



Phyllanthus coi (Phyllanthaceae), a new herbaceous species from the Philippines

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ABSTRACT: *Phyllanthus coi* M.J. Wu, Ferreras & Y.J. Chen, a new species from Benguet Province, Island of Luzon, the Philippines, is described and illustrated. Compared to its congeners in the same section, *P. coi* can be differentiated by having long plagiotropic branchlets with up to 30 leaves per side, seeds with sharp honey-comb-like ridges on the dorsal side, and three free styles that are not lying flat on the top of the ovary. The floral, seed and some vegetative features that distinguish this new species from its nearest morphologically related species, *P. erythrotrichus* C.B. Rob., *P. urinaria* L. and *P. hookeri* Müll. Arg. are provided.

KEY WORDS: Euphorbiaceae, New species, Philippines, Phyllanthaceae, *Phyllanthus*, Section *Urinaria*, Subsection *Benguensis*.

INTRODUCTION

Phyllanthus L., containing about 830 species, is a highly diverse genus well represented throughout the tropical and subtropical regions of the world (Webster, 1956; Govaerts *et al.*, 2000). It is the largest genus from the family Phyllanthaceae and what was considered previously as Euphorbiaceae *sensu lato* (APG II, 2003). In the Philippines, more than 45 species are reported, 27 of which are endemic to the country (Merrill, 1923; Airy Shaw, 1983; Chen, 2009). Some taxa, such as *Phyllanthus balgooyi* Petra Hoffm. & A.J.M. Baker, are strict edaphic specialists, whereas some are restricted to a few localities and islands (Hoffmann *et al.*, 2003). The discovery of *Phyllanthus coi* M.J. Wu, Ferreras and Y.J. Chen is the latest addition to the genus and is hereby described as new.

This new species was collected by Leonardo Co and the first author at Lion's Head near Baguio City, Luzon, Philippines in 2007. Based on Co's collection, Chen (2009) misidentified this species as *P. verrucosus* Elmer. Previously, this species was collected at an unspecified locality in Central Luzon by Loher in 1893 (Loher 4764, but intermixed with two *P. urinaria* specimens Loher 4763 and one other collection on the same sheet, K) and was mislabeled as *P. urinaria* L. *Phyllanthus coi* was also collected at Taal Volcano, Southern Luzon by Merrill in 1917, but was again mistakenly annotated as *P. erythrotrichus* C.B. Rob. Pollen and seed variation are important characters that carry much weight in species identification and infrageneric classification of *Phyllanthus* (Webster, 1956; Rossignol *et al.*, 1987). In this study, pollen and seed morphologies of the closely related species are compared

using scanning electron microscopy to determine the infrageneric classification of the new species.

TAXONOMIC TREATMENT

Phyllanthus coi M.J. Wu, Ferreras & Y.J. Chen, *sp. nov.*
許氏葉下珠 (Figs 1, 2, 3A-C & 4)

Similar to *P. urinaria* L. in having phyllanthoid branchlets and auriculate stipule base, but differing from that species by having long plagiotropic branchlets with up to 30 leaves per side, seeds with sharp, reticulate or honey-comb-like ridges on dorsal side, and three free styles, not lying flat on the top of the ovary.

Type: Philippines, Island of Luzon, Province of Benguet, Municipality of Tuba, Kennon road towards Baguio City, altitude 992 m asl., 3 August 2007, Co 5993 (Holotype: PNH; Isotypes: PUH, CAHUP, TAI).

Erect or procumbent herb, 10–30 cm high, 1.0–1.5 mm in diameter. **Plagiotropic (or deciduous) branchlets:** 6–12 cm long with leaves in 25–30 per side, glabrous or pubescent, **Cataphylls:** stipules triangular, 2.5–3.3 × 1.0–1.2 mm, oblique auriculate at base, caudate at apex, margin entire or slightly serrate; blades triangular, 1.5–2.5 × 0.8–1.0 mm, obliquely auriculate at base, caudate at apex. **Leaves:** stipules linear-lanceolate, obliquely auriculate at base, caudate at apex, 1.0–2.0 mm; petioles 0.2–0.3 mm long; blades elliptic to narrowly elliptic, 7.1–8.5 × 1.5–2.2 mm, greenish above, paler beneath, chartaceous, obliquely rounded at the base, acute at apex, secondary veins 8–11 pairs. **Cymules:** unisexual, the proximal axils of the branchlets with 1 pistillate flower; the distal cymules with 1–3 staminate flowers. **Staminate flowers:** 1.0–



