

## A Revision of the Herbaceous *Phyllanthus* L. (Euphorbiaceae) in Taiwan

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**ABSTRACT** : Some herbaceous species of *Phyllanthus* L. which were confused and difficult to distinguish in Taiwan are revised into eight taxa, viz. *P. amarus* Schum. & Thonn., *P. embergeri* Haic. & Rossign., *P. hookeri* Muell.-Arg., *P. urinaria* L. subsp. *nudicarpus* Rossign. & Haic., *P. ussuriensis* Rupr. & Maxim., *P. virgatus* Forst. f., *P. debilis* Klein ex Willd. and *P. tenellus* Roxb. The last two species were newly naturalized to Taiwan. And *P. urinaria* subsp. *nudicarpus* is new to Taiwan. With the comparison of the SEM photographs of pollen grains and seed surface ornamentation, their identification appeared satisfactory.

**KEY WORDS** : *Phyllanthus*, Euphorbiaceae, Revision, Taxonomy, Pollen Morphology, Seed Morphology, Taiwan.

### INTRODUCTION

Three species of herbaceous *Phyllanthus* L. were reported in Taiwan previously, namely *P. niruri* L., *P. simplex* Ritz. and *P. urinaria* L. (Forbes and Hemsley, 1894; Henry, 1896; Hayata, 1904, 1906; Sasaki, 1928; Keng, 1955). Later, *P. niruri* was revised to *P. amarus* Schum. & Thonn. (Deng and Wang, 1993), *P. simplex* was treated as a synonym of *P. virgatus* Forst. f. (Hsieh, 1977), and the species neither referable to *P. niruri* nor to *P. simplex* was regarded as *P. urinaria* in spite of its diversity (Keng, 1955; Hsieh, 1977; Deng and Wang, 1993). In this paper herbaceous species of the *Phyllanthus* were treated based on a comparison of morphology, especially the pollen grains and seeds on SEM. Eight taxa are recognized. They are referable to *P. amarus*, *P. embergeri* Haic. & Rossign., *P. hookeri* Muell.-Arg., *P. urinaria* L. subsp. *nudicarpus* Rossign. & Haic., *P. ussuriensis* Rupr. & Maxim., *P. virgatus*, *P. debilis* Klein ex Willd. and *P. tenellus* Roxb.

### MATERIALS AND METHODS

Both of the fresh materials and specimens were examined. The vouchers are deposited in the following herbaria: Herbarium, Institute of Botany, Academia Sinica, Taipei, Taiwan (HAST); Herbarium, Department of Botany, National Taiwan University, Taipei, Taiwan

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(TAI); Herbarium, Department of Biology, National Taiwan Normal University, Taipei, Taiwan (TNU), and Herbarium, Department of Mathematics and Science Education, National Hualien Teachers College (HLTC).

Pollen grains were treated by acetolysis method (Erdtman, 1952), via in an alcoholic series dehydration and then golden coating for micrographs by a Hitachi S-520 scanning electron microscope. Pollen size were measured by 3-5 pollen grains. The seeds and fruit exocarps were air dried and coated with gold for SEM.

## RESULTS

### Branching patterns:

Based on the branching patterns (Webster, 1956), two types of the *Phyllanthus* in Taiwan could be recognized. *P. ussuriensis* and *P. virgatus* are categorized as the same group. Here the phyllotaxy is completely distichous. The axis is not differentiated and the flowers occur at each node (Fig. 1). The rest of the species, including *P. amarus*, *P. embergeri*, *P. debilis*, *P. hookeri*, *P. tenellus* and *P. urinaria* subsp. *nudicarpus*, show phyllanthoid branching type (Figs. 2-4). These plants have two different kinds of axes: the stems are distinctly differentiated into long shoots and short shoots; the long shoots are persistent, flowerless and "leafless"; and the short shoots are deciduous, floriferous and "leafy" as described by Webster.

### Pollen grains:

According to the classification of pollen types in *Phyllanthus* (Punt & Rentrop, 1973; Bor, 1979; Punt, 1980; Lobreau-Callen *et al.*, 1988), the eight Taiwanese species can be categorized into four types (Table 1).

I. The *P. amarus* type. *P. amarus*, a widespread species in tropical area, and its close relative, *P. debilis* of South East Asia, are representative of this class. In this pollen type the ornamentation is usually microreticulate or bireticulate (Figs. 5-16).

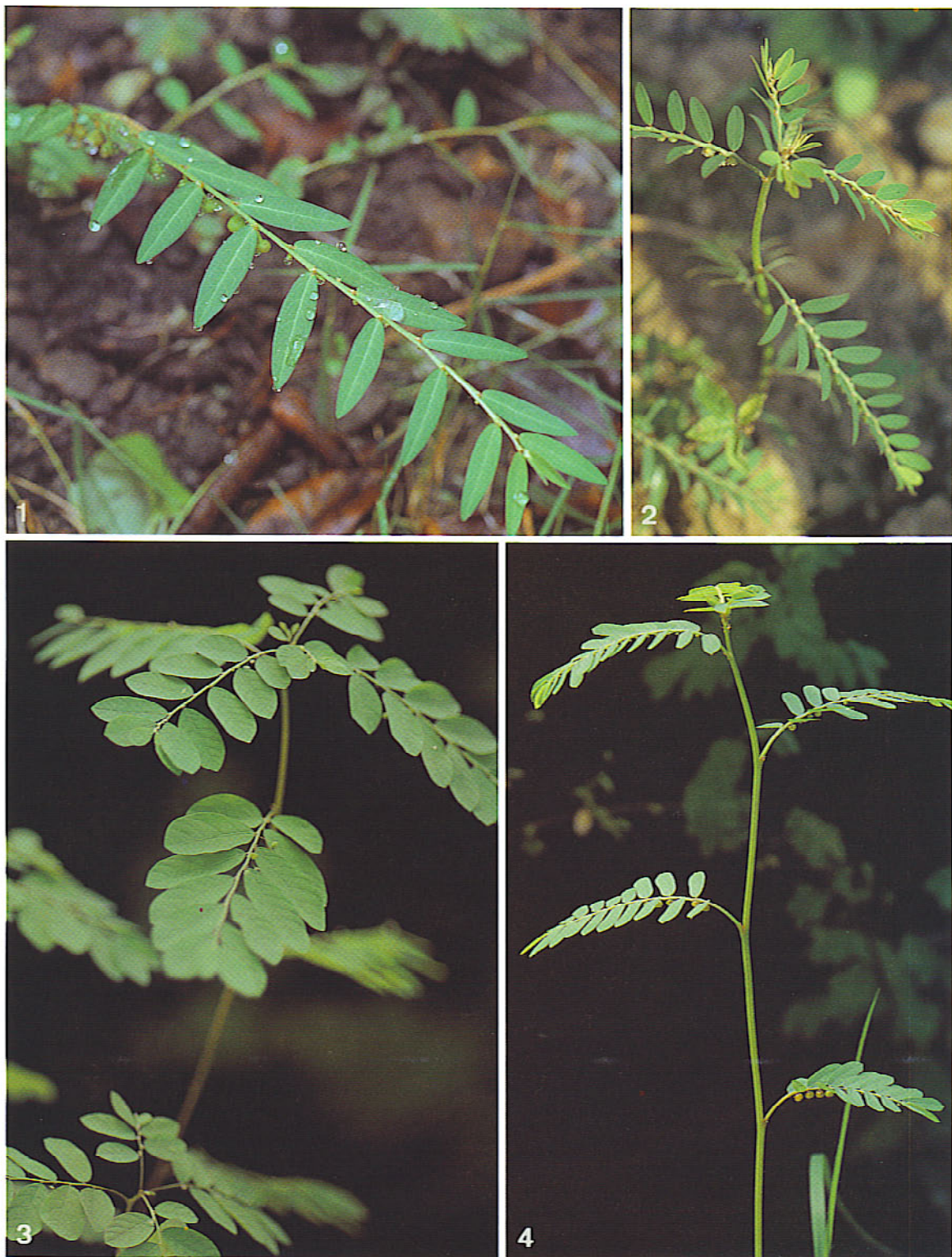
II. The *P. tenellus* type. *P. tenellus*, a species newly naturalized to Taiwan, is the only representative of the group. Pollen ornamentation of this type is very similar to that of *P. amarus* or *P. urinaria*, however, the very irregular reticulum with small lumina intermixed with larger ones made it as a distinctive class (Figs. 17-22).

III. The *P. urinaria* type (Figs. 23-38). Three common weedy species, *P. hookeri*, *P. embergeri* and *P. urinaria* ssp. *nudicarpus* are considered to be this group. Here the pollen type is 4- or 5-colporate with microreticulate or bireticulate ornamentation.

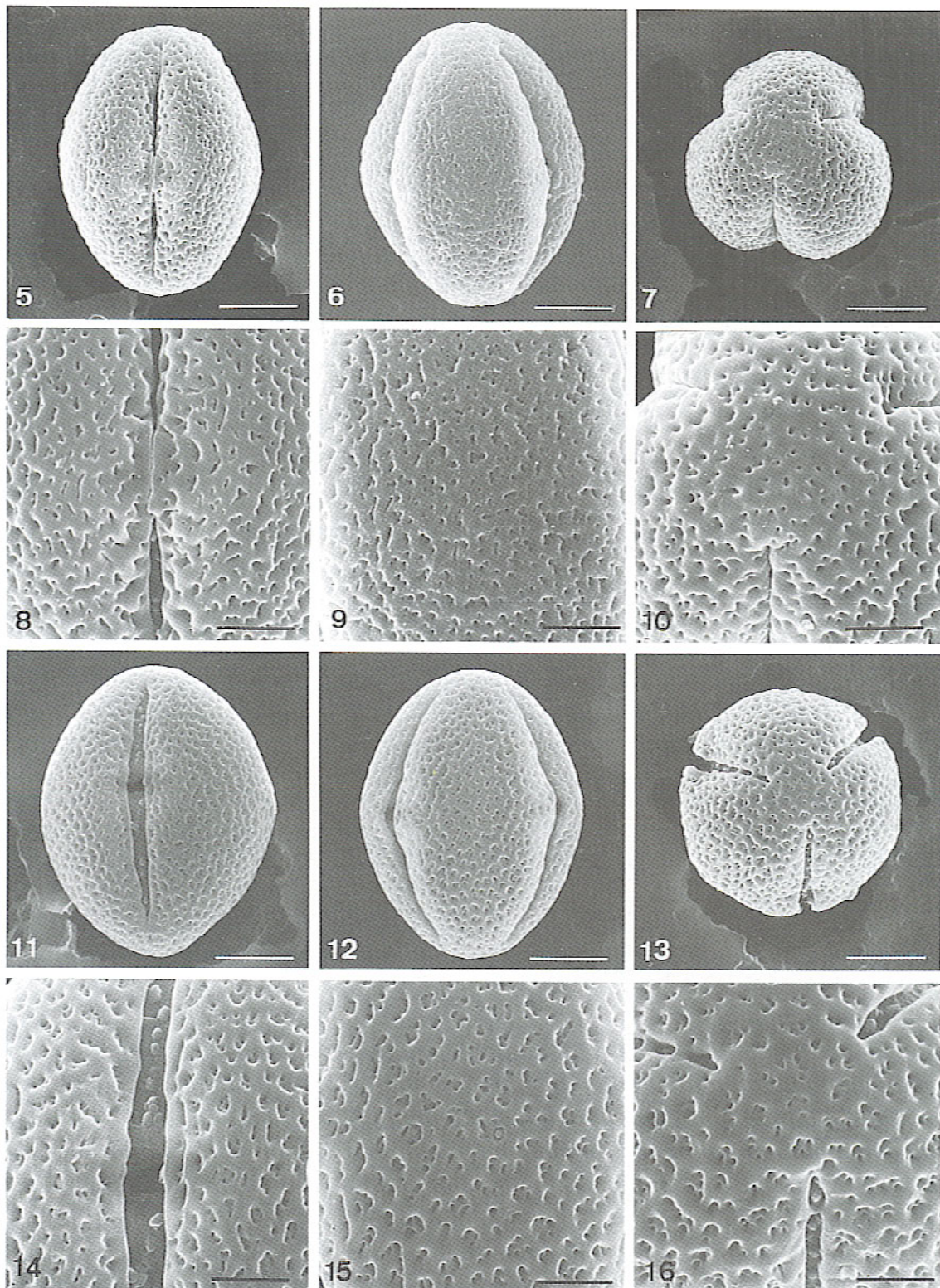
IV. The *P. virgatus* type (Figs. 39-50). In *P. ussuriensis* and *P. virgatus* the pollen morphology presents a completely different type. The pollen grains are sphaeroidal to ellipsoidal and are pantocolporate with very coarsely reticulate ornamentation.

