

## Revision of *Sciaphila* (Triuridaceae) in Taiwan

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**ABSTRACT:** The genus *Sciaphila* (Triuridaceae) is revised based on comparative morphological and palynological studies in Taiwan. Four species are recognized, *i. e.* *Sciaphila arfakiana* Becc., *S. maculata* Miers, *S. ramosa* Fukuy. & T. Suzuki, and *S. secundiflora* Thwaites *ex* Benth. *Sciaphila arfakiana* and *S. maculata* are new record to Flora of Taiwan and *S. secundiflora* distributed in Kueishan Island is a new distribution. SEM micrographs of pollen grains, a key to species, species descriptions, and taxonomic notes are provided.

**KEY WORDS:** *Sciaphila*, Triuridaceae, Pollen grains, New record, Taiwan.

### INTRODUCTION

Triuridaceae consists of 6 genera (Meerendonk, 1984) or 9 genera (Mass-van de Kamer and Weustenfeld, 1998) with about 45 species distributed throughout the Old World and New World tropics (Meerendonk, 1984; Maas and Tubsamen, 1986). One genus *Sciaphila*, the largest genus with ca. 35 species, is distributed in Taiwan. The genus *Andruris* with extended connective is usually treated as another genus (Giesen, 1938; Mass-van de Kamer and Weustenfeld, 1998). However, due to the fact that the extended connective is easily shed and the other characters are similar to *Sciaphila*, here we followed Meerendonk (1984) in treating it as the same genus.

The plants of *Sciaphila* in Taiwan are very rare. Fukuyama and Suzuki (1936) first described two species, *S. megastyla* and *S. ramosa* based on two specimens collected from Lanyu Island (Botel Tobago Is.). Due to the poor collection in Taiwan herbarium, this genus was not treated in the first edition of Flora of Taiwan. Recently *Sciaphila megastyla* was treated as a synonym of *S. secundiflora* (Ohashi, 2000a), but *S. ramosa* was still insufficiently known (Zhou and Zhong, 1992; Ohashi, 2000b). This genus was therefore poorly known in Taiwan.

Recently, we collected some specimens of *Sciaphila* in Taiwan, therefore a new revision is proposed.

### MATERIALS AND METHODS

Since the male flowers were very rare, the pollen grains were dehydrated in an ethanol series and dried in the air. Dried grains were coated with gold and examined using SEM.

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## RESULTS

### External morphology

The plants of *Sciaphila* in Taiwan are small, delicate, reddish or dark-purplish red mycotrophic herbs. Among the four species, *Sciaphila maculata* is distinct in its 30-flowered inflorescence, recurved pedicels (Figs. 1C, D), 3-celled stamens (Fig. 2B), and short styles just exceeding the carpels (Table 1).

*Sciaphila secundiflora* has large fruit (4 mm in diameter) and short pedicels (1-2 mm in diameter) (Figs. 1G, H and table 1). *Sciaphila arfakiana* is close to *S. ramosa*, but differs from it by having long pedicel (7-9 mm long) (Fig. 1A), connective extending into a long grooved appendage (Figs. 1B & 2A), and long style (1 mm long). On the other hand, *S. ramosa* has short pedicel (2-3.5 mm long) (Figs. 1E, F), connective not extended (Fig. 2C), and short style (0.2 mm long) (Table 1).

### Pollen grains

The pollen grains of *Sciaphila* in Taiwan are monosulcate, isopolar, boat shaped-ellipsoidal in equatorial view, and exine covered with microverrucae (Fig. 3).

The pollen grains of *S. secundiflora* can be used to distinguish from the other species in Taiwan. In *S. secundiflora*, the exine has big crown shaped microverrucae (Fig. 3F). In *S. arfakiana*, *S. ramosa*, and *S. maculata*, the exine has smaller round microverrucae, but in *S. arfakiana* and *S. ramosa*, the exine has big microverrucae (0.36-0.53  $\mu\text{m}$  in diameter) (Fig. 3B), in *S. maculata*, the exine has small ones (0.21-0.31  $\mu\text{m}$  in diameter) (Fig. 3C).

*Sciaphila arfakiana* with extended connective usually treated as another genus *Andruris* (Giesen, 1938; Mass-van de Kamer and Weustenfeld, 1998), but the pollen grains are similar to *S. maculata* and *S. ramosa*.

