

Five New Species of *Didymocarpus* (Gesneriaceae) from Peninsular Malaysia

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Abstract

Five new species of *Didymocarpus* are described from Peninsular Malaysia. Two, *D. anthonyi* Kiew and *D. leiophyllus* Kiew, are from the east coast and belong to sect. Boeopsis; *D. leucanthus* Kiew is from the foothills of Selangor; *D. stoloniferus* Kiew from Gunung Ulu Kali, Pahang; and *D. salicinoides* Kiew, from Trengganu and southern Kelantan, is raised to specific rank having previously been described as *D. salicinus* var. *major* Ridley. The sections Boeopsis and Salicini are defined and keys to their species provided. *Didymocarpus lithophilus* Kiew is validated.

Introduction

In common with several other large families of herbaceous plants, such as the Begoniaceae and Orchidaceae, the Gesneriaceae exhibits a high level of endemism (more than 90 per cent) in Peninsular Malaysia. Of the 85 odd species of *Didymocarpus* presently described, only *D. crinitus* Jack, *D. platypus* C.B.Cl. and *D. reptans* Jack (and possibly *D. fasciatus* Ridley) occur outside Peninsular Malaysia and southern Thailand. Within the peninsula, the majority of species is not widespread and 70 per cent are known from a single locality (Kiew, 1991).

Recent exploration of areas that are still botanically little known, such as the east coast, has led to the discovery of several new species. Two described here belong to sect. Boeopsis, a section which has a south-easterly distribution. However, even relatively well-known areas, such as Gunung Ulu Kali, may harbour undescribed species.

The last complete account of Malayan *Didymocarpus* is that in Ridley's flora (1923). There he recognised six sections based largely on characters of habit, inflorescence and floral morphology. These sections have remained broadly useful although several contain anomalous species. Sect. Elati (sect. Eudidymocarpus of Ridley) has been redefined by Weber & Burt (1983). Section Didymanthus contains a hotchpotch of species including the anomalous *D. parviflorus* and *D. leucanthus* (see below), *D. falcatus* and *D. flavobrunneus*, which belong to another alliance (Burt, 1990) and a group of species with large bracts (to be excluded from sect. Didymanthus and placed in a new section based on *D. venustus*). Section Reptantes and sect. Heteroboaea remain as Ridley circumscribed them. Section Pectinati has been redefined to exclude *D. densifolius* (Kiew, 1987), which is now placed in sect. Salicini (see below). Section Boeopsis is here redefined. In addition, the genus *Codonoboaea* is now reduced to sectional level in *Didymocarpus* (Kiew, 1990). There remain several species that do not fit comfortably into any of these sections, such as *D. caelestis* (Ridley) Kiew, *D. cordatus* Jack, *D. geitleri* Weber, *D. leucocodon* (Ridley) Kiew, *D. longipes* C.B.Cl., *D. primulinus*

Ridley, and *D. violascens* Ridley. Until details of floral morphology of the majority of species are better known, not only for the peninsular species but also for species throughout the geographic range of the genus, a fundamental revision of the sections will not be possible.

Descriptions of New Species

1. *Didymocarpus anthonyi* Kiew sp. nov.

Differt a *Didymocarpus heterophyllo* Ridley statura majore, foliis longioribus, lamina in petiolum decrescente et floribus majoribus.

Typus: Trengganu, Ulu Besut R. Kiew RK 2700 (holo UPM; iso K, SING).

Erect, unbranched plant, stem woody to 37 cm by 6 mm thick, flowering at 9 cm tall. Indumentum of stem apex and petioles deep brown, densely matted with long uniseriate hairs. Leaves in a tuft at top of stem, upper internodes crowded, lower internodes to 5 mm apart. Lamina oblanceolate, (12.5–) 16 (–19) by 4–4.3 cm, narrowed to apex, base narrowly cuneate, sometimes unequal, glabrous above and beneath, in life deep green above and light green beneath, drying thinly leathery. Margin in the upper half of the leaf finely and distantly serrate with a tuft of hairs in the notch, in lower half \pm entire, marginal strip hairy beneath. Secondary veins 11–16 pairs, midrib and secondary veins plane but conspicuous above, prominent beneath and sparsely hairy, arching close to margin, tertiary veins obscure above, prominent beneath. Petiole 1–2 cm long in youngest leaves elongating to 1.7–2.5 cm in older leaves, grooved above, geniculate abaxially.

Inflorescence 4-flowered cyme, several per axil. Peduncle 6–8.5 (–11 cm), erect with flowers held above leaves, brownish-purple, pedicel 10–17 mm. Bract pair ligulate, 6 by 1.5 mm long. Indumentum of peduncle, pedicel, bracts and calyx sparse with appressed, long, multicellular eglandular hairs with fewer short glandular hairs. Flowers nodding. Calyx divided almost to base, lobes narrowly acute, 2–3 by 1 mm. Corolla broadly campanulate, tube 5–6 by 7–8 mm, white, minutely pubescent outside, lobes broadly oblong, apex rounded, upper two 4–6 by 6 mm, pale to deep purple, reflexed, lower three 5 by 5–6 mm, white suffused purple, projecting 6–10 mm beyond upper. Stamens with thick fleshy filament, c. 2.5 mm long, joined to base of corolla tube, anthers white, broadly sagittate, 3 by 2 mm, connivent at apex. Ovary ellipsoid, 3 by 1.5 mm, purplish red, style whitish-green, 5 mm long and projecting beyond corolla tube, ovary and style minutely pubescent, stigma minute, rounded, c. 0.3 mm across, white, glistening, apex papillose. Disc none. Capsule narrowly ellipsoid, slightly curved, 3 cm long, c. 1.5 mm thick, \pm glabrous.

Distribution: Endemic to Peninsular Malaysia — Trengganu, Ulu Besut.

Habitat: Hill slope, common on earth banks.

Specimens examined: Trengganu — Ulu Besut: Kg. Keruak 1 September 1986 S. Anthony SA 675 (SING, UPM); Kg. La 7 May 1988 R. Kiew RK 2700 (K, SING, UPM).

Notes: By virtue of its broadly campanulate, purple corolla and large, shortly stalked anthers, this species belongs to sect. *Boeopsis*. However, it is the most robust species in this section with stems that attain 37 cm in height. In its leaves, which are glabrous above, and in its simple cymes, it resembles *D. heterophyllus* Ridley, from which it is readily distinguished not only by its greater height, but also by its larger leaves, which are strongly narrowed to the base (in *D. heterophyllus* the leaf base is rounded), and in its larger flowers (Table 1).

Table 1

Diagnostic differences between *Didymocarpus anthonyi*, *D. heterophyllus* and *D. leiophyllus*

Character	<i>D. anthonyi</i>	<i>D. heterophyllus</i>	<i>D. leiophyllus</i>
Stem height (cm)	9-37	0-7	2-19
Lamina length (cm)	12.5-19	5-13.5	7-11
Lamina width (cm)	4-4.3	2-4	2.5-4
Lamina base	narrowed	rounded	narrowed
Leaf margin	distantly serrate	crenulate	± entire
Petiole length (cm)	1-2.5	0.5-3	1-2
No. flowers/inflorescence	4	3-4	1
Calyx length (mm)	2-3	1-2	4
Corolla length (mm)	9-12	3-4	11

This species is named for S. Anthonysamy, herbarium assistant in the Department of Biology, Universiti Pertanian Malaysia, who is an excellent field botanist and who made the first collection of this species.

Among species of *Didymocarpus* the indumentum of the ovary and style is variable both with regard to trichome type and their density. The difference between a finely pubescent indumentum of long-stalked trichomes and a pustulate indumentum consisting of short-stalked glandular ones is clearly discernible with the naked eye.

The range of styler indumentum is illustrated in Plate 1. All species examined possess short-stalked glandular hairs, either with a single-celled rounded head (*D. corneri* Pl. 1e; *D. geitleri* Pl. 1g; *D. yongii* Pl. 1d) or with a 2-celled head (*D. leucanthus* Pl. 1a; *D. leucocodon* Pl. 1b) or with a 4-celled head (*D. anthonyi* Pl. 1c). Except for *D. yongii* (Pl. 1d), they possess in addition short, 2 or 3-celled eglandular hairs on a raised base. Those of *D. anthonyi* are exceptionally short. *D. leucanthus*, *D. quinquevulnerus* (Pl. 1h) and *D. platypus* possess a third type, long-stalked glandular hairs.

The density of styler trichomes varies from extremely sparse (the style of *D. anthonyi* is almost glabrous), moderately sparse (*D. leucanthus*, *D. quinquevulnerus* and *D. platypus*) to, in most cases, dense (*D. corneri*, *D. geitleri*, *D. leucanthus*, *D. leucocodon*, and *D. yongii*).