Fig. 1. *Phyllanthus coi* M.J. Wu, Ferreras & Y.J. Chen *sp. nov.* **A**, habit and habitat; **B**, One cataphyllary blade (Cb) and two cataphyllary stipules (Cs) at the base of a plagiotropic branchlet (Pb); **C**, pistillate flowers on the proximal end (left) and staminate flowers (right) on the distal end of a flowering branchlet; **D**, a staminate flower on an axil; **E**, a pistillate flower on an axil; **F**, capsules on the proximal end of a terminal branchlet; **G**, seeds. Scale bar: B & C = 2mm; D, E & G = 1mm.

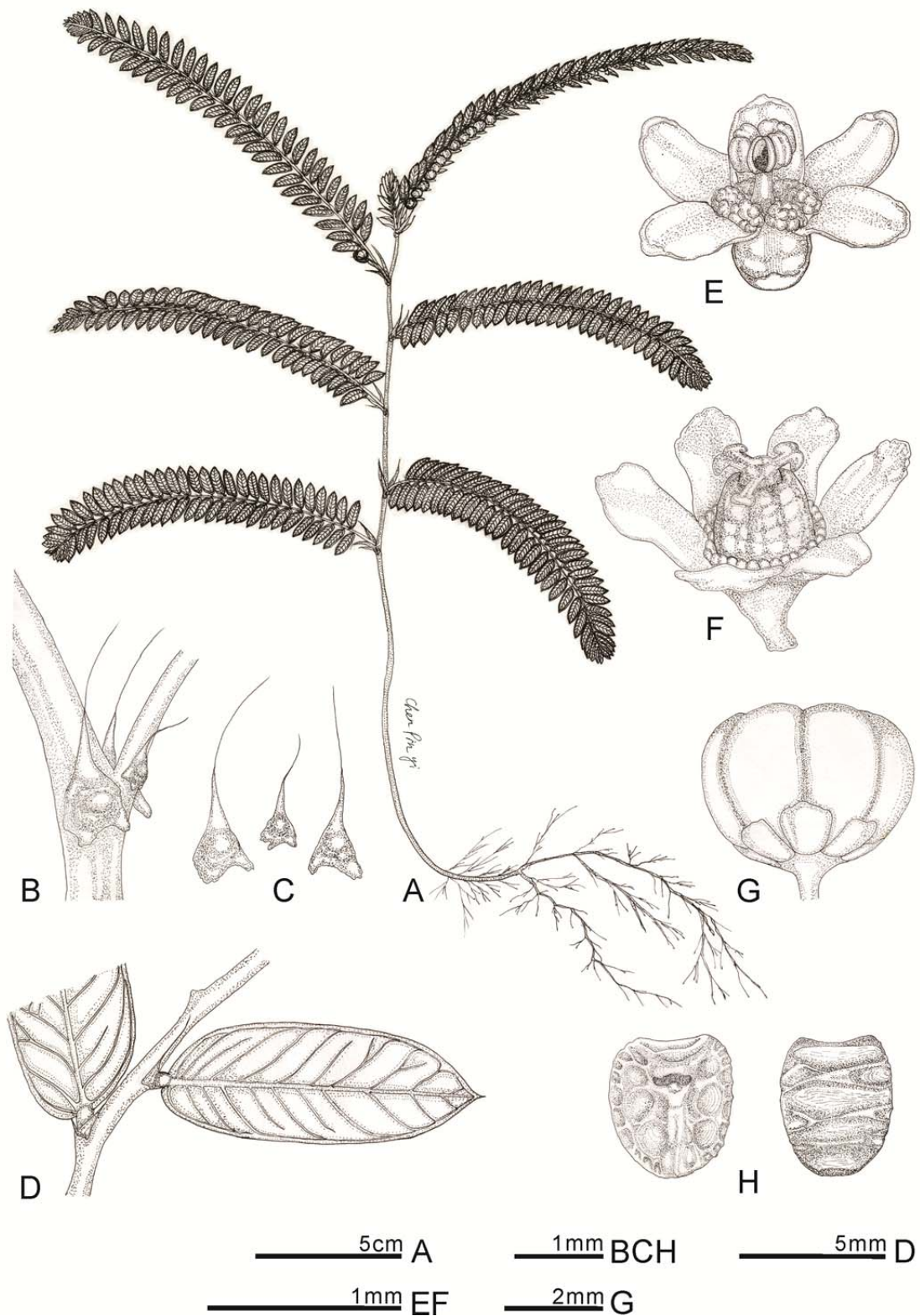


Fig. 2. *Phyllanthus coi* M.J. Wu, Ferreras & Y.J. Chen sp. nov. **A**, habit; **B**, one cataphyllary blade and two cataphyllary stipules at the base of a plagiotropic branchlet; **C**, dissected cataphyll blade (the middle) and cataphyll stipules (the laterals); **D**, leaves and stipules at nodes of a branchlet; **E**, staminate flower; **F**, pistillate flower; **G**, fruit; **H**, seeds, ventral and dorsal views.

