

## A New Infrageneric Classification of *Mucuna* (Leguminosae-Papilionoideae): Supported by Morphology, Molecular Phylogeny and Biogeography

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**Abstract**—The previous infrageneric classification of *Mucuna* (Leguminosae, Papilionoideae) recognized two subgenera, *M. subg. Mucuna* and *M. subg. Stizolobium*, but that classification is not supported fully by molecular phylogenetic analyses, which reveal three main clades in *Mucuna* (rather than the traditional two). A new taxon *M. subg. Macrocarpa* is proposed based on the results of a molecular phylogenetic analysis, supported by fruit characters and biogeography. Historically, the representatives of this new subgenus were considered as members of *M. subg. Mucuna*, but species of subgenus *Macrocarpa* differ from species of the other two subgenera by their longer ovaries containing a higher number of ovules and, consequently, longer pods containing more seeds, and by the different fruit length to width ratio. This study presents a new infrageneric classification of the genus *Mucuna*. The six species of *M. subg. Macrocarpa* are reviewed, and species descriptions, typifications (including five new lectotypes), a distribution map, and a species identification key are presented.

**Keywords**—Character evolution, cladistics, Fabaceae, new taxon, taxonomy

*Mucuna* Adans. comprises 115 taxa with an overall pantropical distribution; 25 taxa are recorded for the Neotropics, 19 for Africa, and 77 in the Paleotropics (excluding Africa). Most species are lianas or vines; one species, *Mucuna stans* Welw. ex Baker, is an erect shrub. Among the lianas, only *Mucuna stanleyi* C. T. White has an erect inflorescence, whilst the others present pendent inflorescences. Flowers are arranged in pseudopanicles, pseudoracemes, or umbel-like pseudoracemes, and the inflorescence peduncle ranges from 2 cm to more than 2 m long. Fruits are oblong, laterally compressed or thick, with the valve surfaces sometimes lamellate, and usually with irritant hairs.

Phylogenetic studies undertaken by Moura (2013) and Moura et al. (2016) revealed that a new infrageneric classification for *Mucuna* is necessary. Traditionally, two subgenera were recognized: *M. subg. Mucuna*, with the fruit opening along one suture and discoid or sub-lenticular (rarely globose or compressed-ellipsoid) seeds lacking a rim-aril and with the hilum circling more than 50% of the seed circumference; and *M. subg. Stizolobium* (P. Browne) Baker, with a dehiscent (opening along both sutures) or indehiscent fruit and reniform or compressed-ellipsoid seeds with a conspicuous rim-aril and the hilum circling less than 20% of the seed circumference.

Moura et al. (2016) have shown that the genus *Mucuna* is monophyletic and that within it *M. subg. Stizolobium* is also monophyletic. In contrast, *M. subg. Mucuna* was resolved as paraphyletic. A group of four species hitherto considered as members of the typical subgenus clustered together in a well-supported clade (Fig. 1), which appeared as a sister group of *M. subg. Stizolobium*, whereas the remaining species of *M. subg. Mucuna* were resolved in a strongly supported clade in a combined ITS + *trnL-F* analysis. Three separate

clades of *Mucuna* are thus recognized, and we will refer to this new clade as the *Macrocarpa* clade.

The initial four species that comprise the *Macrocarpa* clade are *M. birdwoodiana* Tutcher, *M. calophylla* W.W. Sm., *M. macrocarpa* Wall., and *M. sempervirens* Hemsl. (Moura et al. 2016). The new clade correlates strongly with geographical distribution, all four species occurring in southern or southwestern China. *Mucuna birdwoodiana* and *M. calophylla* are endemic to the region, *M. sempervirens* extends to the eastern Himalayas and northern Myanmar (Burma), and *M. macrocarpa* occurs from the eastern Himalayas to southern China, southern Japan, Indochina, and northern Thailand. The Thailand endemic *M. thailandica* Niyomdham & Wilmot-Dea [not sampled in the Moura et al. (2016) study] is so similar in flower and fruit morphology to *M. macrocarpa* (Wilmot-Dea 1992) that we hypothesize that it also belongs to this group; we make a similar assumption about the endemic Chinese species *M. bodinieri* H. Lév. due to its similar flower and fruit morphology. Lack of suitable material prevented confirmation of this hypothesis (only five collections are known, all very old).

The *Macrocarpa* clade also correlates well with some aspects of gross morphology. Fruits of all five species are distinctive in being linear (length 6 × to over 10 × width), woody and (in all but *M. bodinieri*) consistently indented between seeds with the valve surfaces lacking ornamentation, but often longitudinally deeply wrinkled, whereas fruits of the species of *M. subg. Mucuna* that we sampled are leathery and mostly relatively broader (length rarely over 4.5 × width), oblong to linear-oblong, rarely slightly indented between seeds, and the majority have their surfaces ornamented with raised lamellae or, less often, lack ornamentation, or have a slightly raised reticulate pattern, or are rarely

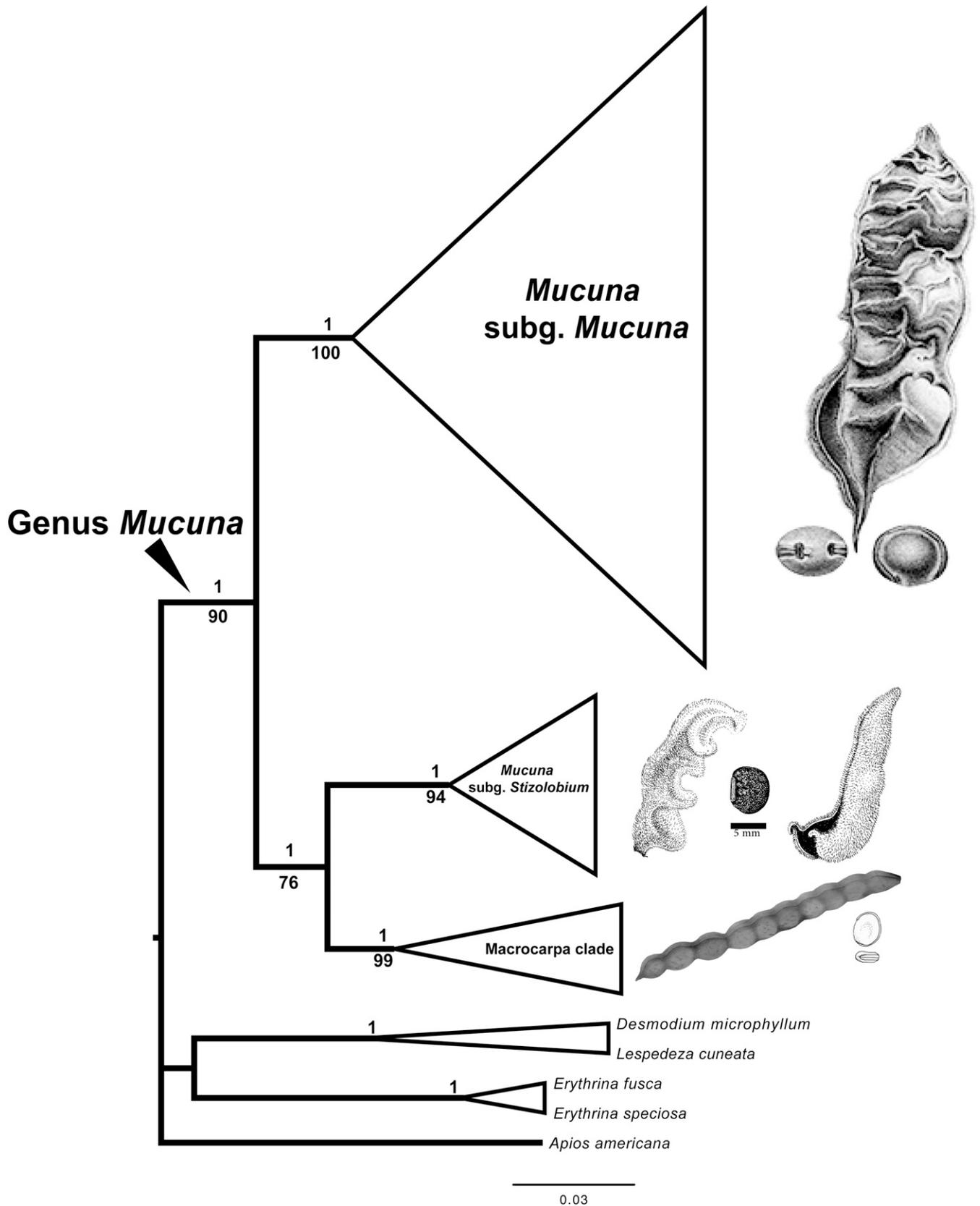


FIG. 1. Simplified scheme of the phylogeny of *Mucuna*, representing the combined ITS + *trnL-F* analysis, highlighting the three main clades within the genus. Numbers above and below branches are posterior probabilities and bootstrap supports, respectively. Fruit illustrations not to scale. Adapted from Moura et al. (2016).

somewhat wrinkled. Vegetatively the *Macrocarpa* clade is rather unusual in having caducous stipels. Only in nine of the ca. 70 Asiatic species of subgenus *Mucuna* are the stipels caducous.