Even with this small sample, trichome type is not apparently related to taxonomic affinity. Within sect. *Boeopsis* styler trichome type differs among species: *D. anthonyi* has long eglandular and glandular hairs (the latter with a 4-celled head); *D. yongii* has only glandular hairs and these have a single-celled head. In addition, long-stalked glandular hairs are found in species in sect. *Didymanthus* (*D. leucanthus*) and in sect. *Heteroboea* (*D. quinquevulnerus*) and short, glandular trichomes with a rounded head are found in sect. *Codonoboea* (*D. corneri*) and sect. *Boeopsis* (*D. yongii*).

In species where the style projects beyond the corolla tube (*D. anthonyi*, *D. corneri* and *D. geitleri*), the predominant trichome type is short-stalked glandular trichomes and, in contrast, eglandular hairs are extremely sparse. It is tempting to suggest that these glandular hairs function to secrete substances that attract the pollinator either by scent (none of these species has a scent perceptible to the human nose) or by sight. The indumentum is glistening in all species and in some species contrasts in colour

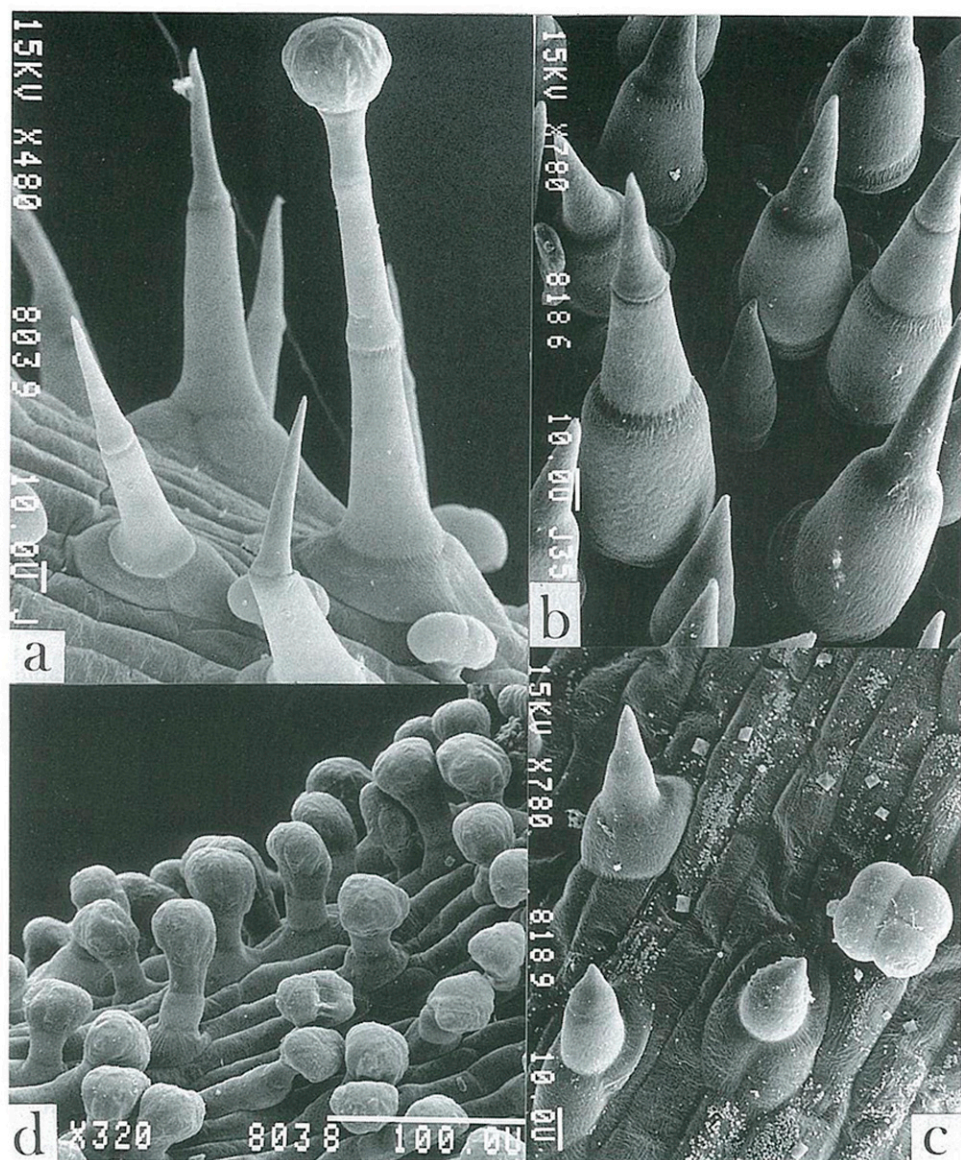


Plate 1. Stylar trichomes in *Didymocarpus*.

a. *D. leucanthus*; b. *D. leucocodon*; c. *D. anthonyi*; d. *D. yongii*.

with the white corolla. It is pale fawn in *D. corneri* and magenta-purple in *D. geitleri*. Weber (1989) recorded the indumentum of the latter species as orange. In contrast, the white style of *D. anthonyi* is almost glabrous.

Long-stalked glandular hairs are found in those species which have a long corolla tube which includes the style, namely *D. leucanthus* and *D. quinquevulnerus*. It is possible, therefore, that trichome type is related to pollinator guild rather than to taxonomic affinity.

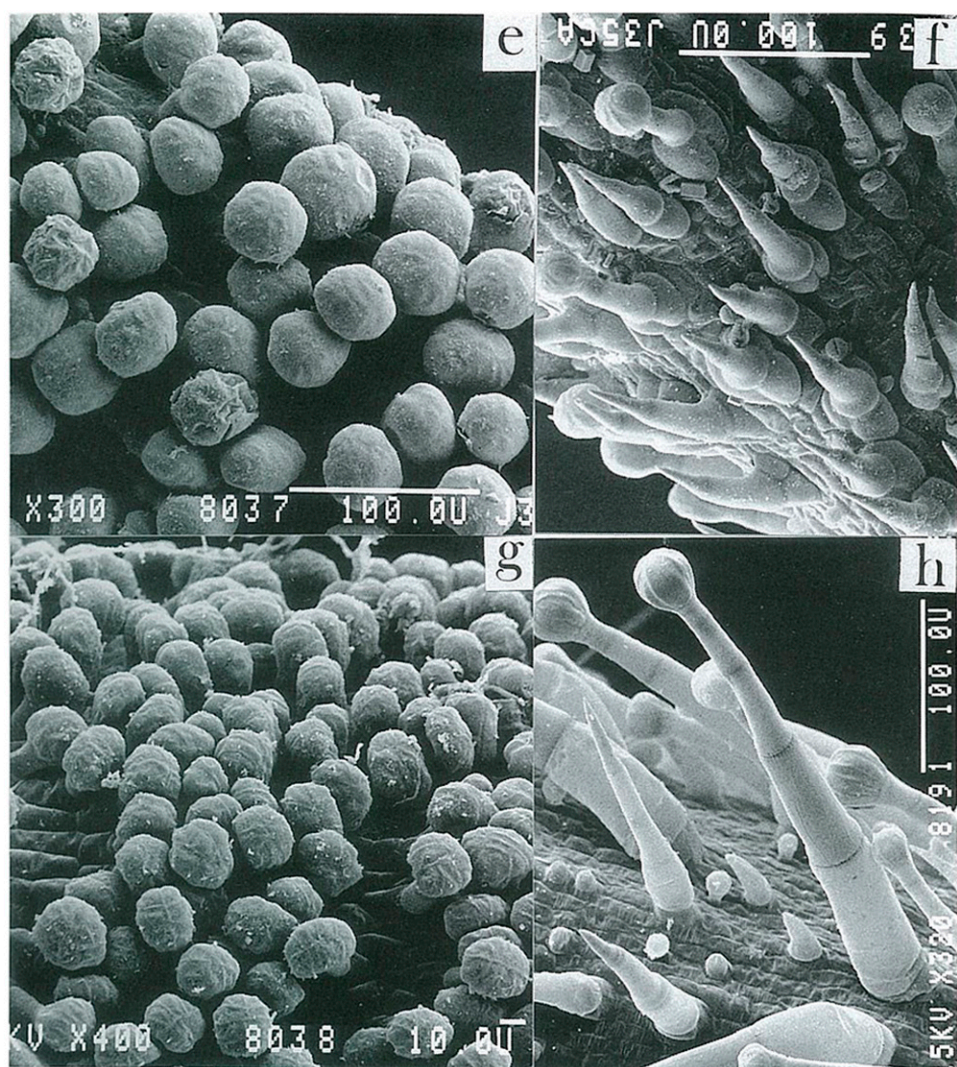


Plate 1. Stylar trichomes in *Didymocarpus* (cont.).
e. *D. corneri* (below stigma); f. *D. corneri* (above ovary); g. *D. geitleri*; h. *D. quinquevulnerus*.

