

## *Mussaenda lancipetala* X. F. Deng & D. X. Zhang, a new species of Rubiaceae from China

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**Abstract** *Mussaenda lancipetala* X. F. Deng & D. X. Zhang, a new species of Rubiaceae from Yunnan Province, Southwestern China, is described and illustrated. The new species is characterized by its reverse herkogamous sexual system, its ovate-lanceolate corolla lobes with caudate apex, and corolla tube covered with sparse farinose pubescence, by which it is clearly distinguished from other species of *Mussaenda*.

**Key words** *Mussaenda*, *Mussaenda lancipetala* X. F. Deng & D. X. Zhang, new species, pollen morphology, sexual system, taxonomy.

*Mussaenda* L. s.s. is a paleotropical genus of ca. 132 species (Alejandro et al., 2005), with ca. 30 species occurring in China (Hsue & Wu, 1999). Species in *Mussaenda* are characterized by having enlarged petaloid calyx lobes, valvate-reduplicate aestivation of the corolla lobes and indehiscent, berry-like fruits, and the woody, scandent or liana habit.

The generic circumscriptions have always been controversial since the genus was established (Bremer & Thulin, 1998; Huysmans et al., 1998; Puff et al., 1993; Robbrecht, 1988; Li, 1943; Wernham, 1916). A recent molecular phylogenetic analysis based on ITS and *trnT-F* sequences revealed that the genus in its broad sense is polyphyletic, although the Asian species together form a monophyletic clade (Alejandro et al., 2005).

In order to revise the Chinese *Mussaenda*, we have carried out extensive field work in Yunnan Province. Among a large number of *Mussaenda* collections, one of them was not in accordance with any of the known species recorded in China and neighboring Asian countries based on the observation to its gross morphology, habit and habitat in the field, SEM observation of pollen morphology, and LM and SEM observation of leaf epidermal characters. The proposed new species, *M. lancipetala*, presents a superficial resemblance to *M. roxburghii* Hook. f. in having ovate-lanceolate corolla lobes with filiform tips, but differs in having adaxially glabrous leaves, with 11–13 pairs of secondary veins and farinose pubes-

cence out of the corolla tube. The pollen and leaf epidermal morphology, gross morphology of the species is different from the known taxa, and a new species, *M. lancipetala*, was eventually proposed.

### 1 Material and Methods

Field studies were undertaken by the authors in 2005 and also in 2006 in Yunnan Province, China, and specimens from HITBC, IBSC, KUN and PE and other main herbaria in Europe were examined. The measurements and other details given in the description are based on field study as well as herbarium specimen measurements.

Pollen material was collected in the field in Yunnan (vouchers were deposited in IBSC), as well as from the herbarium of Kunming Institute of Botany, Chinese Academy of Sciences (KUN), and all material used in leaf epidermal observation were sampled from the herbaria KUN and IBSC (see Appendix for a list of specimens examined).

Dried pollen was acetolysed (fresh pollen was not acetolysed) following Erdtman (1969), then suspended in 70% ethyl alcohol after washed, air dried on brass stubs and coated with gold palladium, and observed under a JSM-6360LV scanning electron microscope. Twenty pollen grains per sample were measured.

The samples for leaf epidermal observation were treated for both light (LM) and scanning electron microscopy (SEM). Samples were taken from fully expanded mature leaves. For LM, the samples were boiled in water for 20 min, then macerated in NaOCl solution. Pieces of leaf epidermis were stained with a solution of safranin, then dehydrated through an

alcohol series and washed with xylene before mounted in neutral gum, and then photographed with OLYMPUS AX 70. For SEM, the samples were clarified using absolute alcohol, air dried, and then sputtered with gold palladium, and examined and photographed with JSM-6360LV.

## 2 Results and Discussion

### 2.1 Morphological observation

At first glance *M. lancipetala* somewhat resembles *M. roxburghii* in leaf and flower shape. Nevertheless, upon careful examination of the specimens it is clear that they are different species. *Mussaenda lancipetala* has 11–13 pairs of secondary veins (vs. only 7–9 pairs in *M. roxburghii*), 2.5–3.0 cm long corolla tubes, with sparse pallid farinose hairs abaxially (vs. ca. 1.8–2.3 cm long corolla tubes with densely adpressed primrose villose abaxially in *M. roxburghii*) and the leaves glabrous on the adaxial surfaces (vs. sparse short pallid pubescence in *M. roxburghii*) (Table 1).

