THAI FOR. BULL. (BOT.) 33: 185–192. 2005.

Dioscorea craibiana Prain & Burkill: an endemic Thai yam rediscovered, with new data on its distribution and the morphology of the male plant

CHIRDSAK THAPYAI*, PAUL WILKIN & KONGKANDA CHAYAMARIT*****

ABSTRACT. *Dioscorea craibiana* Prain & Burkill is fully described for the first time following the discovery of male plants. The characters which confirm its affinities with the compound-leafed taxa of *D.* sect. *Botryosicyos* (Hochst.) Uline are discussed, and its distribution within Thailand clarified. The specimen of this species from Vietnam cited in previous studies is *D. arachidna* Prain & Burkill. Thus D. *craibiana* appears to be endemic to Thailand. A provisional conservation assessment is given.

INTRODUCTION

When research began on Dioscoreaceae for the Flora of Thailand project, the compound-leafed species *D. craibiana* Prain & Burkill was known from just two specimens (Prain & Burkill 1936). The type was collected by Mrs D.J. Collins at Sriracha in South-East Thailand in 1927. Prain & Burkill (1936) also cited a Poilane collection from Vietnam. Both specimens are females, with immature fruit. As Prain & Burkill noted, this relatively large compound-leafed species has a distinctive terminal leaflet with three main veins. Only the central vein reaches the apex; the outer pair diminish towards it and are not visible in the apical third of the leaflet blade. This character appears to be intermediate between *Dioscorea* sect. *Lasiophyton* Uline and *D.* sect *Botryosicyos* (Hochst.) Uline, which have three or more main veins and a single main vein per terminal leaflet respectively (Wilkin 1999). The other character which divides these two species groups, six fertile stamens in the male flower (*D.* sect. *Lasiophyton*) versus three fertile stamens and three staminodes (*D.* sect. *Botryosicyos*) had not been evaluated for this species before this study. Prain & Burkill (1936) also noted the unusual tendency of this species to have entire leaves on its fertile upper stems.

In the course of the project more herbarium specimens collected since 1940 but not recognised, have been found, and wild populations have been located. This has allowed the male inflorescences and flowers to be fully described. Its tuber morphology has also been partially revealed, permitting a virtually complete description given below. The new collections have also provided additional data on the distribution of *D. craibiana* within Thailand.

*Department of Biology, Faculty of Science, Naresuan University, Phitsanulok, Thailand.
**Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK.
***The Forest Herbarium (BKF), National Park, Wildlife and Plant Conservation Department, 61 Phahonyothin Rd., Chatuchak, Bangkok 10900, Thailand.

MATERIALS & METHODS

The Dioscoreaceae treatment for the Flora of Thailand is based on examination of 1220 specimens from Thailand from the following herbaria: AAU, B, BK, BKF, BM, CMU, E, K, L, P, Biology Department, Naresuan University, Phitsanulok (PNU) and QSBG. Abbreviations (except PNU) follow Holmgren & Holmgren (1990). Comparative morphology was used to delimit species in all cases.

DESCRIPTION

Dioscorea craibiana Prain & Burkill, Bull. Misc. Inform. Kew 1931: 425. 1931; Prain & Burkill in Ann. Roy. Bot. Gard. (Calcutta) 14(1): 142.1936. Type: Thailand, Chon Buri, Siracha, E fr. 24 Nov. 1927, *Collins* 1547 (holotype K!; isotypes BM!, K!): Figs. 1 & 2.