In general, the indumentum of the ovary is more dense than that of the style (with the exception of *D. leucocodon* Pl. 2b) where it is more dense on the style). In some cases trichome type is the same on the style and ovary, although the hairs may be longer (e.g. *D. leucanthus* Pl. 2a, *D. anthonyi* Pl. 2c) or shorter (e.g. *D. leucocodon*) on the ovary. In other species, (*D. geitleri* Pl. 2f, *D. corneri* Pl. 2e and *D. yongii* Pl. 2d) trichome type on the style and ovary is different because short-stalked glandular trichomes with a rounded head are absent from the ovary. In *D. yongii*, in addition to eglandular hairs, there are long-stalked glandular hairs on the ovary. These latter species have a transitional zone in the lower part of the style where all types of trichome are present. This is seen in *D. corneri* (Pl. 1f) where three trichomes types are present. The transitional zone in *D. geitleri* is illustrated by Weber (1989).

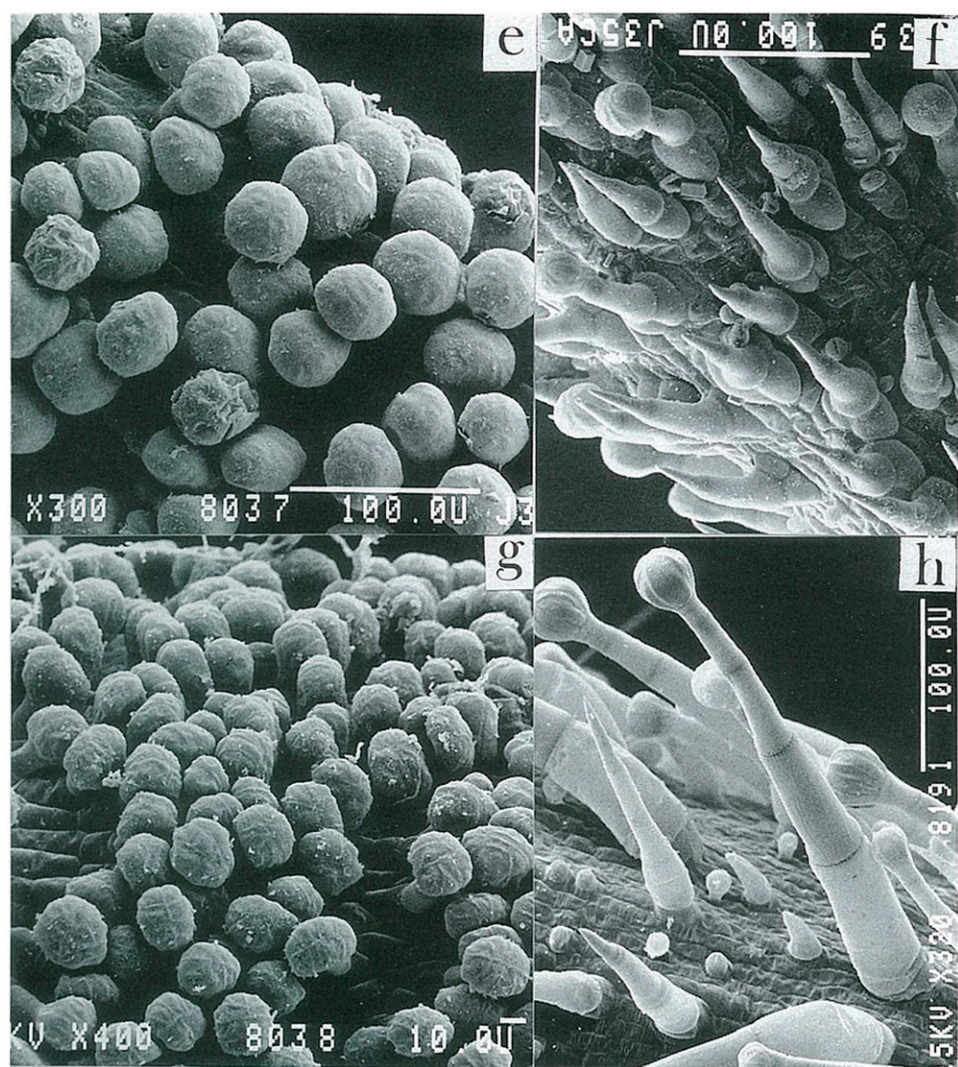


Plate 1. Stylar trichomes in *Didymocarpus* (cont.).
e. *D. corneri* (below stigma); f. *D. corneri* (above ovary); g. *D. geitleri*; h. *D. quinquevulnerus*.

In general, the indumentum of the ovary is more dense than that of the style (with the exception of *D. leucocodon* (Pl. 2b) where it is more dense on the style). In some cases trichome type is the same on the style and ovary, although the hairs may be longer (e.g. *D. leucanthus* Pl. 2a, *D. anthonyi* Pl. 2c) or shorter (e.g. *D. leucocodon*) on the ovary. In other species, (*D. geitleri* Pl. 2f, *D. corneri* Pl. 2e and *D. yongii* Pl. 2d) trichome type on the style and ovary is different because short-stalked glandular trichomes with a rounded head are absent from the ovary. In *D. yongii*, in addition to eglandular hairs, there are long-stalked glandular hairs on the ovary. These latter species have a transitional zone in the lower part of the style where all types of trichome are present. This is seen in *D. corneri* (Pl. 1f) where three trichomes types are present. The transitional zone in *D. geitleri* is illustrated by Weber (1989).

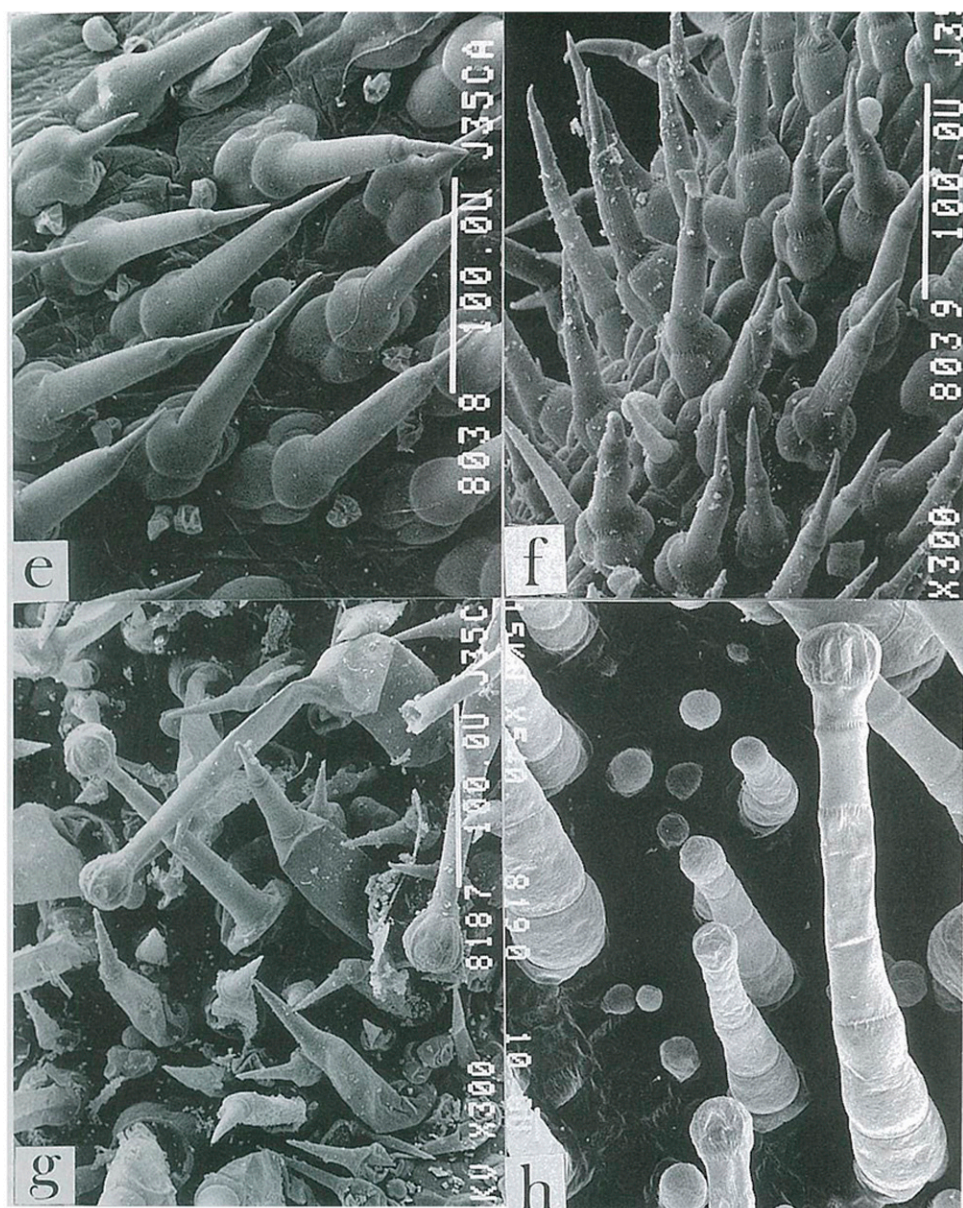


Plate 2. Trichomes of the ovary of *Didymocarpus* (cont.).
 e. *D. corneri*; f. *D. geitleri*; g. *D. platypus*; h. *D. quinquevulnerus*.