In addition, field observations indicated that *M. lancipetala* have reverse herkogamous flowers (4 population for sampling). The flowers of *M. lancipetala* were hermaphrodite, monomorphic, with only short-styled flower morph present in the populations observed. We are not certain about the sexual system of *M. roxburghii*, which is morphologically heterosty-

lous though.

### 2.2 SEM observation

Pollen and leaf samples of the two species of *Mussaenda*, viz., *M. roxburghii*, and the species described here, were examined under SEM. The pollen grains of both species are single, isopolar, radially symmetrical, small-sized, suboblate or subspheroidal, and 4-colporate. However there is a considerable variation in the size of pollen grains, exine ornamentation and characters of apertures between the new species and its ally (Table 2). In *M. lancipetala* the pollen is subspheroidal in shape, the exine ornamentation is finely rugulose, and the colpus membrane is sparsely and finely granulate (Fig. 1: A), while in *M. roxburghii* the exine ornamentation of pollen grains is roughly rugulose with perforate, and the colpus membrane is granulate (Fig. 1: C).

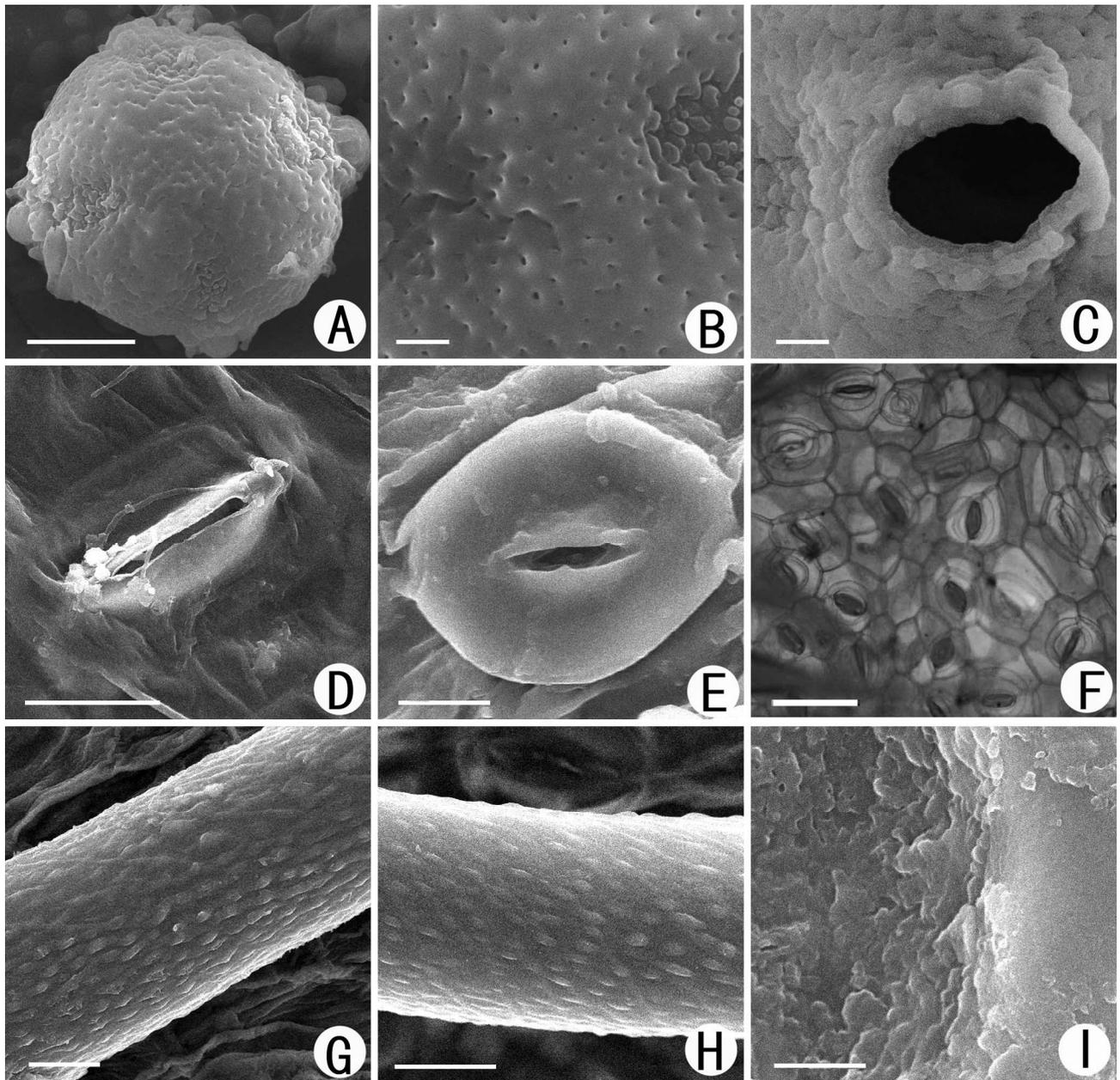
In a preliminary observation of the indumentum and stomata of the investigated species, we found that stomata occur only on the lower epidermis, and trichomes and stomata in the leaf are not evenly distributed (Fig. 1). Generally the hairs along the veins are slightly denser and longer than those on the inter-vein areas of the leaves. The ornamentation of cuticular membrane (Fig. 1: I) and trichome, the density of trichome and stomata, along with the size of stomata are different between our new taxon and its ally, and the results of the observations are shown in Table 3.