Climber to 7 m. *Tubers* incompletely known, probably annually replaced, slender, spreading, cylindric to clavate (see *Wilkin* 1082), probably with thickened apices, epidermis thinly chartaceous, pale brown, parenchyma whitish. *Indumentum* present on inflorescences only (all parts pubescent except male flower inner tepals), hairs simple (Fig. 1C), 0.1–0.2 mm long, whitish to grey-brown in colour. *Stems* 2–5 mm in diam., towards base slightly woody with a few prickles, unarmed or almost so on upper stems, terete with shallow longitudinal ridges, pale green to yellowish-green in colour. *Leaves* 3-foliolate, sometimes simple on reproductive shoots, alternate, chartaceous and a little fleshy when fresh, bright green to dark green above, paler and glossy below; leaflets 3-nerved, veins prominent on both surfaces, with only the main vein reaching the apex; terminal leaflet blades 4.3–11.5 by 3.2–7 cm, obovate, base acute to cuneate, apices 3–5 mm long, acuminate, outer vein pair diminishing towards apex and not visible in the apical third; lateral leaflet blades 3.1–10.5 by 1.7–7 cm, ovate to obovate, base acute, apices to 2 mm long, acute to acuminate; forerunner tips 2–4 mm long, brown to dark brown, one per leaflet; *petioles* 3.5–7.5 cm long, slender, terete, sometimes angled and prickly especially on leaves toward base of stem, channeled above, colour as stem; petiolules 2.5–5 mm long. *Cataphylls* (Fig. 1B) 14–16 by 10–11 mm, ovate, apex 13–15 mm long, acuminate, pale yellow-brown. *Lateral nodal organs* absent. *Bulbils* present in some races, 1.5–5 mm in diameter, globose to ovoid, epidermis thinly chartaceous, brown to dark brown, parenchyma white to yellow. *Inflorescences/partial inflorescences* racemose, pendent, axis shape as stem, sometimes with prickles, yellow-green to bright green in colour, primary and floral bracts chartaceous; tepals inserted on a small, shallowly saucer-shaped torus (Fig. 1F, 2E), free, erect, white to brownish or cream in colour. *Male inflorescences* compound (Fig. 2A), 6–15(–50) cm long, 1–2 per axil; primary bracts (Fig. 2C) 3.9–7.6 by 1.2–1.7 mm, narrowly lanceolate or narrowly ovate to lanceolate, apex acute, green to dark green; partial inflorescences (Fig. 2B) 1–2 per node, peduncles 2.5–7 mm long, axes 1.2–3.2 cm long. *Female inflorescences* (Fig. 1A) simple, 1–2 per axil, peduncles 2.5–3 cm long, axes 9–20 cm long, flowers orientated at angle of 20°–45° to axis when receptive. *Male flowers* on pedicels 0.7–0.9 mm long, floral bracts (Fig. 2F) 2.9–3.2 by 1.7–1.9 mm, broadly to very broadly ovate, apices 0.8–1 mm long, acuminate; bracteoles (Fig. 2G) 2.1–2.5 by 1.4–1.5 mm, ovate to broadly ovate, apices 0.2–0.3 mm long, acuminate; tepals thinly chartaceous, outer tepals (Fig. 2H) 2–2.5 by 0.8–1.1 mm, narrowly ovate to ovate, apex