2 cm tall. Leaves forming a tuft at the top of the stem, lower leaves to 2.5 cm apart, spirally arranged. Lamina oblanceolate, 7–11 by 2.5–4 cm, apex acute or sometimes shortly acuminate, narrowed to base, unequal, glabrous above and beneath, in life dark green above, paler beneath, fleshy drying thinly leathery. Margin \pm entire, sometimes shallowly dentate towards apex, marginal strip hairy beneath. Midrib prominent above and beneath, secondary veins 8–14 pairs, plane above, prominent beneath, arching close to margin, tertiary veins \pm obscure beneath. Petiole 1 (–2) cm. Indumentum

of stem apex, petiole, and lower surface of midrib and secondary veins of appressed uniseriate hairs.

Inflorescence 1-flowered. Peduncle and pedicel slender, purple-red, minutely pubescent, erect, 3.5–6 cm long with flowers held above leaves. Bract pair ligulate, 1.5–2 mm long. Calyx divided almost to base, lobes narrowly acute, 4 by 1 mm, purple-red, pubescent. Corolla broadly campanulate, tube 6 by 5 mm, white or bluish purple, minutely pubescent outside, lobes broadly oblong, apex slightly rounded, 5 by 4–5 mm, pale lilac, upper lobes reflexed. Stamens with filaments 1.5–2 mm long, broadening to the base and joined to base of corolla tube, anthers broadly sagittate, 2 by 1 mm, connivent. Ovary narrowly ovoid, 5 by 1.3 mm, style 5 mm long, yellowish, minutely hairy and projecting beyond the corolla tube, stigma slightly discoid \pm 1 mm across. Disc encircling base of ovary, c. 0.5 mm tall, deeply lobed. Capsule narrowly ovoid, slightly curved, 1.5–3.3 cm, purple, minutely hairy.

Distribution: Endemic to Peninsular Malaysia — Trengganu, Ulu Setui.

Habitat: Locally common in lowland forest on slopes above river banks or on steep earth banks.

Specimens examined: Trengganu — Ulu Sg. Setui 28 April 1986 R. Kiew RK 2265 (UPM, SING), 29 April 1986 RK 2272 (UPM), 30 August 1986 S. Anthony SA 662 (UPM), 31 August 1986 SA 670 (UPM), 5 November 1986 SA 718 (UPM).



Plate 3. *Didymocarpus leiophyllus*.

Notes: *D. leiophyllus* (Pl. 3) is a distinctive species in its smooth leaf surface (the veins are not impressed above) and in its almost entire leaves. It belongs to sect. *Boeopsis*. In its flower it most resembles *D. anthonyi* in size (both have a larger flower than *D. heterophyllus*) and in colour (they both have a white or very pale purple corolla tube and lobes which are a deeper purple compared with *D. heterophyllus* where the corolla tube and lobes are uniformly mid-purple). Leaves of both *D. leiophyllus* and *D. anthonyi* are rather fleshy and have a pronounced pubescent marginal strip. *D. leiophyllus* differs from both *D. anthonyi* and *D. heterophyllus* in its single-flowered inflorescence (Table 1). Some populations of *D. puncticulatus* also have single-flowered inflorescences but *D. leiophyllus* would not be confused with it as *D. puncticulatus* has hairy leaves which are punctate above and which frequently have a paler band down the centre.

3. *Didymocarpus leucanthus* Kiew sp. nov.

Didymocarpo parvifloro Ridley affinis sed foliis margine crenaturis praeditis supra pubescentibus et floribus albis differt.

Typus: Selangor, Ulu Ampang R. Kiew RK 2767 (holo, UPM, iso SING).

Stem prostrate with erect branching woody shoots to 1 m tall and 3 mm thick, deep purple in life. Leaves opposite, equal-sized, distant up to 7 cm apart. Lamina lanceolate, 12–13.5 by 5–5.5 cm, apex acute or sometimes acuminate, base cuneate, in dried state chartaceous, margin minutely crenate. In life dark green above and pale beneath. Lateral veins c. 9 pairs and ascending towards margin, sometimes with a minor vein parallel to lateral veins but petering out midway to margin, lateral veins and midrib plane above, prominent beneath, tertiary veins obscure above and below. Indumentum of short uniseriate hairs with c. 4 cells, on stem and petiole dense and appressed, lamina silky above and roughly pubescent beneath, with both long and short hairs. Lamina minutely pustulate beneath. Petiole terete, 1.5 to 3 cm long, deep purple in life.

Inflorescence axillary, 1-flowered, produced in a series so that axils bear buds, flowers and fruits at the same time. Peduncle and pedicel slender, 6–8 mm long, lengthening to 12 mm in fruit. Indumentum of peduncle, pedicel, bracts and calyx dense consisting of minute glandular hairs. Bracts ligulate 2 mm long. Calyx divided to base, lobes ligulate, 2 by 1 mm. Corolla narrowly tubular, white with a yellow spot at base of tube, tube 9 by 4–5 mm, minutely pubescent outside, lobes 5, oblong, apex broadly rounded, upper lobes 3 by 2.5 mm, reflexed, minutely glandular hairs on inner surface, lower lobes 3 by 4 mm, projecting 5 mm beyond upper lobes. Stamens 2, filaments slender 4 mm long, anthers ellipsoid, 1.5 by 0.5 mm, connivent. Ovary narrowly cylindric 4 mm long, style enclosed within tube 3 mm long, densely pubescent, stigma rounded, 1 mm across, papillose. Disc 1 mm tall, subtending lower half of base of ovary. Capsule 3.5–4 cm long and 1 mm wide, densely pubescent.

Distribution: Endemic to Peninsular Malaysia — Selangor, Ulu Ampang.

Habitat: In lowland forest at c. 100 m, locally common and forming clumps on earth banks.

Specimens examined: Selangor, Ulu Ampang at Ampang Impounding Reservoir: 20 May 1984 R. Kiew RK 1307 (UPM); 16 August 1988 RK 2767 (UPM, SING).

Notes: *Didymocarpus leucanthus* most resembles *D. parviflorus* Ridley in its habit (it is decumbent producing erect, branching stems), in its long-petioled leaves and in its small, tubular corollas. It differs from *D. parviflorus*, which is a smaller, more or less

prostrate plant and which has smaller leaves (25–50 by 6–13 mm) with entire margins, yellow flowers and shorter fruits (c. 1 cm long).

Ridley (1905, 1923) included *D. parviflorus* in sect. *Didymanthus*, presumably as it has distant pairs of leaves. However, both *D. parviflorus* and *D. leucanthus* differ from other members of this section by their smaller, tubular flowers, which are not produced on long-peduncled cymes. These two species should therefore be excluded from sect. *Didymanthus* as it is presently circumscribed. However, until the Malayan species are better known, it is premature to erect a new section for them. For example, the little-known *D. flavescens* Ridley is similar to these two species in its small tubular, yellowish-white flowers on single-flowered inflorescences, but it is conspicuously different in its long peduncles, which are 2.5–7 cm long.

Among Malayan species of *Didymocarpus*, *D. leucanthus* (Pl. 4a) is unusual in possessing a nectary that does not completely surround the base of the ovary. The most common type of nectary in the genus is cylindrical and relatively large. In sect. *Heteroboea*, nectaries range from 0.7 mm tall (*D. platypus*, Pl. 4e) to 0.9 mm (*D. quinquevulnerus*, Pl. 4f) to 1.5 mm tall in *D. polyanthoides*. This type of nectary is also seen in most other sections, e.g. in sect. *Didymanthus* (*D. parvifolius*), in sect. *Codonoboea* (*D. corneri*, Pl. 4d) and in sect. *Boeopsis* (*D. yongii*, Pl. 4c). That of *D. yongii* is unusual in being distinctly lobed.

Nectary morphology is not always a reliable indicator of taxonomic affinity, although all species in the *D. falcatus*–*D. flavobrunneus*–*D. pyroliflorus* alliance have unilateral nectaries (Weber, 1989). *D. leucanthus* also has a unilateral nectary but is not at all related to this alliance. Some closely related species have different nectary types, such as *D. parvifolius* and *D. leucanthus* (*D. parvifolius* has a cylindrical nectary c. 0.5 mm tall and *D. leucanthus* has a unilateral one) and *D. anthonyi* and *D. leiophyllus* (the former species does not have a nectary and in the latter the nectary is cylindrical and lobed).