**Table 1** Diagnostic morphological characters of *Mussaenda lancipetala* and *M. roxburghii*

| Character          | <i>M. lancipetala</i>  | <i>M. roxburghii</i>   |
|--------------------|--|--|
| Leaf trichome      | glabrous adaxially; sparse white pubescent abaxially             | sparse appressed pubescent adaxially; gray pubescent abaxially   |
| Leaf size (cm)     | 15–24 × 6–8  | 10–12 × 3.5–5  |
| 2° veins           | 11–13 pairs  | 7–9 pairs  |
| Inflorescence      | slightly diffuse pleiochasium                                    | slightly compacted pleiochasium                                  |
| Semaphylls         | 6–7.5 × 4–5 cm   | 4.5 × 2 cm   |
| Calyx lobe         | 10–12 mm long  | 5 mm long  |
| Corolla tube       | 2.5–3.0 cm long, with sparse pallid farinose pubescent abaxially | 1.8–2.3 cm long, with dense adpressed primrose villose abaxially |
| Corolla lobes (mm) | 7–8 × 2.5–3.0  | 4–6 × 1.5–2  |

**Table 2** Pollen characters of *Mussaenda lancipetala* and *M. roxburghii*

| Character          | <i>M. lancipetala</i>               | <i>M. roxburghii</i>                |
|--------------------|-------------------------------------|-------------------------------------|
| Pollen shape       | subspheroidal                       | subspheroidal                       |
| Pollen size (µm)   | 14.7 (11.3–17.0) × 15.6 (12.6–17.3) | 14.4 (13.5–18.0) × 16.1 (14.4–20.0) |
| Polar view         | circular                            | quadrivalve-circular                |
| Aperture type      | 4-colporate                         | 4-colporate                         |
| Colpus sculpture   | sparsely finely granulate           | coarse granulate                    |
| Endoaperture shape | round, with thickened margin        | round, with thickened margin        |
| Ornamentation      | finely rugulose                     | roughly rugulose with foveolatus    |



**Fig. 1.** A–C, SEM photomicrographs of pollen grains of two taxa of *Mussaenda*. **A.** *M. lancipetala*. Polar view. **B.** *M. lancipetala*. Polar view showing exine ornamentation. **C.** *M. roxburghii*. Equatorial view showing colporate aperture. **D–I,** SEM and LM photomicrographs of leaf epidermis of two taxa of *Mussaenda*. **D.** *M. lancipetala*. A stoma. **E.** *M. roxburghii*. A stoma. **F.** LM micrographs of leaf epidermis of *M. lancipetala*. Abaxial surface with stomata. **G.** *M. roxburghii*. Hair on abaxial surface showing ornamentation. **H.** *M. lancipetala*. Hair on abaxial surface showing ornamentation. **I.** *M. lancipetala*. Adaxial cuticular membrane. Scale bars: A, E=5  $\mu$ m; B, C=1  $\mu$ m; D, G, H=10  $\mu$ m; F=50  $\mu$ m; I=2  $\mu$ m.