## TAXONOMIC TREATMENT

**Sciaphila** Blume, Bijdr. 10: 514, 1826; Giesen, Pflanzenrich 104 (IV. 18): 30, 1938; Meerendonk in Fl. Males. ser. I. 10: 109, 1984; Mass-van de Kamer and Weustenfeld in Family and Genera of Vascular Plants. 3: 452, 1998. — *Andruris* Schltr, Bot. Jahrb. 49: 71, 1912; Giesen, Pflanzenrich. 104 (IV. 18): 15, 1938; Mass-van de Kamer and Weustenfeld in Family and Genera of Vascular Plants. 3: 456, 1998.

Small, delicate, whitish, pinkish, or reddish achlorophyllous, mycotrophic herbs. Stems erect, simple or branched; rhizome and stem provided with small scale-like leaves. Inflorescences terminal, racemose. Monoecious, male flowers toward the top. Flowers actinomorphic, perianth 4-10, usually 6, valvate, patent or reflexed, equal or alternating unequal segments, connects at base, at top glabrous or bearded, or with knob-like appendages. Male flowers with 2-6 stamens, anthers 1-4-celled, 2-4-lobed, extrose; connective in each anther extended into a long grooved appendage or not. Female flowers with c. 10-80, obovoid, free ovaries, each with 1 ovule; style laterally or basally, usually exceeding the ovary, club- or awl-shaped. Bisexual flowers with 3-6 persistent stamens, anthers 1-celled; ovaries ca. 10-50, like in the female flower, style club-shaped. Fruits follicle, obovoid, with persistent style; seed 1, with copious endosperm.

About 35 species; pantropical and subtropical area mainly in tropical Asia. 4 species in Taiwan.