As previously noted, the taxa of *M. subg. Stizolobium* differ markedly from the taxa of the other two clades in their hilum and seed shapes and in their linear or linear-oblong, small fleshy fruits up to 10 cm long and with a maximum of five seeds. Nevertheless, fruit length and seed number do overlap somewhat between the species of *M. subg. Mucuna* and those of the *Macrocarpa* clade, which in large part explains why, prior to molecular studies of *Mucuna*, the *Macrocarpa* clade went undetected. Fruits of all but one of the *Macrocarpa* clade species are over 30 cm long and mostly have more than 10 (up to 18) seeds, whereas those of subg. *Mucuna* vary from 10–30 cm long and have up to seven seeds (8–10 in *M. warburgii* K. Schum. & Lauterb.). Contrary to this trend, *M. calophylla* (clearly placed in molecular phylogenetic analyses within the *Macrocarpa* clade and conforming in fruit shape and texture) has fruits only 13–15 cm long, each with up to a maximum of seven seeds.

Despite this partial overlap in gross fruit morphology, the *Macrocarpa* clade appears as well supported in the analyses of both markers studied by Moura et al. (2016). The result obtained with the ITS marker (Fig. 2A) is similar to that seen for the combined tree (see Fig. 1), but in the *trnL-F* analysis (Fig. 2B) the *Macrocarpa* clade is the sister group of *M. subg. Mucuna*, which therefore can be considered to be monophyletic as traditionally circumscribed. Nevertheless, the species content of the *Macrocarpa* clade remains consistent for both markers analyzed and it is geographically and morphologically coherent with respect to fruit morphology, surface, and texture (and for most species also with respect to fruit size and seed number).

For a better understanding of the phylogeny of *Mucuna*, we present here a character evolution analysis that focuses on the three main clades of the genus. Based on geographical correlation, morphological consistency, and molecular phylo-

genetic results, we consider the *Macrocarpa* clade worthy of formal recognition and here propose the new infrageneric taxon *Mucuna subg. Macrocarpa*, and present a taxonomic treatment of the six species currently recognized within it. Further studies are still necessary to investigate the precise infrageneric relationships of this new subgenus. Species descriptions, typifications, a distribution map, and a key to species identification are presented.

## MATERIALS AND METHODS

**Morphological Assessments**—Morphological characters of the whole genus were analyzed by T. M. Moura and M. Wilmot-Dea using collections housed in nearly 70 different herbaria. After the phylogenetic analyses by Moura et al. (2016) had revealed the probable occurrence of a new subgenus, special attention was given to species with long pods, with the aim to identify synapomorphies for the newly recognized clade.

**Character Evolution Analysis**—The most informative characters that distinguish the three main clades of *Mucuna* are: (1) type and size of fruit; (2) seed shape; and (3) hilum length. The *Macrocarpa* clade is characterized by a relatively long, narrow fruit. Fruit length is a good predictor of ovule and seed number but ovule number is difficult to assess in dry material because ovaries and ovules both turn black on drying. In our analyses, we measured mature fruit size and counted seed number, and inferred ovule number by adding the number of developed seeds in a fruit to undeveloped ovules.

To assess evolutionary transitions in morphological characters among *Mucuna* species we implemented maximum likelihood (ML) optimization of character evolution. The ML reconstruction was applied using the “Trace character” option in Mesquite v. 3.03 (Maddison and Maddison 2015) and conducted using the Markov k-state 1-parameter model (Mk1) which is a generalization of the Jukes-Cantor DNA substitution model and assumes equal transitions among discrete character states (Lewis 2001). For the input file, the 50% majority-rule consensus tree from Bayesian inference of combined *trnL-F* and ITS data was used (original tree from Moura et al. 2016, represented here in Fig. 1). Character states for all taxa presented in the phylogeny of Moura et al. (2016) were scored from herbarium specimens.

## RESULTS

**Character Evolution Analysis**—Distributions of fruit and seed characters on the Bayesian tree (Figs. 3, 4) suggest

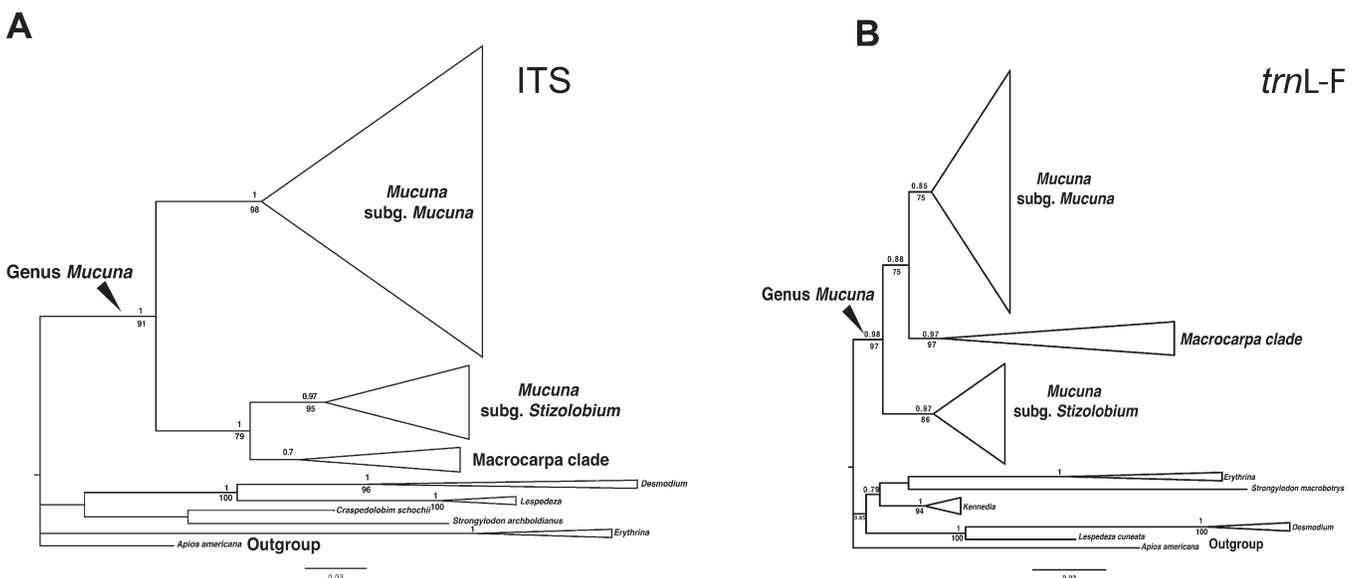


FIG. 2. Simplified scheme of the phylogeny of *Mucuna*, highlighting the three main clades obtained within the genus. A. Tree presenting the results obtained with the ITS marker. B. Tree presenting the results obtained with the *trnL-F* marker. Numbers above and below branches are posterior probabilities and bootstrap supports, respectively. Adapted from Moura et al. (2016).

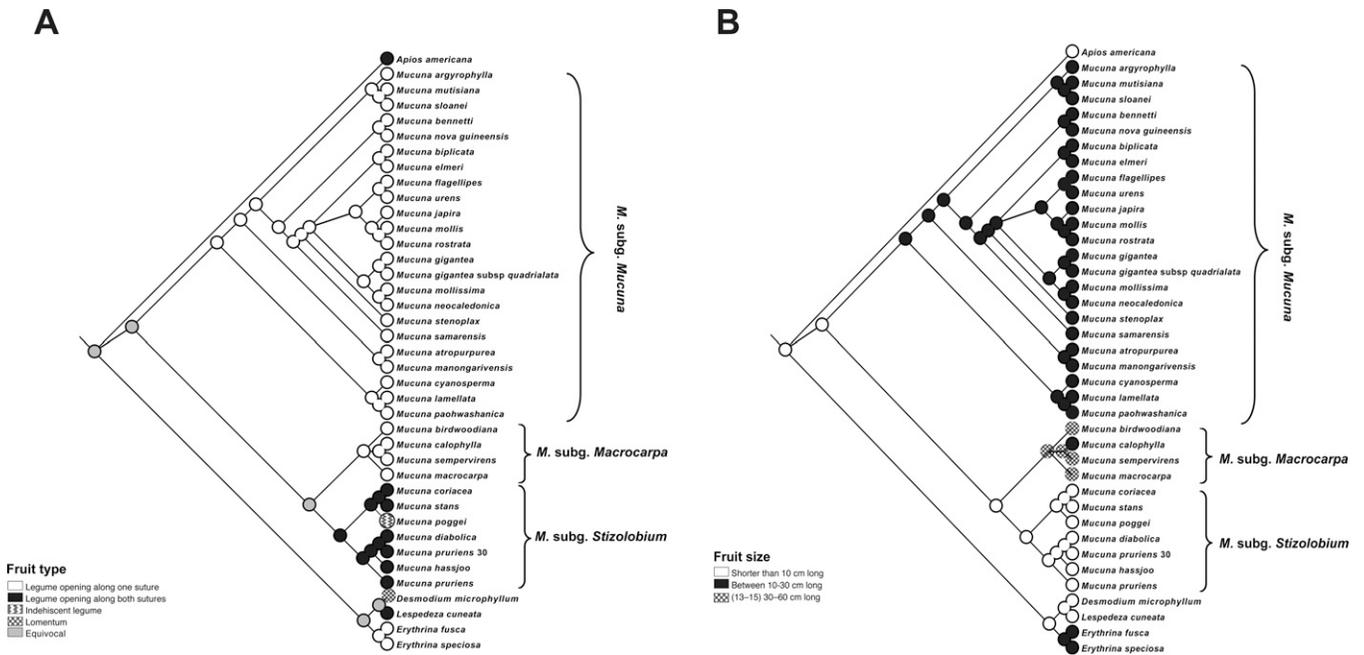


FIG. 3. Character evolution analysis of fruit morphology of *Mucuna*. A. Fruit type. B. Fruit size.