Flowers of a few *Didymocarpus* species do not have a nectary (e.g. *D. anthonyi* and *D. codonion*) or have a very small one (*D. geitleri*, Weber, 1989; *D. leucocodon*, Pl. 4b). Weber has described the features of pollen flowers in *D. geitleri* and pointed out that the evolution from nectar to pollen as a floral reward has occurred in several genera of the Gesneriaceae. In the pollen flower, not only is the nectary reduced in size but the anthers are large and conspicuous in the gaping mouth of the corolla, which has a short tube. In *Didymocarpus* this type of flower often has a style which projects beyond the mouth of the corolla. This flower type is seen in sect. *Boeopsis*, in sect. *Salicini* and in sect. *Codonoboea* (*D. corneri*). However, in sect. *Boeopsis* nectary size ranges from large (*D. yongii*) to absent (*D. anthonyi* and *D. codonion*). In *D. yongii* the style is not exerted as it is in *D. anthonyi*. Some species, such as *D. leiophyllus*, while having an exerted style, also have a nectary.

That pollen flowers have evolved several times in the Gesneriaceae and probably also within a large genus such as *Didymocarpus* means that the position of *D. geitleri* should be reconsidered, especially as its leaf morphology and indumentum is more typical of sect. *Heteroboea* than sect. *Boeopsis*, with which Weber (1989) suggested it was allied.

There is still a great deal to be learnt about pollination in *Didymocarpus*. Although many *Didymocarpus* species produce striking flowers often in abundance (a single plant of *D. quinquevulnerus* Ridley can have up to 40 flowers open at any one time, although 20–30 are more usual), it is an extremely rare event to see an insect visitor. I have only observed pollination in one species, *D. robinsonii* Ridley, where on Gunung Tahan its flowers were visited by bumblebees. It is probable that various types of bees visit the large, trumpet-shaped flowers that have conspicuous nectar guides. For those

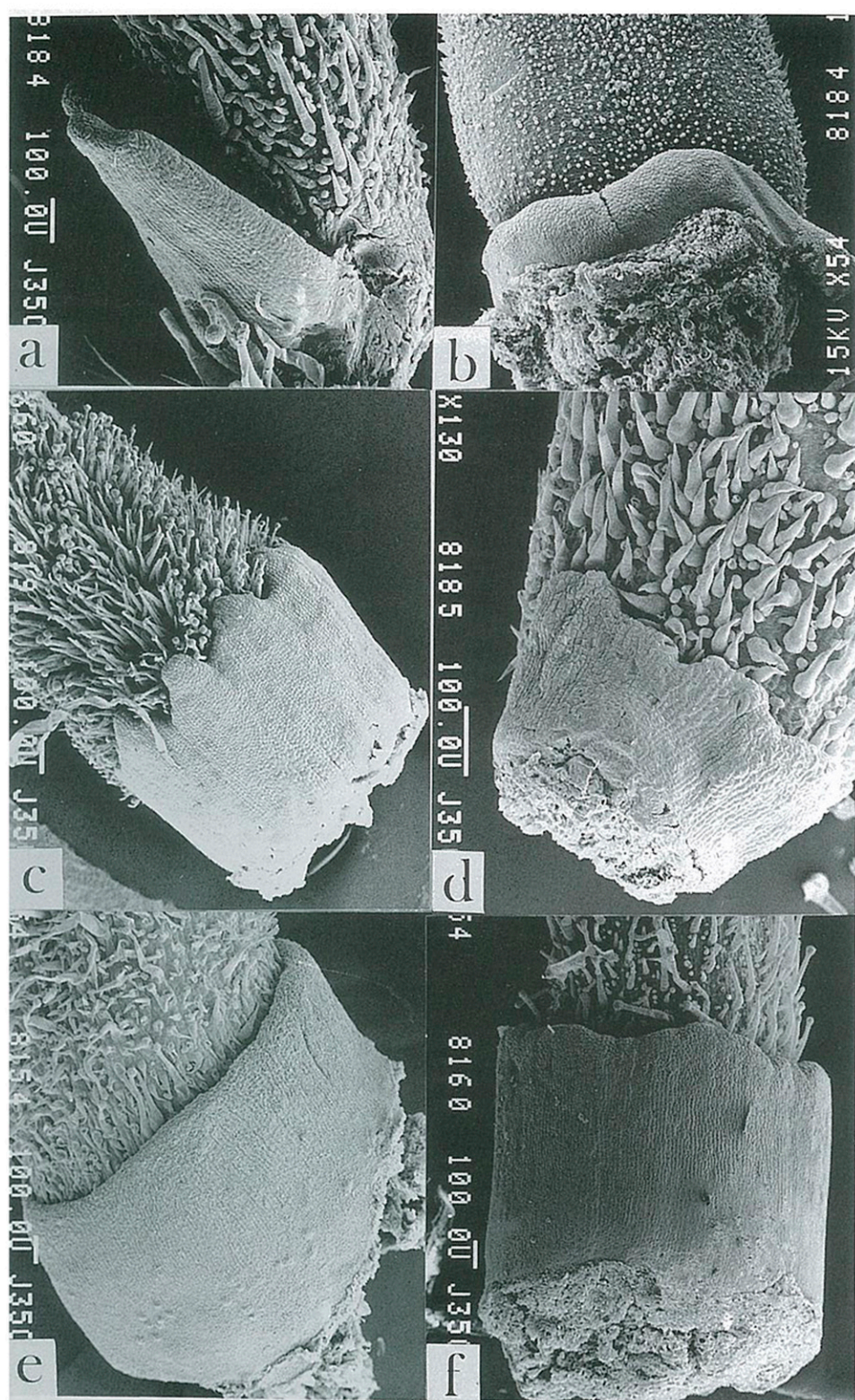


Plate 4. Nectary morphology in *Didymocarpus*.

a. *D. leucanthus*; b. *D. leucocodon*; c. *D. yongii*; d. *D. corneri*; e. *D. platypus*; f. *D. quinquevulnerus*.

species with narrow-tubed flowers, such as *D. leucanthus*, or small purple flowers of sect. *Boeopsis* and sect. *Salicini*, which do not have conspicuous nectar guides, or small white flowers with exserted styles found in *D. corneri*, *D. geitleri* and *D. pyroliflorus* the pollinator remains unknown. Nor is it known whether flowers of *D. leucocodon*, which are large, pure white and bell-like and have a relatively small nectary, are pollen or nectar flowers.

In all species of *Didymocarpus* that I have observed in the field, the stigma in the receptive phase is white and glistening, presumably due to secretions by the papillose cells (Pl. 5b). (Papillose cells in *D. leucocodon*, Pl. 5c, may be undeveloped as the stigma shown is from an immature gynaecium from a flower bud.)

In general, flowers with tubular corollas and enclosed anthers and style have larger, more or less discoid, peltate stigmas, e.g. *D. leucanthus* (Pl. 5a), *D. parviflorus* and *D. quinquevulnerus* (Pl. 5h), compared with those flowers with a projecting style, where the stigma is globose or minute and rounded (*D. anthonyi*, Pl. 5d; *D. corneri*, Pl. 5f; *D. geitleri*, Pl. 5g). The stigma of *D. geitleri* is unique among *Didymocarpus* species in possessing a conspicuously naked zone between the stigma and the pustular trichome layer on the style.

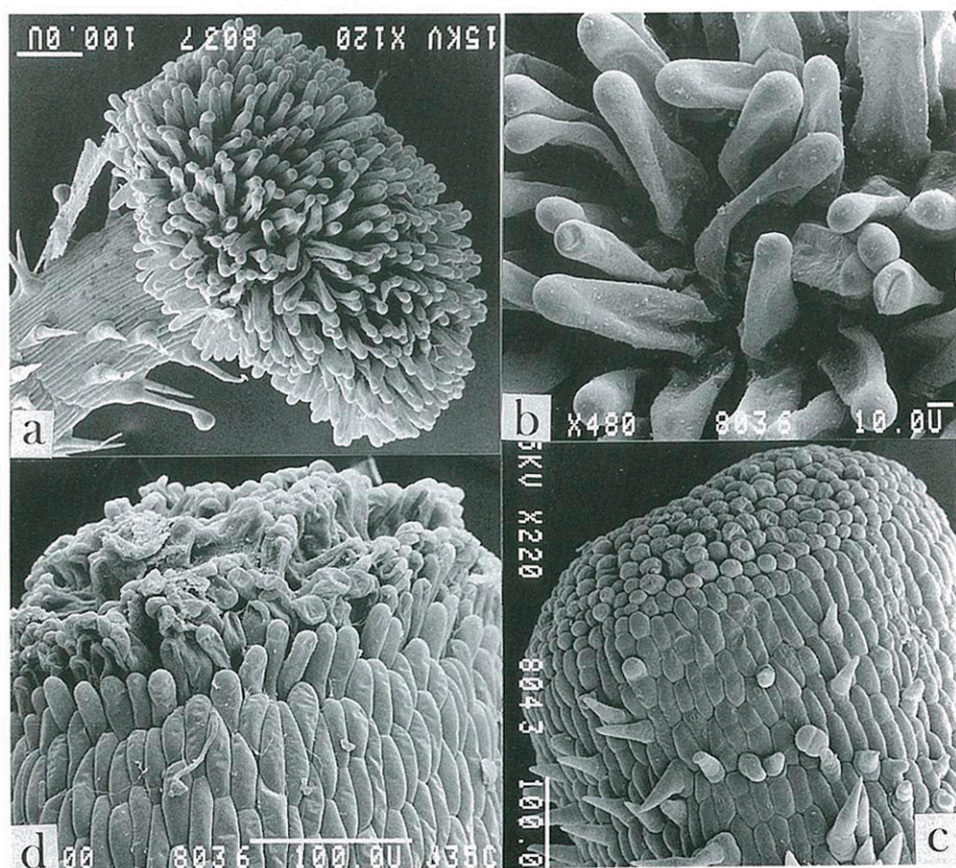


Plate 5. Stigma morphology in *Didymocarpus*.

a. *D. leucanthus*; b. papillose surface of *D. leucanthus*; c. *D. leucocodon*; d. *D. anthonyi*.

