

Taxonomic Studies on the Genus *Phyllodium* Desv. (Leguminosae) in Thailand

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Abstract.– The taxonomy of genus *Phyllodium* in Thailand was studied. The results showed that six species are enumerated. Morphological descriptions and photographs, key to species, distribution and some ecological data are given. Moreover, both pollen morphological and leaf epidermal characters of three and five species respectively are presented.

KEY WORDS: Taxonomy, *Phyllodium*, leaf epidermis, pollen morphology, Thailand

INTRODUCTION

Phyllodium is a small genus of the tribe Desmodieae (Leguminosae-Papilionoideae) with eight species that is distributed in India, southeastern and eastern Asia and with a few species in northern Australia. The genus name consists of two Greek words: phyllon refers to leaf and -odion refers to both likeness and smallness. Both two words refer to the primary bracts of the inflorescences that are like small leaves (Lewis et al., 2005). The genus was first described by Desvaux (1784–1856), a French botanist who named *P. pulchrum* and *P. lutescens*. Later, the genus was placed in its own section under *Dicerma* by de Candolle (1825) and under *Desmodium* by Bentham and Hooker (1865), while Baker (1879) placed it under the genus *Desmodium* as subgenus *Phyllodium*. This genus has recently been reported from Myanmar by Kress et al. (2003) and from Lao PDR by Newman et al. (2007). In the Malesian region, Gagnepain (1920) studied the genus for Indonesia, Ridley (1922) for

the Malay Peninsula and Ohashi (2004) for the whole region. Moreover, the genus is revised for the flora of Asia and Pacific region (Ohashi, 1973) and Australia (Pedley, 1999). Six species of *Phyllodium* were listed in “Thai Plant Names” by The Forest Herbarium, Royal Forest Department (2014). However, there is no information on the morphology, distribution, ecology, leaf epidermis and pollen morphology of the Thai species of *Phyllodium*. Accordingly, this study aims to increase such information and in turn contribute to the advancement of the Flora of Thailand project.

MATERIALS AND METHODS

The study was based on herbarium specimens from the following herbaria AAU, ABD, BCU, BK, BKF, CMU, CMUB, E, K, KKU, QBG and PSU (Theirs, 2014) and field specimens collected in all Thai floristic regions. Pollen grains of three species were prepared using acetolysis as described by Erdtman (1966) and subsequently examined using an Olympus

CH30 light microscope (LM) and Leo 1450 VP scanning electron microscope (SEM). The terminology follows Walker and Doyle (1975), Erdtman (1966), Punt et al. (2007) and Hesse et al. (2009). The symmetry, aperture type and length, size, shape, amb type and exine thickness and ornamentation of pollen grains are presented. Leaf epidermis was scraped using razor blade and then it was carefully cleared using a paintbrush. The epidermis was stained with 1% safranin O for 20–30 minutes, dehydrated with 70%, 95% and absolute ethanol for 5 minutes each, immersed in xylene to absolute ethanol (1:1) and pure xylene for 5 and 10–15 minutes, respectively and mounted on slides with DePeX mounting medium. Sample slides were investigated and photographed under an Olympus CH30 LM.

1. TAXONOMIC TREATMENT

Genus *Phyllodium*

Desv., Journ. Bot. 1: 123. 1813. Type species: *Phyllodium pulchellum* (L.) Desv.

Dicerna sect. *Phyllodium* (Desv.) DC., Prodr. 2: 339. 1825.

Desmodium sect. *Phyllodium* (Desv.) Benth. in Benth. & Hook.f., Gen. Pl. 1(2): 519. 1865.

Desmodium subgen. *Phyllodium* (Desv.) Baker in Hook.f., Fl. Brit. Ind. 2: 162. 1879.

Shrubs. *Leaves* trifoliolate, alternate, petiolate, stipulate. *Leaflets* alternate, petiolulate, stipellate; pinnate venation distinct on lower side of leaf blade. *Inflorescences* terminal or axillary, pseudo-racemose or compound pseudoracemose; foliaceous primary bracts with two lateral leaflet-like and a terminal bristle; simple primary bracts rarely present (only in

Phyllodium insigne); secondary bract 1, at the base of pedicel. *Flowers* fasciculate, pedicellate; bracteoles 2, near the base of calyx tube, caducous. *Calyx* green, cup-shaped or campanulate with 4 teeth, persistent. *Corolla* papilionaceous. *Stamens* 10, monadelphous; anther longitudinally dehiscent. *Ovary* superior, 1-carpellate. *Pods* flat, indehiscent lomentum with (1–) 2–7 articles.

Key to the species

1. Plants with foliaceous primary bracts on the lower part of inflorescence rachis.....
..... **2. *P. insigne***
1. Plants with foliaceous primary bracts along entire inflorescence rachis and rachilla..... **2**
2. Lower surface of leaflets puberulous or pubescent; pods puberulous, distinctly reticulate..... **3**
2. Lower surface of leaflets tomentose; pods densely silvery sericeous, smooth.....
..... **1. *P. elegans***
3. Lateral leaflets less than the half as long as of terminal leaflet; terminal leaflet with more than 10 lateral veins per side.....
..... **4. *P. longipes***
3. Lateral leaflets equal to or more than the half as long as terminal leaflet; terminal leaflet with up to 10 lateral veins per side..... **4**
4. Pedicels 7–10 mm long; pods 3–5-articulate, rarely 1-seeded...**3. *P. kurzianum***
4. Pedicels 3–5 mm long; pods 2-articulate, rarely 3-articulate..... **5**
5. Terminal leaflet with 8–10 lateral veins per side; terminal bristle of foliaceous primary bract 6–7 mm long; flowers 8.5–9 mm long; staminal tube 7–8 mm long; wings white to creamy..... **5. *P. pulchellum***

5. Terminal leaflet with 4–6 lateral veins per side; terminal bristle of foliaceous primary bract 9–11 mm long; flowers ca. 12 mm long; staminal tube 11–12 mm long; wings purplish red..... **6. *P. vestitum***

1. *Phyllodium elegans* (Lour.) Desv., Mém. Soc. Linn. Paris 4: 324. 1826. Type: China, Canton and Macao, *M. Gaudichaud* 147, Jan. 1837 (neotype P n.v. designated by Dy Phon in Fl. Camb. Laos Vietn. 27: 38, 1994). Fig. 1 (A–C).

Hedysarum elegans Lour., Fl. Cochinch. 2: 450. 1790.

Zornia elegans (Lour.) Pers., Syn. Pl. 2(2): 318. 1807.

Dicerma elegans (Lour.) DC., Prodr. 2: 339. 1825.

Desmodium elegans (Lour.) Benth., Fl. Hongk.: 83. 1861.

Meibomia elegans (Lour.) Kuntze, Rev. Gen. 1: 198. 1891.

Desmodium blandum van Meeuwen, Reinwardtia 6: 247. 1962. Type: not located.

Shrub to 3 m high; twigs brown tomentose. *Leaves* tomentose throughout: stipules triangular, 4–6 by 1.5–3 mm, apex acuminate; petioles 0.5–2 cm long, tomentose; rachis 0.5–1 cm long. *Leaflets*: stipels linear to cuneate, ca. 2 mm long; petiolules 2–3 mm long. *Terminal leaflet* lanceolate, 5–10 by 2–6 cm, apex acute to shallowly retuse, base cuneate to rounded, margin repand; lateral veins 9–11 per side. *Lateral leaflets* ovate to asymmetrical, 3–7 by 2–4 cm, apex obtuse to shallowly retuse, base asymmetrical, margin repand. *Inflorescences* 10–50 cm long. *Foliaceous primary bracts* along entire inflorescence rachis and rachilla; stipules triangular, 3.5–4 mm long, apex acute, tomentose; stipels 2–2.5 mm long; petioles 2–3 mm long; petiolules 1–2 mm long; terminal bristle ca.

4 mm long; lateral leaflet-like suborbicular to broadly ovate, 0.5–2 cm wide, apex retuse to rounded, base asymmetrical, margin entire, both surfaces pubescent to tomentose; lateral veins 4–5 per side. *Secondary bracts* ovate, 0.6–0.8 by ca. 0.2 mm, apex acute, tomentose. *Flowers* 7.5–8 mm long in fascicles of 10–15; bracteoles linear, 0.9–1 by 0.1–0.2 mm, tomentose; pedicels 2–3 mm long, tomentose. *Calyx*: tube 2–3 mm long; teeth 1–2 mm long, apex acuminate, puberulous to pubescent. *Corolla* white; standard obovate or elliptic, 5–7 by 3–4 mm, apex obtuse, middle part rugose, upper margin auriculate, puberulous, claw 1–2 mm long; wings oblong, 6–6.5 by ca. 1 mm, upper margin distinctly auriculate, claw ca. 1.5 mm long; keels 5–7 by 2–2.5 mm, puberulous, claw 2–3 mm long. *Staminal tube* 6–7 mm long; anthers ellipsoid, ca. 0.5 mm long. *Ovary* puberulous to tomentose; style 4–6 mm long, puberulous. *Pods* 3 (–4)-articulate, 1.5 (–2.5) cm long, surface smooth, densely silvery sericeous.