### Fruits:

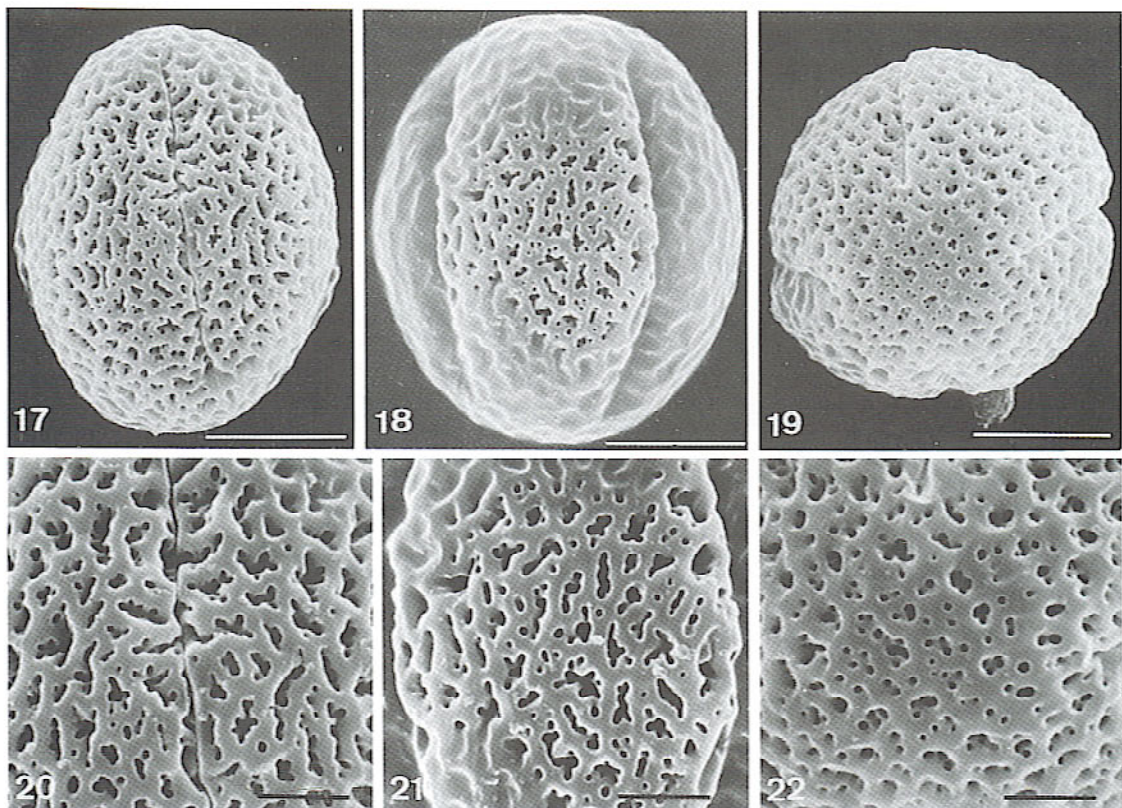
In separation of the species of *Phyllanthus*, the characteristics of the fruit morphology is not satisfactory. However, in Taiwanese species, the varying length of the pedicel and the surface of the exocarp are useful for separating a few sections in the genus. In *P. tenellus* of sect. *Floribundi*, the fruits are smooth. Its noticeable character is the very long and pendulous



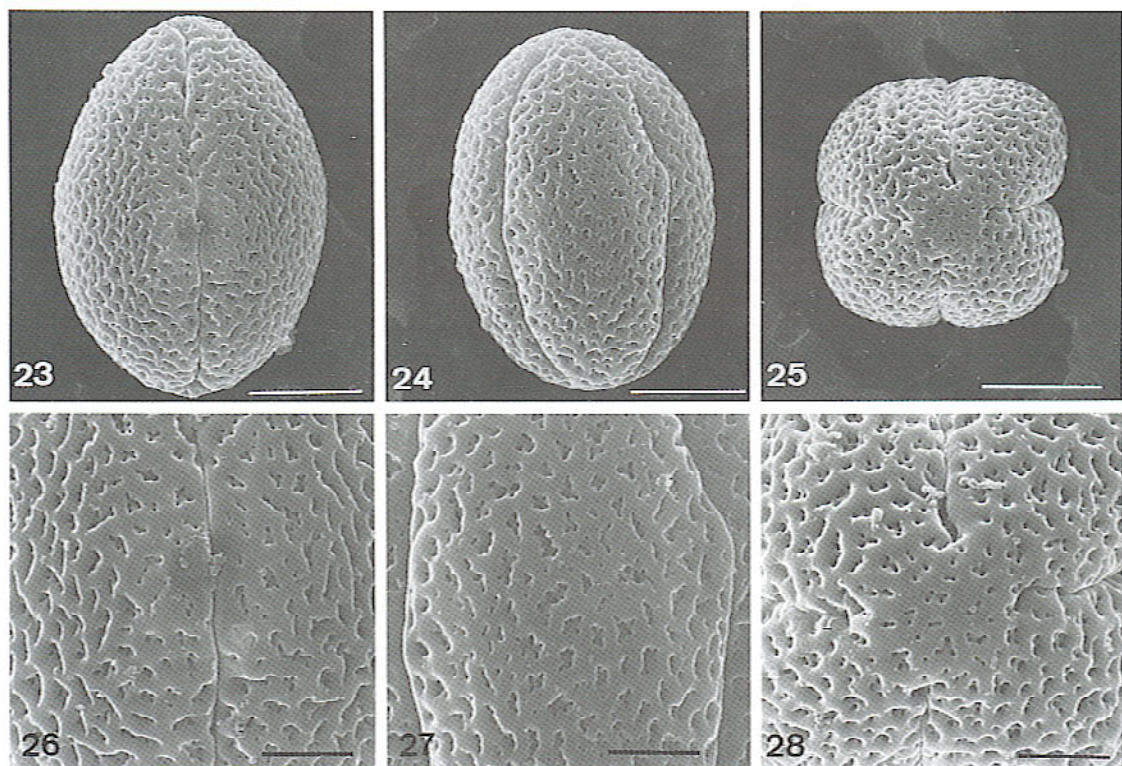
Figs. 1-4. The branching patterns of Taiwanese *Phyllanthus* L. have two different types. *P. ussuriensis* Rupr. & Maxim. have distichous phyllotaxy and non-phyllanthoid branches (Fig. 1). Figs. 2-4 representative of *P. debilis* Klein ex Willd., *P. tenellus* Roxb. and *P. urinaria* L. subsp. *nudicarpus* Rossign. & Haic. respectively are Phyllanthoid branching.



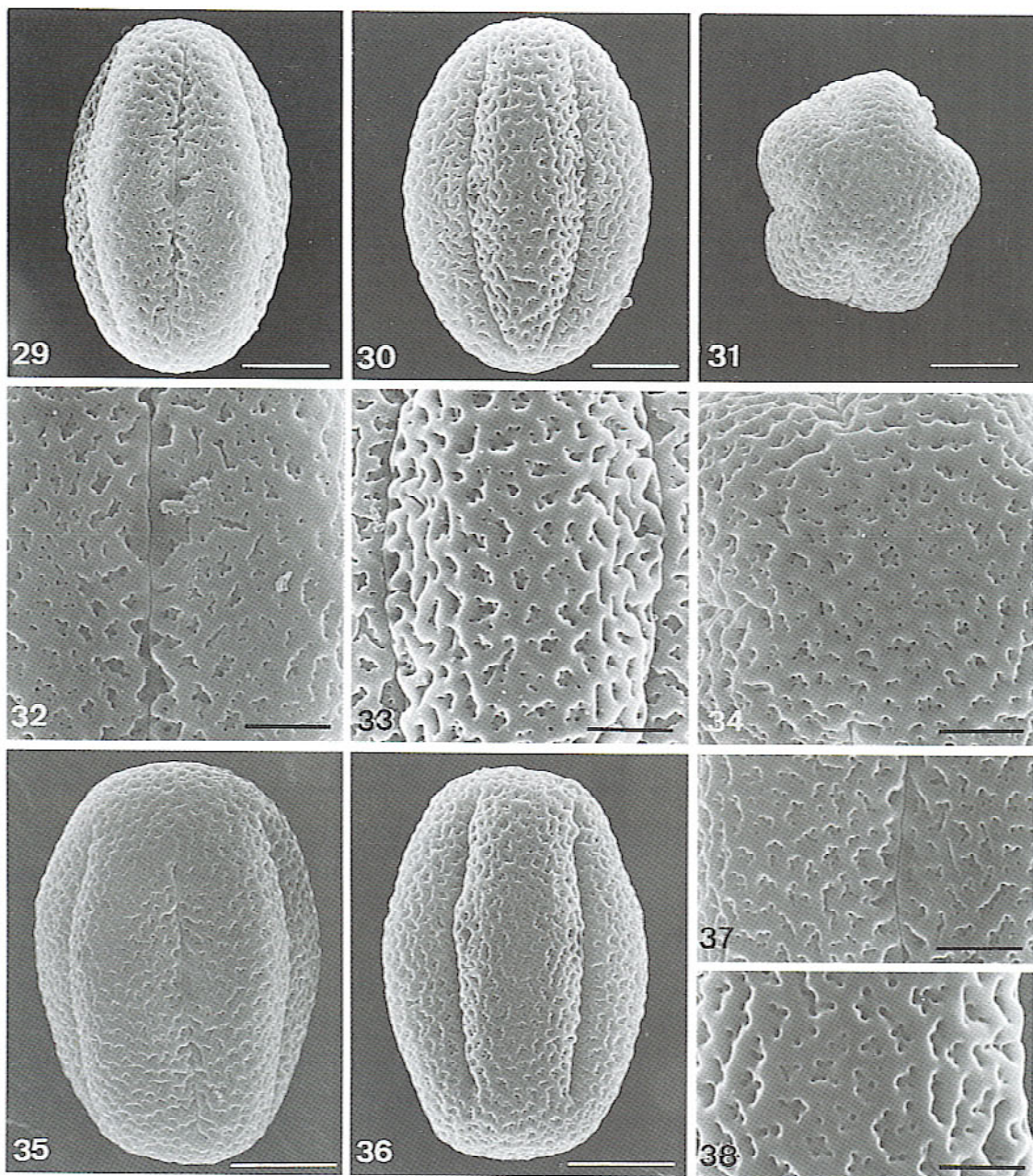
Figs. 5-16. Pollen grains of *Phyllanthus amarus* type are 3-colporate with microreticulate or bireticulate ornamentation on mesocolpi area. The micrograph showing their equatorial view, polar view and its enlargement in each species. Figs. 5-10: *P. amarus* Schum. & Thonn., *Wu* 1548. Figs. 11-16: *P. debilis* Klein ex Willd., *Wu* 1554. White bar=5  $\mu$ m; black bar=2  $\mu$ m.