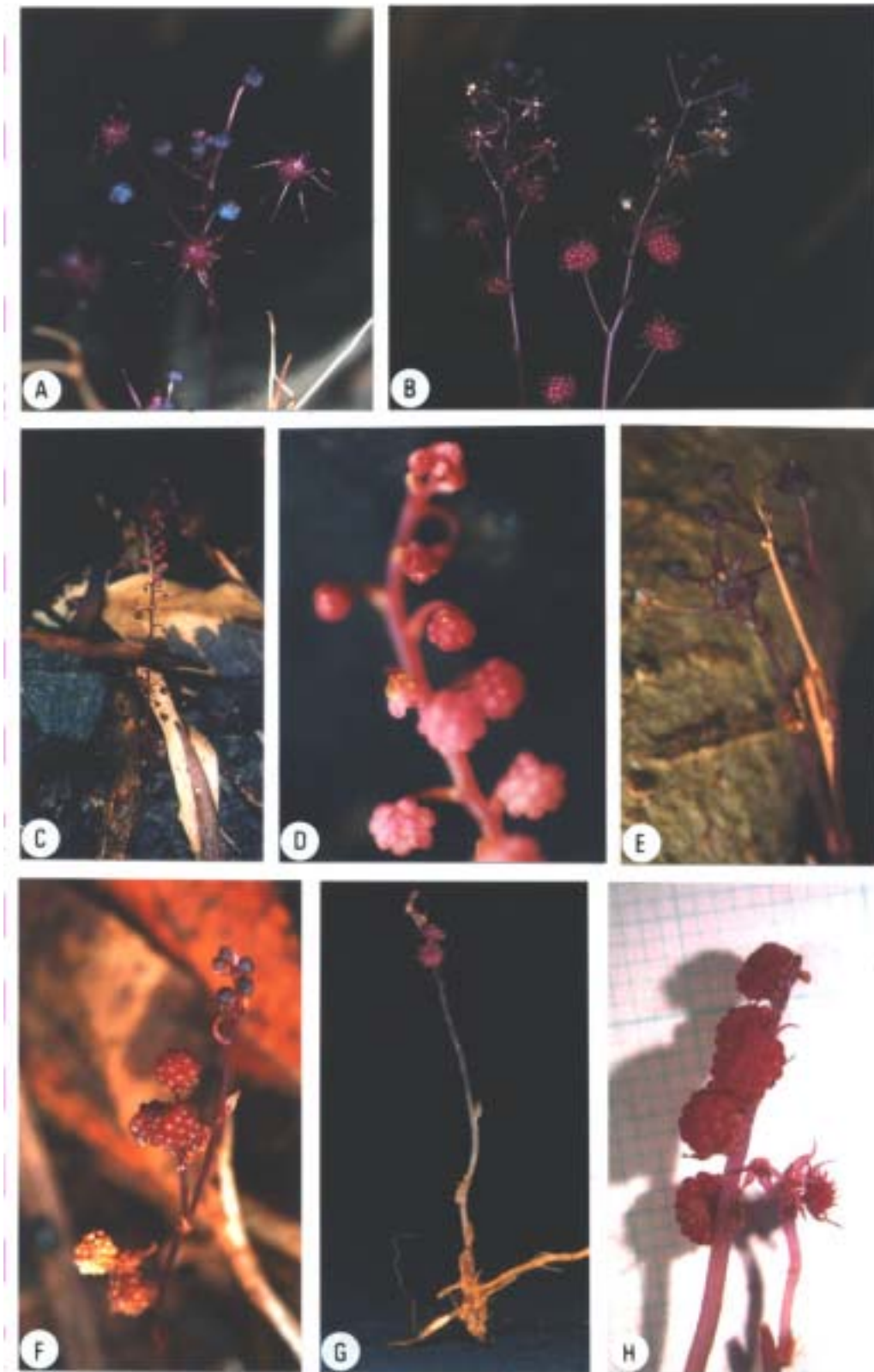


Fig. 1. Habit and flower of *Sciaphila* in Taiwan. A and B: *S. arfakiana* Becc.; C and D: *S. maculata* Miers; E and F: *S. ramosa* Fukuy. & T. Suzuki; G and H: *S. secundiflora* Thwaites ex Benth.

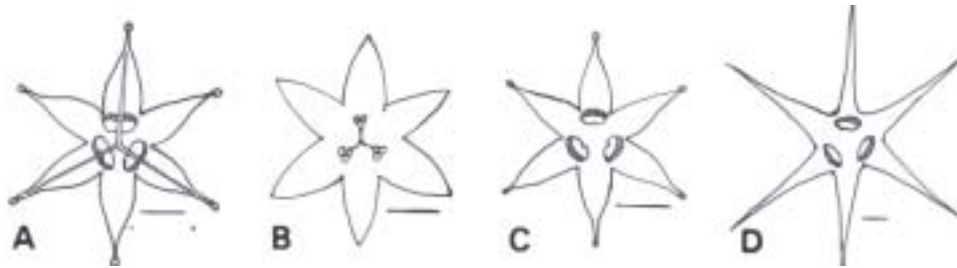


Fig. 2. Male flower of *Sciaphila* in Taiwan. A: *S. arfakiana* Becc.; B: *S. maculata* Miers; C: *S. ramosa* Fukuy. & T. Suzuki; D: *S. secundiflora* Thwaites ex Benth. Scale bar = 0.5  $\mu$ m.

### Key to the species

1. Style awl-shaped; stems 0.3-0.5 mm in diameter
  2. Connective extended into a long appendage, ca. 1.3 mm long; pedicels 7-9 mm long ..... 1. *S. arfakiana*
  2. Connective not extended; pedicels short, 2-3.5 mm long ..... 3. *S. ramosa*
1. Style club-shaped; stems 0.6-1 mm in diameter
  3. Flower bisexual and male; inflorescence ca. 30-flowered ..... 2. *S. maculata*
  3. Flower unisexual; inflorescence 3-9-flowered ..... 4. *S. secundiflora*

**1. *Sciaphila arfakiana*** Becc., Malesia 3: 337, 1890; Giesen in Pflanzenrich 104 (IV. 18): 57, 1938; Meerendonk in Fl. Males. ser. I. 10: 117, 1984.

Erect herb, dark-purplish red, glabrous. Stem simple or branched, ca. 6-12 cm high, 0.3-0.5 mm in diameter. Leaves scake-like, oblong, acuminate to acute, ca. 1 mm long. Inflorescence terminal, racemose, erect, ca. 1-5 cm long, 5-30-flowered. Flowers unisexual. Bracts lanceolate, acute, ca. 1 mm long. Pedicels (4-) 7-9 mm long, straight. Male flower perianth segments 6, 3 larger ones with alternating 3 smaller ones, segments oblong-ovate, ca. 1.3 mm long, the apex with a stipulate globosely knob, stamens (2-) 3, connective extended into a long grooved appendage, ca. 1.3 mm long; anther 4-celled. Female flower perianth segments 6, more or less equal, oblong to triangular, acute, ca. 0.5 mm long, apex without appendage. Carpels ca. 20-30, style subapical, awl-shaped, apex papillate, exceeding the ovary. Fruits 2 mm in diameter. Seeds 0.7 mm long, rounded at the top and appressed towards the helium.