Thailand. — NORTHERN: Chiang Mai; NORTH-EASTERN: Phetchabun, Sakon Nakhon, Maha Sarakham, Khon Kaen; EASTERN: Chaiyaphum, Nakhon Ratchasima, Buri Ram, Surin, Yasothon, Si Sa Ket, Ubon Ratchathani; SOUTH-WESTERN: Prachuap Khiri Khan; SOUTH-EASTERN: Prachin Buri, Chon Buri, Chanthaburi, Trat.

Distribution. — China, Laos, Cambodia, Vietnam, Indonesia (Java).

Ecology. — Evergreen, dry dipterocarp and mixed deciduous forests, 5–430 m alt. Flowering: August to November.

Vernacular. — Klet lin (เกล็ดลีน) (Ubon Ratchathani); klet pla chon (เกล็ดปลาช่อน) (Khon Kaen); klet pla mo (เกล็ดปลาหมอ) (Buri Ram, Prachin Buri, Sakon Nakhon).

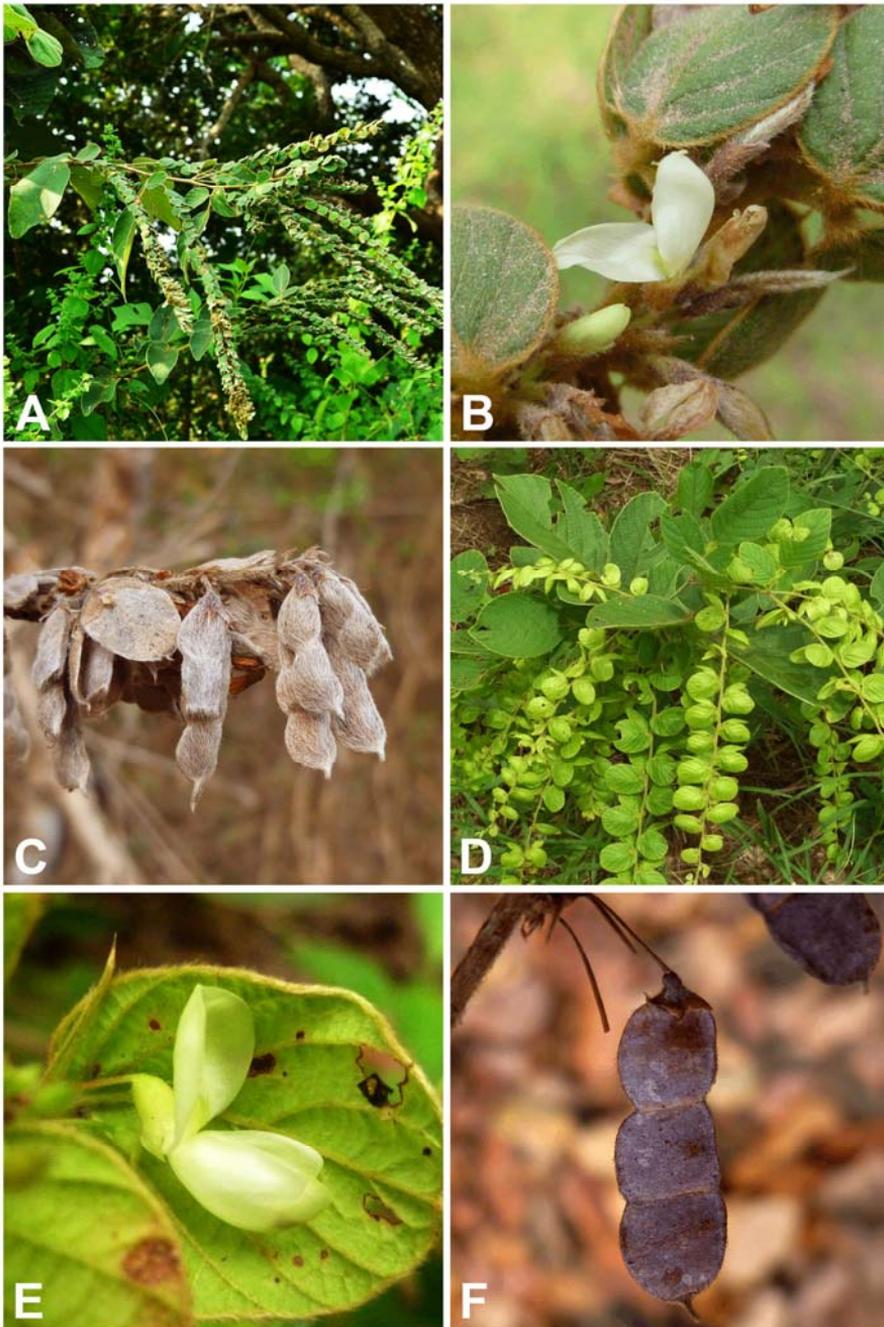


FIGURE 1. (A–C) *Phyllodium elegans* and (D–F) *P. kurzianum*.

Specimens examined. — BR s.n. (AAU);
D. Bunpheng 146 (BKF); *D.J. Collins* 286
 (E, K) & 1314 (ABD, K); *A.F.G. Kerr* 2139

(K) & 13458 (ABD, BK, E, K); *H. Koyama*,
H. Terao & *T. Wongprasert* T-30761
 (BKF); *K. Larsen* & *T. Santisuk* 31846

(AAU); *K. Larsen, T. Santisuk & E. Warncke* 2161 (BKF, E); *C. Leeratiwong* 99-89 (KKU, QBG); *S. Mattapha* s.n. (KKU); *J.F. Maxwell* 01-414 (CMUB) & 03-332 (CMUB); *G. Murata, C. Phengkklai, S. Mitsuta, H. Nagamasu & N. Nantasan* T-37216 (BKF), T-37254 (AAU, BKF) & T-48888 (BKF); *Y. Paisooksantivatana* y1623-85 (BK) & y2540-89 (BK); *C. Phengkklai* 912 (BKF, K); *C. Phengkklai et al.* 3598 (BKF, PSU); *A. Piyamputra* 3 (BCU); *R. Pooma, W.J.J.O. de Wilde, B.E.E. Duyffjes, V. Chamchumroon & K. Phattarahirankanok* 2173 (BKF); *R. Pooma, K. Phattarahirankanok & S. Sirimongkol* 4710 (BKF); *R. Pooma, K. Phattarahirankanok, S. Sirimongkol & B.* 5926 (BKF); *Pradet* 598 (BK); *Put* 2202 (AAU, ABD, BK, E, K) & 3178 (AAU, ABD, BK, K); *W. Saisorn* 42 (KKU), 47 (KKU), 52 (KKU), 53 (KKU) & 57 (KKU); *B. Sangkhachand* 565 (BKF); *R. Schultze-Kraft & S. Pattanavibul* 017/032-01 (K); *R. Schultze-Kraft, S. Pattanavibul & P. Sornprasitti* 060/33A-06 (K) & 060/038-02 (K); *P. Silprakab & P. Inlakon* s.n. (KKU, QBG); *T. Wongprasert* 039-11 (BKF) & *S.N.* (KKU).

2. *Phyllodium insigne* (Prain) Schindl. in Fedde, Repert. Spec. Nov. Regni Veg. 20: 270. 1924.

Desmodium insigne Prain, Journ. Asiat. Soc. Beng. 66(2): 398. 1897. Type: Myanmar, Tenasserim, at Endine Ghor, 1,000 ft alt., *G. Gallatly* 131, 21 Jan. 1877 (isotype CAL n.v.).