Figs. 17-22. Pollen grains of *Phyllanthus tenellus* type are (3-)4-colporate with microreticulate and irregular perforate ornamentation on mesocolpi, as in *P. tenellus* Roxb., Wu 1869. White bar=5  $\mu$ m; black bar=2  $\mu$ m.

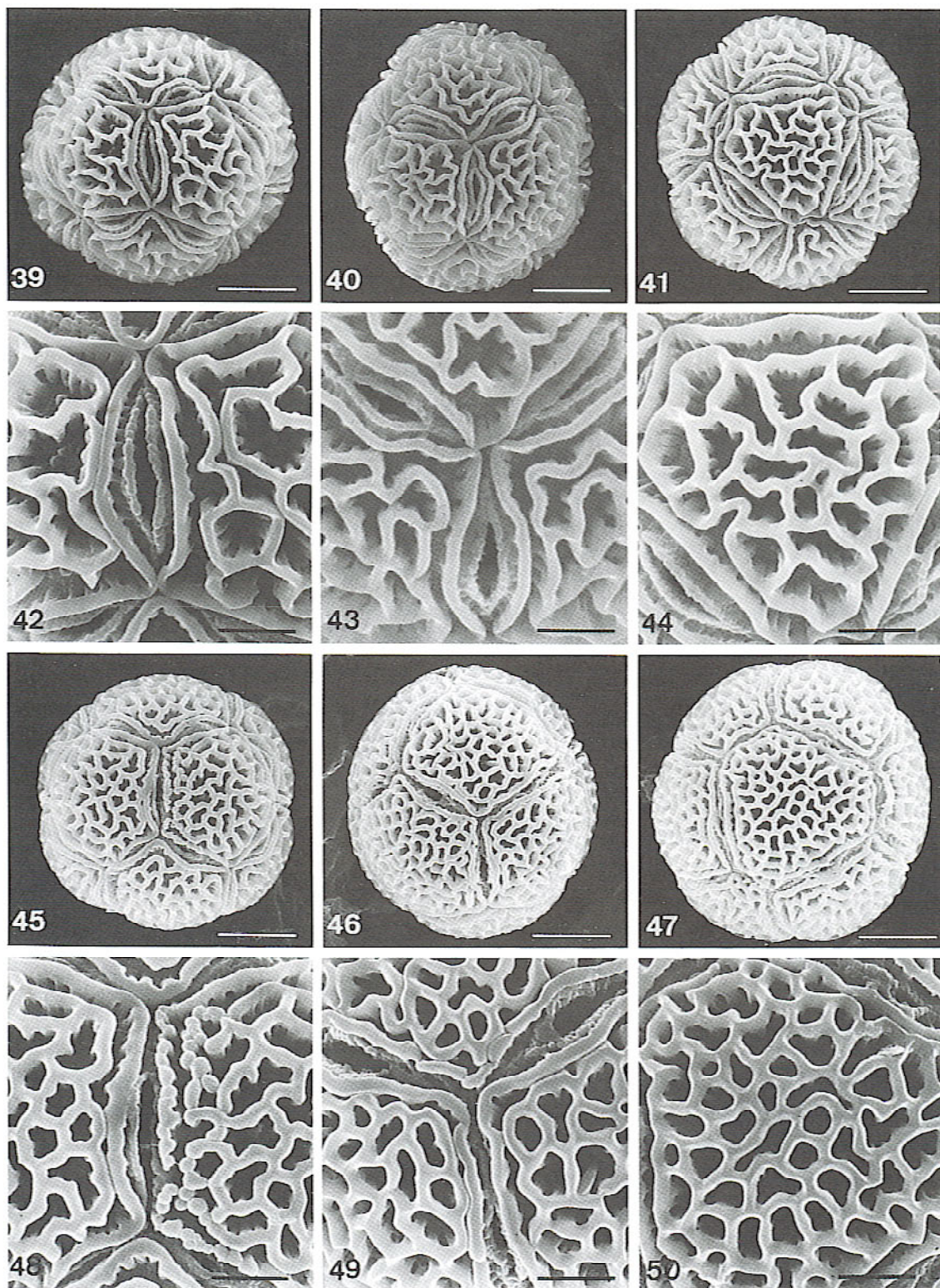


Figs. 23-28. Pollen grains of *P. urinaria* type in *P. urinaria* L. subsp. *nudicarpus* Rossign. & Haic. showing 4-colporate, Wu 1614. White bar=5  $\mu$ m; black bar=2  $\mu$ m.



Figs. 29-38. Pollen grains of *Phyllanthus urinaria* type in *P. embergeri* Haic. & Rossign. and *P. hookeri* Muell-Arg. are 5-colporate with microreticulate or bireticulate ornamentation. Figs. 29-34: *P. embergeri* Haic. & Rossign., Wu 1552. Figs. 35-38: *P. hookeri*, Kao 4104. White bar=5  $\mu$ m; black bar=2  $\mu$ m.

pedicel. In *P. embergeri*, *P. hookeri* and *P. urinaria* ssp. *nudicarpus* of sect. *Urinaria*, the fruits exocarp are smooth, slightly mamillate-rugose to very mamillate-rugose or echinate (Figs. 51-53). In addition, the pedicels are very short to the axils. In *P. amarus* and *P. debilis* of sect. *Phyllanthus*, the fruits are glabrous, and the pedicels are present but shorter than those of *P. tenellus*. In *P. ussuriensis* and *P. virgatus* of sect. *Macraea* the fruit glabrous or near so, and the pedicels are present and as long as those of *P. tenellus*.



Figs. 39-50. Pollen grains of *Phyllanthus virgatus* type are pantocolporate with very coarsely reticulum, and have different muri. Figs. 39-44: *P. ussuriensis* Rupr. & Maxim., Chen s.n., Jul. 18, 1994.; Figs. 45-50: *P. virgatus* Forst. f., Wu 1731. White bar=5 μm; black bar=2 μm.

Table 1. Pollen morphology of Taiwanese herbaceous *Phyllanthus* L.

Subgenus	Section	Taxa	Colporate No.	Size ( $\mu\text{m}$ )	P / E*	Shape	Ornamentation
<i>Phyllanthus</i>	<i>Phyllanthus</i>	<i>P. amarus</i>	3	17.5-18.0 x 13.0-14.5	1.13- 1.26	subprolate	bireticulate
		<i>P. debilis</i>	3	19.0 x 14.5- 15.5	1.29- 1.31	subprolate	bireticulate
	<i>Urinaria</i>	<i>P. embergeri</i>	5	21.0 x 13.0- 15.0	1.43- 1.56	prolate	bireticulate
		<i>P. hookeri</i>	5	18.5-19.5 x 12.5-13.5	1.42- 1.45	prolate	bireticulate
		<i>P. urinaria</i> ssp. <i>nudicarpus</i>	4	16.0-16.5 x 11.5-12.0	1.37- 1.39	prolate	bireticulate
<i>Kirganelia</i>	<i>Floribundi</i>	<i>P. tenellus</i>	(3-)4-	15.0-16.0 x 11.5-13.5	1.16- 1.29	subprolate	irregular reticulate
<i>Isocladius</i>	<i>Macraea</i>	<i>P. ussuriensis</i>	numerous	16.5-18.5	-	sphaeroidal to ellipsoidal	coarsely reticulate; 10-20 lumina per areola
		<i>P. virgatus</i>	numerous	16.0-18.5	-	sphaeroidal to ellipsoidal	coarsely reticulate; ca. 60 lumina per areola

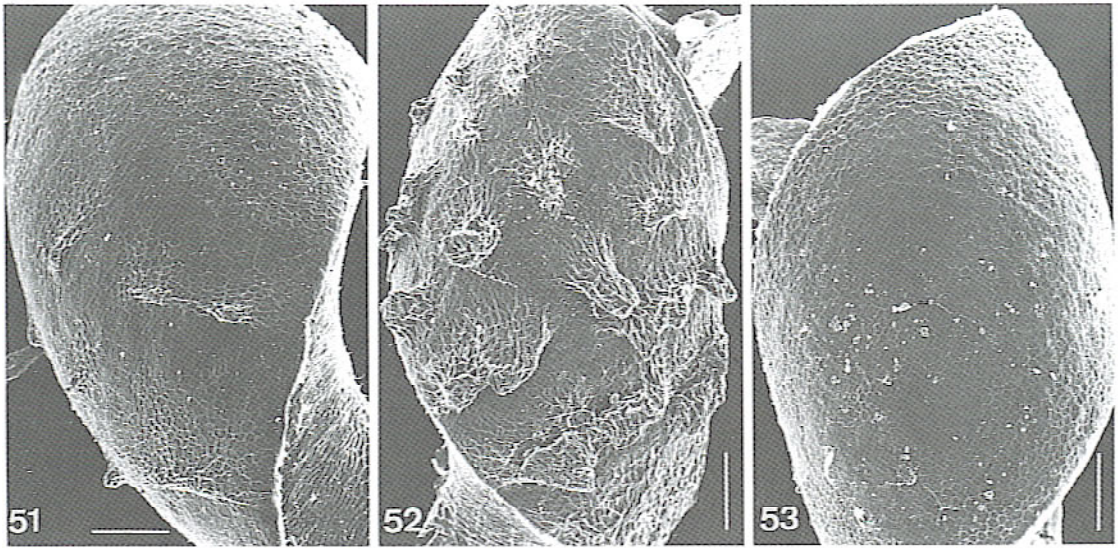
\*: The ratio of polar axis to equatorial axis.