The veins and adaxial side of leaves of *M. lancipetala* are glabrous, while on *M. roxburghii*, there are sparse, short and straight pubescences. Although on the veins and abaxial side of leaves of both *M. lancipetala* and *M. roxburghii* there are sparse, short and

straight pubescences, the ornamentation of the hair surface is different: the former is short striate (Fig. 1: H) while the latter is papillate striate (Fig. 1: G). *M. lancipetala* has much bigger and denser stomata than *M. roxburghii* on the leaves.

**Table 3** Leaf epidermal characters of *Mussaenda lancipetala* and *M. roxburghii*

| Taxa                  | Upper epidermis    |                                    |                                     | Lower epidermis                         |                                      |                    |  |
|-----------------------|--------------------|------------------------------------|-------------------------------------|---|--------------------------------------|--------------------|--|
|                       | Cuticular membrane | Trichome                           | Stomatal size                       | Stomatal density (No./mm <sup>2</sup> ) | Inner margin of outer stomatal ledge | Cuticular membrane | Trichome                                     |
| <i>M. lancipetala</i> | crass-scaly        | absent                             | 24.9 (18.9–28.6) × 14.8 (13.3–15.3) | 555                                     | smooth                               | smooth             | sparse, with striate ornamentation           |
| <i>M. roxburghii</i>  | undulate-striate   | sparse, with striate ornamentation | 20.0 (16.2–26.2) × 14.3 (11.5–14.8) | 273                                     | smooth                               | smooth             | sparse, with papillate striate ornamentation |

### 2.3 LM observation

Under LM, the epidermal cell of these two species is irregular polygonal and the pattern of anticlinal walls are straight. The stomatal apparatuses of the investigated species are nearly identical, belonging to the paracytic type, occurring only on the lower epidermis (Fig. 1: F).

According to our observations based on morphological analysis, LM and SEM observation, there are very obvious differences among these investigated species, and the specific status of *M. lancipetala* is thus warranted.

## 3 Taxonomic treatment

***Mussaenda lancipetala*** X. F. Deng & D. X. Zhang, sp. nov. Fig. 2.

狭瓣玉叶金花

Species *M. roxburghii* Hook. f. affinis, sed foliis supra subglabris; corollae tubis 2.5–3.0 cm longis, lobis 5 angustioribus ovato-lanceolatis, 7 mm longis differt.

Shrubs 2–4 m high, young branches angulate, with sparse, grayish white pubescent, gradually glabrescent, terete when old. Leaves opposite, chartaceous, oblong or elliptic, 15–24×6–8 cm, margin entire, apex acuminate, base cuneate, glabrous adaxially, sparse white pubescent abaxially; midrib and veins with white pubescent sparse adaxially, dense abaxially; secondary veins 11–13 pairs, arc ascending, prominent beneath; petiole 1.0–3.0 cm long, with sparse white pubescent; stipule triangular-lanceolate, dense pallid villose in the middle, 8 mm long, bifid, lobe lanceolate. Inflorescences pleiochasium, terminal, peduncle ca. 3.0 cm long, flowers dense, pedicel 1 mm long; bract trifid or bifid, the middle longest lobe up to 1 cm, bracteole lanceolate, 4–7 mm long; densely white pubescent; hermaphrodite, reverse herkogamous; calyx tube 3×2 mm, elliptic-turbinate, sparse grayish white pubescent, calyx lobes 5, lanceolate, 1.0–1.2 cm long, 1 mm wide at the base, densely grayish white pubescent outside, semaphylls white, glabrous, ovoid,

6–7.5×4–5 cm, apex acuminate, base gradually angustate, longitudinal veins 5, dense pubescent, stipe 2.5–3 cm long, densely pubescent. Corolla tube 2.5–3.0 cm long, ampliate from the middle, narrow part 1 mm in diameter, ampliate part 2.5 mm in diameter, with sparse pallid farinose hairs outside, inside densely yellow clavillose villous at amplification, thinly yellow pubescent below, corolla lobes 7–8 mm long, ovate-lanceolate, tip caudate, with sparse farinose hairs outside, densely yellow-papillate inside. Stamens 5, inserted in middle of the corolla, filament glabrous, 5 mm long, anther linear, 5 mm long. Style glabrous, 1.2–1.5 cm long, stigma bifid-lamella equal, glabrous, lamella oblong, 3 mm long; long-styled flower not observed. Immature berry elliptic, 8×4 mm. Flowering from May to July, fruiting from June to November.