Shrub, 2–3 m high; stems and twigs golden tomentose. *Leaves*: stipules triangular, 7–8 by 2.5–5 mm, apex acuminate, pubescent; petioles (0.5–) 1.5–4 cm long, tomentose; rachis 1–3 cm long, tomentose. *Leaflets*: stipels narrowly

triangular, 3–4 mm by ca. 1 mm, pubescent; petiolules 3–6 mm long, tomentose. *Terminal leaflet* lanceolate, (6–) 12–20 by 2–6 cm, apex acute to obtuse, base cuneate to rounded, margin entire, upper surface pubescent, lower surface golden tomentose; lateral veins 11–12 per side. *Lateral leaflets* lanceolate, 7–14 by 3–7 cm, apex acute, base asymmetrical, margin entire, upper surface pubescent, lower surface golden tomentose. *Inflorescences* 10–50 cm long. *Foliaceous primary bracts* on the lower part of inflorescence rachis; stipules ca. 4 by 2 mm, apex acute, pubescent; stipels 2–3 mm long; petioles ca. 4 mm long; petiolules 1–2 mm long; terminal bristle 1.3–1.5 mm long; lateral leaflet-like suborbicular, 2–4.5 by 1.5–4.5 cm, apex retuse; lateral veins 4–6 per side. *Simple primary bracts* narrowly triangular, 5–6 by 1 mm. *Secondary bract* ovate, ca. 1 mm long, apex acute, tomentose. *Flowers* 8–11 mm long in fascicles of ca. 10 flowers; bracteoles ovate, ca. 1 mm long, apex acute, tomentose; pedicels 7–12 mm long, tomentose. *Calyx*: tube 4–6 mm long, pubescent; teeth acute. *Corolla* light yellow and purplish red; standard ca. 8 by 6 mm, apex obtuse, claw 2–3 mm long; wings oblong, ca. 8 by 2–2.5 mm, claw 2–3 mm long; keel ca. 10 by 3–4 mm, claw 2–3 mm long. *Staminal tube* 9–10 mm long; anthers ca. 0.5 mm long. *Ovary* puberulous. *Pods* (2–) 3–6-articulate, (1–) 2–4 by 0.5–0.6 cm; surface reticulate, puberulous.

Thailand. — NORTHERN: Mae Hong Son, Chiang Mai, Lamphun, Tak; SOUTH-WESTERN: Uthai Thani.

Distribution. — Myanmar.

Ecology. — Dry dipterocarp forest, mixed with lower montane oak and mixed deciduous forests, 110–1,500 m alt. Flowering: September to November.

Vernacular. — Kao fom (ข้าวฟ้อม), ya paep nok (หญ้าแปเปนนอก) (Chiang Mai); pan kadang (Lamphun).

Specimens examined. — *B.O.T.* 60 (BCU-3 sheets); *BGO-staff* 9700 (QBG); *C.C. Hosseus* 61 (E, K); *A.F.G. Kerr* 1453 (K); *Khantchai* 694 (BKF); *N. Mao* s.n. (BK); *J.F. Maxwell* 57-1263 (BKF), 87-1263 (CMU), 90-54 (E) & 94-1226 (CMUB, BKF); *R. Pooma, N. Pattharahirantricin, S. Sirimongkol & N. Silapasorn* 7770 (BKF); *B. Sangkhachand* 18 (BK); *R. Schultze-Kraft & S. Pattanavibul* 33094 (K); *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-22441 (BKF) & T-22471 (BKF); *Somdet* 203 (BKF); *T. Sørensen, K. Larsen & B. Hansen* 5729 (BKF) & *Winit* 1236 (AAU, ABD, BK, K) & 1540 (K).

3. *Phyllodium kurzianum* (Kuntze) H. Ohashi, *Ginkoana* 1: 272. 1973. Fig. 1 (D–F).

Meibomia kurziana Kuntze, *Rev. Gen.* 1: 197. 1891. Type: not located.

Desmodium grande Kurz, *Journ. Asiat. Soc. Beng.* 43(2): 184. 1874, non E. May. Type: Burma (Myanmar), Tagoung, *Anderson* 168 (isotype CAL n.v.).

Phyllodium grande (Kurz) Schindl. in *Fedde, Repert. Spec. Nov. Regni Veg.* 20: 270. 1924.

Desmodium kurzii Craib, *Bull. Misc. Inform., Kew* 1911: 37. 1911. Type: Thailand, Chiang Mai, in deciduous jungle on Doi Suthep, 300 m, *A.F.G. Kerr* 766 (holotype K!).

Phyllodium kurzii (Craib) Chun, *Sunyatsenia* 4: 213. 1940.

Shrub to 1.5 m high; young twigs 5-ridged, tomentose on and puberulous between the ridges. *Leaves:* stipules

triangular, 4–5 by 2–3 mm, persistent, apex acuminate, puberulous; petioles 3.5–5.5 cm long, tomentose; rachis 2.5–4 cm long. *Leaflets:* stipels triangular, 2–3 by ca. 1.5 mm, apex acuminate, puberulous; petiolules 2.5–4 mm long. *Terminal leaflet* lanceolate to broadly ovate, 12–18 by 8–11 cm, apex acute, base cuneate to obtuse, margin entire or slightly repand, upper surface puberulous, lower surface pubescent; lateral veins 7–10 per side. *Lateral leaflets* narrowly ovate to lanceolate or asymmetrical, 9–15 by 5–9 cm, apex acute to obtuse, base asymmetrical, margin entire or slightly repand, puberulous above, pubescent below. *Inflorescences* 10–50 cm long. *Foliaceous primary bracts* along entire inflorescence rachis and rachilla; stipules triangular, ca. 4 by 1.5–2 mm, apex acuminate, puberulous; stipels ca. 0.3 mm long, puberulous; petioles 4–4.5 mm long, pubescent; petiolules ca. 1.5 mm long, pubescent; terminal bristle 1.3–1.5 cm long, puberulous; lateral leaflet-like ± ovate or suborbicular, 2–4 by 2–3 cm, apex retuse to obtuse, base asymmetrical, margin entire to shallowly repand, surface appressed puberulous; lateral veins 4–6 per side. *Secondary bracts* ovate, ca. 0.7 by 0.5 mm, margin ciliate. *Flowers* 0.8–1 cm long in fascicles of ca. 15 flowers; bracteoles ovate, ca. 0.7 by 0.5 mm, margin ciliate; pedicels 0.7–1 cm long, with hooked hairs. *Calyx:* tube 3.5–4 mm long; teeth ca. 1.5 mm long, externally puberulous. *Corolla* white to light yellow; standard broadly obovate, ca. 9 by 6 mm, apex obtuse, glabrous, claw ca. 2 mm long; wings narrowly elliptic, ca. 8 by 2 mm, claw 2–2.5 mm long, upper margin distinctly auriculate, glabrous; keels ca. 9 by 3 mm, glabrous, claw 2.5–3.5 mm long. *Staminal tube* ca. 1 cm long; anthers ellipsoid, ca. 0.6 mm long. *Ovary* puberulous; style ca. 8 mm long. *Pods* (1–)

3–5 articulate, 1–1.5 by 0.5–0.7 cm, distinctly reticulate, puberulous. *Seeds* 3.2–3.5 by 2.5–3 mm.

Thailand. — NORTHERN: Chiang Mai, Phayao, Nan, Lamphun, Lampang, Phrae, Phitsanulok; NORTH-EASTERN: Phetchabun, Loei, Buengkan, Sakon Nakhon; EASTERN: Chaiyaphum, Buri Ram; SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Chon Buri.

Distribution. — China, Myanmar.

Ecology. — Lower montane pine-oak, dry dipterocarp, mixed deciduous and pine-deciduous dipterocarp forests, 200–1,010 m alt. Flowering: July to December.

Vernacular. — Ket pla (เค็ดปลา) (Kanchanaburi); klet pla chon (เค็ดปลาชอน) (Chiang Mai, Lampang, Phitsanulok); mai klet min (ไม้เค็ดคั้น) (Loei).

Specimens examined. — *BGO. staff* 19 (QBG), 119 (QBG), 1551 (QBG) & 1663 (QBG); *P. Chantaranothai et al.* 339 (KKU), 715 (KKU) & 1409 (KKU); *C. Charoenphol, K. Larsen & E. Warncke* 4886 (AAU, BKF); *D.J. Collins* 1859 (BK, K); *B. Hansen, G. Seidenfaden & T. Smitinand* 11233 (K); *T. Jonganurak, N. Hemrath & J. Pithpheth* 1523 (AAU, BKF); *A.F.G. Kerr* 766 (K); *S. Khrongton* 166-1 (KKU); *H. Koyama, H. Terao, C. Niyomdham & T. Wongprasert* T-30374 (BKF); *K. Larsen* 4807 (BKF); *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 31522 (AAU, BKF); *K. Larsen, T. Smitinand & E. Warncke* 853 (AAU); *C. Leeratiwong* 98-19 (KKU), 99-61 (KKU, QBG) & 2001-7 (PSU); *I. Makkan* 131 (BKF); *C. Maknoi* 1149 (QBG); *S. Mattapha* 944 (KKU, QBG); *J.F. Maxwell* 74-1062 (AAU, BK), 87-1426 (CMUB, BKF), 91-1050 (CMUB, E), 93-1099 (CMUB), 93-1287 (CMUB, BKF-2 sheets) & 94-1255 (CMUB, BKF); *G. Murata, C. Phengklai, S. Mitsuta, H.*

Nagamasu & N. Nantasan T-37276 (BKF) & T-37338 (BKF); *P. Nangngam* 1849 (BKF); *M. Norsaengsri* 7175 (QBG); *M. Panatkool* 390 (CMUB); *J.A.N. Parnell, C. Pendry, M. Jebb & R. Pooma* 95-230 (BKF, K); *C. Phengklai et al.* 12311 (BKF); *R. Pooma* 259 (CMUB, BKF) & 1311 (CMUB, BKF); *R. Pooma, K. Phattarahirankanok, S. Sirimongkol & M. Poopath* 5963 (BKF); *Prayad* 999 (BK); *Put* 1841 (BK, K); *W. Saisorn* 81 (KKU), 110 (KKU) & 157 (KKU); *B. Sangkhachand* 2031 (BKF); *W. Sankamethawee* 372 (CMUB, BKF); *R. Schultze-Kraft & S. Pattanavibul* 053/037-08 (K), 053/056-10 (K) & 053/057-04 (K); *R. Schultze-Kraft, S. Pattanavibul & P. Sornprasitti* 060/017-04 (K); *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-21906 (BKF); *T. Smitinand* 4881 (BKF, K); *S. Suwannaratana* 20 (CMUB); *K. Warintorn* 07-119 (BKF, QBG) & *Winit* 1489 (ABD, BK, K).