that any morphological similarities between species of the *Macrocarpa* and *Mucuna* clades are due to convergent evolution, based on the assumption that the ancestor of *Mucuna* was morphologically similar to a species of *M. subg. Stizolobium*. Alternatively, based on the *trnL-F* analysis (Fig. 2B), these fruit similarities could result from either the sharing of ancestral traits (symplesiomorphies) between the *Macrocarpa* and *Mucuna* clades or from these traits being secondarily lost in subgenus *Stizolobium*. One striking exception is the character of fruit length (Fig. 3B) which, in subgenus *Macrocarpa* (except in *M. calophylla*), is not similar to the fruit length in subgenera *Mucuna* or *Stizolobium*.

DISCUSSION

The fruits of *M. calophylla* are 13–15 cm long and have up to seven seeds; they are thus more similar in length (although not in length to width ratio) to members of *M. subg. Mucuna* than to the other species of the *Macrocarpa* clade. One hypothesis is that the species normally has more than 10 ovules per ovary, but some do not develop. More specimens are required to test this. Alternatively, either the reduced number (if shown to be consistent) of ovules (and consequent shorter fruit length) in *M. calophylla* is an evolutionary reversion within the *Macrocarpa* clade, or if the

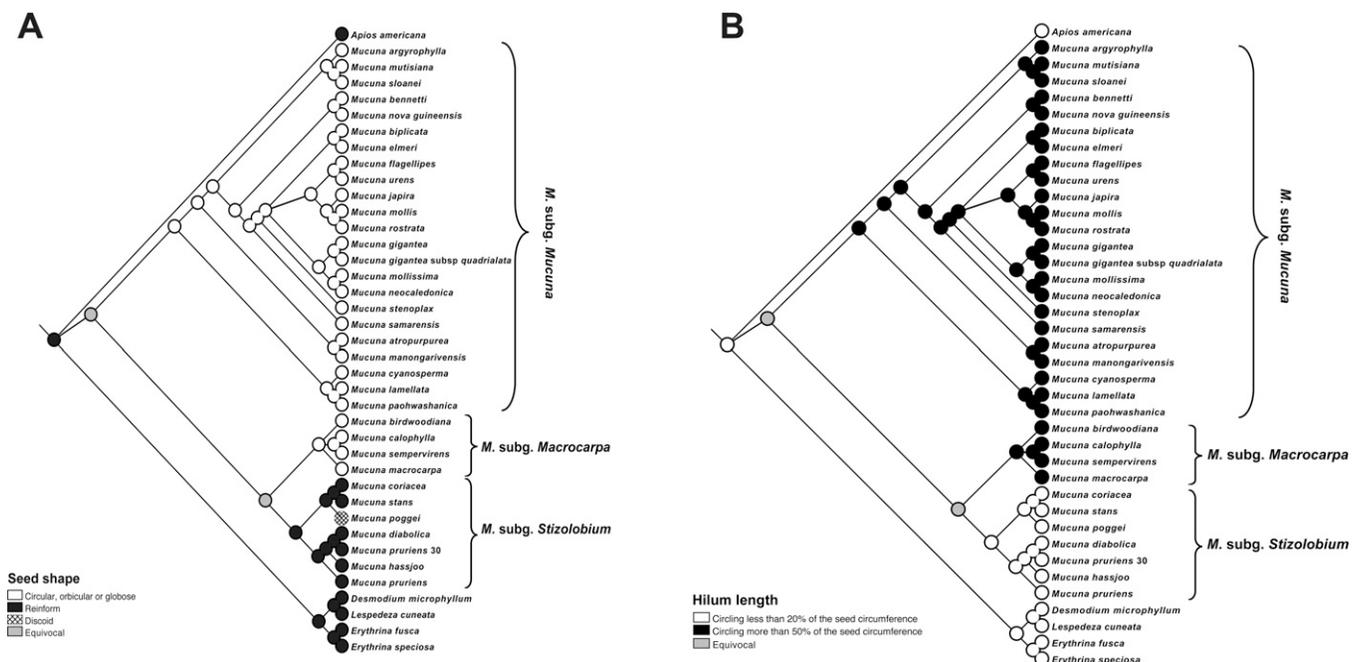


FIG. 4. Character evolution analysis of seed morphology of *Mucuna*. A. Seed shape. B. Hilum length.

ancestor of *Mucuna* had pods with many seeds then the reduction in the number of seeds in *M. calophylla* would be a derived character within the genus.

The results based on the seed shape and hilum length (Fig. 4A–B), show that the members of *M. subg. Stizolobium* more closely resemble species of the outgroup genera than those of *Mucuna subg. Mucuna*, suggesting that the ancestor of *Mucuna* was morphologically more similar to a species of *M. subg. Stizolobium*. If this hypothesis is confirmed, the type of fruit (Fig. 3A), seed shape (Fig. 4A), and hilum length (Fig. 4B) in the *Macrocarpa* clade and *M. subg. Mucuna* might be apomorphic characters that have arisen during the infrageneric evolution of *Mucuna*. Many species of *M. subg. Mucuna* and of the *Macrocarpa* clade are found in river valleys and some species of *Mucuna subg. Mucuna* occur in coastal habitats; the seed morphology, which allows the seeds to float, probably arose as an adaptation to these environments and has facilitated the long-distance dispersal of the species throughout the tropics. This characteristic in both *Macrocarpa* and *Mucuna* clades might be the result of convergent

evolution; however, if the *Macrocarpa* clade is the sister group of *M. subg. Mucuna* (as indicated by the *trnL-F* analysis, Fig. 2B), specialized fruit, seed, and hilum characters must have arisen only once during the evolutionary process.

It is noteworthy that an indehiscent fruit evolved among the members of *M. subg. Stizolobium* (*M. poggei* Taub. (Fig. 3A) and *M. occidentalis* (Hepper) T. M. Moura & G. P. Lewis). This is probably a derived character that provides the seeds with additional protection against predation. Other strategies for avoiding predation include: irritant hairs on ovaries and fruits, high concentrations of L-dopa (3,4-dihydroxyphenylalanine) within seeds, embryos, and cotyledons which deters predation by some seed-eating animals (Daxenbichler et al. 1972; Modi et al. 2008 *apud* Kuprewicz 2010), including insects (Rehr et al. 1973 *apud* Kuprewicz 2010), mammals (Emenalom et al. 2004), and birds (Harms et al. 1961). Kuprewicz (2010) noted that in *M. holtonii* (Kuntze) Moldenke (a member of *M. subg. Mucuna*) seeds not only have a chemical defense, but, in addition, structural defenses provided by the seed coat can also prevent post-dispersal seed predation by invertebrates.

#### TAXONOMIC TREATMENT

##### KEY TO THE SUBGENERA OF *MUCUNA*

1. Pods woody; ovary (10–)20–30 × (0.5–)1–1.5 mm, with (4–)9–18 ovules ..... *Mucuna subg. Macrocarpa*
1. Pods leathery or fleshy; ovary 5–14 × 1–2 mm, with 1–5(–10) ovules ..... 2
  2. Pods dehiscent along one suture, hilum circling more than 50% of the seed circumference, aril lacking ..... *Mucuna subg. Mucuna*
  2. Pods dehiscent along both sutures, hilum circling less than 20% of the seed circumference and bordered by a conspicuous rim-aril ..... *Mucuna subg. Stizolobium*

***Mucuna subg. Macrocarpa*** T. M. Moura, Wilmot-Dear, M. Vatanparast, A. M. G. Azevedo & G. P. Lewis, subg. nov.—SUBGENUS TYPE: *Mucuna macrocarpa* Wall., Pl. Asiat. Rar. 1: 41, pl. 47. 1830.—SPECIES TYPE: NEPAL. *Wallich 5618* (holotype: K!).