obtuse; inner tepals (Fig. 2I) 1.8–2.1 by 0.8–1.2 mm, narrowly obovate to obovate, apex obtuse; stamens 3 (Fig. 2E, 2H), inserted on outer tepal bases, filaments 0.4–0.6 mm long, apically recurved so that basifixed anthers are held almost pendent, anthers 0.35–0.45 by 0.35–0.45 mm, ovate in outline; staminodes 3 (Fig. 2E, 2J), 0.8–1.0 mm long, clavate to flattened and narrowly oblanceolate, inserted on inner tepal base; pistillodes (Fig. 2E) 0.8–1.1 by 0.2–0.3 mm, fused to form an erect column, apex 3-lobed, capitate. *Female flowers* on 0.6–1.6 mm long pedicels, floral bracts (Fig. 1G) 3.9–4.4 by 2.0–2.2 mm, lanceolate, apices 0.25–0.8 mm long, acuminate; bracteoles (Fig. 1H) 2.5–2.7 by 1.3–1.4 mm, elliptic-ovate to narrowly ovate, apices 0.2–0. 45 mm long, acuminate; tepals ventrally concave, fleshy in texture with inner whorl tepals thicker than outer, apex weakly cucullate; outer tepals (Fig. 1I) 1.5–1.9 by 1.2–1.4 mm, broadly ovate, apices obtuse; inner tepals (Fig. 1J) 1.5–1.6 by 1.3–1.7 mm, obovate, apex obtuse; ovaries (Fig. 1D) 3.8–5.8 by 2.6–3.4 mm, terete with 3 shallow longitudinal ridges, pubescent, green to dark green; staminodes 6 (Fig. 1F), 0.15–0.5 mm long, clavate, inserted on tepal bases; styles 0.35–0.45 by 0.5–0.7 mm, free, ascending; stigmas 0.35–0.45 mm long, recurved. *Infructescences* (Fig. 2J) 10–30 cm long; *capsules* (Fig. 2K) 17–29 by 10–15 mm, oblong in outline, base truncate to shallowly retuse, sinus (where present) to 0.8 mm deep, apices truncate to acute, sometimes shallowly retuse with sinus to 0.6 mm deep, persistent tepals 0.5–1 mm long, capsular stipes 1.5–2.5 mm long, filiform; immature capsules pale to dark green, mature capsules reflexed at angle of 120°–170° to axis, glabrous with age. *Mature seeds* not seen, immature seeds (Fig. 2L) 5.5–7 by 4–5 mm, ovoid to lenticular, wings oblong, apex obtuse to rounded, extending from seed base, upper seed wings 7–9 by 3–3.5 mm, lower seed wings 9–11 by 5–6 mm.

Thailand.— NORTHERN: Tak [Bhumiphol Dam, E fl. Dec. 1959, *Boon nak* /*Sanan* ? 609 (BK); Um Phang, Mae Sot road large limestone outcrop on LHS of road ca. 22.5 from Um Phang, 16° 10’ 70” N, 98° 52’ 87” E, E fl. & young fr. 5 Nov. 1998, *Wilkin*, *Suddee* & *Puudjaa* 1081 (BKF, K); very old G fl. 5 Nov. 1998, *Wilkin*, *Suddee* & *Puudjaa* 1082 (BKF, K); Um Phang, Mae Sot road large limestone outcrop on LHS of road ca. 22.4 km from Um Phang, 16° 10’ 70” N, 98° 52’ 87” E, E fl. & young fr. 5 Nov. 1998, *Wilkin*, *Suddee* & *Puudjaa* 1083 (BKF, K)]; Kamphaeng Phet [Khlong Lan National Park, trail N of waterfall, ca. 0.5 km from junction with road to new ranger station, 16° 7.82’ N 99° 16.84’ E, G fl. 9 Nov. 1998, *Wilkin*, *Suddee & Puudjaa* 1094 (BKF, K)]; Phrae [Long District, Huai Mae Lan, along trail near the stream from Ban Pin to the waterfall, Eyoung fr. 7 Nov. 2004, *Thapyai* 537 (BKF, QBG, PNU)]; NORTH-EASTERN: Loei [Phu Luang, G fl. 8 Sept. 1968, *Bunchuai* 1767 (BK)]; EASTERN: Nakhon Ratchasima [Lat Bua Khao, G fl. 9 Nov.1931, *Put* 4373 (K)]; SOUTH-WESTERN: Kanchanaburi [Ban Phu Toei, Sai Yok Distr. about 56–57 km from on roadside of Kanchanaburi to Thong Phaphum, G fl. 29 Sept. 2001, *Thapyai* 159 (BK, BKF, PNU, QBG);E fl. 29 Sept. 2001, *Thapyai* 163 (BK, BKF, NU, QBG); E fr. 11 Oct. 2001, *Thapyai* 177 (BK, BKF, PNU, QBG); Sai Yok, 14° 09’ N 99° 10’ E, G fl. 23 Nov. 1971, *van Beusekom*, *Phengkhlai*, *Geesink* & *Wongwan* 3912 (L, BKF); Mae Klong Watershed Research Station, Thong Phaphum Distr., sterile 11 Aug. 2001, *Thapyai* 143 (BK, BKF, PNU, QBG); Si Sawat, 14° 45' N, 101° 05' E, E fl. 5 Nov. 1971, *van Beusekom*, *Phengkhlai*, *Geesink* & *Wongwan* 3405 (BKF, K); Tapoh, 21 Dec. 1961 E fr., *Larsen* 8892 (AAU)]; SOUTH-EASTERN: Chon Buri [Khao Khiao, Si Racha Distr., 13° 16' N, 101° 5' E, E fr. 2 Nov. 1976, *Maxwell* 76-713 (AAU)]; Chanthaburi [Ban Pong Liang, Pong Nam Ron Distr., E fr. 24 Oct. 1956, *Smitinand* 3615 (BKF)].