4. *Didymocarpus salicinoides* Kiew stat. et nom. nov.

Synonym: *Paraboea salicina* (Ridley) Ridley var. *major* Ridley. Flora Malay Peninsula 5 (1925) 325.

Typus: Kelantan, Kuala Aring, Yapp 193 (lecto K, isolecto CGE).

Distribution: Endemic to Peninsular Malaysia — south Kelantan, Trengganu.

Habitat: Lowland forest growing on earth banks.

Specimens examined: Kelantan — Kuala Aring 12 September 1899 Yapp 193 (K, CGE); Trengganu — Kemaman, Ulu Bendong 30 October 1935 Corner SFN 30027 (K), Bk.

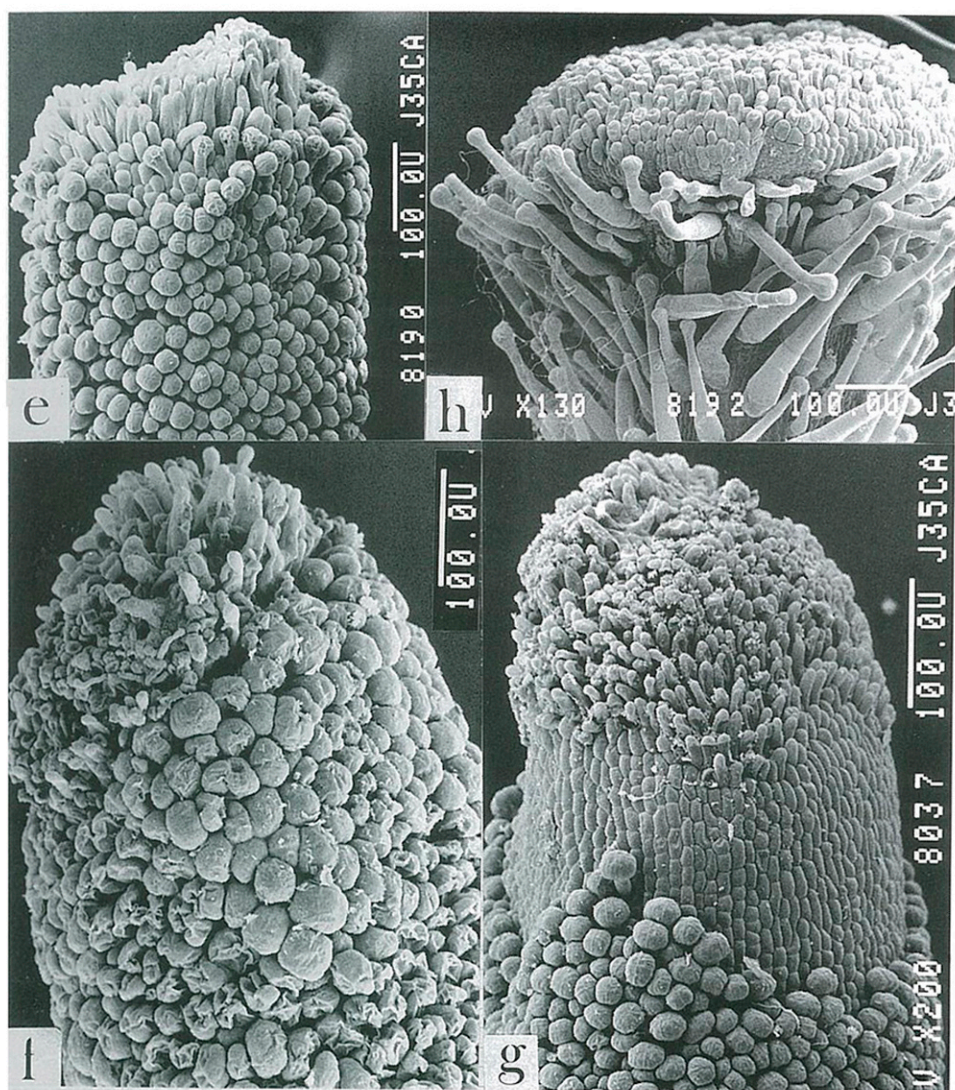


Plate 5. Stigma morphology in *Didymocarpus* (cont.).
 e. *D. yongii*; f. *D. corneri*; g. *D. geitleri*; h. *D. quinquevulnerus*.

Kajang 2 November 1935 *Corner SFN 30198* (K), Bk. Bauk 27 August 1986 *S. Anthony SA 596* (UPM), Sg. Nipa 5 May 1988 *R. Kiew RK 2654* (K, L, SING, UPM).

Notes: This species shares several common characters with *D. salicinus* Ridley. Both are plants with a wiry stem with a tuft of narrowly lanceolate leaves at the top; the leaves are flat (i.e. the veins are not impressed above), glabrous and shiny above, thinly leathery and the margin is finely serrate; the flowers are small; and the fruits are short (12–20 mm long) and narrow. In addition, both produce young leaves which are white or pale pink at the base. The species epithet is chosen to reflect the close relationship between the two species.

Ridley (1925) distinguished his var. *major* from the typical variety by its broader leaves and paniced cymes. Table 2 lists additional differences between them.

Table 2
Diagnostic differences between *Didymocarpus salicinoides* and *D. salicinus*

Character	<i>D. salicinoides</i>	<i>D. salicinus</i>
Stem	unbranched	branched (small plants unbranched)
Leaf width (mm)	20–33	10–22
Leaf apex	acute	acuminate
Petiole length (mm)	(8–) 20 (–27)	(7–) 11 (–14)
Petiole & midrib with transverse ribs	+	–
Corolla length (mm)	3 (–4)	(2–) 3
Corolla colour	white with purple upper lobes	pale violet-pink
Inflorescence length (cm)	(4–) 5 (–8)	3 (–4)
Inflorescence type	twice branched cyme	simple cyme
No. flowers/inflorescence	7 (–10)	2–4

In addition, the habitat of these two taxa differs. Plants of *D. salicinus* are rheophytes, while those of *D. salicinoides* grow on earth banks in lowland forest not necessarily close to streams. While differences in leaf width may be attributed to the different conditions under which they live (and indeed plants of *D. salicinus* that grow above the flood level do have broader leaves, Kiew 1989), even when this is taken into account there is still a difference (Table 2).

It may be a coincidence that another species pair (*D. heterophyllus*–*D. floribundus*) shows this same difference in the riverine taxon having simple cymes and the forest undergrowth species paniced cymes and that these two species pairs grow together. Thus the plants with simple cymes, *D. salicinus* and *D. heterophyllus* grow along the Sg. Tahan, and *D. salicinoides* and *D. floribundus* grow together in the Kemaman area.

Didymocarpus salicinus and *D. salicinoides* belong to sect. *Salicini*.

5. *Didymocarpus stoloniferus* Kiew *sp. nov.*

Inter congeneribus Peninsulae Malaysiae habitu, foliis et fructibus ad *D. puncticulatum* accedens, sed stolonibus, pedunculis brevibus et corollis majoribus et tubaeformibus differt.

Typus: R. Kiew *RK 1638* (holo UPM, iso SING).

A rosette plant producing thin stolons 30 cm or longer with plantlets at intervals. Leaves in opposite pairs forming a compact rosette of c. 8 leaves. Lamina broadly elliptic 3–6 by 1.5–2.5 cm, apex acute (rarely acuminate), base rounded sometimes unequal, in life fleshy, drying membranous, margin serrate. Indumentum on upper surface of lamina dense with 4-celled unbranched hairs with conspicuously raised hair base, dense on lower surface of lamina, midrib, veins and petiole. Midrib and secondary veins depressed above and prominent beneath, secondary veins 6–9 pairs, tertiary veins obscure above and below. Petiole slender, 6–40 mm long.