4. *Phyllodium longipes* (Craib) Schindl. in Fedde, Repert. Spec. Nov. Regni Veg. 20: 270. 1924. Fig. 2 (A–C).

Desmodium longipes Craib, Bull. Misc. Inform., Kew 1910: 20. 1910. Type: Thailand, mixed jungle at foot of Doi Sutep, 10 Jul. 1909, *A.F.G. Kerr* 715 (ABD!, BM!, K!-2 sheets).

Desmodium tonkinense Schindl. in Engler, Bot. Jahrb.: 53. 1917. Type: Vietnam, Tonkin, 12 Sept. 1885, *B. Balansa* 1252 (BR n.v.-2 sheets).

Shrub to 3 m high; young twigs puberulous; leaves and inflorescence bracts puberulous to pubescent on leaflet-like below or glabrescent on leaflets above. *Leaves*: stipules triangular, 3.5–5.5 by 3–3.5 mm, apex acuminate; petioles 3–5 mm long; rachis 0.8–1.5 cm long. *Leaflets*: stipels

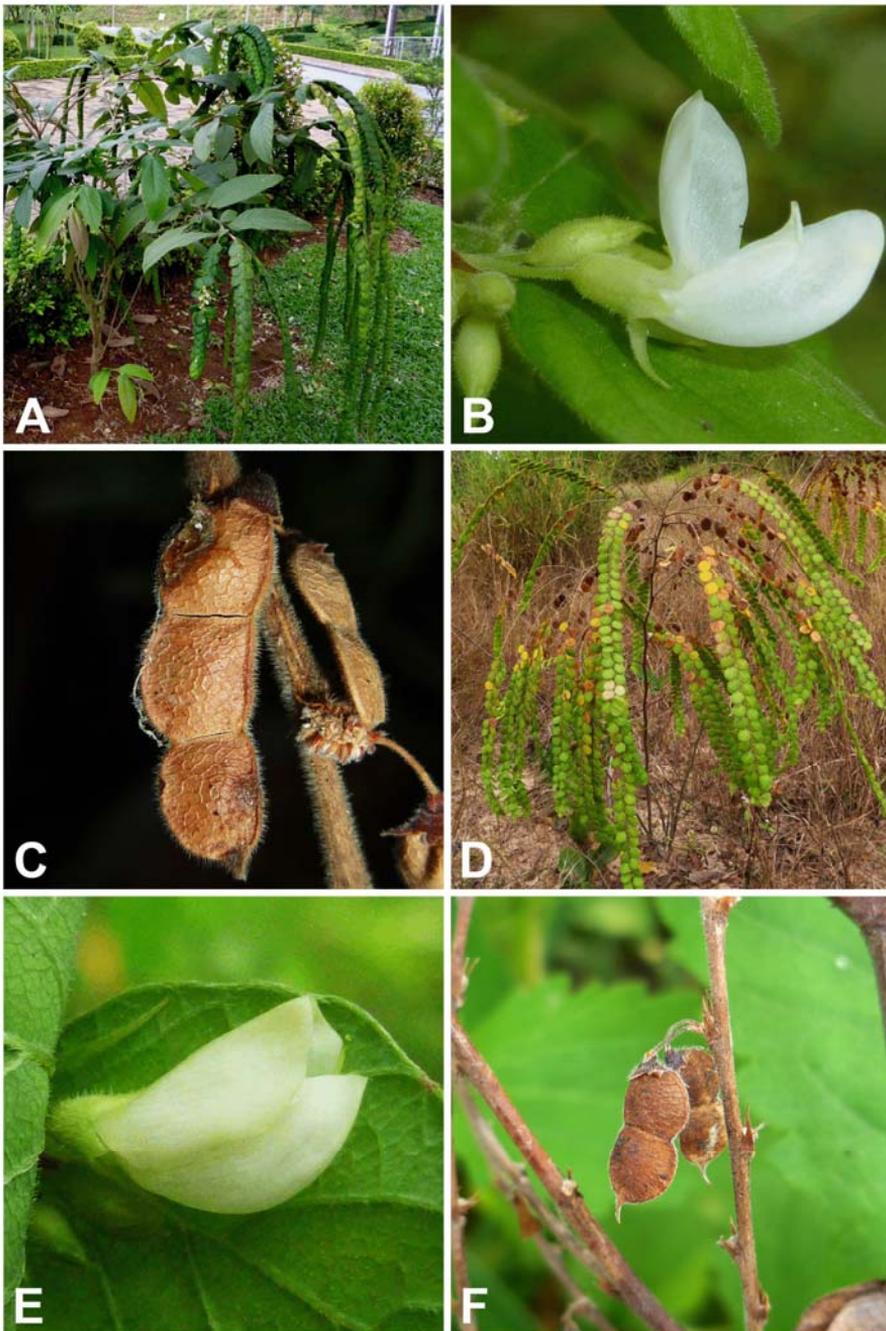


FIGURE 2. (A–C) *Phyllodium longipes* and (D–F) *P. pulchellum*.

triangular, 2–3.5 by 0.5–0.7 mm, apex acuminate; petiolules 2–4 mm long. *Terminal leaflet* lanceolate, 11–18 by 4–6

cm, apex acute to acuminate, base obtuse, margin entire or slightly repand; lateral veins 11–14 per side. *Lateral leaflets*

narrowly ovate or asymmetrical, 3–3.5 by 2–3 cm, apex acute to acuminate, base asymmetrical, margin entire. *Inflorescences* 20–150 cm long. *Foliaceous primary bracts* along entire inflorescence rachis and rachilla; stipules triangular, 3.5–4.5 by 1.2–1.5 mm, apex acuminate; stipels 1.2–2 by ca. 0.3 mm; petioles 3–4 mm long; petiolules ca. 1 mm long; terminal bristle 0.9–1.6 cm long; lateral leaflet-like ± ovate, 2.5–3.5 by 2–3 cm, apex acute, base asymmetrical, margin entire; lateral veins 6–7 per side. *Secondary bract* ovate, 0.8–1 by 0.4–0.5 mm, apex acute. *Flowers* 8.5–9 mm long in fascicles of 10–15; bracteoles ovate, 0.8–1 by 0.4–0.5 mm, acute; pedicels 4.2–4.5 mm long. *Calyx*: tube 4.5–5 mm long; teeth 1–2 mm long. *Corolla* white; standard obovate, ca. 8 by 5–5.5 mm, apex retuse, base attenuate, claw 2–2.5 mm long; wings oblong to narrowly elliptic, 7.5–8 by 1.5–2 mm, upper margin with distinct ca. 0.8 mm long auricles; keels 8.5–9 by 3–3.5 mm, claw 3–3.5 mm long. *Staminal tube* 7.5–9 mm long; anthers ca. 0.5 mm long. *Ovary* puberulous; style 6.5–7.5 mm long. *Pods* (2–) 4–5 articulate, (0.8–) 1.5–2 by ca. 0.5 cm, distinctly reticulate, puberulous.

Thailand. — NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Uttaradit, Phitsanulok; NORTH-EASTERN: Phetchabun, Loei, Sakon Nakhon, Nakhon Phanom, Kalasin, Khon Kaen; EASTERN: Chaiyaphum, Yasothon, Si Sa Ket, Ubon Ratchathani; SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; PENINSULAR: Phangnga.

Distribution. — China, Myanmar, Laos, Vietnam.

Ecology. — Dry evergreen, lower montane coniferous, lower montane oak, dry dipterocarp, dry dipterocarp mixed with lower montane oak and mixed deciduous

forests, 280–1,424 m alt. Flowering: June to March.

Vernacular. — Klet lin (เกล็ดลิ้น) (Mae Hong Son); klet pla (เกล็ดปลา), luk lip (ลูกลิ้น), luk lip ton (ลูกลิ้นตัน), lup lip (ลูกลิ้น), lup lip ton (ลูกลิ้นตัน), so ho mae (โซโฮแม) (Chiang Mai).