Distributed in Micronesia, W. Polynesia, Solomons, and Malesia. In Taiwan, distributed in Lanyu Island on the windward slop of Mt. Tashenshan. It is common and grows in tropical rainforest which is dominated by *Garcinia linii* and *Syzygium densinervium* var. *insulare*.

**Specimens examined:** Taitung County: Lanyu (Kotosyo) Is. (Botel Tobago Is.): Tashenshan, ca. 300 m alt. T. H. Hsieh 2016, 5035 (TAI, HAST, NTNTC).

Notes: *Sciaphila arfakiana* is close to *S. ramosa* and both distributed in the same locality in Lanyu Is., but differs from the later by having long pedicel (7-9 mm long), connective extending into a long grooved appendage, and long style (1 mm long). The extended connective when male flower at anthesis is prominent, but the extended connective is easily shed (Giesen, 1938; Meerendonk, 1984).

This species is similar to *Sciaphila japonica* Makino distributed in Ryukyu Island, but differs from it by having globose knobs on all segments of male flower; the later has globose knobs on 3 smaller ones (Walker, 1976). Since the difference is very little, further study is needed.

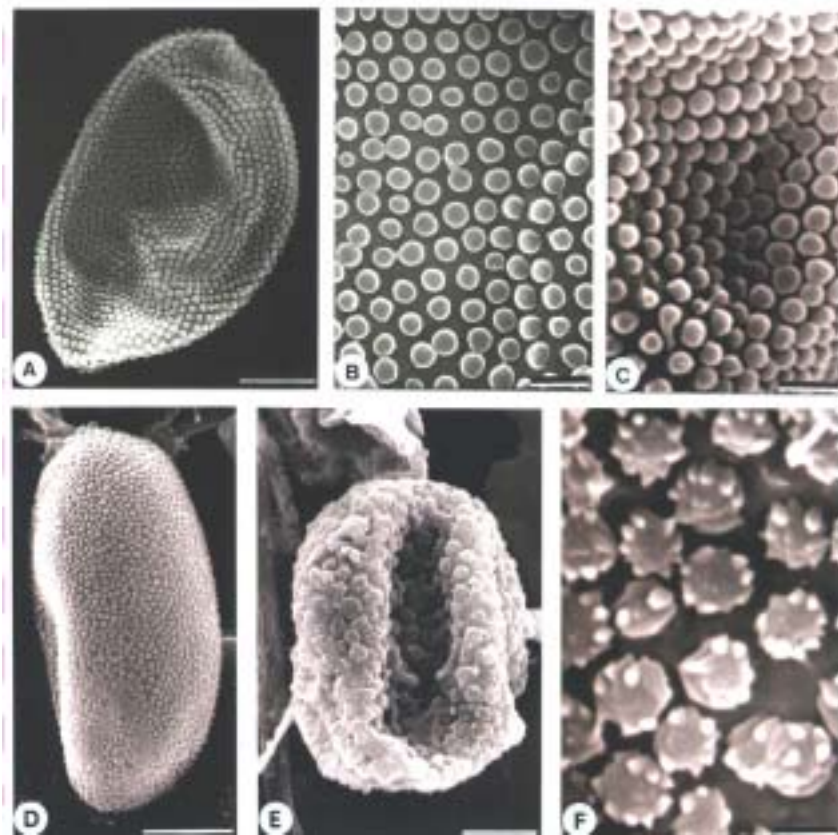


Fig. 3. SEM micrographs of pollen grains of *Sciaphila* in Taiwan. A and B: *S. arfakiana* Becc.; C and D: *S. maculata* Miers; E and F: *S. secundiflora* Thwaites ex Benth. Scale bar = 5  $\mu$ m, except 1  $\mu$ m in B, C and F.

Table 1. Comparison of *Sciaphila* in Taiwan.

	<i>S. arfakiana</i>	<i>S. maculata</i>	<i>S. ramosa</i>	<i>S. secundiflora</i>
Stem	6-12 cm high; 0.3- 0.5 mm in diameter	10 cm high; 0.6-1 mm in diameter	8-12 cm high; 0.3-0.5 mm in diameter	4-12 cm high; 0.7-1 mm in diameter
Leaf	ca. 1 mm long	ca. 1.2 mm long	0.8-1.3 mm long	2-3 mm long
Inflorescence	5-30-flowered	30-flowered	3-7-flowered	3-9-flowered
Bisexual flower	absent	present	absent	absent
Size of Male flower (diam.)	2.5-3 mm	2 mm	2 mm	6-7 mm
Connective	extended into a long appendage	not extended	not extended	not extended
Anther sac	4-celled	3-celled	4-celled	4-celled
Style shape	awl-shaped	club-shaped	awl-shaped	club-shaped
Style length	1.0 mm	0.2 mm	0.5-0.6 mm	0.6-0.7 mm
Pedicel in fruiting stage	(4-)7-9 mm	2-2.5 mm	(1.4-)2-3.5 mm	1-2 mm
Fruit size (diam.)	2 mm	2 mm	2 mm	4 mm