### Seeds:

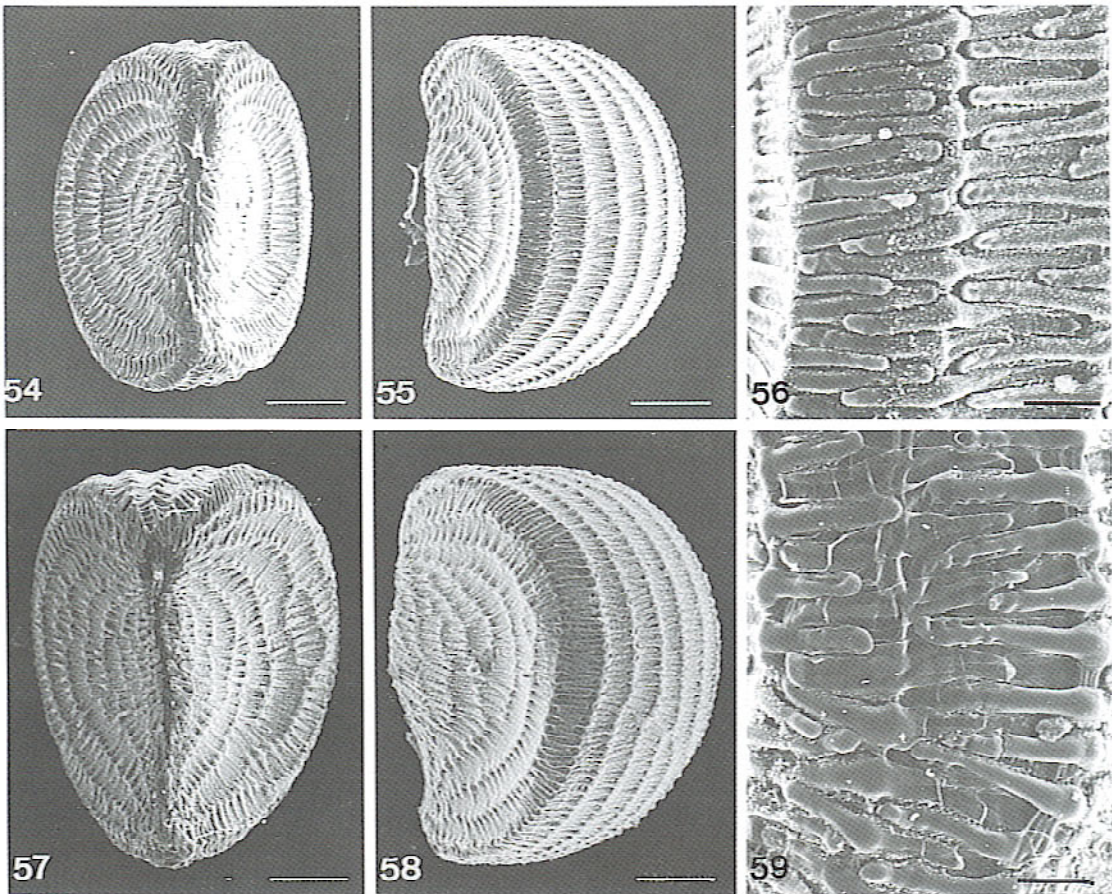
In eight species of Taiwanese herbaceous *Phyllanthus*, all the seeds are ungula-shaped and two in each cell of the capsular fruits. Through a close examination on seed coats, four types, which are agreeable with the pollen types mentioned above, are recognized.

In the *P. amarus* type (Figs. 54-59) the seed coats have 5-9 dorsal longitudinal ribs. The ribs are emerged by the aggregation of finger-shaped cells. In the *P. urinaria* type (Figs. 60-68) the seed coats radically have a very characteristic form. There are many transeversal ridges on the back. The ornamentation on side is symmetrical or asymmetrical. The *P. tenellus* type (Figs. 69-71) and the *P. virgatus* type (Figs. 72-77) are the same in shape. However, the ornamentation are different, being stellate in the *P. tenellus* type and dotted in the *P. virgatus* type.

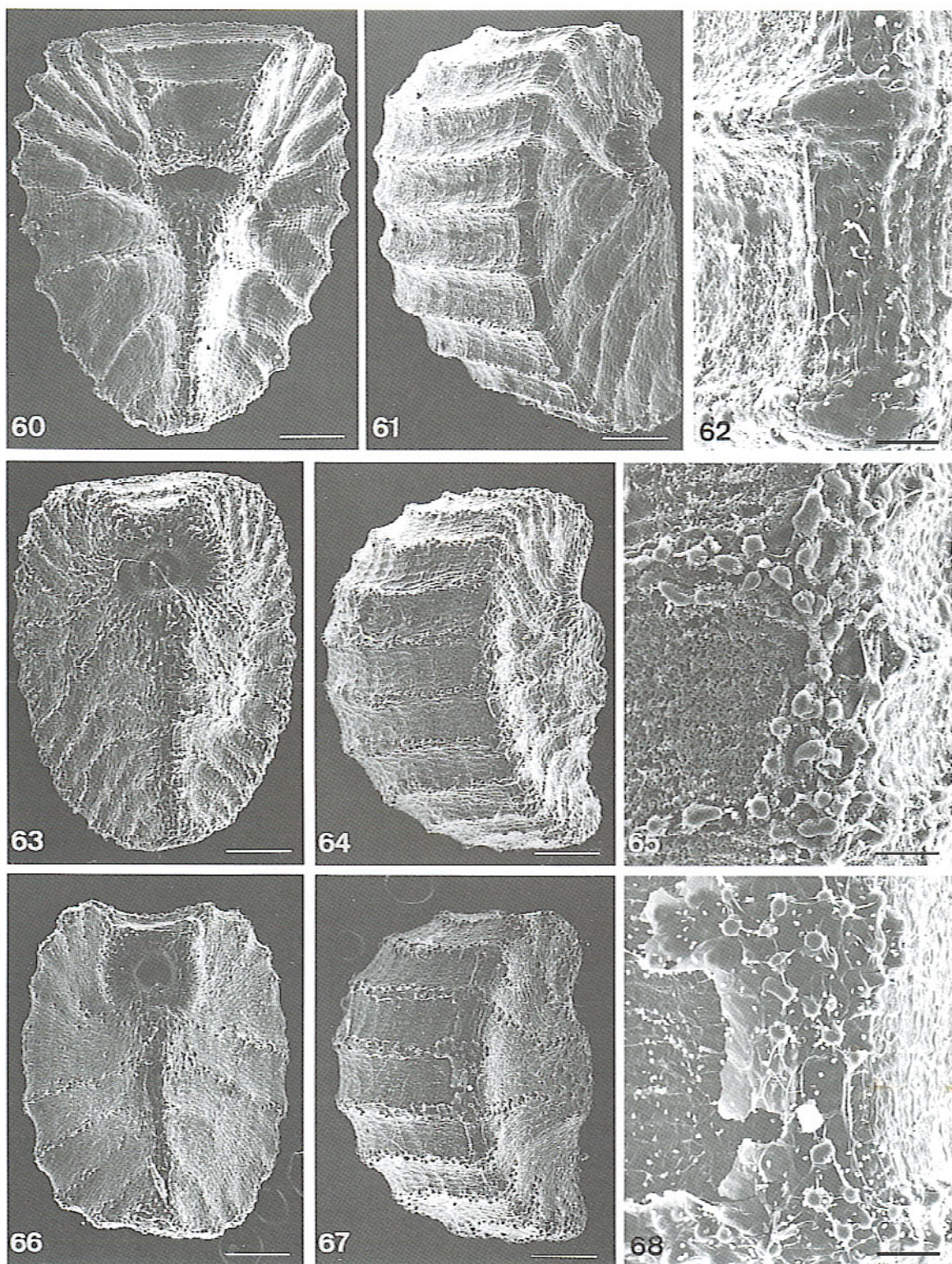




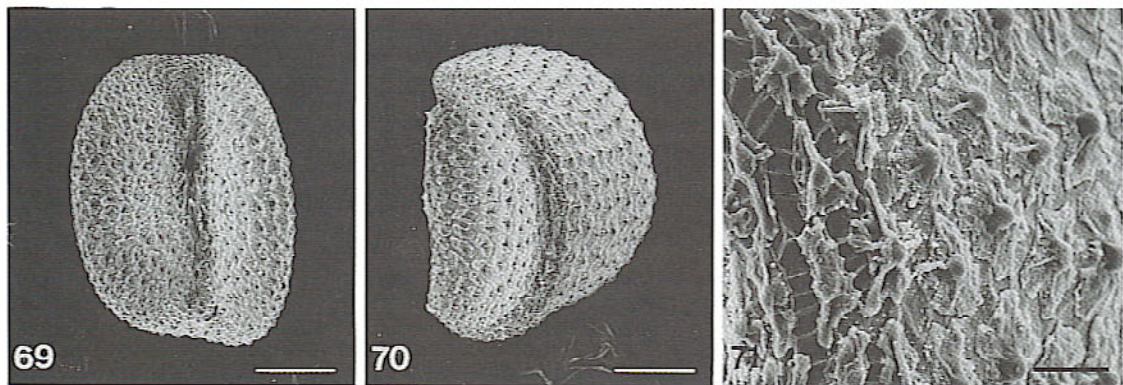
Figs. 51-53. The characteristics of dried, matured exocarps can be used for separating some taxa in sect. *Urinaria*. Fig. 51: Exocarp slightly mamillate-rugose in *Phyllanthus embergeri* Haic. & Rossign., *Wu 1546*. Fig. 52: Exocarp very mamillate-rugose or echinate in *P. hookeri* Muell-Arg., *Kao 4104*. Fig. 53: Glabrous exocarp in *P. urinaria* L. subsp. *nudicarpus* Rossign. & Haic., *Wu 1644*. Bar=200  $\mu$ m.