Specimens examined. — *BGO. staff* 9 (QBG), 86 (QBG) & 7665 (QBG); *K. Bragg* 74 (CMU); *K. Bunchuai* 1273 (ABD, K); *P. Chantaranothai et al.* 98-37 (KKU), 770 (KKU) & s.n. (KKU); *Chusie* KY493 (QBG); *D.J. Collins* 309 (K) & 1865 (BK, K); *C. Glamwaewwong* 1278 (QBG); *Y. Hanmontri* 7 (QBG) & 11 (KKU); *B. Hansen, G. Seidenfaden & T. Smitinand* 11233 (BKF); *K. Jatupol* 07-022 (QBG) & 08-240 (PSU); *T. Jonganurak, N. Hemrath & J. Rithipheth* 1547 (CMUB); *K. Kansuntisukmongkol* 1115 (CMUB); *A.F.G. Kerr* 715 (ABD, K-2 sheets); *F. Konta & S. Khao-Iam* 11374 (BKF); *F. Konta, C. Phengkklai & S. Khao-Iam* 4821 (BKF-2 sheets); *H. Koyama, H. Terao & T. Wongprasert* T-30853 (BKF) & T-31918 (BKF); *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 31578 (AAU); *K. Larsen, S.S. Larsen, C.T. Nørgaard, K. Pharsen, P. Puudjaa & W. Uerchirakan* 44525 (AAU); *K. Larsen, T. Smitinand & F. Warncke* 666 (AAU, BKF) & 2832 (BKF); *K. Larsen & E. Warncke* 1832 (AAU); *C. Leeratiwong* 98-66 (KKU); *N. Mao* s.n. (BK); *S. Mattapha* 898 (KKU, QBG); *J.F. Maxwell* 87-769 (CMU), 87-1048 (BKF, CMU), 90-025 (CMU), 90-139 (CMU), 95-607 (CMUB, BKF), 96-1549 (CMUB, BKF), 97-1268 (CMUB), 98-17 (CMUB, BKF), 98-1428 (CMUB, BKF), 01-481 (CMUB) & s.n. (BKF); *G. Murata, N. Fukuoka & C. Phengkklai*, T-17166 (BKF); *G. Murata, C. Phengkklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-41681 (BKF), T-51213 (BKF) & T-51378 (BKF); *M.*

Norsaengsri 6349 (QBG) & 6419 (QBG); *C. Phengklai et al.* 7220 (BKF); *C. Phengklai & T. Smitinand* 6126 (BKF); *W. Pongamornkul* 2784 (QBG) & 2791 (QBG); *R. Pooma* 260 (CMUB, BKF); *R. Pooma, W.J.J.O. de Wilde, B.E.E. Duyffjes, V. Chamchumroon & K. Phattarahirankanok* 2332 (BKF); *P. Pornpongrueng et al.* 102-1 (KKU); *Pradit* 423 (BK); *W. Saisorn* 11 (KKU), 44 (KKU), 50 (KKU), 78 (KKU), 104 (KKU), 117 (KKU), 139 (KKU) & 147 (KKU); *B. Sangkhachand* 9 (BKF) & 180 (K); *R. Schultze-Kraft, S. Pattanavibul & P. Sornprasitti* 060/028-05 (K); *T. Smitinand* s.n. (BKF); *S. Suddee* 142 (BCU-3 sheets); *S. Suddee, T. Jonganurak & V. Chamchumroon* 3 (BKF); *Suradet* 200 (BKF); *S. Sutheesorn* 3517 (BK), 3565 (BK) & 4117 (BK); *S. Tahkaru* T-61650 (BKF); *M.N. Tamura* T-60122 (BKF); *S. Tsugaru* T-60057 (BKF-2 sheets, QBG); *T. Wangprasert* s.n. (BKF no. 104356); *Th. Wangprasert et al.* s.n. (CMUB, BKF-3 sheets); *W. Yahnpaisahn* 133 (CMUB) & *S.N.* (BCU).

5. *Phyllodium pulchellum* (L.) Desv., Journ. Bot. ser. 2, 1: 124. 1813. Fig. 2 (D–F).

Hedysarum pulchellum L., Sp. Pl. 2: 747. 1753. Type: Herb. Linn. No. 921.24 (lectotype LINN n.v.).

Dicerma pulchellum (L.) DC., Prodr. 2: 339. 1825.

Desmodium pulchellum (L.) Benth., Fl. Hongk.: 83. 1861.

Meibomia pulchella (L.) Kuntze, Rev. Gen. 1: 197. 1891.

Phyllodium elegans Benth. in Jungh. & Miq., Pl. Jungh.: 217 & 218. 1853, non DC. Type: not located.

Phyllodium blumei Zipp. ex Miq., Fl. Ind. Bat. 1(1): 260. 1855. Type: not located.

Shrub, 1–2 m high; young twigs, leaves and inflorescence bracts puberulous. *Leaves:* stipules triangular, 6–7 by 2–2.5 mm, apex acuminate; petioles 0.5–1.5 cm long; rachis 1–2.5 cm long. *Leaflets:* stipels narrowly triangular, 3–3.5 by 0.5–0.6 mm; petiolules 2–5 mm long. *Terminal leaflet* ± lanceolate, 8–20 by 2.5–8 cm, apex obtuse to acute, base cuneate to obtuse, margin slightly repand; lateral veins 8–10 per side. *Lateral leaflets* ± ovate, (2–) 4–11 by 1–5 cm, apex acute to obtuse, base asymmetrical, margin slightly repand; lateral veins 4–6 per side. *Inflorescences* 10–100 cm long. *Foliaceous primary bracts* along entire inflorescence rachis and rachilla; stipules triangular, ca. 3.5 mm long, apex acute; stipels ca. 1.2 mm long; petioles ca. 2 mm long; petiolules ca. 1 mm long; terminal bristle 6–7 mm long; lateral leaflet-like ± orbicular, 1–1.5 cm wide. *Secondary bract* ovate, ca. 1 by 0.5 mm. *Flowers* puberulent to puberulous on bracteoles and both surfaces of the calyx, 8.5–9 mm long, born in 4–6 flowered fascicles; bracteoles ca. 1 by 0.5 mm; pedicels 3–3.5 mm long. *Calyx:* tube green, 3–3.5 mm long; teeth 1–1.5 mm long, apex acute. *Corolla* white to creamy; standard elliptic to obovate, 7.5–8 by 4–4.5 mm, apex rounded to retuse, claw 1.5–2 mm long; wings elliptic to oblong, 7–7.5 by ca. 1.5 mm, apex obtuse, upper margin auriculate, claw ca. 2 mm long; keels ca. 8.5 by 2.5–3 mm, obtuse to acute, upper margin auriculate, claw 2.5–3 mm long. *Staminal tube* 7–8 mm long; anthers ca. 0.5 mm long. *Ovary* puberulous; style 7–8 mm long. *Pods* 2-articulate, 8–10 by 4–4.5 mm, distinctly reticulate, puberulous.

Thailand. — NORTHERN: Chiang Mai, Chiang Rai, Phayao, Nan, Lamphun, Lampang, Phrae, Tak, Sukhothai, Phitsanulok, Kamphaeng Phet; NORTH-EASTERN: Phetchabun, Loei, Nong Khai,

Buengkan, Sakon Nakhon, Nakhon Phanom, Mukdahan, Khon Kaen; EASTERN: Chaiphaphum, Nakhon Ratchasima, Buri Ram, Surin, Yasothon, Ubon Ratchathani; SOUTH-WESTERN: Uthai Thani, Kanchanaburi, Ratchaburi, Phetchaburi, Prachuap Khiri Khan; CENTRAL: Lop Buri, Suphan Buri, Saraburi, Nakhon Nayok; SOUTH-EASTERN: Sa Kaeo, Prachin Buri, Chon Buri, Rayong, Chanthaburi; PENINSULAR: Ranong, Surat Thani, Satun, Songkhla, Narathiwat.

Distribution. — India, Sri Lanka, China, Myanmar, Japan, Taiwan, Laos, Cambodia, Vietnam, Malaysia, Philippines, northern Australia.

Ecology. — Dry evergreen, lower montane coniferous, dry dipterocarp and dry dipterocarp mixed with lower montane oak forests, 0–1,800 m alt. Flowering: July to December.

Vernacular. — Ket lin lek (เก็ดหลั่นเล็ก) (Sa Kaeo); klet lin (เก็ดลั่น) (Lamphun, Nakhon Nayok, Phetchabun, Phitsanulok, Sukhothai, Surin, Ubon Ratchathani); klet lin noi (เก็ดลั่นน้อย) (Sakon Nakhon); klet lin Yai (เก็ดลั่นใหญ่) (Nakhon Ratchasima); klet pla (เก็ดปลาด) (Nan); klet pla chon (เก็ดปลาดชอน) (Chiang Mai, Kanchanaburi, Khon Kaen, Lop Buri, Rayong, Saraburi); klet pla mo (เก็ดปลาดหมอ) (Ratchaburi); lin ton (ลั่นตัน), ya song plong (หย้าสองปล่อง) (Central); luk lip (ลูกลีน) (Chiang Mai); luk nip ton (ลูกหนีบตัน) (Lampang, Prachin Buri); mai hang lin (ไม้หางลั่น), hang lin (หางลั่น) (Surat Thani); pa pae (ปะเปะ) (Suay-Surin); ya klet lin (หย้าเก็ดลั่น) (Northern, Peninsular).