Woody liana. Stipels not persistent. Inflorescence a pseudoraceme; peduncle 2–15 cm long; flowers 3.5–8.5 cm long; corolla white, greenish, yellowish, purple, reddish purple, dark purple, or bicolored (purple and either greenish, yellowish or white); ovary (10–)20–30 × (0.5–)1–1.5 mm, with (4–)9–18 ovules. Fruit a legume opening along one suture only, linear, laterally compressed, (13–)23–60 cm long with length 6–10(–20) × width, epicarp woody, surface not ornamented by lamellae, but often conspicuously longitudinally wrinkled; caducous hairs on mature fruits. Seeds to (4–)7–18 per fruit, discoid or compressed-oblong; hilum circling more than 50% of the seed circumference, aril lacking.

The name ‘*Macrocarpa*’ was chosen for the new subgenus both to indicate the characteristically long fruit compared to the two other subgenera, and because the most well-known and widespread species in the subgenus is *Mucuna macrocarpa*. Four main characteristics diagnose *M. subg. Macrocarpa*: (1) ovary length, (1–)2–3 cm long (vs. 0.5–1.4 cm long for the other two subgenera); (2) number of ovules in the ovary (4–)9–18 (vs. 1–5(–10) for the other two subgenera); (3) fruit linear, length at least 6 times width, epicarp woody, usually somewhat wrinkled but otherwise lacking any ornamentation (vs. relatively broader, epicarp leathery, usually ornamented by lamellae, ribs or, rarely ± wrinkled or lacking

ornamentation in *M. subg. Mucuna* and epicarp fleshy in *M. subg. Stizolobium*). Fruits are usually 30–60 cm long and up to 18-seeded (Fig. 5); *M. calophylla* is the only exception, with a shorter ovary and fruit and fewer ovules/seeds per ovary/fruit.

We recognize six species in *M. subg. Macrocarpa*: (1) *M. birdwoodiana*; (2) *M. bodinieri*; (3) *M. calophylla*; (4) *M. macrocarpa*; (5) *M. sempervirens*; and (6) *M. thailandica*, with a total distribution from the eastern Himalayas through southern China to northern Thailand and Indochina (Fig. 6).

The phylogenetic position of the Chinese endemic *M. bodinieri* (only five specimens known, and not sampled in Moura et al. (2016)) is unresolved; its fruits are linear, ± woody, wrinkled, over 40 cm long and 16–18-seeded. Although the fruits are scarcely torulose, (a characteristic evident in other members of the group) they conform in most respects to those of other members of the clade.

One Philippine endemic, *M. longipedunculata* Merr., (we were unable to amplify DNA from this species) has 4–9-seeded fruits somewhat similar in shape to *M. bodinieri*, but they are more or less leathery rather than woody, and from the species distribution and its fruit texture we hypothesise that it does not belong to *M. subg. Macrocarpa*. Another Philippine endemic, *M. pachycarpa* Parreno ex Wiriadinata (again not sampled in our study due to lack of material), also has a somewhat similar long, wrinkled fruit but it is relatively much broader, and only has six seeds. We conclude that *M. pachycarpa* does not belong to *M. subg. Macrocarpa*.

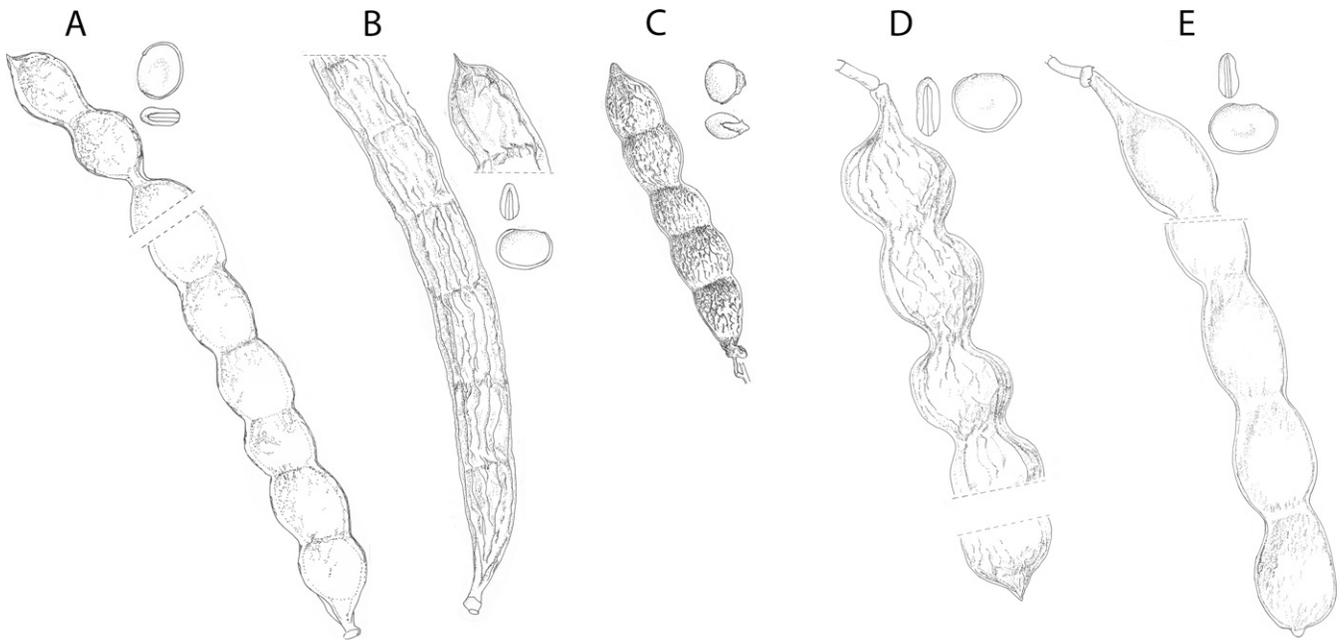


FIG. 5. Fruit and seed morphology of the representatives of *Mucuna* subg. *Macrocarpa* (only *M. thailandica* is not figured). A. *M. birdwoodiana*. B. *M. bodinieri*. C. *M. calophylla*. D. *M. macrocarpa*. E. *M. sempervirens*. Illustrations not to scale. Adapted from Wilmot-Dear (1984).

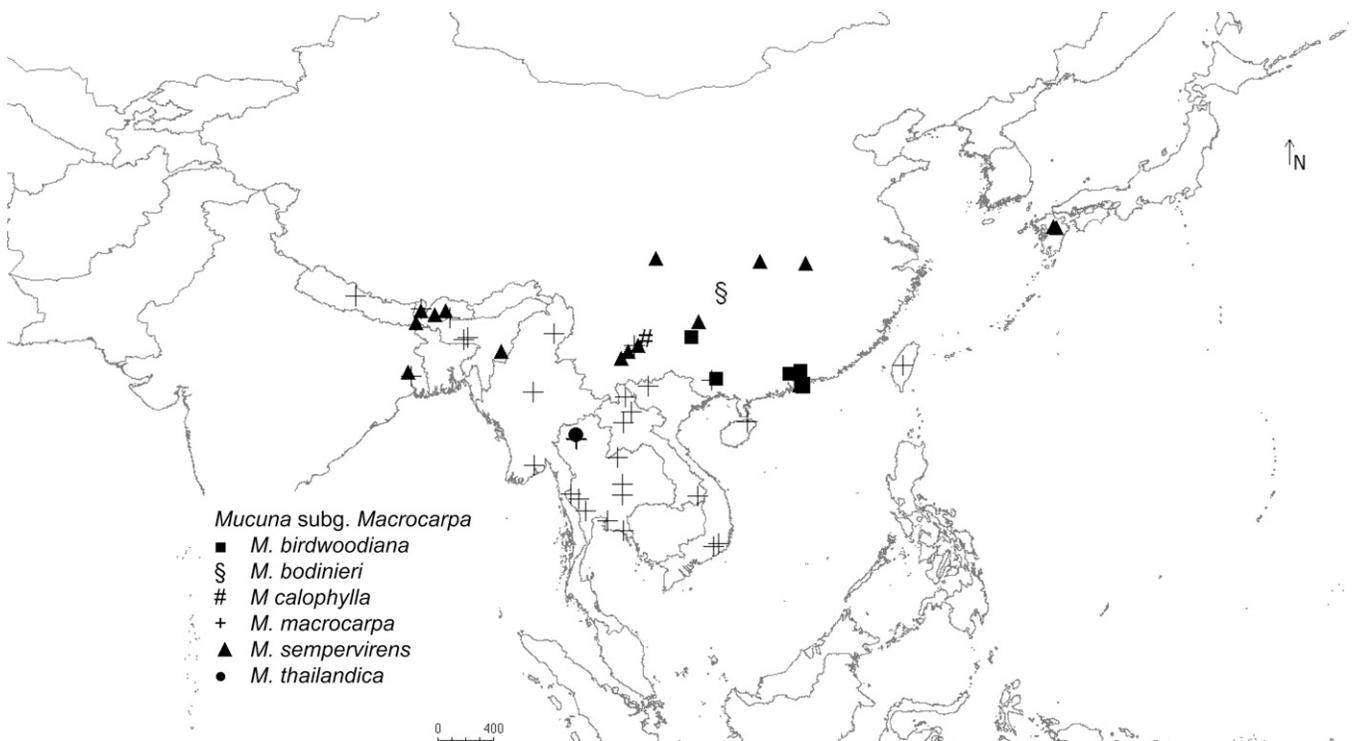


FIG. 6. Distribution of the six species of *M. subg. Macrocarpa* in Asia. Map plotted using DIVA-GIS.