2. ***Sciaphila maculata*** Miers, Proc. Linn. Soc. 2: 72, 1850, repr. Ann. Mag. Nat. Hist. II, 7: 324, 1851; Trans. Linn Soc. 21: 48, 1852; Giesen, in Pflanzenrich 104 (IV. 18): 39, 1938; Meerendonk in Fl. Males. ser. I, 10: 113, 1984.

Erect herb, dark-purplish red, glabrous. Stem simple, ca. 10 cm high, 0.6-1 mm in diameter. Leaves scake-like, oblong, acuminate to acute, ca. 1.2 mm long. Inflorescence terminal, racemose, erect, ca. 7 cm long, 30-flowered. Flowers andromonoecious. Bracts lanceolate, acute, ca. 1-2 mm long. Pedicels 2-2.5 mm long, recurved at flowering and fruiting stage. Perianth segments 6, 3 larger ones with alternating 3 smaller ones, reflexed; segment triangular, ca. 0.6 mm. Male flower stamens 3, filaments short; anther 3-lobed. Bisexual flower stamens 3. Carpels ca. 20-30, style inserted basally, club-shaped, apex papillate, exceeding the ovary. Fruits 2 mm in diameter. Seeds ellipsoidal, 0.6 mm long, with three concave grooves on abaxial side.

Distributed in Philippines, Malaysia, Borneo, and New Guinea. In Taiwan, distributed on mud stone slop at lower elevation in Taitung County. It is very rare and grows in the *Leucaena leucocephala* – *Champereia manillana* forest type which is dominated by *Myrica adenophora*, *Acacia confusa*, *Rhus javanica roxburghiana*, *Leucaena leucocephala*, *Miscanthus floridulus*, and *Arundo formosana* in mudstone slope (Wu, 1999).

**Specimens examined:** Taitung County: Luanshan Bridge, ca. 200 m alt. C. S. Wu 1625 (TAI).

Notes: *Sciaphila maculata* is distinct in its 30-flowered inflorescence, recurved pedicels, 3-celled stamens, and short styles just exceeding the carpels. The perianth segments of male flower are terminated by a tuft of hairs on Malaysia specimen (Meerendonk, 1984), but the specimen in Taiwan is glabrous at top of perianth segments. Since only one individual in this collection, more specimens are needed for this species in Taiwan.

3. ***Sciaphila ramosa*** Fukuy. & T. Suzuki in J. Jap. Bot. 12: 414, 1936; Giesen in Pflanzenrich 104 (IV. 18): 70, 1938; L. Y. Zhou & X. W. Zhong in Fl. Reip. Popul. Sin. 8: 193, 1992; Ohashi in Fl. Taiwan 2<sup>nd</sup> ed. 5: 1088, 2000.

Erect herb, dark-purplish red, glabrous. Stem usually branched, ca. 8-12 cm high, 0.3-0.5 mm in diameter. Leaves scale-like, oblong, acuminate to acute, ca. 0.8-1.3 mm long. Inflorescence terminal, racemose, erect, ca. 1 cm long, 3-7-flowered. Flowers unisexual. Bracts lanceolate, acute, 0.8-1.3 mm long. Pedicels (1.4-)2-3.5 mm long, straight. Male flower perianth segments 6, 3 larger ones with alternating 3 smaller ones, segments oblong-ovate, ca. 0.75 mm long, the apex with a stipulate globosely knob, stamens 2 or 3, anther 4-celled. Female flower perianth segments (4-5-) 6, more or less equal, oblong to triangular, acute, ca. 0.7 mm long, apex without appendage. Carpels ca. 20-30, style subapical, 0.5-0.6 mm long, awl-shaped, apex papillate, exceeding the ovary. Ovules 1. Fruits 2 mm in diameter. Seeds 1, 0.6 mm long, with three concave grooves on abaxial side.

Distributed on the windward slope of Mt. Tashenshan in Lanyu Island. It is very rare and grows in tropical rainforest which is dominated by *Garcinia linii* and *Syzygium densinervium* var. *insulare*.