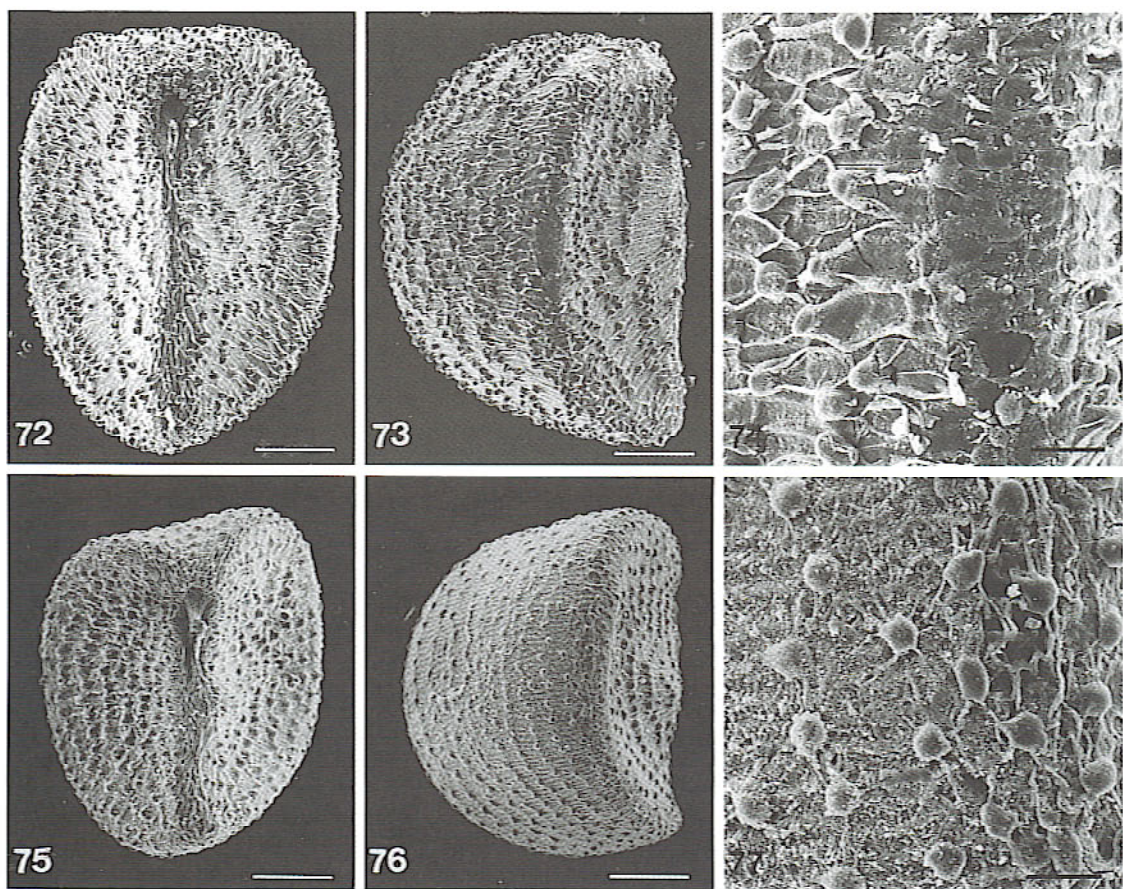
Figs. 54-59. Seed-coat ornamentation type of *Phyllanthus amarus* Schum. & Thonn. has several longitudinal ridges on the seed back, each species showing hilum view, side view and partial enlargement of seed back. Figs. 54-56: *P. amarus* *Wu 1548*. Figs. 57-59: *P. debilis*. Klein ex Willd. *Wu 1546*. White bar =200  $\mu$ m, black bar =50  $\mu$ m.



Figs. 60-68. Seed-coat ornamentation type of *Phyllanthus urinaria* has transverse ridges on the seed backs, each species showing hilum view, side view and partial enlargement of seed back. Figs. 60-62: *P. embergeri* Haic. & Rossign. has a foveole and asymmetrical ornamentation on side view, *Wu 1564*. *P. hookeri* Muell.-Arg. (Figs. 63-65, *Kao 4104*) and *P. urinaria* L. subsp. *nudicarpus* Rossign. & Haic. (Figs. 66-68, *Wu 1644*) have symmetrical ornamentation on the side view. White bar = 200 μm, black bar = 50 μm.



Figs. 69-71. Seed-coat of *Phyllanthus tenellus* Roxb. has a line-up and stellate verruculose ornamentation, Wu 1869. White bar =250  $\mu\text{m}$ ; black bar =50  $\mu\text{m}$ .



Figs. 72-77. Seed-coat of *Phyllanthus virgatus* type showing verruculose ornamentation. The ornamentation may be irregularly verruculose in *P. ussuriensis* Rupr. & Maxim. (Figs. 72-74, Chen s. n. Jul. 18, 1994), or regularly line-up verruculose in *P. virgatus* Forst. f. (Figs. 75-77, Wu 1682). White bar =250  $\mu\text{m}$ ; black bar =50  $\mu\text{m}$ .

## TAXONOMIC TREATMENT

*Phyllanthus matsumurae* Hay. was listed in flora of Taiwan by Hayata (1906) and Kawakami (1910), however, it was not mentioned since then. After comparing its relatives of

Asia, Murata (1958) considered *P. matsumurae* to be the synonym of *P. ussuriensis*, and identified *P. simplex* and *P. ussuriensis* as two different species. However, Webster (1976) suggested that the species *P. simplex* mentioned above to be a synonym of *P. virgatus* and considered *P. matsumurae* as a variety, *P. virgatus* var. *chinensis* (Muell.-Arg.) Webster (Webster, 1971, 1976). Through our accurate inspection of pollen grains and seeds by SEM (Figs. 39-50, 72-77, Table 2), the concept of Murata's two species is supported. *P. simplex* and *P. ussuriensis* should be separated. However we accept Webster's suggestion to replace *P. simplex* by *P. virgatus*.

Table 2. Comparison between *Phyllanthus ussuriensis* Rupr. & Maxim. and *P. virgatus* Forst. f.

Authors, Characters or Distributions	<i>P. ussuriensis</i>	<i>P. virgatus</i>
Murata, 1958	<i>P. ussuriensis</i>	<i>P. simplex</i>
Webster, 1971, 1976	<i>P. virgatus</i> var. <i>chinensis</i>	<i>P. virgatus</i>
Male flowers*		
tepals	4-6	6
glands	4-5	6
stamens	2-(3)	3
Fruit pedicels*	2-3-(4) mm	(3)-4-7-(8) mm
Seed coat ornamentation	irregularly or regularly papillose	regularly papillose
Pollen exine ornamentation	10-20 lumina per areola	ca. 60 lumina per areola
Distribution*	Ussuri to N.E. China, Korea, Japan, the Ryukyus and (Taiwan)	India to S. China, Taiwan, the Ryukyus, Malaysia and Polynesia.

\*: Data from comparison by Murata, 1958.

The data in parentheses: Data from the authors' observations.

According to the morphology of leaves, floral parts, pollen colporate number, seed and fruit morphology, chromosomal number, and hybrid experiments, Rossignol *et al.* (1987) elevated the previous *P. urinaria* L. or the "*Urinaria* complex" to the subsection, *P.* subsect. *Urinaria*, and classified it into five taxa. *P. embergeri* and *P. hookeri* are the two of them and firstly reported in Taiwan (Rossignol *et al.*, 1987). Comparing the morphology of pollen grains, seeds, and exocarps, we also found a taxon, *P. urinaria* subsp. *nudicarpus* distributed in this island (Table 1., Figs. 5-17, 23-38, and 51-68).

The two naturalized plants, *P. debilis* and *P. tenellus* are first reported here. The former was collected and identified by C.-C. Hsu in 1973, but it had not been published. Until now it has been confused with *P. amarus* or *P. virgatus* in herbaria. The latter might be naturalized to Northern Taiwan in the recent decade.

### Key to the species of the herbaceous *Phyllanthus* of Taiwan

1. Branches phyllanthoid branching; seed surface ornamentation ridged or ribbed, rarely veruculose; pollen grains 3 to 5-colporate.
    2. Seed surface ornamentation ridged or ribbed; stamens 3; filaments totally connate or free at the upper portion.
      3. Seed surface with transversed ridges on the back side; cymules unisexual, female flowers solitary at the proximal axils; pollen grains 4 or 5-colporate.
        4. Seed ornamentation of the lateral faces symmetrical or near so, with obtuse, rounded hilum, without foveole.
          5. Fruits mamillate-rugose with fleshy scales; pollen grains 5-colporate ..... *P. hookeri*
          5. Fruits smooth-skinned; pollen grains 4-colporate ..... *P. urinaria* subsp. *nudicarpus*
        4. Seed ornamentation of the lateral faces asymmetrical, with a pointed, wedge-shaped hilum, and usually with a small foveole ..... *P. embergeri*
      3. Seeds surface with longitudinal ridges on the back side; cymules bisexual, if unisexual then the female flowers solitary at the distal axils; pollen grains 3-colporate.
        6. Leaves obovate; cymules bisexual except at the first or second proximal axils, male flowers tepals 5 ..... *P. amarus*
        6. Leaves ovate to elliptic; cymules unisexual, male flower tepals 6 ..... *P. debilis*
    2. Seeds surface ornamentation veruculose; stamens 5; fillaments free or only connate at the base ..... *P. tenellus*
  1. Branches non-phyllanthoid branching; seeds surface ornamentation veruculose; pollen grains pantocolporate.
    7. Male flower tepals 4~5(-6); stamens 2(-3), glands 4-5, elliptic; fruit pedicels 2-4 mm long; seeds surface covered with regularly or irregularly raised dots ..... *P. ussuriensis*
    7. Male flower tepals 6; stamens 3, glands 6, round; fruit pedicels 3-8 mm long; seed surface covered with regularly (lined up) raised dots ..... *P. virgatus*
- 1. *Phyllanthus amarus*** Schum. & Thonn., Kongl. Danske Vidensk. Selsk. Skr. 4: 195, 1829; Webster & Burch in Ann. Missouri Bot. Gard. 54: 226, 1967; Brunel & Roux in Nord. J. Bot. 4 (4): 469, f. 1~6, 20a, 1984; Deng & Wang in Huang *et al.* Fl. Taiwan 2nd ed. 3: 495, 1993. 小返魂 Figs. 5-10, 54-56

*P. niruri* auct. non L. : Hayata in J. Coll. Sci. Univ. Tokyo 20: 7, t. 1B. 1904; Keng in Taiwania 6: 62, 1955; Hsieh in Li *et al.* Fl. Taiwan 3: 491, 1977.

Annual glabrous herb, up to 60 cm high. Cataphylls on the primary stem: stipules oblique-triangular, 1.2-1.5 mm long, brownish; blades linear, 1.0-1.2 mm long, brownish. Leaves on the phyllomorphic branchlets: stipules lanceolate, 0.8-1.2 mm long; petioles 0.5mm long; blades elliptic, ovate or obovate, 5.0-10.0 mm long, 3.0-5.0 mm wide, slightly oblique at base, rounded at apex. The floriferous branchlets with 1-2 axillary male cymules at the proximal segment, bisexual cymules at the distal nodes. Staminate flower tepals 5, glands 5, stellate. Pistillate flower tepals 5. Fruit pediceles 2-4 mm long, capsules smooth, ca. 2 mm in diameter. Seeds trigonous, light brown, 1.0 mm long, with 5-7 dosal longitudinal ribs.

Distribution: Widespread in tropical area, common from Thailand, to Malaysia and Singapore and even to Indonesia, West Africa, Madagasca.