KEY TO THE SPECIES OF *MUCUNA* SUBG. *MACROCARPA*

1. Indumentum on the abaxial surface of the leaflets silvery sericeous and usually dense; flowers 3.5–4.5 cm long; fruits 13–15 cm long, up to 7-seeded ..... 3. *M. calophylla*
1. Indumentum on the abaxial surface of the leaflets absent or sparse or if dense then spreading and often red-brown; flowers  $\geq$  5.5 cm long; fruits 23–60 cm long, up to 18-seeded ..... 2
2. A pair of lignified wings present along both sutures of the fruit; corolla white, margin of standard and wings ciliate around apex; leaflets drying pale green, glabrous or almost so, length to width ratio of terminal leaflet (2–)3–4:1 ..... 1. *M. birdwoodiana*
2. Fruit with or without a thickened margin but lacking any wings; corolla deep purple, reddish purple or deep crimson or bicolored deep purple + white (petal-apices ciliate or not); leaflets drying brownish green or black, length to width ratio of terminal leaflet 1.5–1.75 (rarely 2):1 ..... 3
3. Flowers 7–8 cm long, purple, margin of standard and wings ciliate around apex; leaflets with a dense, soft, pale, spreading indumentum ..... 2. *M. bodinieri*
3. Flowers 5.5–7 cm long or if longer then white with glabrous apical margins; leaflets glabrous or sparsely hairy or with a ferruginous indumentum ..... 4
4. Corolla white, keel 7.5–8.5 cm long ..... 6. *M. thailandica*
4. Corolla purple or bicolored, keel 5.5–7 cm long ..... 5
5. Peduncle up to 5.5 cm long; corolla purple, apical margins glabrous; abaxial surface of the leaflets glabrous or rarely with sparse, stiff, pale hairs ..... 5. *M. sempervirens*
5. Peduncle ca. 15 cm long; wing-petals purple, standard and sometimes keel petals whitish, margins of standard and wings ciliate around apex; abaxial surface of the leaflets with ferruginous, spreading, sometimes dense, hairs ..... 4. *M. macrocarpa*

1. *MUCUNA BIRDWOODIANA* Tutcher, Journ. Linn. Soc., Bot. 37: 65. 1904 —TYPE: HONGKONG. Mt. Gough. *Tutcher 980* (lectotype designated here: K! 000894824; isolectotype: K! 000894825).

Large liana. Young stems glabrous or with very sparse adpressed pale hairs. Stipels not persistent. Leaflets glabrous or sparsely adpressed-hairy, rather long and narrow, often glossy above, terminal leaflet ovate, elliptic or slightly obovate, 9–16 × 2–6 cm, length (2–)3–4 × width, apex with  $\pm$  distinct acumen up to 2.2 cm long. Inflorescence a ramiflorous or axillary pseudoraceme, 20–38 cm long; peduncle 2–8.5 cm long; rachis 19–26 cm long; bracts ovate, ca. 2 cm long, caducous; bracteoles caducous; pedicels 1–1.5 cm long; flowers 7–8.5 cm long; corolla white or greenish to greyish-white; lateral calyx lobes broadly triangular, 5–8 mm long, lowest narrow-triangular, 5–15 mm long, often twice length of laterals; standard 3.5–4.5 cm long;  $\pm$   $\frac{1}{2}$  the keel length; wings 6.2–7.1 cm,  $\frac{3}{4}$  –  $\frac{5}{6}$  keel length, margin of standard and wings conspicuously brown-ciliate around apical  $\frac{1}{2}$  –  $\frac{1}{3}$ . Fruits woody, linear-oblong, laterally compressed and torulose, slightly curved,  $\pm$  acute at apex, 23–45 × 3.5–4.5 × 1–1.5 cm with (5–)9–13 seeds, smooth with a dense, spreading, dark brown or red-brown pubescence and caducous bristles, marginal wings very thick, 3–5 mm wide. Seeds brown, oblong-discoid; hilum,  $\frac{1}{2}$  to  $\frac{3}{4}$  the length of the seed circumference.

*Mucuna birdwoodiana* is distinctive in its narrow, leathery, glossy, often glabrous leaflets which lack persistent stipels, leaflets also often dry pale green, in its large white flowers with conspicuously ciliate petal margins and its linear woody and markedly torulose fruits with robust marginal wings.

**Phenology**—Flowers from April to June; fruits from June to November.

**Distribution and Habitat**—Endemic to China (Fujian, Guangdong, Guangxi, Guizhou, Hongkong, Jiangxi, Sichuan). Dense or open woodland, rocky areas, wet hillsides and valleys; 800–2,500 m.

**Representative Specimens Examined**—CHINA. Endemic. Sichuan: inter Lomapu et Tu yung pu, May 1910, *Schneider 1733* (A). Guizhou: Gan-Chouen, *Cavalerie 3910* (E, P) & *7157* (K). Guangxi: Ling Wan dis-

trict, 19 June 1937, *S. K. Lau 28436* (A). Guang-dong: Chu Feng Shan, 9 June 1928, *R. C. Ching 5874* (A). Lo Fu Shan [Lo Fau Shan]: *N. K. Chun 40387* & *43098* (IBSC), *Levine 1536* (E), *Levine, McClure & Ah To 6817* (A), *Merrill 11062* (A, HK), *Metcalfe & Lau Fun 18276* (A), 19 Sept. 1892, *U. On s.n.* (HK) & *T. M. Tsui 45* (A, K) & *97* (K); Taai Leng Shan, *S. Y. Lau 20091* (IBSC); Nam Kwan Shan, *W. T. Tsang 20285* (A, K); Kau Lung Fung, *Tsang 20038* (A); Sam Kok Shan, *Tsang 20607* (A, K) & Kwai Shan, *Tsang 28587* (A); Pak-Wan Cheung, *T. M. Tsui 110* (A, P). Hongkong: *Chan & Chan 47* (P); Mt Parker, *Ford 71* (K) & *s.n.* (BM) (syntype); Little Hongkong, *Ford 1767* (A); Ma On Shan, *S. Y. Hu 6475* (K); Mt Gough: *H. C. Tang 1710* (HK), & *7260* (HK); Mt Parker, *Tutcher 1054* (HK, K) (probable syntype); Shek Kong, *Wu & Wu 385* (A, P). New Territories: Tai Mo Shan: *Hu 9947* & *12110* (K) & *H. C. Tang 2433* (HK); Tai-Po-Kau, *Y. S. Lau 1106*, *1176* & *2852* (HK); Shing-Min Reserv., *Lau 424* (HK). Without locality: [?Guizhou] 8 May 1895 *Bodinier s.n.* (E); *W. Y. Chun 6698* (A, E).

Although Wilmot-Dear (1984) cited *Tutcher 980* (K) as the holotype of *M. birdwoodiana*, we consider lectotipification to be necessary because in the species' protologue the author cited four syntypes stating: "the plant was found by Mr. Ford on Mt. Parker, and last year (1903) I found it at same place, as well as on Mt. Gough, flowering in April, and previously on Tai-mo-shan in the New Territory, in fruit". The protologue describes flowers and fruits, and the Kew specimens only have flowers; however, among all the syntypes, two sheets of *Tutcher 980* were found in K (K000894824 and K000894825). Therefore, it is not possible to simply follow Wilmot-Dear's (1984) holotype designation (by just considering her use of holotype as a lectotype) because the specimen cited by her is not a single collection in the Kew herbarium (as presented above, there are two sheets). As K000894824 is the most informative specimen, we are designating it here as the lectotype of *M. birdwoodiana*.

2. *MUCUNA BODINIERI* H. Lév., Bull. Soc. Bot. France. 55: 408. 1908.—TYPE: KOUY-TCHÉOU. 21 April 1897. *Émile Bodinier 2282* (lectotype designated here: E! E00570078; isolectotype: A!, P!).

*Mucuna terreus* H. Lév., Repert. Spec. Nov. Regni Veg. 13 (363–367): 264. 1914.—TYPE: SUD DU KOUY-TCHÉOU. April 1908, *Jul. Cavalerie 2974* (holotype: E!; isotype: A!).

*Mucuna corvina* Gagnep., Notul. Syst. (Paris) 3: 28–29. 1914.—TYPE: KOUY-TCHÉOU. a Gran-Chouen, May to

Dec. 1910. *Cavalerie* 3782 (lectotype designated here: P! P00708445; isolectotypes: A!, E!, K!).