Distribution.— Endemic to Thailand, where it is found mainly in the areas with a seasonal climate. The specimen of *D. craibiana* from Vietnam cited by Prain & Burkill (1936) (*Poilane* 12524) has roven to be *D. arachidna* Prain & Burkill, because it has glabrous immature capsules and ovaries and a single main vein in each terminal leaflet.

Ecology.— Open areas in mixed deciduous forest, often on limestone substrates, at elevations from near sea level to 650 m. One specimen from Phu Luang gives its habitat as hill evergreen forest. If correct, this will be from a higher altitude. Flowering occurs from September to November, and fruiting from November onwards.

Vernacular name.— Not known.

Conservation.— Probable IUCN red list category: NT (IUCN 2001). The few specimens known to Prain & Burkill suggested at the outset of this research that *D. craibiana* was a rare species. The collections made since their treatment suggest that scattered populations of *D. craibiana* exist over a wide geographical area in Thailand. It appears to be most frequently encountered in Kanchanaburi. Four of the areas in which it occurs (Phrae, Um Phang, Khlong Lan and Kanchanaburi) are known to have currently extant populations, and it appears to be tolerant of disturbance to some degree. If significant decline in numbers was detected, then a vulnerable rating might be merited. Its status as a species endemic to Thailand also is of conservation concern.

Notes.— *D. craibiana* differs from *D. arachidna* Prain & Burkill, the most closely related species, in its pedicellate male flowers, pubescent ovaries, and three prominent main veins on the terminal leaflet and the diminished outer pair are not visible in the apical third of the leaf. *D. arachidna* has sessile male flowers, is completely glabrous, and has a single main vein in its terminal leaflet.

DISCUSSION

The male flowers of *D. craibiana* have three stamens and three staminodes, suggesting its affinities with *D.* sect. *Botryosicyos* in the sense of Prain & Burkill (1936). This hypothesis is further supported by *rbc*L sequence data (unpublished). Thus the unusual leaflet venation with an outer pair of main veins must represent an autapomorphy for *D. craibiana* and not an intermediate state with *D.* sect. *Lasiophyton*. Its tubers, leaf morphology and texture suggest that its closest relative is *D. arachidna* (see notes above).

ACKNOWLEDGEMENTS

CT would like to express his gratitude to the QBG - DANCED Program for granting a scholarship for conducting research and study at the Faculty of Forestry, Kasetsart University. We thank all the Royal Forest Department staff who helped us, especially Somran Suddee and Pachok Pudjaa. Thanks also to Phillip Cribb for critically reading an earlier version of this manuscript.

REFERENCES

Holmgren, P.K. & Holmgren, N.H. 1990. Index Herbariorum. Part 1: the Herbaria of the World. 8th ed. NYBG Press, New York, USA.

IUCN. 2001. IUCN Red List Categories: Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland & Cambridge, UK.

Prain, D. & Burkill, I. H. 1936. An account of the genus *Dioscorea* in the East, Part 1. The species which twine to the left. Annals of the Royal Botanic Garden (Calcutta) 14(1): 1–210.

Wilkin, P. 1999. A revision of the compound-leaved yams (*Dioscorea*, *Dioscoreaceae*) of Africa. Kew Bulletin 54(1): 19–39.