Specimens examined: Miaoli: Tsaochiao, *Kao 3741* (TAI). Chianghua: Wanhsing, *C. Hsu 4716* (TAI); *T. Shimizu & Kao 10680* (TAI). Taichung: Tachiya, *Kao 3650* (TAI). Tainan: Shuichia, *Kao 10632* (TAI); Hsinhwa, *Kao 9288* (TAI); Matou, *Kao 10145* (TAI). Pingtung: Kentin, *Kao 4223* (TAI); Liukiusyo, *Hosokawa 1961* (TAI). Taitung: Is. Lanyu, *C. Hsu 9374* (TAI); Is. Lutao, *Huang & Kao 6974* (TAI). Hualien: Hualien: City, *Wu 1548, 1558* (HLTC). Penghu: *Huang & Kao 6837* (TAI).

**2. *Phyllanthus debilis* Klein ex Willd., Sp. Pl. 4: 582, 1804; Brunel & Roux in Nord. J. Bot. 4 (4): 470, f. 7-12, 20B, 20D, 1984, p. p.** 銳葉小返魂 Figs. 2, 11-16, 57-59, 78

*P. virgatus* auct. non Forst. f.: Deng & Wang in Huang *et al.* Fl. Taiwan 2nd ed. 3: 498, 1993.

Annual glabrous herb, 10-70 cm high. Stem erect, often ligneous at base. Cataphylls on the primary stem: stipules oblique-triangular, 1.5-1.8 mm long, white or pale green, blades lanceolate, 1.2-1.5 mm long. Leaves on the phyllomorphic branches: stipules triangular-lanceolate, 1 mm long, white, with one green vein; petioles 0.5-1.0 mm long; blades narrowly elliptic to elliptic or ovate, 8-16 mm long, 2-5 mm wide, acute at apex and base. The distribution of axillary inflorescences: above a proximal segment of 1-3 axils with staminate cymules, the distal axils produce single pistillate flowers. Staminate flower tepals 6 in 2 subequal whorls, obovate, 0.6 mm long, glands 6, stellate, the filaments completely fused into a column. Pistillate flower tepals 6, elliptic or obovate, 0.8-1.0 mm long. Seeds trigonous, 1.0 mm long, light brown, with 6-9 longitudinal ribs on the back.

Distribution: Indigenous to S.E. Asia. From India, Thailand, Malaysia to Singapore and Indonesia, even to Micronesia, Honolulu.

Specimens examined: Taipei: Taipei, *Wu 1626B* (HLTC); Kueishan, *Deng 652* (TNU). Taoyuan: Tachi, *S.-L. Ching s. n.* Aug. 22, 1977 (TAI). Changhua: Pakuashan, *Deng 381* (TNU). Chiayi: Tapu, *Deng 629* (TNU). Kaohsiung: Liukuei, *Peng 14764* (HAST). Pingtung: Suchongshi, *C.-C. Hsu 13522* (TAI); Fongkang, *S.-F. Huang 2460* (TAI); *S.-F. Huang & S.-Y. Yang 4943* (TAI); Pingtung, *M.-T. Kao 9729* (TAI); Nanjenshan, *Ou & Kao 9032* (TAI); Shoka - Tsaopu, *T.-C. Huang & S.-F. Huang 14059* (TAI); Hsiang tan, *Wu 1706, 1708* (HLTC). Iilan: Nanao, *Wu 1639* (HLTC). Hualien: Hualien, *Wu 1538* (HLTC); Soufong, *Wu 1627* (HLTC). Sanmin, *Kao 9587* (TAI), *9812* (TNU, TAI). Taitung: Chengkung, *Wu 1630* (HLTC); Luyeh, *Wu 1646* (HLTC); Shangwu, *C.-C. Hsu 13362* (TAI); Tawu, *Ou & Kao 10853* (TAI).

**3. *Phyllanthus embergeri* Haic. & Rossign. in Amer. J. Bot. 74 (12): 1860. 1987.**

擬葉下珠 Figs. 29-34, 51, 60-62

*P. urinaria* auct. non L.: Keng in Taiwania 6: 63. 1955. p.p.; Hsieh in Li. *et al.* Fl. Taiwan 3: 493. 1977. p. p.; Deng & Wang in Huang *et al.* Fl. Taiwan 2nd ed. 3: 498, pl. 260. 1993. p.p.

Annual glabrous herb, erect or procumbent, up to 40 cm high. Cataphylls: stipules oblique triangular, 2.2-2.5 mm long, caudate; blades triangular, 1.8-2.0 mm long. Leaves: stipules triangular, 1.2-1.5 mm long; petioles 0.5-0.8 mm long; blades, elliptic to narrowly obovate, 7.5-22.0 mm long, 3.0-7.0 mm wide, oblique at the base, obtuse or mucronulate at apex. Cymules unisexual, the proximal axils of the branchlets with 1 pistillate flower; the

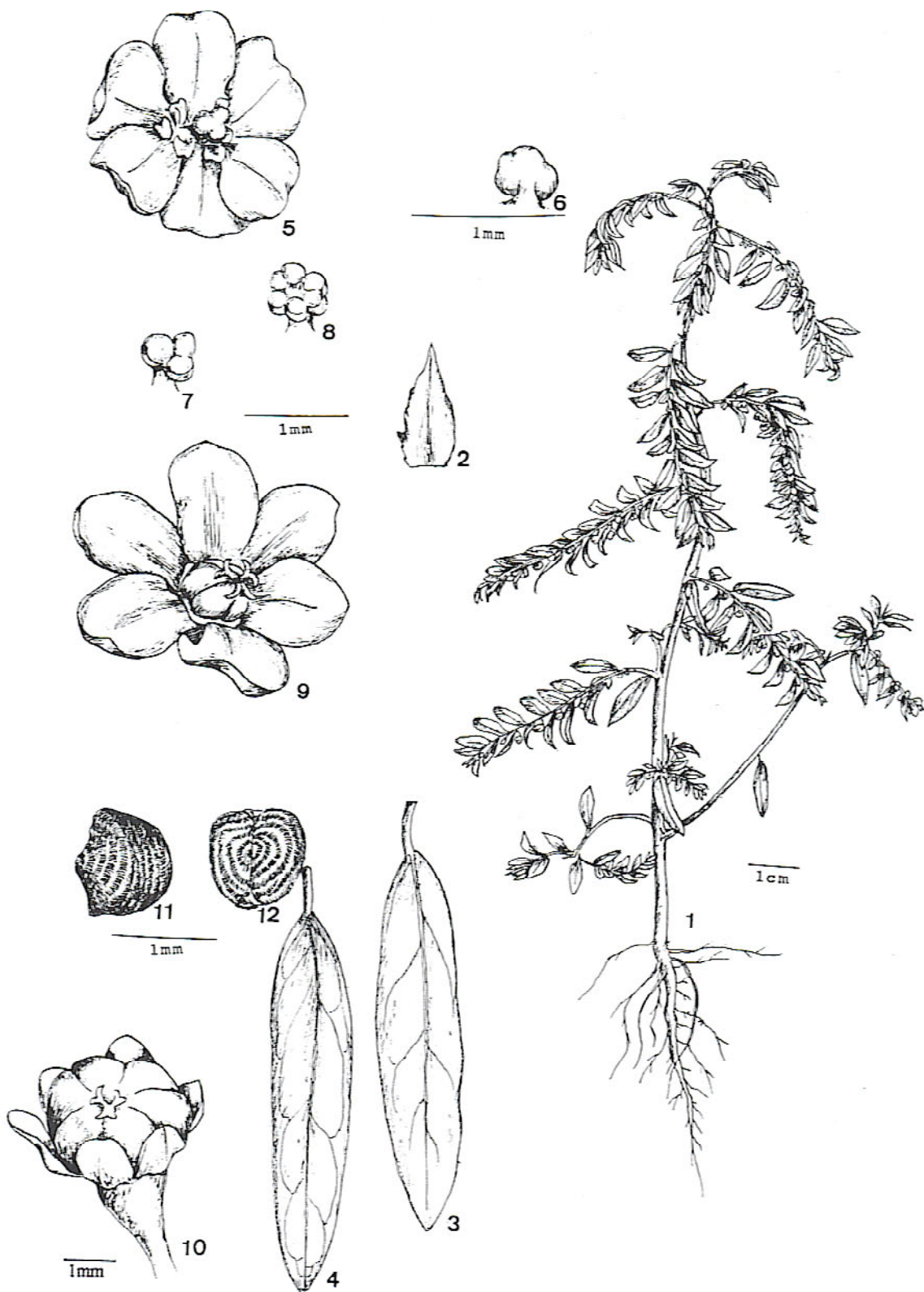


Fig. 78. *Phyllanthus debilis* Klein ex Willd. 1: habit; 2: stipule; 3: leaf, upper surface; 4: leaf, lower surface; 5: staminate flower; 6: gland; 7, 8: anthers; 9: pistillate flower; 10: fruit; 11, 12: seeds, lateral and ventral views.

distal cymules with 1-3 staminate flowers. Staminate flowers 1.5 mm in diameter, tepals 6, ovate, hyaline or whitish, midrib greenish; glands 6, stellate; stamens 3; filaments completely fused into a column; pollen grains 5-colporate. Pistillate flowers 1.5 mm in diameter, tepals 6, lanceolate, 0.8 mm long, hyaline or whitish, midrib greenish; superior margin of disc digitate; ovary 3-lobed; styles 3, bifid at the tips. Fruits sessile, exocarps thin scally. The side surfaces of seed-coat ornamentation asymmetrical, with a small foveole.

Distribution: India to Indochina, S. China and Taiwan.

Specimens examined: **Taipei:** Taipei, C.-C. Hsu 15038 (TAI); Kuangyinshan, Fukuyama 210 (TAI); Shihtin, C.-M. Kuo 6351 (TAI); Paisawan to Chinshan Power Plant, C.-M. Kuo 8941 (TAI). **Keelung:** Keelung, Deng 616 (TNU). **Taoyuan:** Jenmei, C.-M. Kuo 6321 (TAI); **Taichung:** C. H. U. Campus, C.-M. Kuo 5648 (TAI). **Hualien:** Hualien, Wu 1557, 1546 (HLTC).

**4. *Phyllanthus hookeri* Muell.-Arg.** in *Linnaea* 32: 19. 1863; Rossignol *et al.* in *Amer. J. Bot.* 74 (12): 1862. 1987. 疣果葉下珠 Figs. 35-38, 52, 63-65

*P. urinaria* auct. non L.: Keng in *Taiwania* 6: 63. 1955. p. p.; Hsieh in Li. *et al.* *Fl. Taiwan* 3: 493. 1977. p. p.; Deng & Wang in Huang *et al.* *Fl. Taiwan* 2nd ed. 3: 498. 1993. p. p.