Large woody liana. Young stems, leaflet lower surface, and often upper surface also, with sparse, short pale spreading hairs. Stipels not persistent. Terminal leaflet broadly elliptic-ovate or elliptic to slightly obovate or almost rhombic, 11–14 × ca. 8 cm, length 1.3–1.75 × width, apex broadly rounded with an abrupt minute acumen. Inflorescence a ramiflorous pseudoraceme, over 10 cm long (peduncle + rachis), densely dark-pubescent; bracts persistent, 2 × 1.5 mm; pedicels 1–1.5 cm (flower), ± 2.5 cm long (fruits); corolla deep purple (sometimes yellowish white, see note below); calyx with lateral lobes 3–6 mm long, lowest lobe 6–10 mm long, flowers 7–8 cm long; standard 3.4–4 cm,  $\frac{1}{2}$  –  $\frac{2}{3}$  keel length; wings very narrow, 6–7 × 1.5–2 cm,  $\frac{4}{5}$  – 1 × keel length, margin of standard and wings conspicuously pale-pubescent on apical  $\frac{1}{5}$ ; fruit woody, linear, slightly curved, 47–60 cm long, not or scarcely constricted between the ca. 18 seeds, valves irregularly ± longitudinally ridged and reticulate-patterned, each margin thickened into a ridge up to 1 mm high either side of the suture; seeds oblong-discoid, almost black, circling ca.  $\frac{1}{3}$  of the seed circumference.

*Mucuna bodinieri* is distinctive in its broad, densely pubescent, rounded, short-acuminate leaflets which lack persistent stipels, its large purple flowers with ciliate petal apices, and its large linear, woody, scarcely torulose fruits, with unwinged thickened margins. *Mucuna macrocarpa* and *M. birdwoodiana* also have ciliate petal apices and large linear, but distinctly torulose, fruits (in *M. birdwoodiana* also winged) and differ also in their acute or acuminate leaflets, which in *M. birdwoodiana* are more or less glabrous, and in *M. macrocarpa* are reddish-brown (often sparsely) hairy, and generally have fewer secondary veins.

Flower colour may be variable; in nearly all original descriptions it is stated as being purple, but the field label on one of the cited syntypes (*Seguin s.n.*) states “white dirty yellowish.”

**Phenology**—Flowering in April and May; fruiting from February to May.

**Distribution and Habitat**—Endemic to China. Known only from Guizhou.

**Specimens Studied**—CHINA. Endemic to Guizhou: [Kouy Tchéou]: Hoa-Kiang, 21 April 1897 *Bodinier* 2282 (A, E, P); Gan-Chouen, May & Dec. 1910, *Cavalerie* 3782 (A, E, K, P) 3784 (A, P); Sud de Kouy Tchéou, April 1908, *Cavalerie* 2974; Hoa-Ko-Chou, 6 April 1898 *J. Seguin s.n.* (P).

In the protologue of *M. bodinieri* the author cited two syntypes “Kouy Tchéou: Hoa-Kiang, *émile Bodinier* 2282 (21 April 1897); *environs de Hoa-Ko-Chou J. Seguin* (6 April 1898)”. *J. Seguin s.n.* was only found at P. *Bodinier* 2282 was found in A, E, and P. The P material is represented only by five flowers glued on the sheet; the specimen in A comprises flowers and one leaflet and seems to be part of the collection located in E which consists of a leaf (with two leaflets), an inflorescence axis and flowers. As the specimen at E is the most complete material, we designate *Bodinier* 2282, E00570078, as the lectotype of *M. bodinieri*.

In the protologue of *M. corvina* the author cited two syntypes “China: prov. Kouy-Tchéou, a Gran-Chouen, May to Dec. 1910, *Cavalerie* 3782 et 3785?” *Cavalerie* 3782 was located in A, E, K and P; *Cavalerie* 3785 was not found. *Cavalerie* 3784 was located in A and P, and was considered by Wilmot-Dear (1984) as a syntype, although the number

was not cited in the protologue. As the herbarium and types of the author (Gagnepain) are located in P, we designate here *Cavalerie* 3782 (P) as the lectotype of *M. corvina*.

3. *MUCUNA CALOPHYLLA* W. W. Sm., Notes Roy. Bot. Gard. Edinburgh 12(59): 216–217. 1920.—TYPE: WEST CHINA. Western flank of the Tali Range, on dry grassy slopes. Lat 28°40' N. Alt. 9000 ft. July 1917. *G. Forrest* 15619 (holotype: E! 00570076; isotypes: E! 00570077, K! 000894910).

Liana, ca. 1–3 m, young stems with abundant fine, long, adpressed hairs, later glabrous or glabrescent. Stipels not persistent. Leaflets rather long and narrow with silvery sericeous hairs, these usually dense on lower surface, sparse above, terminal leaflet ovate, elliptic or rhombic, 7–11.5 × 3–5 cm, relatively narrow, length 2–2.5 × width. Inflorescence an axillary or ramiflorous pseudoraceme, 3–12 cm long; peduncle up to 4 cm long; rachis up to ca. 8 cm long, usually with abundant fine, short, adpressed silvery hairs; bracts and bracteoles caducous, bracts narrowly ovate, up to 3 mm long, bracteoles elliptic, ovate or slightly obovate, up to 6 mm long; pedicels 4–10 mm; flowers 3.5–4.5 cm long; corolla reddish purple or deep crimson; lowest calyx lobe (3.5–)5–6 mm long, laterals 2–4 mm long; standard 2–2.4 cm,  $\frac{1}{2}$  –  $\frac{2}{3}$  keel length; wings 2.8–3.2 × ca. 1 cm, ±  $\frac{3}{4}$  keel length. Fruits woody, linear not curved, very swollen around seeds, 13–15 × 1.8–3 × 1.5 cm, with up to 7 seeds, covered in dense reddish or pale brown, long irritant bristles, short spreading hairs and with a raised reticulate surface pattern. Seeds compressed-ellipsoid, ca. 2 × 1.5 × ca. 1 cm, brown; hilum ca.  $\frac{1}{2}$  to  $\frac{3}{4}$  the length of the seed circumference, brownish orange.

*Mucuna calophylla* is distinguished by its dense silvery sericeous indumentum on the abaxial surface of its leaflets, its narrow leaflets that lack persistent stipels, its small flowers, and its linear woody, but rather small, pod, much smaller than the other species in subgenus *Macrocarpa*. Although relatively small, its pods cannot be confused with the small, ± linear fruits of other mainland Asian *Mucuna* species because in subgenus *Stizobolium* fruits are fleshy and even smaller, often with longitudinal ribs and so densely hairy that the pod valve surface is completely hidden, and in subgenus *Mucuna* fruits are leathery, with marginal wings and often with an surface ornamentation of lamellae.

**Phenology**—Flowering in July.

**Distribution and Habitat**—China (Yunnan). Forest or open thickets; 1,000–3,000 m.

**Representative Specimens Examined**—CHINA. Western Yunnan: Eastern Likang, 21 Sept. 1939, *R. C. Ching* 21690 (A); Ta Mi Lang pres de Ta Pintze, 6 April 1885, *Delavay* 1977 (K, P); Hokin, 23 April 1939, *K. M. Feng* 789 (A); Pien Oua, Yunpe, 23 April 1920, *S. Ten* 389 (E); Yung-jen Hsien, 10 May 1933, *H. T. Tsai* 52797 (A).

In the species protologue the author stated “West China: flowers deep crimson-maroon. July 1917. *G. Forrest no. 15619.*” According to Taxonomic Literature II (Stafleu and Cowan 1976–1988) the types of William Wright Smith are located at E. In her treatment of *M. calophylla* Wilmot-Dear (1984) cited: “(holotype E!; isotype K!)” and we follow that decision here. In addition there is a second sheet of *Forrest* 15619 housed in E: E00570077 which lacks a field label and has “sheet II” written on it; this is an additional isotype.

4. *MUCUNA MACROCARPA* Wall., Pl. Asiat. Rar. 1: 41, pl. 47. 1830.—TYPE: NEPAL. *Wallich* 5618 (holotype K!).

*Mucuna castanea* Merr., Lingnan Sci. J. 11(1): 44–45. 1932.—TYPE: HAINAN. *Tsang & Fung 504* (holotype: Lingnan Herb. (LU 18038); isotypes: BM!, K!).

*Mucuna collettii* Lace, Bull. Misc. Inf. Kew 9: 398–399. 1915.—TYPE: INDO-CHINA. Myanmar (Burma). *Lace 5866* (lectotype designated here: E! E00570060; isolectotypes: E! E00570068, E00570062, E00570066, E00570069, K! K000797542, K000797541. Remaining syntypes C. G. Rogers 19 E! E00570067; *Hauxwell s.n.* E! E00570070, E00570063, E00570065; *Collett 458* K! K000797543; *Henry 11702* A!, K!, US!: US00902325, US00902326).

*Mucuna ferruginea* Matsum., J. Coll. Sci. Imp. Univ. Tokyo 12: 422. 1899.—TYPE: TAIWAN, 17 Jan. 1898. *Owatari s. n.* (holotype and isotype: TI!)