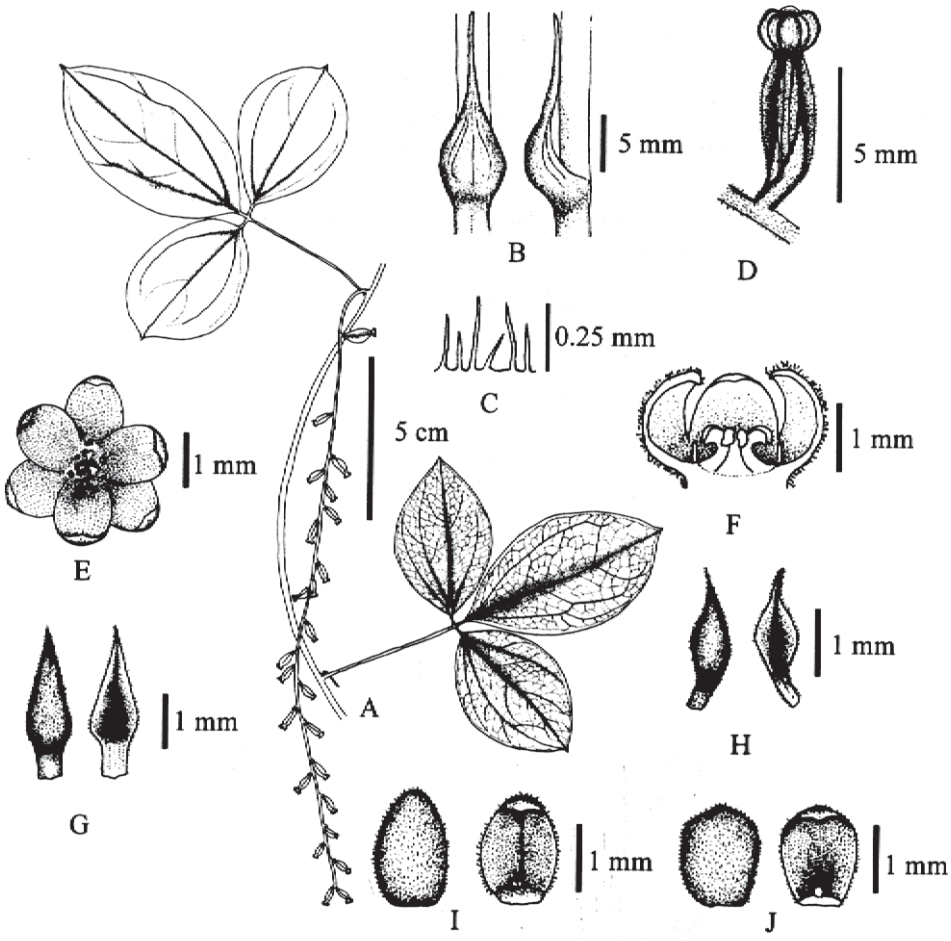

Figure 1. The morphology of *Dioscorea craibiana* Prain & Burkill; vegetative and female floral organs:A. habit of plant, showing female inflorescence, leaf morphology and venation; B. cataphyll, dorsal and side view; C. hairs; D.–K. female flower; D. side view of flower showing floral bract, ovary and its insertion on the inflorescence axis; E. view from above (tepals opened); F. half flower showing staminodes, styles and stigmas; G. floral bract dorsal and ventral surfaces;H. bracteole dorsal and ventral surfaces; I. outer tepal dorsal and ventral surfaces; J. inner tepal dorsal and ventral surfaces;A. from *Wilkin* et al. 1083; B. from *Wilkin* 1082; C.–J. from *Thapyai* 163. Drawn by C. Thapyai.