Annual glabrous herb, erect or procumbent, up to 35 cm high. Cataphylls: stipules oblique triangular, 2.0-2.5 mm, long, caudate; blades lanceolate, 1.5-2.0 mm long. Leaves: stipules lanceolate, 1.0 mm long; petioles 0.5-0.8 mm long; blades oblong or narrowly obovate, 7.5-20.0 mm long, 2.5-5.5 mm wide, oblique at the base, obtuse or mucronulate at apex. Cymules unisexual, the proximal axils of the branchlet with 1 pistillate flower; the distal cymules with 2-3 staminate flowers. Staminate flower tepals 6, obovate; stamens 3; filaments completely fused into a column; pollen grains 5-colporate. Pistillate flower tepals 6, lanceolate; ovary 3-lobed; styles 3, bifid at the tips. Fruits sessile, exocarps mamillate-rugose, generally with fleshy scales or sometimes with a few thin scales, 2.5 mm in diameter. The side surfaces of seed-coat ornamentation symmetrical, without foveole.

Distribution: Sri Lanka, India, Thailand, Malaysia, Vietnam, China, Taiwan and the Philippines.

Specimens examined: **Taipei:** Urai, S. Sasaki s.n. Oct.16,1932 (TAI). **Nantou:** Lienhuachih, S. Sasaki s.n. Aug. 30, 1929 (TAI). **Hualien:** Tailuko, M.-T. Kao 4104 (TAI); Honlin, M.-T. Kao 9793 (TAI).

**5. *Phyllanthus tenellus* Roxb.,** *Fl. Ind.* (ed. 2) 3: 668. 1832; Hook. f. in Hook. *Icon.* 1569. 1887. Webster in J. Arnold. *Arb.* 38: 52 Text-fig. 6, Plate I, fig.3 1957. 五蕊油柑 Figs. 3, 17-22, 69-71, 79

Annual herb, up to 50 cm high. Stem ridged, up to 8 mm thick. Cataphylls: stipules lanceolate, 1 mm long; blades linear-lanceolate, 0.9 mm long. Leaves: stipules lanceolate, 1 mm long; petioles 1 mm long; blades membranous, glabrous, ovate or obovate to broadly elliptic, 8-12 mm long, 8-10 mm wide, acute to rounded at the base, acute or obtuse at apex. Proximal axils of the branchlet bisexual, with 1 or 2 pistillate flowers beneath, the 2 or 3 staminate flowers above; distal most cymules usually reduced to a single pistillate flower. Staminate flowers 1.6 mm across, tetals 5, obovate, hyaline or whitish, midrib greenish.



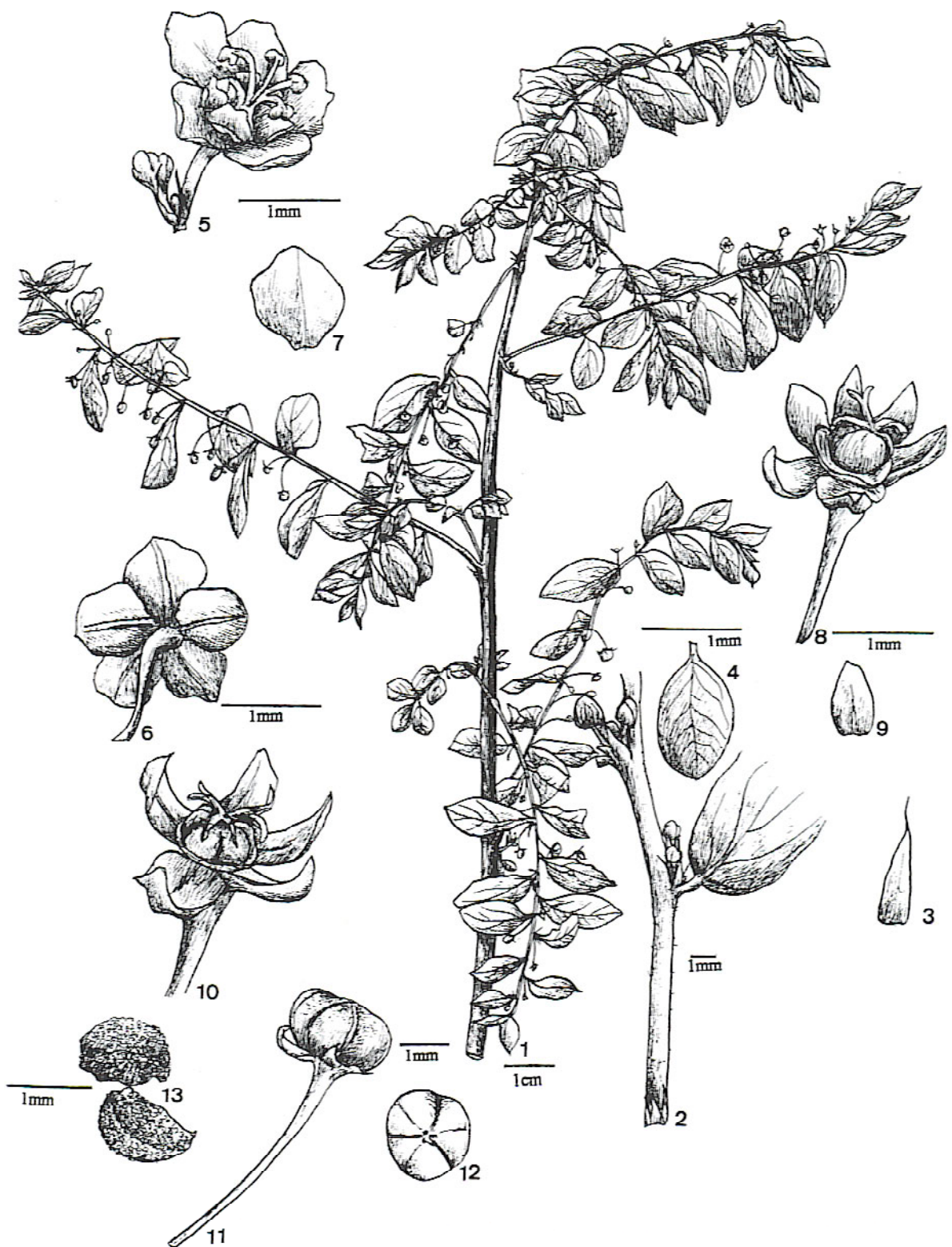


Fig. 79. *Phyllanthus tenellus* Roxb. 1: flowering and fruiting phyllanthoid branches; 2: cymules on leaf axils; 3: stipule; 4: leaf; 5: staminate flower in a cymule; 6, 7: staminate flower and its tepal; 8, 9: pistillate flower and its tepal; 10: unmaturing fruit; 11, 12: matured fruit; 13: seeds.

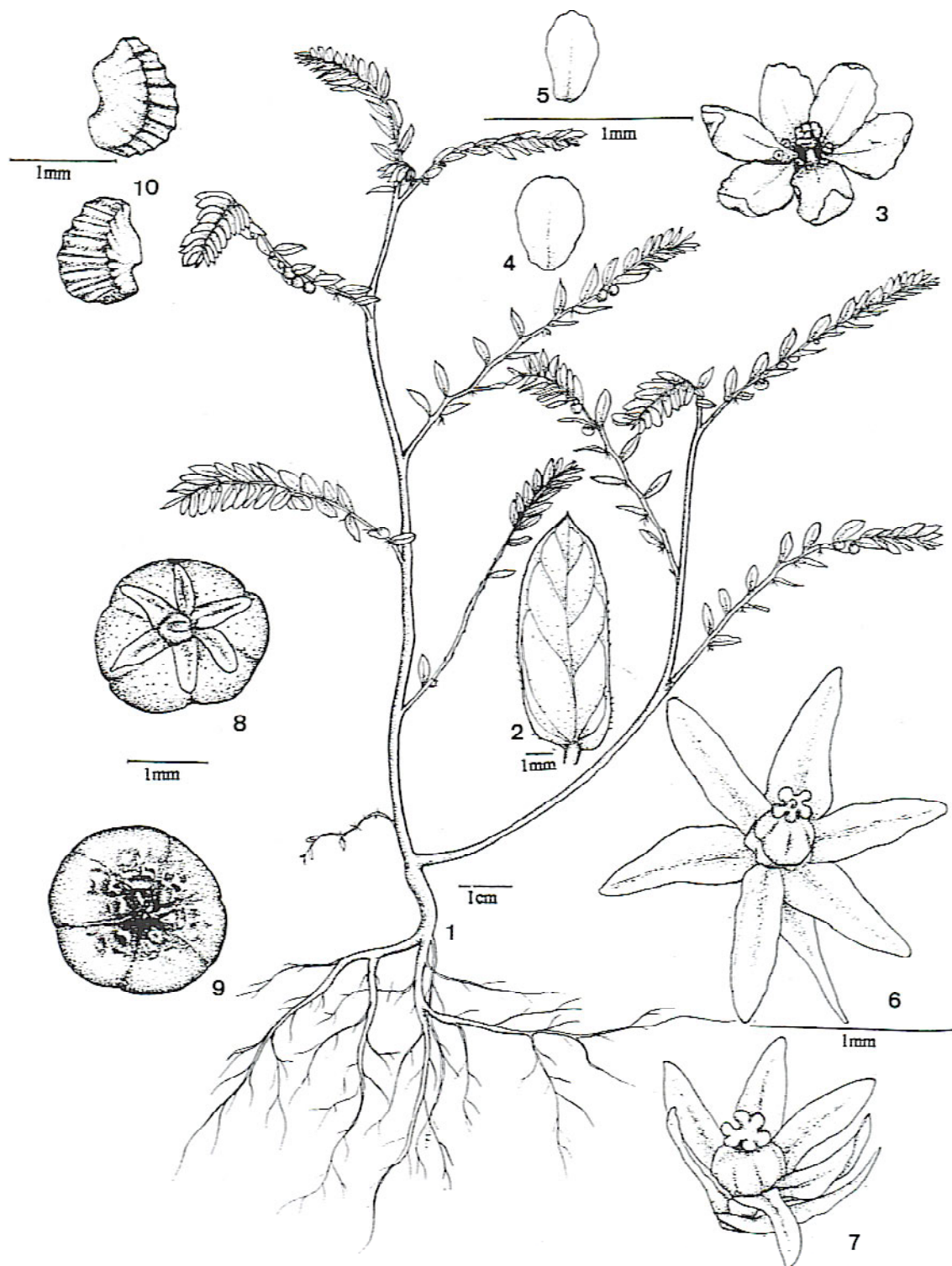


Fig. 80. *Phyllanthus urinaria* L. subsp. *nudicarpus* Rossign. & Haic. 1: habit; 2: leaf, lower surface; 3: staminate flower; 4: outer and 5: inner whorl tepals; 6, 7: pistillate flowers; 8, 9: fruits; 10: seeds.

glands 5, deltoid; stamens 5; filaments free; anthers 0.2 mm; pollen grains 4-colporate. Pistillate flowers 1.0 mm long, 1.5 mm across; tepals 5, rarely 6, lanceolate, 0.8 mm long, 0.5 mm wide, hyaline or whitish, midrib greenish; disc yellowish, ovary 3-lobed, 0.5 mm

across; styles 3, bifid at the tips. Capsules depressed globose; pedicels 6 mm long. Seeds brown, 1 mm long, 0.4 mm wide.

