Miconia burkeae (Melastomataceae), a new dioecious tree from the montane forests of the Peruvian Andes

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Abstract: We describe **Miconia burkeae**, a new dioecious species of *Miconia* section *Cremanium* from the Peruvian Andes. The new species shares the presence of nearly sessile and glabrescent leaves with two other Andean species in section *Cremanium*, *M. lilacina* and *M. opacifolia*, but differs in leaf shape and texture, as well as other characters. The occurrence of dioecy in *Miconia* is discussed.

Keywords: Cremanium, dioecy.

Resumen: Describimos **Miconia burkeae**, una nueva especie dioca de *Miconia* sección *Cremanium* de los Andes Peruanos. La nueva especie comparte la presencia de hojas casi sésiles y glabrescentes con otras dos especies de sección *Cremanium*, *M. lilacina* y *M. opacifoli*, pero difiere en la textura y forma de las hojas entre otros caracteres. Se discute la presencia de diocismo en *Miconia.*

Palabras clave: Cremanium, diocismo.

The tribe Miconieae (Melastomataceae) contains over 1900 species spread throughout the Neotropics and has had a dynamic history of taxonomic circumscription. Traditionally, the tribe was split into 18 separate genera, but these circumscriptions were poorly defined, often with homoplasious or misinterpreted characters. Phylogenetic work based on both morphology and DNA sequence data revealed extensive paraphyly among genera (Michelangeli et al., 2004; Goldenberg et al., 2008; Gavrutenko et al., 2020), leading to a merger of all species from the tribe into a single genus, *Miconia* (Michelangeli et al., 2016, 2019, 2022). Despite this, the sectional classification based primarily on stamen morphology (Cogniaux, 1891; Renner, 1993; Goldenberg et al., 2013) remains taxonomically useful in categorizing species. The largest sectional grouping in the genus, *Miconia* section *Cremanium* (224 species), is defined by the presence of subcuneiform to obovate anthers opening by 1, 2, or 4 broad apical pores. Most species of section *Cremanium* are interspersed within the broader *Miconia III* clade, consisting of mainly Andean members of sections *Chaenopleura* and *Amblyahrrena* (Goldenberg et al., 2008), totaling c. 500 species. The species of section *Cremanium* are shrubs and trees found in cool tropical montane habitats (1000–2800 m), but several species also reside in lowlands or high-elevation sub-alpine environments from Mesoamerica and the Caribbean, but with a center of diversity in the tropical Andes. After Colombia, Peru has second highest diversity of section *Cremanium* (at least 61 species), many of which are endemics with restricted ranges (Goldenberg et al. 2013).

The tropical Andes hold extraordinary angiosperm diversity from which new species of *Miconia* continue to be described. In the last decade, several new species of *Miconia* have been described from Andean cloud-forests from Venezuela to Bolivia, highlighting the need for continued collections and investigations of herbarium specimens from these habitats (e.g., Michelangeli & Meier, 2013; Cardenas et al.,

Brittonia, 75(4):411–418 2023,
10.1007/s12228-023-09759-7

Published Online: 31 August 2023

2014; Gamba et al., 2014; Burke et al., 2017; Michelangeli & Goldenberg, 2018; Posada-Herrera & Mendoza-Cifuentes, 2016; Mendoza-Cifuentes et al.. 2019). Some of these species have dimorphic flowers in different individuals, strongly suggesting a dioecious reproductive system. Here, we describe a new dioecious species of *Miconia* section *Cremanium* from the Peruvian Andes that is morphologically similar to *Miconia lilacina* Triana and *Miconia opacifolia* J.F.Macbride, both also of section *Cremanium*.

Materials and methods

Herbarium specimens of the new species and *M. lilacina* were examined from NY. Digital specimens of the new species were examined from MO and CUZ and digital specimens of *M. lilacina* were examined from MO, K, and LPB. Measurements of vegetative characters were made using digital calipers, measured to the nearest 0.1 mm, while floral characteristics were measured using both rehydrated flowers and scaled scientific illustrations using ImageJ. Seeds were obtained from dried specimens, mounted on an aluminum stub, sputter-coated with gold–palladium for six minutes in a Denton Vacuum Desk V, and then photographed using a Hitachi SU3500 SEM.

Taxonomic treatment

Miconia burkeae J. C. Angulo & Michelang., **sp. nov.**—Type: Peru. Prov. La Convención, Huayapata, San Cristobal, 12°58'51"S 72°32'58"W, 2120 m, disturbed cloud forest, 6 May 2006 (♀, fl), *H. van der Werff, L. Valenzuela, E. Suclli, J. Farfan 21402* (holotype: NY barcode 3676841 [!]; isotypes: CUZ [image!], MO [n.v.]. (Figs. 1, 2 and 3).