Inflorescence 1-flowered. Peduncle and pedicel 12–16 mm long. Indumentum of pedicel and calyx with glandular hairs with a multicellular stalk. Bracts linear 1.5–2 mm long. Calyx divided to base, lobes ligulate, 2–3 by 1 mm. Corolla trumpet-shaped, tube 17 mm long by 1.5 mm wide at base dilating to 9 mm across at mouth, glabrous, whitish tinged purplish-pink, throat white with 2 lemon-yellow nectar guides, lobes pale purple-pink, equal-sized, broadly oblong, apex rounded, 4 by 4–5 mm. Stamens 2, filaments slender 4 mm long, anthers ellipsoid, 2 by 1 mm, connivent. Ovary ovoid, 2.5 by 1 mm, style slender 19 mm long, ovary and style densely pubescent, stigma discoid c. 0.5 mm across, not projecting beyond the corolla tube. Disc cylindrical, c. 0.5 mm tall. Capsule 8–10 by 2.5 mm, spreading pubescent (Burt & Stone B 11690).

Distribution: Endemic to Peninsular Malaysia — Pahang, Gunung Ulu Kali.

Habitat: Growing in moss on large granite rocks or rockfaces in upper montane forest at c. 1,600 m a.s.l.

Specimens examined: Pahang, G. Ulu Kali — 12 October 1978 B.L. Burt & B.C. Stone B 11690 (E); 25 March 1985 Ruth Kiew RK 1638 (UPM, SING).

Notes: This species has been found at just two sites: one population was growing on the drier side of large rocks in forest (B 11690), the other on a sheer rock face some 15 m high, which forms one side of a damp, dark gully (RK 1638). Although the latter population has been visited at all times of year over a period of more than ten years, it has only been found in flower on two occasions (March 1985 and October 1989), when many plants were in flower. It is interesting that the other collection was also made in October (1978) when “the plants were flowering freely” (Burt, pers. comm.).

The assignment of this species to one of the presently circumscribed sections is problematic. On the one hand its small rosette habit and short fruits ally it with sect. *Boeopsis* but it has neither the long peduncles nor the short campanulate corolla of this section; on the other hand its trumpet-shaped flower with distinct yellow nectar guides resembles species in sect. *Heteroboaea* but it is not a robust plant with a woody stem and large leaves. Although it superficially resembles *D. puncticulatus* in sect. *Boeopsis* in its one-flowered inflorescence, its short fruit and small crenate leaves, which are hairy above; it differs from this species as *D. puncticulatus* does not have stolons, its leaves are punctate above and have a broad pale green band down the midrib, its inflorescence has a long peduncle and its flowers are shortly campanulate. In possessing stolons *D. stoloniferus* is unique among Malayan *Didymocarpus*.

Didymocarpus lithophilus Kiew Validated

Mr B.L. Burt has pointed out to me that the application of *Didymocarpus kompoboea* C.B.Cl. to a Malayan taxon being simply a misidentification, the new name *D. lithophilus* (Kiew, 1989) therefore requires a latin diagnosis to be valid, which is here supplied,

***Didymocarpus lithophilus* Kiew spec. nov.**

Gardens' Bull. Singapore 42 (1989): 54.

Synonym: *D. kompsoboea* auct.; Ridley Trans. Linn. Soc. 2nd Ser. 3 (1893) 328; Fl. Mal. Pen. 2 (1923): 518 — non C.B.Cl. in DC Mon. Phan. 5 (1883) 92.

Typus: Ridley 2152 Kuala Tahan, Pahang (holo K; iso SING).

Didymocarpus platypodi affinis sed venatione (in *D. lithophilo* areolis oblongis; in *D. platypode* areolis polygonalibus) et fructibus brevioribus differt. Differt a *Didymocarpus rugoso* foliis tenuibus non bullatis et pedunculis duplo longioribus.

Section Boeopsis

Section Boeopsis includes species that are smallish rosette plants with broadly campanulate flowers. The earliest Malayan species in this group, *D. heterophyllus*, was described by Ridley in 1893. In 1896, he grouped it with *D. puncticulatus* Ridley in sect. Kompsoboea. The latter includes species with a rosette habit but their flowers are larger and trumpet-shaped compared with the smaller campanulate ones of either *D. heterophyllus* or *D. puncticulatus*. (Sect. Kompsoboea is not represented in Peninsular Malaysia.) In 1905 Ridley described a new section, Acaules, which he defined as comprising plants that are 'Stemless or nearly so. Leaves crowded' and in which he included *D. violaceus* Ridley, *D. lacunosus* Hook. f., *D. pumilus* Ridley as well as *D. heterophyllus*, *D. perditus* Ridley and *D. puncticulatus*. (Acaules is not available as a sectional name in *Didymocarpus*, as its lectotype, *D. lacunosus* has been transferred to *Chirita*.)

In 1907 Ridley described a new section, Boeopsis, to accommodate *D. perditus*, *D. puncticulatus*, *D. heterophyllus* and *D. battamensis* Ridley, the latter a species from Pulau Batam, an island south of Singapore. He described the species in this section as being small plants with short corolla tubes and two short stamens with thick sigmoid filaments and subglobose or elliptic anthers.

In his 1923 account of the genus, Ridley defined sect. Boeopsis as comprising plants with 'leaves crowded in a tuft at the top of a woody root stock, peduncles slender, flowers usually small' and in this he included *D. longipes* C.B.Cl., *D. primulinus* Ridley, *D. soldanella* Ridley, *D. pumilus* and *D. grandiflorus* Ridley, as well as those included in his 1907 account. *D. grandiflorus* (now renamed *D. ridleyanus* Burt), on account of its distant pairs of leaves and large tubular flowers, obviously does not belong to this section and is now placed in sect. Didymanthus (Kiew, 1989). *D. longipes* and *D. primulinus* are both anomalous within this section in possessing yellow flowers with narrow corolla tubes. All other species in sect. Boeopsis have purple, campanulate corollas.

D. longipes is quite unlike any other Malayan species in its leaves and its condensed cymes borne on long peduncles. Its narrow tubular flowers recall those of *D. flavobrunneus* Ridley and *D. falcatus* Kiew. In 1896 Ridley had noted that 'it is difficult to find any species really nearly allied to this' and he did not place it in sect. Kompsoboea. In his 1905 account he included *D. longipes* in sect. Didymanthus (i.e. not in sect. Acaules with *D. heterophyllus* and *D. puncticulatus*). Burt (1954) selected *D. longipes* as the lectotype of sect. Boeopsis based on Ridley's flora account of 1923 as he did not realize that this section had already been published in 1907 where it did not include *D. longipes* (Burt, pers. comm.)

It is proposed here that sect. Boeopsis be redefined in its original 1907 sense and that *D. longipes*, *D. primulinus* and *D. ridleyanus* be excluded from the section. Burt (1971) returned most species that Ridley had included in *Paraboea* sect. Campanulati

to *Didymocarpus* sect. *Salicini*. However, sect. *Salicini* is best kept in Ridley's original sense for narrow-leaved species (see below). Only two of the remaining *Paraboea* species conform to the circumscription of sect. *Boeopsis*, viz. *D. floribundus* (Henderson) Burt and *D. rubiginosus* (Ridley) Burt, both of which have a rosette habit and purple, campanulate flowers. Apart from the two new species described above, another three recently described species, *D. codonion* Kiew, *D. n.sp.* (proposed to be named *D. oreophilus* Kiew) and *D. yongii* Kiew all belong to this section. *D. perditus* Ridley is a synonym of *D. puncticulatus* (Kiew, 1987). Therefore at present, this section includes eleven species. *D. heterophyllus* is here chosen as the lectotype of the section as it is typical in its small rosette habit, its purple campanulate flowers and its short capsule.

Section *Boeopsis* Ridley J. Str. Br. Roy. Asiatic Soc. 49 (1907) 22; Ridley Fl. Mal. Pen. 2 (1923) 508.

Lectotype: *D. heterophyllus* Ridley Trans. Linn. Soc. 2nd Ser. 3 (1893) 329.

Small to medium-sized herbs, stemless or not, with a rosette of usually oblanceolate leaves, flowers held above the leaf rosette in a lax cyme of 3–18 (rarely 1–2) flowers, corollas short and broadly campanulate, purple (sometimes pink) without yellow nectar guides, stamens with short, thick filaments, anthers large, broadly oblong and prominently positioned in the mouth of corolla tube, style either contained within corolla tube or projecting well beyond it, ovary short, capsule short (up to 2.5 cm long).