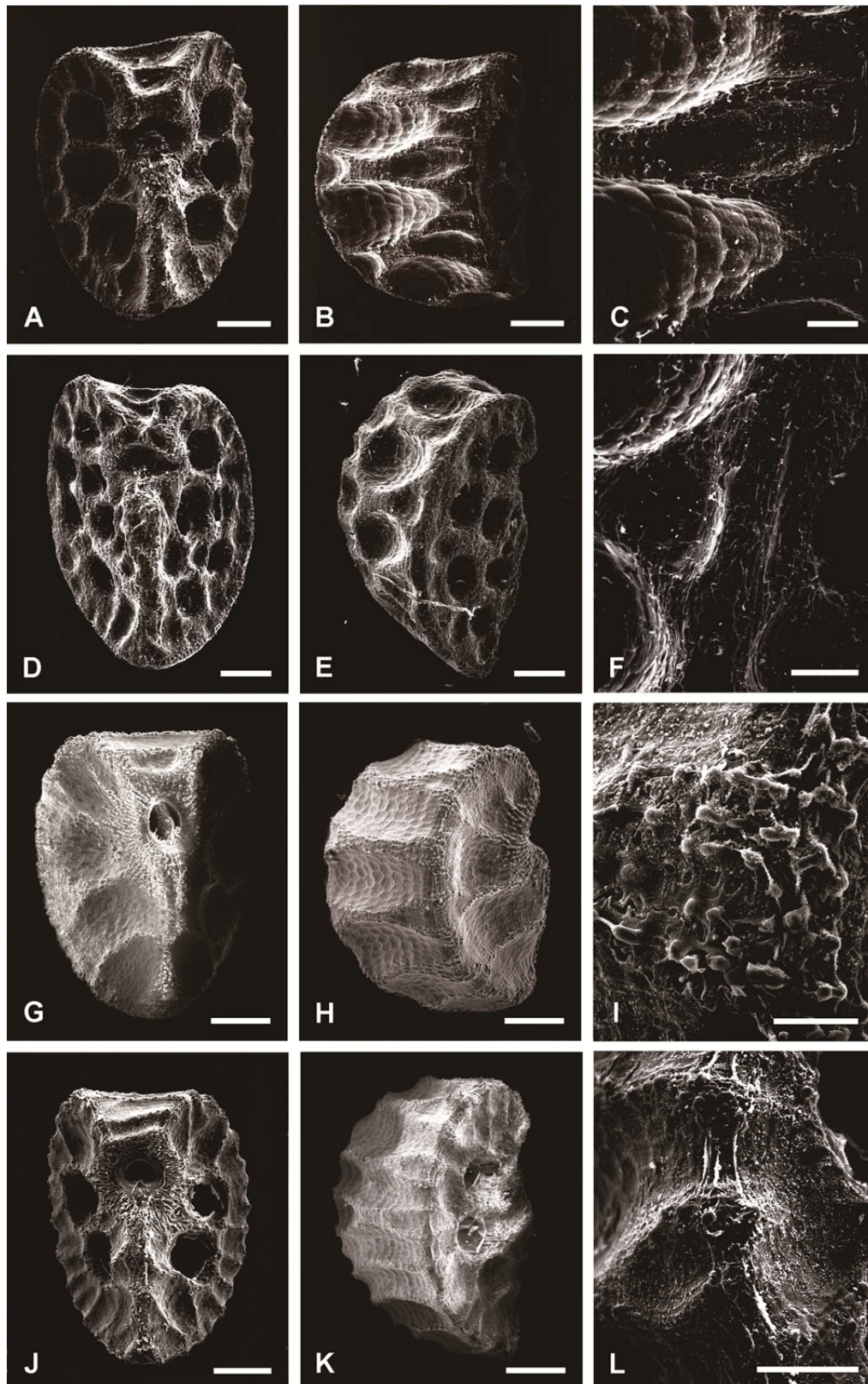


Fig. 3. Scanning electron micrographs of *Phyllanthus* seeds: A–C: *Phyllanthus coi* M.J. Wu, Ferreras & Y.J. Chen (Co 5993); D–F: *Phyllanthus erythrotrichus* C.B. Rob. (Robinson 9542); G–I: *Phyllanthus hookeri* Müll. Arg. (Wu 2952); J–L: *Phyllanthus urinaria* L. (Wu 2954). Scale bar: A, B, D, E, G, H, J, K=250µm, C, F=150µm, I=50µm, L=100µm.

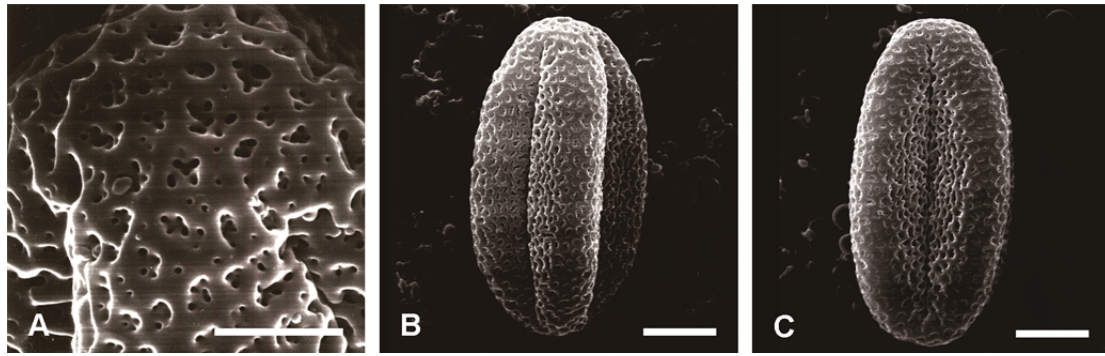


Fig. 4. Scanning electron micrographs of *Phyllanthus coi* pollen (Co 5993). Bar: A= 2 μ m, B & C= 5 μ m.

1.2 mm in diameter, pedicel up to 0.5 mm long; tepals 6, hyaline or whitish, midrib greenish, elliptic, 0.6–0.7 \times 0.2–0.3 mm, entire, obtuse or rounded at apex; glands 6, elliptic-star-shaped, ca. 0.15 \times 0.10 mm; stamens 3; filaments completely fused into a column, 0.2 mm long, anthers oblong, 0.1–0.2 mm long, longitudinally dehiscent; pollen grains 4-colporate. **Pistillate flowers:** 1.0–1.2 mm in diameter, pedicel up to 0.5 mm long; tepals 6, hyaline or whitish, midrib greenish, elliptic, 0.6–0.7 \times 0.3–0.4 mm, entire, rounded at apex; disc annular, superior margin crenulate; ovary globose, c. 0.5 \times 0.3 mm, styles 3-branched, branches dichotomous, c. 0.2 mm long. **Capsules:** brownish when mature, slightly scabrate, globose, 1.4–1.6 \times 2.0–2.2 mm. **Seeds:** orange-segment-shaped, 1.0–1.2 \times 0.8–1.0 mm, c. 0.8 thick, testa with honey-comb-like or reticulate-transverse 6–7 ridges on the back, with 2–4(–5) foveoles on the lateral sides.