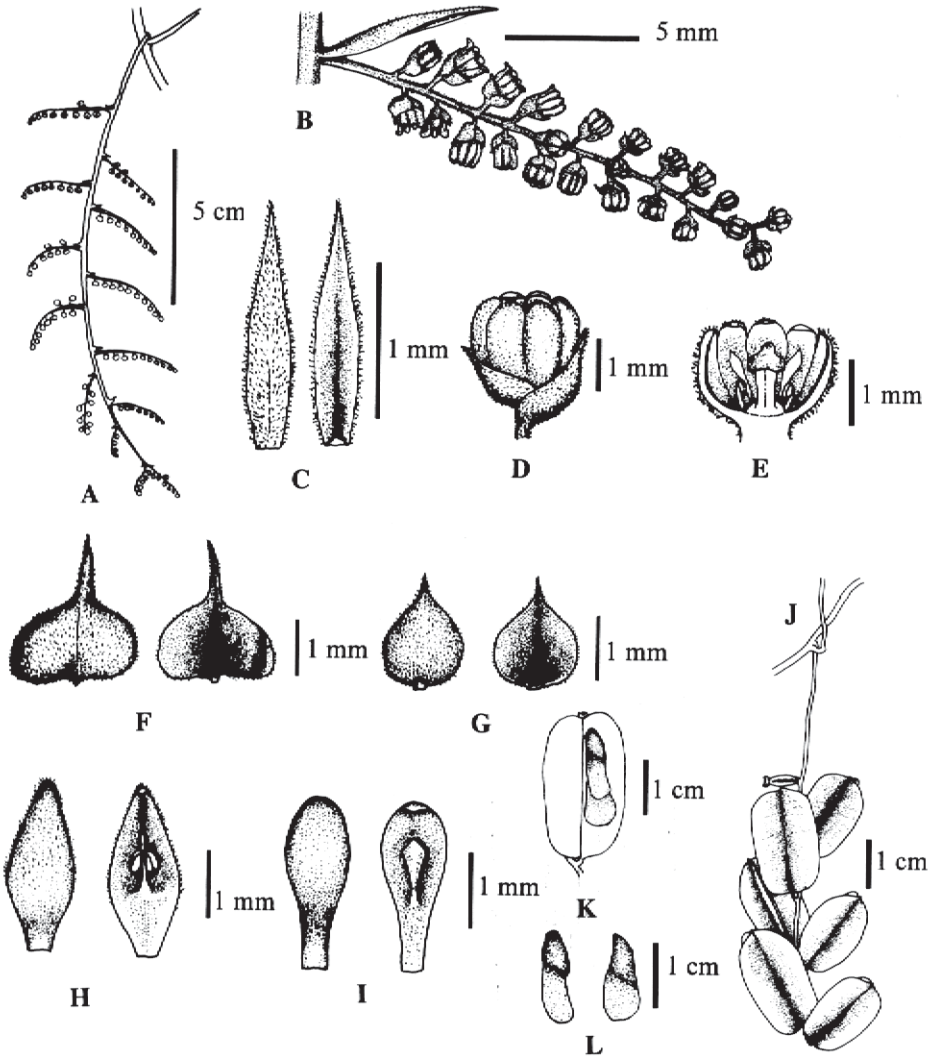

Figure 2. The morphology of *Dioscorea craibiana* Prain & Burkill; male inflorescence and flowers and female infructescence and capsule: A. compound male inflorescence; B. male partial inflorescence, showing large primary bract at node; C. primary bract; D.–I. male flower; D. side view, showing position of tepals, bract and bracteole; E. half-flower, showing stamens, staminodes and long, columnar pistillode; F. floral bract dorsal and ventral surfaces; G. bracteole dorsal and ventral surfaces; H. outer tepal plus part of torus, dorsal and ventral surfaces, ventral view showing position of stamen insertion; I. inner tepal plus part of torus, dorsal and ventral surfaces, ventral view showing position of stamen insertion; J. immature infructescence; K. immature capsule, longitudinal section showing position of two seeds; L. immature seeds. A.–I. from *Thapyai* 176; J. from *Wilkin* 1081; K.–L. from *Larsen* 8892: drawn by C. Thapyai).