**Specimens examined:** Taitung County: Lanyu (Kotosyo) Is. (Botel Tobago Is.): in pluviisivis monte Omori-yama (Mt. Tashenshan), c. 300 m alt. Fukuyama 3617. (Type of *S. ramosa* Fukuy. & T. Suzuki, TAI!); Mt. Tashenshan, c. 300 m alt. T. H. Hsieh 5036 (TAI, HAST).

- 4. *Sciaphila secundiflora* Thwaites ex Benth.** in Hook. J. Bot. Kew Misc. 7: 10, 1855; Giesen in Pflanzenreich 104 (IV. 18): 60, 1938; Meerendonk in Fl. Males. ser. I. 10: 116, 1984; Ohashi in Taiwania 45(4): 351-354, 2000.

*Sciaphila megastyla* Fukuy. & T. Suzuki in J. Jap. Bot. 12: 412, 1936 [Type: Lanyu Island: *T. Suzuki* 3616. TAI. Photo & table! ]; Giesen in Pflanzenreich 104 (IV. 18): 69, 1938; Zhou & Zhong in Fl. Reip. Popul. Sin. 8: 191, 1992.

Erect herb, reddish, glabrous. Stem simple, c. 4-12 cm high, 0.7-1 mm in diameter. Leaves scake-like, oblong, acuminate to acute, 2-3 mm long. Inflorescence terminal, racemose, erect, c. 1-5 cm long, 3-9-flowered. Flowers unisexual. Bracts lanceolate, acute, c. 2 mm long. Pedicels 1-2 mm long, straight. Male flower perianth segments 6, patent, equal, subulate, c. 2.5-3.5 mm long, stamens 3 or 2, subsessile; anther 4-celled. Female flower globose, perianth segments 6, more or less equal, oblong to lanceolate, acuminate, c. 2-2.5 mm long. Carpels c. 10-80, obovate, 0.5-1 mm long, upper part papillate, apex round; style 0.6-0.7 mm long, inserted basally, club-shaped, apex papillate, exceeding the ovary. Ovules 1. Fruits 4mm in diameter. Seeds 0.7 mm long, rounded at the top and tapering towards the helium.

Distributed in Sri Lanka, Malaysia, Hongkang, Japan and the Pacific islands. Taiwan, disjunctly distributed at lower elevation in northern and southern offshore island. It is very rare and grows in tropical rainforest on the windward slope in Lanyu Island, which is dominated by *Garcinia linii* and *Syzygium densinervium* var. *insulare*. On the other hand, It is common and grows in bamboo forest in Kueishan Island, which is dominated by *Phyllostachys makinoi*.

**Specimens examined:** **Ilan County:** Kueishan Is., ca. 100 m. alt. *K. C. Yang s. n.* May 18, 2003 (TAI, HAST, NTNTC). **Taitung County:** Lanyu Is. (Botel Tobago Is.): in pluviisivis monte Omori-yama (Mt. Tashenshan), c. 300 m alt. *T. Suzuki* 3616. (Photo of type of *S. megastyla* Fukuy. & T. Suzuki, TAI!); Tashenshan, c. 300 m alt. *T. H. Hsieh* 5037 (TAI).

Notes: This species is easily identified by its large flower (6-7 mm in diameter) (Fig. 2D), large fruit (4 mm in diameter) and short pedicels (1-2 mm in diameter). *Sciaphila megastyla* and *S. tosaensis* were treated as synonym of *S. secundiflora* (Ohashi, 2000a). Our study agrees.

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## 台灣產霉草屬 (霉草科) 植物訂正

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### 摘 要

霉草屬(霉草科)植物為腐生性細小草本，甚易被忽略，作者等近年來採集到一些新標本，根據植株外部形態和花粉型態特徵，將台灣產霉草屬植物訂正為四個種，分別為蘭嶼霉草 *Sciaphila arfakiana* Becc., 斑點霉草 *S. maculata* Miers, 多枝霉草 *S. ramosa* Fukuy. & T. Suzuki 和錫蘭霉草 *S. secundiflora* Thwaites ex Benth.。其中蘭嶼霉草和斑點霉草為新紀錄種，錫蘭霉草新發現於龜山島。蘭嶼島共有三種，為種類最多之處，目前所發現之分布地區均位於台灣島之東部。本文並提供檢索表和特徵描述等資料。

關鍵詞：霉草屬、霉草科、分類訂正、台灣。

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