Distribution: Endemic to the Philippines. So far known only from the type locality in Tuba, Benguet and Taal Volcano, Province of Batangas, Luzon.

Habitat and Ecology: *Phyllanthus coi* M.J. Wu, Ferreras & Y.J. Chen occurs in between small hairline cracks in bare rock and gravelly soil deposits at the base of basalt and andesite rock faces and road cuts, where parent material is exposed at elevations between 800–1,000 meters above sea level. It prefers partially shaded habitats and rock outcrops that are damp and humid throughout the year. It does not seem to prefer full sun exposure and is generally absent in more open sites.

Conservation Status and Threats: Data deficient. It would be reasonable to expect that more individuals can be encountered with more thorough field exploration in similar habitats in this general area. Less than a hundred individuals were observed with a more or less clumped distribution along the stretch of Kennon Road, Twin Peaks, Tuba, Benguet. During the time of a site visit in 2015 it became apparent that the road maintenance crew, who periodically weed out and maintain the road embankment, had decimated a great number of the known *Phyllanthus coi* population. Unless this can be controlled, it will remain an ongoing

threat that could result in local extirpation and possible extinction as species is at present no longer extant in the other known distribution locality in Taal, Batangas.

Etymology: The epithet is to honour the late Leonardo L. Co (1953–2010) who together with the first author had first collected this plant from Twin Peaks, Benguet. Leonardo Co had spent a great deal of his life studying forest plants and was a highly esteemed figure in the local conservation scene. He inspired many young Filipinos to seriously venture into and establish careers in botanical and ecological research.

Note: This new species was previously reported by Wu *et al.* (2016) as *Phyllanthus* aff. *urinaria* 2, which possesses the *P. urinaria* pollen type, 4-colporate pollen with a bi-reticulate ornamentation (Fig. 4).

Phyllanthus coi can be classified into section *Urinaria* subsection *Benguensis*. The *Urinaria* section belongs to subgenus *Phyllanthus*, which includes the majority of the herbaceous species of the genus (Webster, 1955, 1957). *Phyllanthus coi* is similar to *P. urinaria* L., the type species of section *Urinaria*, in having phyllanthoid and angled or winged branchlets, with pistillate flower solitary in the proximal axils of the branchlets and staminate flowers in paucifloral cymes in the distal axils of the branchlets (Figs. 1A–D & 2A). Therefore, there is without doubt that *P. coi* belongs to this section. Section *Urinaria* can be further subdivided into three subsections, namely: *Phyllanthus* subsections *Arenarius*, *Benguensis* and *Urinaria* (Rossignol *et al.*, 1987). *Phyllanthus coi* bears seeds with sharp, reticulate or honey-comb-like ridges on the dorsal side (Figs. 1G, 2H & 3B), and three free styles that are not lying flat on the top of the ovary (Figs. 1E & 2F). Upon considering the above mentioned characters and in subscribing to the key to the subsection in the treatment of Rossignol *et al.* (1987), it is evident that *Phyllanthus coi* most clearly falls under subsection *Benguensis*.

Phyllanthus coi differs from *P. erythrotrichus* C.B. Rob. in the inflorescence, seed and pollen morphology, the former bearing staminate flowers on distal branchlets, 2–4(–5) foveoles on seed sides (Figs. 1G,



2H & 3A–C), and 4-colporate pollen (Fig. 4), while the latter bearing staminate flowers on proximal branchlets (Chen, 2009), 6–8(–9) foveoles on seed lateral sides (Fig. 3D–F), and 3-colporate pollen (Chen *et al.*, 2009, Fig. 1; Wu *et al.*, 2016, Fig. 2)

Phyllanthus coi differs from *P. urinaria* L. by several characters, the former has long plagiotropic branchlets with up to 30 leaves per side, with the margin of the floral disc being crenulate and with honey-comb-like ridges on the seed back, while the latter has short plagiotropic branchlets with leaves numbering less than 22 leaves per side, with margins of the floral disc digitate and having transverse ridges on the seed back (Fig. 3J–L; Rossignol *et al.*, 1987).

