae) a newly recorded plant in Taiwan. Quarterly Journal of Forest Research **36**: 179–182.

Huang, S.-W. 2010. A Taxonomic Study of *Hedyotis* L. (Rubiaceae) in Taiwna. Master thesis, National Taiwan Normal University. 131 pp. (in Chinese).

Huang, S.-W. 2012. *Hedyotis* L. In: Kuo, M.-L. *et al.* (eds.) Flora of Taiwan, 2nd ed. Supplement. National Taiwan Normal University, Taipei. P. 166.

IUCN. 2012. IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. (Available online: www.iucnredlist.org/technical-documents/categories-and-criteria). (Accessed: 28 Apr 2016).

Jung, M.-J., S.-M. Ku and C.-I Peng. 2011. *Oldenlandiopsis* Terell & W. H. Lewis (Rubiaceae), a Newly Recorded Genus in Taiwan. Taiwania **56(1)**: 58–61.

Liu, H.-Y. and T.-Y.A. Yang. 1998. Rubiaceae. In: Huang, T.-C. *et al.* (eds.) Flora of Taiwan, 2nd ed. **4**: 245–340. Editorial Committee, Department of Botany, NTU, Taipei.

Neupane, S., S. Dessein and T.J. Motley. 2009. The *Hedyotis-Oldenlandia-Kohautia* complex (Rubiaceae) in Nepal: A study of fruit, seed and pollen characters and their taxonomic significance. Edinburgh J. Bot. **66(3)**: 371–390.

Neupane, S., S. Dessein, N. Wikström, P.O. Lewis, C. Long, B. Bremer and T.J. Motley. 2015. The *Hedyotis-Oldenlandia* complex (Rubiaceae: Spermacoceae) in Asia and the Pacific: Phylogeny revisited with new generic delimitations. Taxon **64(4)**: 299–322.

Su, J.-Y. 2010. Taxonomic Revision of *Hedyotis* L. (Rubiaceae) in Taiwan. Master thesis, National Dong Hua University. 254 pp. (in Chinese).

Wang, R. J., S.J. Deng and Q. Liao. 2014. Nomenclature clarification of the traditional Chinese medicine Baihuasheshecao and its adulterants based on molecular and morphological evidence. J. Trop. Subtrop. Bot. **22**: 431–442.

Wikström, N., S. Neupane, J. Kårehed, T.J. Motley and B. Bremer. 2013. Phylogeny of *Hedyotis* L. (Rubiaceae: Spermacoceae): Redefining a complex Asian-Pacific assemblage. Taxon **62(2)**: 357–374.

Yang, Y. P., H.Y. Liu, B.L. Shih and S.Y. Lu. 1999. Manual of Taiwan Vascular Plants Vol. 4. The Council of Agriculture, The Executive Yuan, Taipei. 432 pp.