Specimens examined. — *Amnoyperm* s.n. (PSU no. 0000834); *BGO. staff* 1585 (QBG), 1749 (QBG), 4299 (QBG) & 9634

(QBG); *P. Boonkrong* 24 (K); *P. Bunchlang* 34 (BKF); *P. Chantaranothai et al.* 649 (KKU), 739 (QBG), 759 (KKU) & s.n. (KKU, QBG); *P. Chantaranothai, J. Parnell & D. Simpson* 90/409 (K); *N. Chareonraj* 10 (BCU); *C. Charoenphol, K. Larsen & E. Warncke* 4875 (AAU, BKF, K); *C. Chermisrivathana* 1559 (BK); *C. Chermisrivathana & Prayad* 1972 (BK); *D.J. Collins* 30 (AAU, BM, E, K) & 1864 (ABD, BK, K); *Dee* 427 (BKF); *N. Fukuoka & M. Ito* T-35155 (BKF) & T-84790 (BKF); *H.B.G. Garrett* 136 (K-2 sheets) & 1396 (K); *R. Geesink, P. Hiepko & C. Phengklai* 7594 (BKF, K); *Y. Hanmontri* 12 (KKU, QBG); *C.C. Hosseus* 66 (E-3 sheets, K); *Jitaree* s.n. (PSU no. 0000832); *P. Keosangsee* 18 (BCU); *A.F.G. Kerr* 13486 (ABD, BK, E, K) & 13549 (ABD, BK, K); *D. Khruuasan* MS813 (QBG); *F. Konta & S. Khao-Iam* 11251 (BKF); *F. Konta, C. Phengklai & S. Khao-Iam* 4498 (BKF-2 sheets); *H. Koyama & C. Phengklai* T-39836 (BKF); *H. Koyama, H. Terao, C. Niyomdham & T. Wongprasert* T-30375 (BKF) & T-30510 (BKF); *H. Koyama, H. Terao & T. Wongprasert* T-30684 (BKF, QBG), T-30957 (BKF, QBG), T-31850 (BKF) & T-31920 (BKF-2 sheets); *K. Larsen, S.S. Larsen, C.T. Nørgaard, K. Phrasen, P. Puudjaa & W. Uerchirakan* 44517 (AAU); *K. Larsen, S.S. Larsen, I. Nielsen & T. Santisuk* 30785 (AAU, K), 31430 (AAU, BKF) & 31530 (AAU); *K. Larsen, T. Smitinand & Warncke* 1132 (AAU); *C. Leeratiwong* 48-68 (QBG) & 98-68 (KKU-2 sheets, QBG); *M.C. Lakshanakara* 273 (AAU, ABD, BK, E, K); *R. Mahasombat* 146 (CMUB); *C. Maknoi* 2690 (BKF); *A. Marcan* 1059 (ABD, BM); *S. Mattapha* s.n. (KKU, QBG); *J.F. Maxwell* 71-706 (AAU-2 sheets), 73-500 (AAU, BK), 84-354 (BKF, PSU-2 sheets), 86-934 (BKF, CMU, PSU), 87-1306 (BKF,

- CMU), 89-100 (BKF, CMU), 89-1400 (CMU, E-2 sheets), 89-1602 (CMU, E-2 sheets), 91-58 (CMU), 91-826 (CMUB, E), 91-903 (E), 92-715 (CMUB), 94-1259 (CMUB, BKF), 96-1497 (CMUB, BKF), 98-1440 (CMUB), 00-91 (CMUB, BKF), 01-570 (CMUB), 03-350 (CMUB, BKF), 04-627 (CMUB), 05-738 (CMUB) & 07-659 (CMUB, QBG-2 sheets); *W. McClatchey, P. Mokkamul & C. Hobbs* WCM3269A (BKF) & WCM3426 (BKF); *G. Murata, K. Iwatsuki & D. Chaiglom* T-16205 (BKF); *G. Murata, K. Iwatsuki & C. Phengklai* T-2356 (BKF); *G. Murata, K. Iwatsuki, C. Phengklai & C. Charoenphol* T-15665 (BKF); *G. Murata, C. Phengklai, S. Mitsuta, H. Nagamasu & N. Nantasan* T-37257 (AAU) & T-37540 (AAU); *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-38278 (BKF), T-50040 (BKF) & T-50763 (BKF); *R. Namdaeng* 43 (KKU); *W. Nanakorn et al.* 5092 (QBG); *S. Nimanong & S. Phusomsaeng* 116 (BKF, K); *C. Niyomdham* 4875 (BKF); *M. Norsaengsri* 923 (QBG), 1806 (QBG), 2841 (QBG), 2867 (QBG) & 6405 (QBG); *M. Norsaengsri & N. Tathana* 8393 (QBG); *Y. Paisooksantivatana* Y2300-88 (BK) & Y2374-89 (BK); *Y. Paisooksantivatana & P. Sangkhachand* Y2195-87 (BK); *M. Panatkool* 32 (CMUB) & 410 (CMUB); *O. Petrmitr* 240 (CMUB) & 415 (CMUB); *C. Phengklai & T. Smitinand* 6125 (BKF-2 sheets) & 6132 (BKF); *C. Phengklai* 191 (BKF) & 3968 (BKF-2 sheets, PSU); *C. Phengklai et al.* 3310 (BKF-2 sheets, PSU), 7600 (BKF-2 sheets), 13993 (BKF) & 14032 (BKF); *S. Phengnaren* s.n. (BKF no. 47033); *P. Pisuttimarn et al.* 165-1 (KKU); *Ploenchit* 450 (BCU, BKF); *W. Pongamornkul* 2 (QBG) & 50 (QBG); *R. Pooma, W.J.J.O. de Wilde, B.E.E. Duyffjes, V. Chamchumroon & K. Phattarahiran-kanok* 2546 (BKF); *Pradit* 602 (BKF); *Prayad* 700 (BK), 1016 (BK) & 1097 (BK); *Put* 2081 (AAU, ABD, BK, E, K); *P. Puutiea* 760 (BKF); *S. & S.* 1926 (BK); *S.P. et al.* 88 (BKF); *W. Saisorn* 12 (KKU), 32 (KKU), 40 (KKU), 41 (KKU), 43 (KKU), 54 (KKU), 62 (KKU), 69 (KKU), 79 (KKU), 80 (KKU), 88 (KKU), 90 (KKU), 95 (KKU), 107 (KKU) & 122 (KKU); *B. Sangkhachand* 1246 (BKF, K); *W. Sankamethawee* 355 (CMUB, BKF); *I. Schanzer* 02-124 (BKF); *R. Schultze-Kraft & S. Pattanavibul* 024/029-01 (K), 053/001-01 (K), 053/012-05 (K), 053/014-02 (K), 053/043-05 (K), 053/050-05 (K) & 053/053-07 (K); *R. Schultze-Kraft, S. Pattanavibul & P. Sornprasitti* 060/006-03 (K), 060/010-06 (K), 060/019-03 (K), 060/024-04 (K), 060/027-03 (K), 060/033-01 (K), 060/035-03 (K) & 060/037-02 (K); *T. Seelanan et al.* 262 (BCU-2 sheets); *K. Setubra* 8 (BKF); *T. Shimizu, M. Hutoh & D. Chaiglom* T-8766 (BKF); *T. Shimizu, H. Toyokuni, H. Koyama, T. Yahara & C. Niyomdham* T-21429 (BKF), T-21905 (BKF) & T-22567 (BKF); *P. Sirirugsa* 234 (PSU-2 sheets), s.n. (PSU no. 0000835) & s.n. (PSU no. 0000837); *T. Smitinand* 4888 (BKF, K); *Somkhit* 460 (BKF); *T. Sørensen, K. Larsen & B. Hansen* 403 (BKF, E); *S. Suddee, T. Jonganurak & V. Chamchumroon* 4 (BKF); *P. Suksathan* 2805 (QBG); *S. Sutheesorn* 100 (BK), 585 (BKF), 3109 (BK), 3472 (BK) & 4316 (BK); *N. Tanaka, H. Nagamasu, A. Naiki, S. Nishida, P. Srisanga & S. Wathana* HN8023 (QBG); *B. Tantioowic & C. Phengklai* s.n. (BKF); *A. Thammathaworn* 45 (KKU); *W. Thephettee et al.* 25 (BCU-2 sheets); *Umpai* 584 (BK) & 644 (BK); *Vacharapong* 324 (BK); *C.F. van Beusekom & C. Charoenphol* 1981 (AAU, BKF, E); *M. van de Bult* 142 (BKF); *A. Virapongse* AV5 (BKF) & AV159 (BKF, KKU); *K. Wangwasit* 51102.3 (AAU, BKF,

QBG), 51222-1 (CMUB, QBG); *S. Watthana* & *M. Wongnak* 957 (QBG); *P. Wessumrit* 260 (QBG); *Winit* 1473 (BKF-2 sheets, K); *T. Wongprasert* 0012-61 (BKF) & 5011-5 (BKF); *C. Yenabayashi* 93017 (BKF); *Zuang* 54 (BK, K); *S.N.* 401 (AAU); *S.N.* 1645 (BKF); *S.N.* 2025 (QBG) & *S.N.* (BK).