The name *P. verrucosus* Elm. is not only a superfluous name as *P. verrucosus* Thunb. had been published earlier, but is also a synonym with a controversial placement under *P. urinaria* L. Various authors listed *P. verrucosus* Elm. as a synonym of *P. urinaria* L. (Merrill, 1923; Airy Shaw, 1987; Govaerts *et al.*, 2000). However, *Phyllanthus verrucosus* Elm. has a prominently verrucose or scaly fruit surface and flat seed lateral sides that are not pitted (Elmer, 1915; Type specimen, *Elmer 13576*, K). According to Rossignol *et al.* (1987), the species bearing scaly fruit surface and unpitted seeds at lateral sides should be rather classified as *P. hookeri* Müll. Arg. than *P. urinaria* L., although pollen morphology is not available from Elmer's specimens at present. Under closer scrutiny and considering the reasons cited above, however, it seems more apt to place *P. verrucosus* Elm. as a synonym of *P. hookeri* Müll. Arg.

Phyllanthus coi differs from *P. hookeri* Müll. Arg. by several characters, the former possessing long plagiotropic branchlets with up to 30 leaves per side, fruit surface being slightly scabrate, with 2–4(–5) foveoles on seed lateral sides, and 4-colporate pollen, while the latter has short plagiotropic branchlets with leaves less than 20 leaves per side, fruit surface is very scaly with no foveoles on the seed lateral sides (Fig. 3G–I), and 5-colporate pollen (Chen *et al.*, 1997, Figs. 35, 36, 52, 63 & 64).

Additional Specimens examined: The Philippines:

Luzon: Twin Peaks along Kennon Road, Municipality of Tuba, Benguet, *Wu 3368, 3369* (L, PNH, PUH, TAI); Central Luzon, *Loher 4764* (K); Taal Volcano, Province of Batangas, Jan. 1917, *Merrill 10645* (L).

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LITERATURE CITED

- Airy Shaw, H.K. 1983. An alphabetical enumeration of the Euphorbiaceae of the Philippines Islands. Royal Botanic Gardens, Kew.
- Chen, Y.-J. 2009. A Taxonomic Study of *Phyllanthus* L. (Phyllanthaceae; Euphorbiaceae sensu lato) in the Philippines. Thesis National Dong Hwa University, Hualien (in Chinese).
- Chen, Y.-J., S.-H. Chen, T.-C. Huang and M.J. Wu. 2009. Pollen morphology of Philippine species of *Phyllanthus* (Phyllanthaceae; Euphorbiaceae sensu lato). *Blumea* **54**(1): 47–58.
- Govaerts, R., D.G. Frodin, and A. Radcliffe-Smith. 2000. World checklist and bibliography of Euphorbiaceae 4. Royal Botanic Gardens, Kew.
- Hoffmann, P., A.J.M. Baker, D.A. Madulid, and J. Proctor. 2003. *Phyllanthus balgooyi* (Euphorbiaceae s. l.), a new nickel-hyperaccumulating species from Palawan and Sabah. *Blumea* **48**(1): 193–199.
- Merrill E.D. 1923. An enumeration of Philippine flowering plants 2: 391–396. Bureau of Printing, Manila.
- Rossignol, L., M Rossignol and R Haicour. 1987. A systematic revision of *Phyllanthus* subsection *Urinaria* (Euphorbiaceae). *Am. J. Bot.* **74**(12): 1853–1862.
- Webster, G.L. 1955. Studies of the Euphorbiaceae, Phyllanthoideae I. Taxonomic notes on the West Indian species of *Phyllanthus*. *Contr. Gray Herb.* **176**: 45–63.
- Webster, G.L. 1956. A monographic study of the West Indian species of *Phyllanthus*. *J. Arnold. Arbor.* **37**: 91–122, 217–262, 340–358.
- Webster, G.L. 1957. A monographic study of the West Indian species of *Phyllanthus*. *J. Arnold. Arbor.* **38**: 170–198.
- Wu, M.-J., T.-C. Huang, C.-C. Liu, Y.J. Chen, Y.-S. Chang, C.-L. Hsu, S.-Y. Wu, A.-Y. Tseng, Y.-C. Chang, C.-C. Liu and A. Kaewmuan. 2016. Pollen Morphology and Taxonomy in Malesian *Phyllanthus* (Phyllanthaceae) *J. Jap. Bot.* **91**, Suppl.: 257–292.