Key to Malayan Species of Section *Boeopsis*

1. Peduncle more than 13 cm long 2
 2. Leaf velvety above, veins and lamina concolorous *D. rubiginosus*
 2. Leaf \pm glabrous above, veins outlined in white *D. yongii*
1. Peduncle less than 10 cm long 3
 3. Inflorescence with one or sometimes 2 flowers 4
 4. Leaf glabrous above, margin \pm entire *D. leiophyllus*
 4. Leaf hairy above, margin crenate 5
 5. Leaf sparsely hairy and minutely punctate above, fruit to 15 mm long *D. puncticulatus*
 5. Leaf densely velvety and not punctate above, fruit to 25 mm long *D. n. sp.*
 3. Inflorescence cymose with 3 or more flowers 6
 6. Inflorescence with 8 or more flowers 7
 7. Leaf petiole 2.5–7 cm, calyx 1–1.5 mm, corolla to 4 mm long *D. codonion*
 7. Leaf petiole 0.5–2 cm, calyx 3–5 mm, corolla to 7–9 mm long *D. floribundus*
 6. Inflorescences with 3–4 flowers 8
 8. Leaf silky grey above *D. pumilus*
 8. Leaf glabrous above 9
 9. Leaf 12–19 cm long, base narrowed *D. anthonyi*
 9. Leaf 5–13.5 cm long, base rounded 10
 10. Leaf oblanceolate, apex acute, fruit c. 25 mm long *D. heterophyllus*
 10. Leaf obovate, apex rounded, fruit c. 15 mm long *D. soldanella*

The geographic range of species in sect. *Boeopsis* is centred on the east and south of Peninsular Malaysia (Fig. 1). The majority are confined to the lowlands with the exception of *D. puncticulatus*, which has an altitudinal range from near sea level

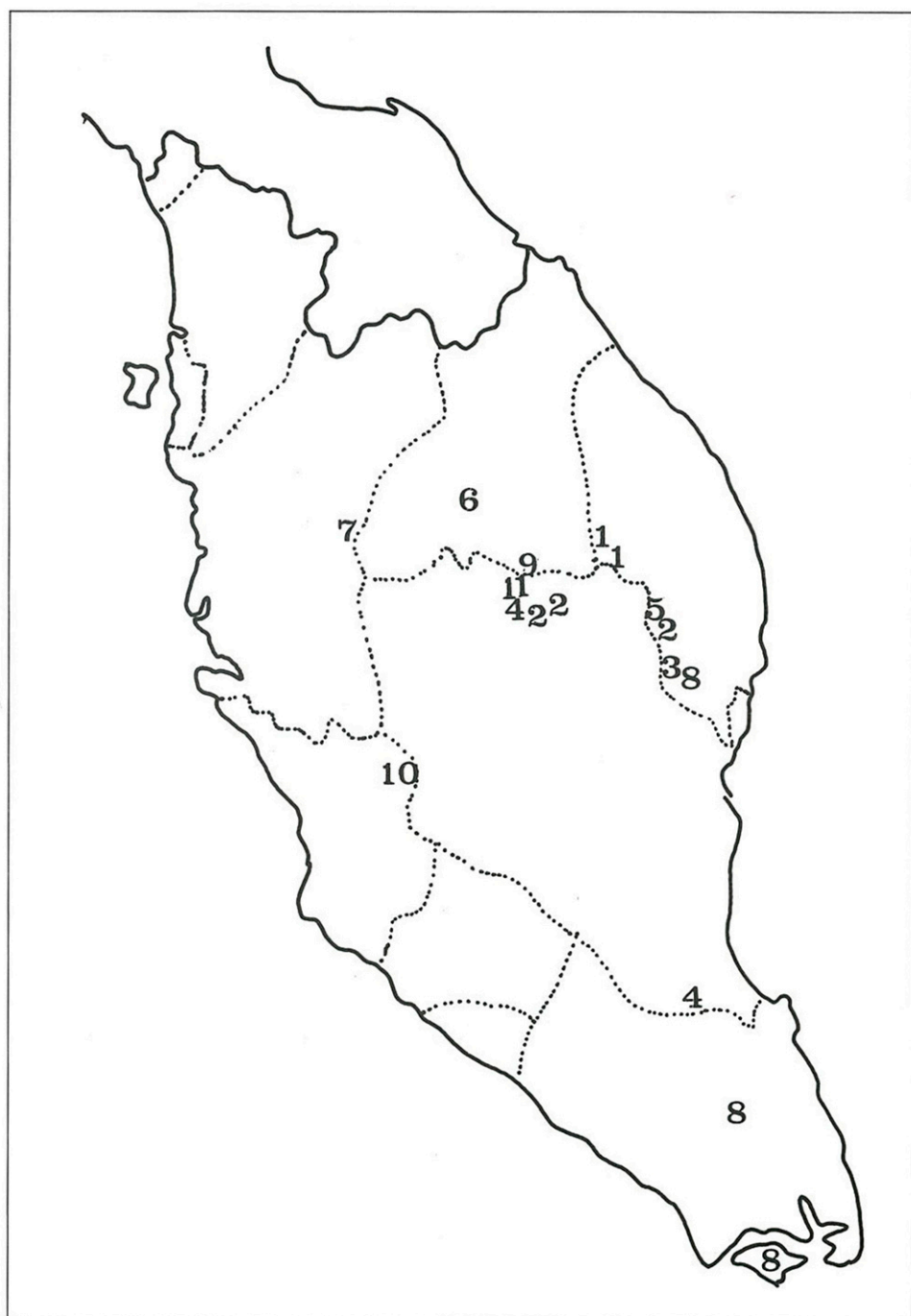


Fig. 1. Distribution of *Didymocarpus* species belonging to Section Boeopsis.

1. *D. anthonyi*; 2. *D. codonion*; 3. *D. floribundus*; 4. *D. heterophyllus*; 5. *D. leiophyllus*; 6. *Didymocarpus* sp. nov.; 7. *D. soldanella*; 8. *D. puncticulatus*; 9. *D. rubiginosus*; 10. *D. pumilus* and 11. *D. yongii*.

to 1,000 m. The few that are confined to the mountains include *D. rubiginosus* on Gunung Tahan (1,300–2,000 m), and *D. n. sp.* on G. Setong (1,000 m), *D. pumilus* on Fraser's Hill (1,000 m) and *D. soldanella* on G. Kerbau, the latter three are from the Main Range but notably not collected from the western side. Apart from *D. soldanella* (unfortunately poorly known from a single scrap of a fruiting specimen), the other montane species all have leaves that are densely hairy on the upper surface, as does *D. puncticulatus*. The grey, silky indumentum of *D. pumilus* recalls the appearance of species of *Loxocarpus* and indeed it is this section that includes the *Didymocarpus* species with the shortest fruits (Kiew, 1987). However, all species of *Loxocarpus* have much smaller flowers and the cymes are more compressed.

Section Salicini

Ridley (1896) described species in section Salicini as being 'small, short flowered species with narrow willow leaves crowded at the top of a short woody stem'. He included in this section *D. pectinatus*, *D. salicinus* and *D. densiflorus*, (the last an undescribed species based on a specimen collected by H.J. Kelsall from G. Janing, Johore). In 1905 he added *D. serratifolius*.

Ridley did not include this section in his 1923 account in which he transferred *D. salicinus* to *Paraboea* sect. *Campanulati*. The species that remained in *Didymocarpus*, *D. densifolius*, *D. pectinatus* and *D. serratifolius*, he placed in a new section *Pectinati*. (Section *Pectinati* is a distinct group of species with deeply serrate or pectinate leaf margins and small white tubular flowers. For this reason *D. densifolius* was excluded from this section, Kiew 1987).

In returning species from *Paraboea* Sect. *Campanulati* to *Didymocarpus* sect. *Salicini*, Burt (1971) only excluded *D. cordatus* and *D. tahananicus* from sect. *Salicini*. However, apart from *D. caeruleus*, *D. filicifolius* and *D. salicinus*, the other species do not conform to Ridley's concept of the section comprising species with willow-shaped leaves. Kiew (1987) has suggested that sect. *Salicini* be used in its original restricted sense. It presently includes the following species: *D. densifolius* Ridley (syn. *Paraboea caerulea* Ridley and *D. azureus* Burt, Kiew 1987), *D. salicinoides*, *D. salicinus* Ridley (syn. *D. filicifolius* Ridley, Kiew, 1989) and *D. tiumanicus* (Ridley) Burt. (Although *D. holttumii* (Henderson) Burt has narrowly lanceolate leaves, 8–11 by 1.5–2 cm, it does not belong to this section as its leaves are arranged in distant pairs. In addition, its flower buds are reported as yellow. Flower colour in sect. *Salicini* ranges from pink to purple to bluish-purple.)

Key to Species in Section Salicini

1. Leaf hairy above *D. tiumanicus*
1. Leaf glabrous above 2
2. Leaves 10–19 cm long, decurrent, leaf margin entire, flowers 12–17 mm long *D. densifolius*
2. Leaves 5–7 cm long, petiolate, leaf margin minutely serrate, flowers 2–6 mm long 3
3. Cymes simple, petiole not transversely ribbed *D. salicinus*
3. Cymes panicle, petiole and midrib transversely ribbed *D. salicinoides*

As mentioned above, *D. salicinoides* and *D. salicinus* are closely similar. They differ from *D. densifolius* and *D. tiumanicus* in their smaller flowers and slender peduncles. (*D. tiumanicus* has corollas c. 12 mm long). This raises the suspicion that this section may include rheophytes, and that the tufted habit and willow-shaped leaves reflect

ecological adaptation rather than relatedness of the species. The purple campanulate corolla with a wide mouth and conspicuous white anthers is also seen in sect. *Boeopsis*. However, until the range of floral structure in *Didymocarpus* is more fully understood, it is premature to split this section further.

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