**China. Yunnan** (云南): Xishuangbanna (西双版纳), Mengla (勐腊), abundant in forest, alt. 790 m, 2005-06-09, X. F. Deng & H. Ren (邓小芳, 任辉) 410 (holotype, IBSC; isotype, IBSC).

#### Additional specimens examined:

**China. Yunnan** (云南): G. D. Tao (陶国达) 7070 (KUN); Cangyuan (沧源), G. D. Tao & H. W. Li (陶国达, 李锡文) 39895, 39913, 40050 (KUN); Hekou (河口), Hekou Exped. (河口队) 57, H. Li (李恒) 149 (KUN), W. S. Liu (刘伟心) 188, 768 (KUN); Jiangcheng (江城), Y. Y. Qian (钱义咏) s.n. (Herbarium No. 110058) (HITBC); Jinping (金平), Lüchun Exped. (绿春队) 1134 (KUN); Lüchun (绿春), T. L. Ming et al. (闵天禄等) 124 (KUN), Y. M. Shui & W. H. Chen (税玉民, 陈文红) 13356, 13369, 13396 (KUN), D. D. Tao (陶德定) 489 (KUN), H. Wang (王洪) 8557, 8558, 8559, 8560 (HITBC, IBSC); Mengla (勐腊), Anonymous 59-1148 (KUN), X. F. Deng & L. Gu (邓小芳, 顾垒) 503 (IBSC), X. F. Deng & H. Ren (邓小芳, 任辉) 404, 456, 457, 459, 461, 462 (IBSC), H. Koyama et al. (小山博滋等) 313 (KUN), G. D. Tao (陶国达) 13701, 16694 (KUN), C. Y. Wu (吴征镒) 46 (KUN); Mengzi (蒙自), S. T. Li (李生堂) 173 (KUN); Ruili (瑞丽), 1986 Exped. (86年考察队) 1189 (KUN); Shuangjiang (双江), G. S. Sin (辛景三) 1060 (KUN); Yingjiang (盈江), 1986 Exped. (86年考察队) 1085, 1112 (KUN), Q. Lin (林勤) 770799 (KUN), G. D. Tao (陶国达) 13148, 13529 (KUN); Yuanyang (元阳), Lüchun Exped. (绿春队) 1205 (KUN).



**Fig. 2.** *Mussaenda lancipetala*. A, flowering branch; B, flower; C, calyx and pistil; D, stigma; E, corolla opened showing stamens; F, anther. Drawn by Y. X. Liu from X. F. Deng & H. Ren 410 (holotype, IBSC).

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## Appendix Vouchers cited in this study

| Taxon                        | Locality  | Voucher                                  |
|------------------------------|---|--|
| <i>Mussaenda lancipetala</i> | Mengla, Xishuangbanna, Yunnan, China (中国云南西双版纳勐腊) | X. F. Deng & H. Ren (邓小芳, 任辉) 410 (IBSC) |
| <i>M. roxburghii</i>         | Sikkim, Gangtok (Orchid Sanctuary)                | H. Harn et al. 69117 (KUN)               |

# 中国玉叶金花属(茜草科)植物一新种

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**摘要** 报道了在云南发现的玉叶金花属 *Mussaenda* 一新种——狭瓣玉叶金花 *M. lancipetala* X. F. Deng & D. X. Zhang。狭瓣玉叶金花的性系统为柱头缩入式雌雄异位；花冠裂片卵状披针形且具有细长的长尖头，花冠管外被有粉末状的毛被，可以很容易与玉叶金花属其他种类相区别。

**关键词** 玉叶金花属；狭瓣玉叶金花；新种；花粉形态学；性系统；分类学