6. *Phyllodium vestitum* Benth. in Jungh. & Miq., Pl. Jungh.: 217. 1853. Fig. 3 (A–B).

Dicerma vestitum Wall., Numer. List no. 5739. 1831-1832, *nom.nud.* Type: Myanmar (holotype K!, isotypes G n.v.-2 sheets).

Desmodium vestitum (Benth.) Benth. ex Baker in Hook.f., Fl. Brit. Ind. 2: 162. 1879.

Shrub, 2–4 m high, pubescent or puberulous on young twigs, leaves and inflorescence bracts; bracteoles and leaflets appressed pubescent below. *Leaves*: stipules triangular, 4–5 by 4–5 mm, apex acuminate; petioles 0.5–1.5 cm long; rachis 0.8–2 cm long. *Leaflets*: stipels triangular, 2.5–3 by ca. 1 mm; petiolules 2.5–3 mm long. *Terminal leaflet* ovate to elliptic, 8–11 by 5–8 cm, apex obtuse to shallowly retuse, base obtuse to rounded, margin slightly repand; lateral veins 4–6 per side. *Lateral leaflets* ±

ovate, 5–8 by 3–4.5 cm, apex obtuse to shallowly retuse, base obtuse or asymmetrical, margin entire or slightly repand; lateral veins 4–5 per side. *Inflorescences* 20–100 cm long. *Foliaceous primary bracts* along entire inflorescence rachis and rachilla; stipules triangular, 2.5–3 by 2–2.5 mm, apex acute; petioles 2–3 mm long; petiolules ca. 0.5 mm long; terminal bristle 9–11 mm long; lateral leaflet-like broadly elliptic to suborbicular, 2–3.5 by 2–3 cm. *Secondary bract* ovate, 1.4–1.5 by 0.5–0.6 mm. *Flowers* in fascicles with 6–8 flowers, ca. 1.2 cm long; bracteoles ovate, ca. 1.2 by 0.6–0.7 mm; pedicels 4–5 mm long. *Calyx*: tube green, 5.5–6 mm long; teeth ca. 1.5 mm long, apex acute, both outside and inside puberulous to pubescent. *Corolla* creamy white to greenish white except wings purplish red; standard obovate, 11.5–12 by 8–8.5 mm, apex rounded, claw ca. 3.5 mm long; wings elliptic to oblong, 11–11.5 by 3–3.5 mm, upper margin auriculate, claw 3–3.2 mm long; keels arcuate, 12–13 by 5–5.5 mm, apex short beak-like, upper margin auriculate, outside of keel blade with a small vesicle, claw 3–3.5 mm long. *Staminal tube* 11–12 mm long; anthers ca. 1 mm long. *Ovary*



FIGURE 3. (A–B) *Phyllodium vestitum*.

puberulous; style 10.5–11 mm long, base puberulous. *Pods* 2 (–3)-articulate, 11–12 by 5–5.2 mm, distinctly reticulate, puberulous. *Seeds* ca. 4 by 3 mm.

Thailand. — NORTHERN: Chiang Mai, Lamphun, Uttaradit; NORTH-EASTERN: Phetchabun, Udon Thani, Nong Khai, Buengkan, Sakon Nakhon, Nakhon Phanom, Khon Kaen; EASTERN: Chaiyaphum, Buri Ram, Surin, Ubon Ratchathani; PENINSULAR: Ranong, Satun.

Distribution. — Myanmar, Laos, Cambodia, Vietnam, Malesia (Malaya, Peninsula Malaysia).

Ecology. — Mixed deciduous, dry dipterocarp and dry dipterocarp mixed with lower montane oak forests, 10–900 m alt. Flowering: June to February.

Vernacular. — Bak klet lin (บั๊กเกล็ดคลื่น) (Udon Thani); klet lin (เกล็ดคลื่น) (Ubon Ratchathani); klet lin yai (เกล็ดคลื่นใหญ่) (Sakon Nakhon); klet pla chon (เกล็ดปลาช่อน) (Buengkan); klet pla mo (เกล็ดปลาหมอ) (Chaiyaphum).

Specimens examined. — *K. Bunchuai* 1531 (BKF, K); *G. Congdon* C227 (AAU, PSU); *S. Gardner & P. Sidisunthorn* ST2537 (QBG); *M. Greijmans* 37 (CMUB); *S. Indaopong* 77 (AAU, BKF); *A.F.G. Kerr* 8230 (ABD, BK, K); *H. Koyama, H. Terao & T. Wongprasert* T-31134 (BKF, QBG); *K. Larsen, S.S. Larsen, C. Niyomdham, P. Sirirugsa, D.D. Tirvengadum & C.T. Nørgaard* 43230 (AAU, PSU); *K. Larsen, S.S. Larsen, T. Santisuk & E. Warncke* 2727 (AAU, E, K); *K. Larsen, T. Santisuk & E. Warncke* 2161 (AAU, K); *J.F. Maxwell* 87-93 (AAU, BKF, CMU, PSU); *W. McClatchey, P. Mookamul & C. Hobbs* WCM3626 (BKF) & WCM3680 (BKF); *G. Murata, C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamasu & N. Nantasan* T-

50645 (BKF); *C. Niyomdham* 4873 (BKF); *C. Niyomdham & W. Ueachirakan* 3530 (BKF); *M. Norsaengsri* 1162 (QBG) & 2870 (QBG); *M. Norsaengsri & N. Tathana* 8734 (QBG); *C. Phengklai et al.* 3601 (BKF, PSU); *S. Phengnaren* 267 (BKF-2 sheets); *R. Pooma* 1346 (CMUB, BKF); *W. Saisorn* 74 (KKU), 82 (KKU), 87 (KKU), 103 (KKU) & 132 (KKU); *T. Santisuk* 651 (AAU, K) & 785 (BKF-2 sheets, PSU); *R. Schultze-Kraft & S. Pattanavibul* 024/025-02 (K) & 053/017-04 (K-2 sheets); *R. Schultze-Kraft, S. Pattanavibul & P. Sornprasitti* 060/019-02 (K); *S. Suddee* 199 (BCU-3 sheets); *T. Wongprasert et al.* s.n. (BKF) & *S.N.* (BKF).

2. POLLEN MORPHOLOGY

The *Phyllodium* pollen is presented as monads, that are isopolar with radial symmetry, 3-colporate, small to medium sized and prolate spheroidal to subprolate ($P=23\text{--}44\ \mu\text{m}$, $E=21\text{--}38\ \mu\text{m}$) (Fig. 4F). Amb type is more or less circular (Fig. 4A & E). The exine is $1.1\text{--}1.25\ \mu\text{m}$ in thickness. The ornamentation is reticulate at the apocolpial and mesocolpial areas and microreticulate and psilate along the aperture (Fig. 4I–K). The pore is $6\text{--}12\ \mu\text{m}$ in diameter. The colpus is $17\text{--}32\ \mu\text{m}$ in length, usually narrow, slightly depressed and usually extending reaching near to both poles (Fig. 4C–D & G–H). The endoapertures are alongate (Fig. 4B). All data of each species are shown in Table 1.