*Mucuna wangii* Hu, Bull. Fan Mem. Inst. Biol., Peiping Bot. Ser. 10: 146. 1940.—TYPE: YUNNAN. C. W. *Wang 72881 & 73389* (syntypes Herb Lingnan HK; isosyntypes A!).

Large woody liana up to 70 m. Stems with a dense, fine indumentum of brown, adpressed or spreading hairs, glabrescent. Stipels usually caducous, rarely persistent. Leaflets abaxially with ferruginous, spreading, often dense hairs, later glabrescent; terminal leaflet ovate, elliptic or slightly obovate, (7–)10–19 × (3–)5–10 cm, length ca. 2 × width, apex broadly acute or short-acuminate. Inflorescence a ramiflorous pseudoraceme, 5–23 cm long; peduncle 15 cm long, rachis 10–32 cm long, with a short (ca. 0.3–0.4 m long) brown, spreading pubescence and fine brownish bristles; bracts and bracteoles ovate, bracteoles 2–5 mm long, shorter than calyx, caducous, pedicels 1(–1.5) cm long; flowers 5.5–6(–7) cm long; calyx lobes triangular, laterals 3–4 mm long, median 5–6 mm long, up to twice the length of the laterals; corolla bicolored; standard greenish or pinkish white, wings dark purple, keel lighter mauve or yellowish green; standard 3–3.5(–4.5) cm,  $\frac{1}{2}$  –  $\frac{3}{5}$  keel length; wings 4–5.2(–6) × 1.5–1.7 cm,  $\pm \frac{4}{5}$  keel length, standard and wings with their margins conspicuously ciliate along the apical  $\frac{1}{4}$  –  $\frac{1}{3}$ . Fruit woody, linear, 6–15-seeded, with margins often markedly constricted between the seeds, 26–45(–48) × 3–5 cm, densely pubescent (rarely glabrous with age), with irregular longitudinal wrinkles when dry, margins without wings or any distinct thickened rim or central groove along the sutures. Seeds black with a dark brown or black hilum, 2.2–3.2 × 1.8–2.8 cm; hilum ca. 5.5 cm long, circling ca. 75% of the seed circumference.

*Mucuna macrocarpa* is distinctive in having leaves usually without persistent stipels, flowers usually bicolored (purple and whitish), petals with a conspicuously ciliate apex, and large linear, torulose pods with thickened, unwinged margins. The fruit is difficult to distinguish from that of *M. sempervirens* (described below), a species which also has caducous stipels but differs in its often very sparse and pale leaflet indumentum, in its flowers being uniformly purple, petals without a ciliate apex, and in its fruit with a finer, more regular, reticulate surface pattern and its margins somewhat thickened into a rounded rim.

**Phenology**—Flowering from November to May; fruiting from April to November.

**Distribution and Habitat**—Thailand, Vietnam, Myanmar (Burma), eastern Himalayas (Sikkim, Nepal, Northeast India), China (Southwest, South, and Taiwan), southern Japan (Kyushu & Ryukyu Is.). Evergreen or deciduous mon-

tane or riverine forest, open thickets and dry sandy areas, often common; 1,000–3,000 m.

**Representative Specimens Examined**—CHINA. Western China, unlocalized: *Vilmorin 1956* (P). Yunnan: *Ducloux 6096* (P); *Szema, Henry 11631* (A, K), *11631A* (E, K) & *13679* (K); between Muang Pan & Muang Hai, *Rock 2389* (A); between Keng Hung & Muang Hing, *Rock 2688* (A, E); Lan-Tsang Hsien, May 1936, *Wang 76608* (A). Guangdong-Guangxi: Sup Man Ta Shan: *H. Y. Liang 69866* (A); *W. T. Tsang 21969* (A, BM, P). Guangxi: *Siu-Luk, W. T. Tsang 21863* (A, BM, P). Hainan: Bai Sha District, *S. K. Lau 26413* (IBSC); *Fan Yah, N. K. Chun & C. L. Tso 44187* (A, K, P). Taiwan: *Faurie 1823* (A); *Sonaro-Arizan, 27 Feb. 1912, Price 71* (K); around Urai, Prov. Taihoku, 30 March 1918, *Wilson 10268* (A, BM, K). NEPAL. West of Meklajam, 24 May 1969, *Williams 166* (BM). E: Dharam, 11 March 1967, *Stainton 5693* (BM). SIKKIM. Himalayas, *Gammil s.n.* (CAL). BHUTAN. Sarbhong Dist., 17 March 1982, *Grierson & Long 3803* (E); *Chaisilakha, 21 Dec. 1963, Subba Rao 287* (CAL). MYANMAR (BURMA). N: Kachin State, Sumprabaung, *Keenan et al. 3849* (E). N.E.: Hills around Hlawgair, Oct. 1924, *Forrest 26012* (E). Mandalay Dist., *Maymyo, 30 April 1915, G. Rogers 971* (E). South Chin Hills, Minlat, 6 March 1856, *Kingdon Ward 21744* (BM). INDIA. West Bengal, Darjeeling: *Dulka Jhar, March 1875 & Feb. 1876 & 4 April 1876, Gamble 465* (DD, K) & *465A* (K) & *465C* (BM); 2 Aug. 1876 & May 1879, *Gamble 886 & 6695* (K); 13 April 1876, *Clarke 27496A* (K). Meghalaya: *Jaintea, Shampoong, Clarke 18292* (K); *Khasia & Jaintea, Deha 18882* (AS-SAM). THAILAND. N: Chiang Mai: *Doi Chiengdao, 1940, Garrett 1172* (K, L) & 1987, *Niyomdham et al. 1372* (AAU, K); *Doi Suthep; 1987, Smitasiri & Elliotte BG1 - BG6* (K) & 1913, *Kerr 2929* (E, K). Me Nga, Me Kang, 1913, *Garratt 101* (E, K). NE: *Loei: Phu Kradung, 1924, Kerr 8701* (K). E: *Nakhon Ratchasima: Khao Yai Nat. Park, van Beusekom et al. 32* (E, K, L, P); *Kao Lem, 1925, Kerr 9964 & 9964A* (AAU, K). *Chaiyaphum: Ban Man Phrom, 1974, Geesinke et al. 6913* (K, L). SW: *Kanchanaburi: Lieuw Long, 1968, van Beusekom et al. 435* (AAU, E, K, L, P); *Sri Sawat, 1974, Larsen & Larsen 33895* (AAU). SE: *Chon Buri: Siricha, Kow Kieo, 1976, Maxwell 76–108* (AAU, L) & 76–384 (L). *Chanthaburi: Pong Nam Rawm, Soy Dow, 1974, ibid. 74–688* (AAU, L). LAOS. *Phuongsaly: Poilane 25882* (AAU, P). *Luang Prabang: Nam Minh, 1932, Poilane 20373* (AAU) & *Muang Ngai, 1932, Poilane 20707* (AAU, P). *Houa Phan: Sam Neua, 1920, Poilane 2108* (AAU). *Saravane: Tateng, 1928, Poilane 15558* (AAU, K). *Attopeu, Harmand 1423* (K, P). VIETNAM. *Huang Lien Son* (Muong Hum): *Lao Cai, 1931, Poilane 18838* (AAU, K P). *Ha Bac: Phocam, 1886, Balansa 1207* (K). *Lam Dong: Langbian Peaks, April 1918, Boden Kloss s.n.* (BM): *Dalat, Schmid s.n.* (P); *Braian, Djiring: 1932, Poilane 24092* (AAU) & 1935, *Poilane 24276* (AAU, K, P).

In the protologue of *M. collettii* the author cited a number of syntypes: “Indo-China: Burma: *Lace 5866*; C. G. *Rogers 19*; *Hauxwell*; Shan Hills, 1230 m, *Collett 458*. China. Yunnan: *Henry 11702*.” We located *Collett 458* at K; *Rogers 19* at E; *Hauxwell s.n.* at E (three sheets); *Henry 11702* at A, K, and US (two sheets); and *Lace 5866* at E (five sheets), K (two sheets). The protologue of *M. collettii* describes flowers and fruit and evidently was put together from a combination of the characters observed on the syntypes. We have seen no syntype collections with both flowers and fruit even where several duplicates exist. We choose to lectotypify the synonym *M. collettii* with a collection made by the author of the plant name. The most complete material, with stem, leaf, and a fruit, is located in E, and we select *Lace 5866* (E00570060) as the lectotype of *M. collettii*. Insufficient material has been seen by the authors to unambiguously select a lectotype from amongst the syntypes of *M. wangii* presented in its protologue.

5. *MUCUNA SEMPERVIRENS* Hemsl., J. Linn. Soc., Bot. 23(154): 190. 1887.—TYPE: HUPEH. Ichang. *A. Henry 1065* (lectotype designated here: K! K000894419; isolectotypes: K! 000894817, P!).