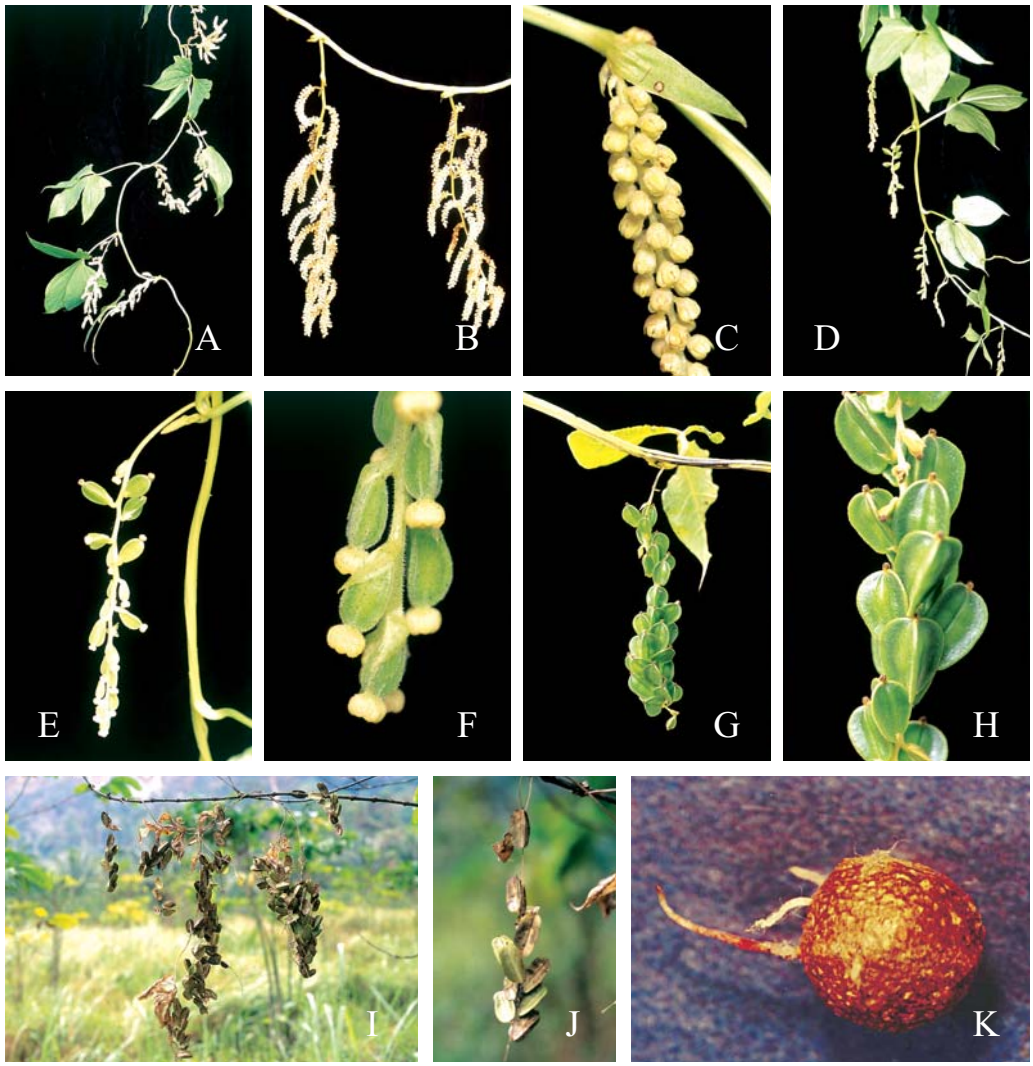

Figure 3. *Dioscorea craibiana* Prain & Burkill: A. plant habit, showing compound male inflorescences; B. Compound male inflorescences; C. part of a male partial inflorescence, showing the inflorescence bract and flowers; D. plant habit, with simple female inflorescences; E. female inflorescence and flowers; F. female flowers, showing pubescent ovaries; G. an immature infructescence in the axil of an entire fertile shoot leaf; H. immature capsules with floral remains; I. capsules beginning to become dry; J. capsules close to maturity; K. germinating bulbil with rootlets. Photographed by C. Thapyai.