3. LEAF EPIDERMIS

The epidermal cells in the genus *Phyllodium* are jigsaw-like, irregular and polygonal. Anticlinal walls of epidermal cell are shallowly to slightly undulate, curved and straight (Fig. 4L–M). There are three

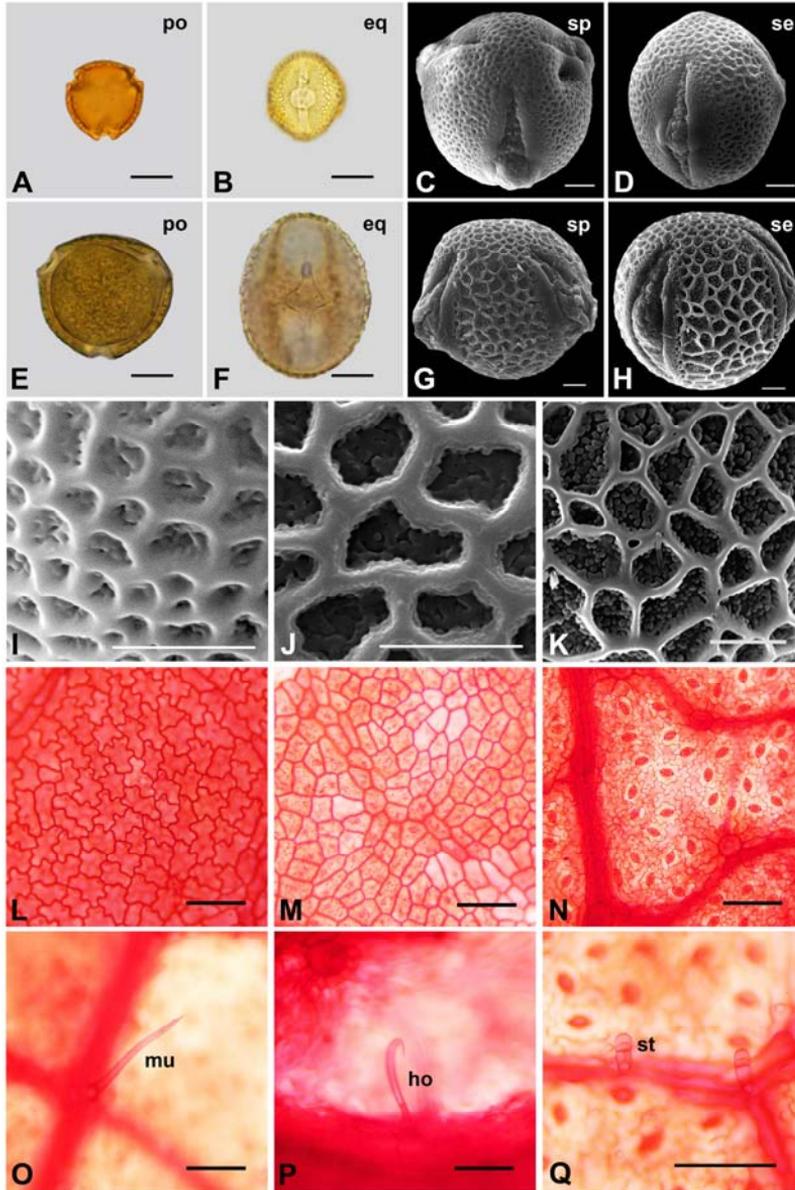


FIGURE 4. (A–K) Pollen morphology: (A–D) *Phyllodium elegans*, (E–H) *P. vestitum* and (I–K) ornamentation (scale bars 10 μm for LM and 3 μm for SEM) and (L–Q) leaf epidermis: (L–M) upper epidermis, (N) lower epidermis and (O–Q) trichome types (scale bars 60 μm); eq = equatorial view, ho = hooked hair, mu = multicellular uniseriate hair, po = polar view, se = subequatorial view, sp = subpolar view, st = stalked gland with unicellular head.

types of trichomes, including multicellular uniseriate hairs, hooked hairs and stalked gland with unicellular heads (Fig. 4O–Q) and stomata are found as two types,

paracytic and anomocytic (Fig. 4N). All anatomical data of the five Thai species of *Phyllodium* are shown in Table 2.

TABLE 1. Pollen of three species of *Phyllodium* in Thailand. Measurements present low, high and mean values (\bar{X}) and standard deviation (S.D.).

Taxa	Aperture length (μm)		Axis length (μm)		P/E	Shape	Size	Amb type	Exine Thickness (μm) ($\bar{X} \pm \text{S.D.}$)	Ornamentation		
	Colpus ($\bar{X} \pm \text{S.D.}$)	Porus ($\bar{X} \pm \text{S.D.}$)	P ($\bar{X} \pm \text{S.D.}$)	E ($\bar{X} \pm \text{S.D.}$)						Ap	Me	AA
<i>P. elegans</i>	17–19 (18.00±0.82)	6–8 (7.27±0.75)	23–24 (23.83±0.41)	21–22 (21.50±0.55)	1.11	Ps	Ss	Ci	1.78±0.30	Re	Re	Mi, Psi
<i>P. longipes</i>	25–27 (25.70±0.82)	7–12 (9.14±1.55)	30–35 (31.60±1.35)	25–29 (27.55±1.37)	1.15	Sp	Ms	Ci	1.55±0.28	Re	Re	Mi, Psi
<i>P. vestitum</i>	29–32 (30.50±2.12)	6.5–7 (6.75±0.35)	41–44 (42.50±1.05)	28–38 (33.88±3.52)	1.25	Sp	Ms	Ci	1.94±0.50	Re	Re	Mi, Psi

AA = an area along the aperture, Amb = the outline of a pollen grain in polar view, Ap = apocolpium, Ci = circular, E = equatorial axis, Me = mesocolpium, Mi = microreticulate, Ms = medium size, P = polar axis, P/E = ratio of polar and equatorial axes, Ps = prolate spheroidal, Psi = psilate, Re = reticulate, Ss = small size, Sp = subprolate.

TABLE 2. Leaf anatomical data of five species of *Phyllodium* in Thailand

Taxa	Upper epidermis				Lower epidermis			
	Shape of epidermal cell	Shape of anticlinal wall	Trichome type	Stomatal type	Shape of epidermal cell	Shape of anticlinal wall	Trichome type	Stomatal type
<i>P. elegans</i>	jigsaw-like	undulate	Mu, Ho	Pa, An	jigsaw-like	undulate	Mu, St	Pa, An
<i>P. kurzianum</i>	jigsaw-like	undulate	Mu, St	Pa	Jigsaw-like	undulate	Mu, Ho, St	Pa, An
<i>P. longipes</i>	jigsaw-like, irregular	undulate	Mu, Ho, St	–	jigsaw-like	undulate	Mu, Ho, St	Pa, An
<i>P. pulchellum</i>	jigsaw-like	±undulate, straight	Mu	An	jigsaw-like	undulate	Mu, Ho, St	Pa, An
<i>P. vestitum</i>	irregular, jigsaw-like, polygonal	±undulate, curved, straight	Mu, Ho	Pa, An	jigsaw-like	undulate	Mu, St	Pa, An

– = absent, An = Anomocytic, Ho = Hooked hair, Mu = Multicellular uniseriate hair, Pa = Paracytic, St = Stalked gland with unicellular head

DISCUSSION AND CONCLUSIONS

All species of *Phyllodium* are recognized by their foliaceous primary bracts as described in the key to the species and the descriptions of the individual species. *Phyllodium insigne* has foliaceous primary bracts on the lower part of inflorescence rachis. This character is used for the first

couplet of the key which is quite different from Ohashi (1973). However, he separated *P. insigne* from others and placed it under the subgenus *Prainia* H.Ohashi, according to the character of primary bracts. Certain species such as *P. longipes* and *P. kurzianum* are quite variable in size of leaves and leaflets. However, the ratios between length and width of these clearly

identify them. In this respect study agrees with previous studies of Ohashi (1973) and The Forest Herbarium, Royal Forest Department (2014). Compared to Myanmar (Kress et al., 2003) and Lao PDR (Newman et al., 2007) *Phyllodium* is more species rich in Thailand. In Thailand, the five species are widely distributed in at least four floristic regions (northern, north-eastern, eastern and peninsular) and there is merely one species, *P. insigne* distributed in a small area of northern and upper of south-western floristic regions. They are distributed in both evergreen and deciduous forests, viz. dry evergreen, lower montane oak, lower montane pine-oak, lower montane corniferous, mixed deciduous and dry dipterocarp forests at an altitude up to 1,800 meters above sea level.

The pollen of the genus *Phyllodium* can be characterized as isopolar, radially symmetric and 3-colporate. On the basis of the pollen morphology, it would appear that the genus is most close to the other genera in the subfamily Papilionoideae such as *Butea*, *Indigofera*, *Kunstleria*, *Lathyrus*, *Meizotropis*, *Spatholobus* and genera in tribe Millettieae (Wu and Huang, 1995; Ridder-Numan and van der Ham, 1997; Hsu and Huang, 2001; Güneş, 2011). However, the species are difficult to separate based on pollen morphology, although there are some slight differences. The pollen of *Phyllodium* generally confirms previous work of Ohashi (1973) and Chen and Huang (1993).

In general, the leaf epidermis of *Phyllodium* is quite similar to that of other genera in the subfamily Papilionoideae as described by Metcalfe and Chalk (1957). Some characters such as multicellular uniseriate and hooked hairs, stalked gland and three types of stomata basically confirm the observations of Lackey (1978) who studied on leaf anatomy of tribe Phaseoleae.

Although the leaf epidermis of this genus cannot be used for species identification, its characters are useful in the classification and identification at higher taxonomic levels.

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