*Mucuna coriolarpa* Hand.-Mazz., Akad. Wiss. Wien, Math.-Naturwiss. Kl., Anz 62: 224. 1925.—TYPE: CHINA. Yunnan, Northwest, *Supra Tschamutong, 13 July 1916. Handel-Mazzetti 9562* (holotype: W!; isotypes: E!, K!).

*Mucuna mairei* H. Lév., Repert. Spec. Nov. Regni Veg. 13(369–369): 337. 1914.—TYPE: CHINA. Yunnan, Foret de San-Tao-Keou, May 1913. *Maire s.n.* (holotype: E!; isotype: A!).

*Mucuna japonica* Nakai, Bot. Mag. (Tokyo) 46: 57. 1932.—TYPE: JAPAN. Kyushu, prov. Higo, Aiva, May 1932. *Kodzuma s.n.* (lectotype designated by Tatieshi and Ohashi (1981) II!).

Woody liana, up to 25 m., old stems over 30 cm in diameter, young stems, leaves and peduncles glabrous or rarely with a sparse indumentum of stiff, pale hairs. Stipels caducous. Terminal leaflet elliptic or elliptic-ovate, 8–15(–19) × 3.5–9 cm, apex with acumen up to 15 mm long. Inflorescence a ramiflorous pseudoraceme, 10–36 cm long; peduncle up to 5.5 cm long, sometimes branched at the base; rachis 10–30 cm long; bracts 1–1.5 × 0.5 cm, usually caducous; bracteoles 2 × 1 cm, usually caducous; pedicels 1–2.5 cm long; flowers 6–7 cm long; corolla deep purple or standard white; calyx 4-lobed, the lowest formed by two connate sepals, the two lateral lobes 5–8 mm long, equalling the lowest lobe or almost so, broadly triangular; standard 3.2–4 cm long,  $\frac{1}{2}$  –  $\frac{2}{3}$  the keel length; wings (4.5–)4.8–6 × 1.8–2 cm,  $\frac{2}{3}$  –  $\frac{4}{5}$  (rarely almost equal to) the keel length. Fruits woody, linear, torulose, more or less straight, 23–60 × 3–3.5 × 1–1.3 cm with (4–)7–2 seeds, surface with dense, short, fine red-brown hairs and sparse, caducous reddish brown bristles and a conspicuous irregularly reticulate pattern, margins without wings but thickened into a well-defined smooth, rounded ridge running along the sutures, but lacking a wing or median groove. Seeds oblong or discoid, 2.2–3.2 × 2–2.8 × ca. 1 cm, shiny reddish-brown or black; hilum 5.5–7 cm long, circling ca. 75% of the seed circumference.

*Mucuna sempervirens* is differentiated by its long, linear, wingless, usually torulose fruit and its caducous stipels, by its vegetative parts being sparsely hairy and usually glabrescent, and by its relatively wide wing petals. In fruit the species is often confused with *M. macrocarpa*, which also has caducous stipels but differs in its fruit without a distinct rounded thickening along its margin and with a coarser surface pattern, its reddish leaf indumentum, and its bicolored flowers with conspicuous ciliate margins at the apex of standard and wings. *Mucuna sempervirens* is easily distinguished from other species in the genus with large purple flowers by its caducous stipels; *M. calophylla* also has caducous stipels, but has much smaller flowers and its fruit and the lower surface of its leaflets are usually densely sericeous-hairy.

**Phenology**—Flowering from April to May; fruiting from August to October.

**Distribution and Habitat**—China, Japan, India. Subtropical forests, thickets, valleys and river edges, on calcareous soils; 300–3,000 m.

**Representative Specimens Examined**—JAPAN (probably introduced). Kyushu, Kumamoto Pref.: Kamoto-gun, *Nakahara s.n.* (II). CHINA. Sichuan: Mt Omei: C. Y. Chiao & C. S. Fan 116 (A), S. C. Sun & K. Chang 1166 (A), Y. S. Shiao 49272 (IBSC), F. T. Wang 23555 (A, IBSC) & Wilson 3411 (A, BM, K); Kiating: H. C. Chow 9609 (A) & L. Y. Tai 624 & 819 (A). Hubei: Yangtze-Kiang, *Faber* 756 (K). Guizhou: Pin-yue to Kouy-yang, *Bodnier* 2604 (E); Tsing chen, S. W. Teng 90287 (A). Yunnan: Ping-pien Hsien, W. Y. Chun 60959 (IBSC); ascent to Yangtze from Eastern boundary of Li Chiang Valley, *Forrest* 10931 (BM, E, K); Salwin-Kiu Chiang divide, *Forrest* 21667 (E); Schweli Valley, *Forrest* 24148 (E); Suen Oui, May, *Maire* 283 (A, E); Ping-Pien Hsien, H. T. Tsai 61796 (A); *Tsai* 60959 (A, IBSC). Hong-kong: East Point, April 1875, *de Poli s.n.* (P). SIKKIM. 25 April 1876, *Clarke* 27608 (K); 1–4000', *Hooker s.n.* (K). BHUTAN. Chukka Distr., 25 Feb. 1982, *Grierson & Long* 3264 (E). Mirichana Tuipu, 21 Nov. 1914, *Cooper* 3667 (E). MYANMAR (BURMA). NE, Maikha-

Salwin divide, May 1919, *Forrest* 17877 (E). Mandalay Distr., Maymyo, 2 June 1912 & 12 March 1913, *Lace* 5811 & 6118 (E, K). INDIA. West Bengal: Darjeeling: June 1876, *Gamble* 834 (DD) & 834A (K) & Birch Hill Peak, 20 April 1895, *Talbot* 3325 (BSI) & 13 April 1876, *Clarke* 27496 (BM) & Batassi, 2 May 1960, *Kanai et al.* 1986 (BM). Manipur: 'Eastern Himalaya', 7 April 1842, *Griffith* 1/199 (K).

The protologue of *M. sempervirens* stated: "Hupeh: Ichang (*A. Henry!*) Herb. Kew". Wilmot-Dear (1984) stated "Type: China: Hubei: Ichang, *A. Henry* 1065 (holotype K!; isotype P!)"; however, there are two sheets of *A. Henry* 1065 at K, both having stem, leaves, and fruits. The specimen K000894419 has a hand-written annotation of the name, presumably by Hemsley, which is absent on the other sample. We therefore select *Henry* 1065 (K000894419) as the lectotype of *M. sempervirens*.

6. *MUCUNA THAILANDICA* Niyomdham & Wilmot-Dear, Kew Bull. 47: 211 & Fig. 2. 1992.—TYPE: THAILAND. Chiang Mai: Doi Inthanon, 1 March 1978. *Niyomdham* 5 (holotype: BKF!; isotype: K!).

Woody liana (10–)25–40 m (very similar in habit to *M. macrocarpa*); stems, petioles and young leaflets with a sparse pale indumentum of adpressed hairs, glabrescent. Stipels caducous. Terminal leaflet 9.5–14 cm, broadly elliptic, length 1.5–1.75 × width, apex acuminate. Inflorescence a ramiflorous pseudoraceme, unbranched but several peduncles arising from the same node, 10–50 cm long, peduncle 1.5–12 cm long; rachis 7 cm long; brachyblasts nodose rarely attaining 1.5 cm in length; pedicels (1.5–)2–3 cm long; bracts and bracteoles ovate-elliptic, acute, 3–7 × 3–5 mm, very caducous; flowers 7–7.7 cm long; corolla green (*C. Niyomdham* 5287 K); calyx lobes broadly triangular, the median lobe 10–13 × 6 mm, laterals 5–8 × 5–8 mm; standard 4.5–5.5 cm, ±  $\frac{1}{8}$  the keel length; wings narrow, 7–7.5 × 1.6–2.3 cm, slightly shorter than keel length. Fruit and seeds similar to those of *M. macrocarpa*, but fruit slightly larger, 47–60 × 4–4.5 cm, and often not torulose.

*Mucuna thailandica* is distinguished from all other Thailand species by its very large calyx and corolla, especially its large standard petal (which is at most 3.5 cm long in other species) and from all except *M. macrocarpa* by its long linear fruit and caducous stipels; *M. macrocarpa* is easily distinguished from it by its smaller flowers with some parts purple, its ciliate petal apices, its relatively broad wing petals, and its usually hairy mature leaflets with the terminal leaflet not as broad and the lateral leaflets more asymmetrical (also see Wilmot-Dear 2009).

**Phenology**—Flowering in March.

**Distribution and Habitat**—Endemic to northern Thailand (known only from Doi Inthanon). Montane forest, gallery forest, often in clearings and near streams; 1,000–2,400 m altitude.

**Specimens Studied**—THAILAND. Doi Inthanon: Konta, Phengklai et al. 4238 (BKF); Koyama et al. 44203 (BKF); Niyomdham et al. 5266 & 5287 (BKF, K) & 5266 (BKF); Phengklai et al. 11001 (BKF) & 11026 (BKF); Pooma 1394 (BKF); Smitinand 90–93 (BKF).

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