Distribution: Native to the Mascarene Islands, India, has been introduced into the tropical and subtropical area.

Specimens examined: **Taipei:** Taipei, N. T. U. campus, *Wu 1733, 1869* (HLTC). *Chen s.n.* May 22, 1996 (HLTC).

**6. *Phyllanthus urinaria* L. subsp. *nudicarpus* Rossign. & Haic. in Amer. J. Bot. 74 (12): 1861. 1987.** 光果葉下珠 Figs. 4, 23-28, 53, 66-68, 80

Annual herb, erect or procumbent, up to 40 cm high. Cataphylls: stipules oblique triangular, 1.5-2.5 mm long, acuminate; blades linear-lanceolate, 1.5-2.0 mm long. Leaves: stipules lanceolate, 1.0-1.5 mm long; petioles 0.2 mm long; blades oblong or narrowly-obovate, 7.5-8.0 mm long, 2.2 mm wide, oblique at the base, obtuse or mucronate at apex. Cymules unisexual, the proximal axils of the branchlets with 1 pistillate flower; the distal cymules with 2-4 staminate flowers. Staminate flowers tepals 6; stamens 3; filaments completely fused into a column; pollen grains 4-colporate. Pistillate flower tepals 6, superior margin of the disc finely crenulate, ovary 3-lobed; styles 3, bifid at the tips. Fruits sessile, 2.0 mm in diameter, exocarp smooth. Seeds with symmetrical ornamentation on seed-coat surfaces, without foveole.

Distribution: Vietnam to S. China, Taiwan, and the Philippines.

Specimens examined: **Ilan:** Lotung, *Suzuki 3691* (TAI). **Hualien:** Hualien, *Wu 1555, 1644* (HLTC); *Chen s. n.* Jan. 4, 1995 (HLTC); Hsingcheng, *Wu 1614* (HLTC). **Pingtung:** Manchou, *T.-C. Huang 16983* (TAI); Nanjenshan, *T.-C. Huang 4873* (TAI). **Taitung:** Taimali, *Wu 1893* (HLTC).

**7. *Phyllanthus ussuriensis* Rupr. & Maxim. in Bull. Phys. Moth. Acad. St.-Petersb. 15: 222. 1857.** Poyarkova in Komarov, Fl. USSR 14: 220, t.15. f. 3. 1949.

蜜甘草 Figs. 1, 39-44, 72-74, 81

*P. virgatus* G. Frost. var. *chinensis* (Muell.-Arg) Webster in J. Jap. Bot. 46: 68. 1971.

*P. matsumurae* Hay. in J. Coll. Sci. Univ. Tokyo 20 (3): 11, t. 1E. 1904.

A glabrous annual herb, up to 20 cm high. Stem simple or few branched. Stipules ovate, sagittate to hastate at base, acuminate at apex, entire, glabrous. Leaves distichous, subsessile, elliptic-oblong to lanceolate, 8-12 mm long, 2-5 mm wide, paler beneath, the apex obtuse, often mucronate, the base rounded. Inflorescence bisexual, cymules with 1-3 staminate flowers and a pistillate flower fasciculated on both main stems and branchlets. Staminate flowers 1 mm in diameter; pedicels 1 mm long; tepals 4-5-(6), ovate, 0.5 mm long, glands 4-5, elliptic; stamens 2-(3), free. Pistillate flower tepals 6, elliptic; ovary globose; styles 3, bifid at apex. Fruiting pedicels 2-4 mm long; capsules depressed-globose, glabrous, about 2.5 mm across. Seeds 1.2-1.5 mm long, seed-coat irregularly or regularly verruculose.

Distribution: Ussuri to N.E. China, Korea, Japan, the Ryukyus and Taiwan.

Specimens examined: **Hualien:** Yenliao, *Chen s. n.* Jul. 18, 1994 (HLTC).

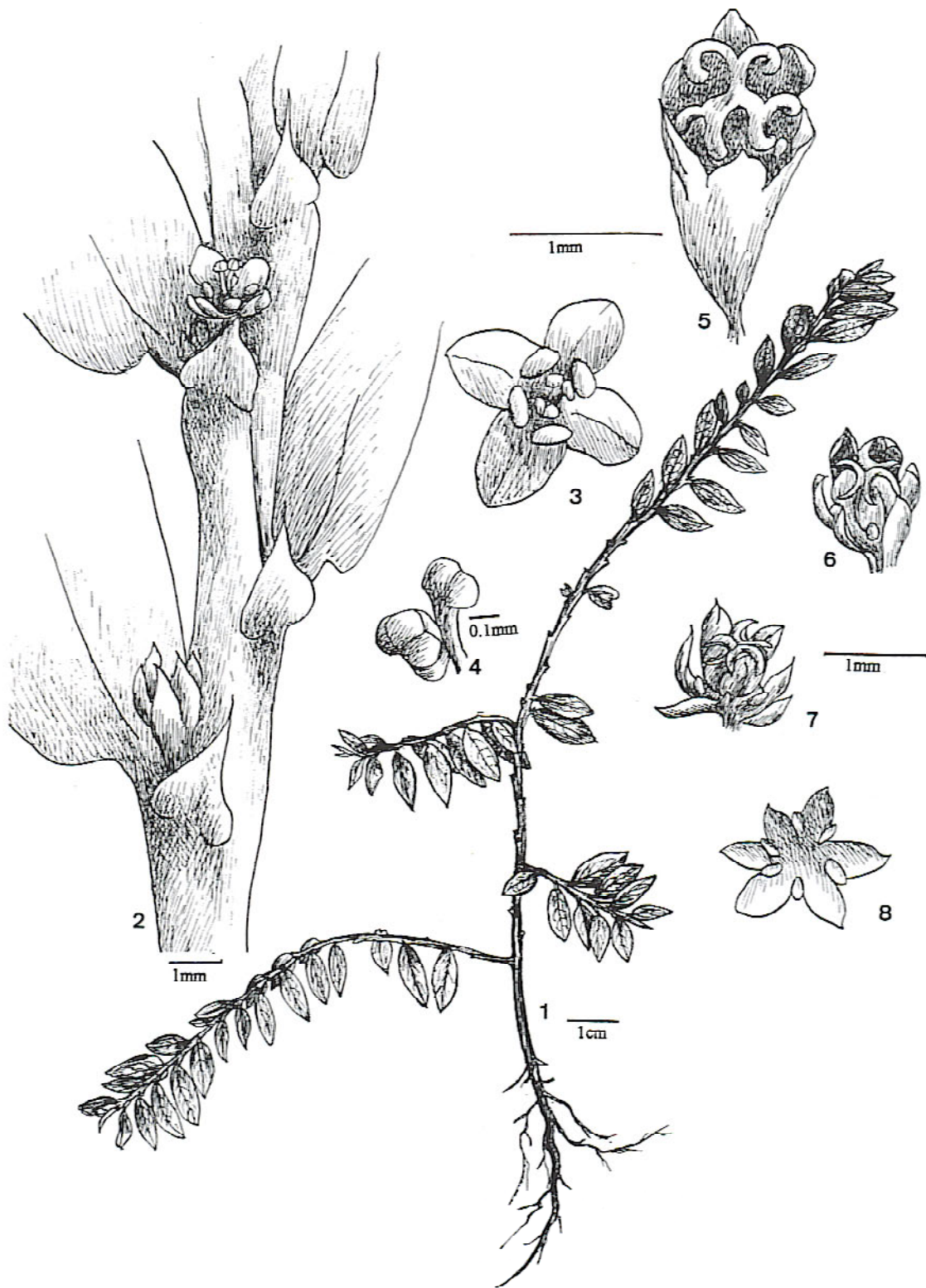


Fig. 81. *Phyllanthus ussuriensis* Rupr. & Maxim. 1: habit; 2: cymules on leaf axils; 3: staminate flower; 4: stamens; 5-7: pistillate flowers; 8: dissected pistillate flower showing 6 glands alternate with tepals.

**8. *Phyllanthus virgatus*** Forst. f., Prodr. 65. 1786; Hsieh in Li *et al.* Fl. Taiwan 3: 493. 1977.  
細葉油柑 Figs. 45-50, 75-77

*P. simplex* Ritz., Obs. Bot. 5:29. 1789; Keng in Taiwania 6: 62. 1955.

A glabrous annual herb, up to 45 cm high. Stem simple or few-branched. Stipules ovate and caudate, oblique-sagittate at base, entire or slightly serrate, glabrous. Leaves distichous, subsessile, elliptic-oblong to lanceolate-linear, 8-16 mm long, 2-5 mm wide, paler beneath, the apex obtuse, often mucronate, the base rounded. Inflorescence bisexual, cymes with 1-3 staminate flowers and a pistillate fasciculated on both main stems and branchlets. Staminate flower pedicels 1 mm long; tepals 6, ovate, 0.5 mm long, glands 6, elliptic; stamens 3, free. Pistillate flower tepals 6, elliptic; ovary globose; styles 3, bifid at apex. Fruiting pedicels 5-8 mm long; capsules depressed-globose, glabrous, about 2.5 mm across. Seeds 1.0-1.2 mm long, seed-coat regularly verruculose.

Distribution: India to S. China, Taiwan, the Ryukyus, Malaysia and Polynesia.

Specimens examined: **Taipei:** Taipei, N. T. U. campus, *Wu 1682, 1731, 1732* (HLTC); Nankang, *Wu 1735* (HLTC); **Taichung:** Chenkunglin, *C.-M. Kuo 6004* (TAI). **Pingtung:** Hsiaochienshihshan, *T.-C. Huang 14823* (TAI); Kentin, *Kao 4220* (TAI).

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## 台灣產草本油柑屬植物之訂正

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### 摘 要

草本之油柑屬 (*Phyllanthus* L.) 植物外形酷似不易區分，本文訂正台灣產草本之油柑屬植物為：小返魂 (*P. amarus* Schum. & Thonn.)、擬葉下珠 (*P. embergeri* Haic. & Rossign., 新擬中名)、疣果葉下珠 (*P. hookeri* Muell.-Arg., 新擬中名)、光果葉下珠 (*P. urinaria* L. subsp. *nudicarpus* Rossign. & Haic., 新擬中名)、蜜甘草 (*P. ussuriensis* Rupr. & Maxim.)、細葉油柑 (*P. virgatus* Forst. f.)、銳葉小返魂 (*P. debilis* Klein ex Willd., 新擬中名)與五蕊油柑 (*P. tenellus* Roxb., 新擬中名)等八種。後兩者為台灣新歸化之植物。光果葉下珠為台灣新記錄之植物。經由花粉及種子表面紋飾之電子顯微鏡掃描照片之比較，有利於本屬植物之鑑定。

關鍵詞：油柑屬、大戟科、訂正、分類學、花粉形態、種子形態、臺灣。

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