Diagnosis.—*Miconia burkeae* differs from *Miconia lilacina* by its sulcate-quadrangular stems with nodal appendages (vs. terete stems lacking appendages), membranaceous oblong-elliptical leaves (vs. coriaceous lanceolate leaves), one pair of secondary veins (vs. two pairs), and auriculate leaf bases (vs. cordate). *Miconia opacifolia* differs by its lanceolate abaxially scabrous leaves, undulate-denticulate margins (vs. inconspicuously serrulate), bi-pored anthers, cordate leaf bases, and lack of nodal appendages on the stems.

Trees, 5–12 m tall. Stems sulcate-quadrangular, glabrous, with scattered white lenticels. Nodes with two pseudostipules at right angles to leaf attachment, 1.5–2.5 mm wide at the base, 1–2 mm long, margins erose. Leaves isophyllous; sessile; blade 10.3–24 cm × 1.8–4.6 cm, elliptical to oblong-elliptical, membranaceous, base auriculate, sinus extending laterally 2.2–6.9 mm, apex acuminate, margin inconspicuously serrulate, teeth 0.2–0.3 mm, revolute when dry; one pair of secondary veins diverging from midrib 3.8–7.8 mm above the leaf base, one pair of submarginal veins, tertiary veins percurrent arched at 80–90 degree angle from midrib and secondary vein pair, quaternary veins reticulate, veins raised on abaxial surface and impressed on adaxial surface; abaxial surface light green, glabrous or with black to brown glands on the leaf surface and inconspicuously on the veins, < 0.1 mm long; adaxial surface green, glabrous. Inflorescence a terminal branched panicle, 6–14.8 cm long; peduncle sulcate-quadrangular to bluntly alate when dry, glabrous with scattered white lenticels; bracteoles not present or early caducous. Flowers 5-merous and unisexual with pedicel 0.07–0.14 mm long, anthopodia 0.3–0.8 mm long. Hypanthium (at anthesis) 0.75–1.4 mm long to the torus, urceolate, 0.8–1.3 mm wide at the torus, glabrous or with scattered black glands < 0.1 mm, terete, with longitudinal ridges when dry. Calyx open in bud, the tube 0.1–0.2 mm long or obsolete, lobes 0.2–0.24 × 0.35 mm, bluntly rounded-triangular, glabrous, margin erose, exterior teeth 5, < 0.1 mm long, triangular, subequal, equal or slightly projecting above the calyx lobes. Petals 0.6–0.7 mm × 0.4–0.5 mm, spreading, glabrous, white at anthesis (drying light yellow), obovate, attenuate base, the apex round, sometimes symmetrically notched at apex, the margin erose. Staminate flowers diplostemonous; stamens isomorphic, 10, exserted and actinomorphic, geniculate at anthesis; filaments 0.5–0.6 mm long from base to inflection, 0.3–0.4 mm long from inflection to apex, 0.8–0.9 mm long in total, glabrous, ventrally inclined anthers with 4-locular thecae 0.3–0.4 mm × 0.6–0.7 mm, oblong to obovate, bilobed ventral appendages, 1 dorsal appendage, opening by one apical pore, glabrous; ovary 3-locular, inferior, ovules present but underdeveloped,

Fig. 1. *Miconia burkeae*. **A.** Habit. **B.** Detail of inflorescence. **C.** Protogynous pistillate flower. **D.** Pistillate flower at anthesis, with exerted stamens. **E–F.** Longitudinal section of pistillate flower at anthesis. **G.** Petal. **H.** Stamens of pistillate flower, from L to R: lateral, ventral, and dorsal view. **I.** Protogynous staminate flower. **J.** Staminate flower at anthesis, stamens exserted. **K.** Longitudinal section of staminate flower. **L.** Stamens of staminate flower, dorsal and ventral view. (A-H drawn from *van der Werff 21,402*, NY; I-L drawn from *Suclli 970*, NY).

smaller, and fewer in number compared to pistillate flowers, apex not protruding; style 0.9–1.3 mm long, straight, glabrous, drying dark brown to black, stigma capitate, 0.2–0.4 mm wide. Pistillate flowers diplostemonous; stamens isomorphic, exserted and actinomorphic at anthesis; filaments 0.1–0.4 mm long from base to bend, < 0.1–0.3 mm long from bend to apex, 0.2–0.7 mm long in total, glabrous, collapsed anthers with 4-locular thecae 0.1–0.2 mm × 0.4–0.5 mm, oblong and obovate, bilobed ventral appendages, 1 dorsal appendage, opening by one apical pore;

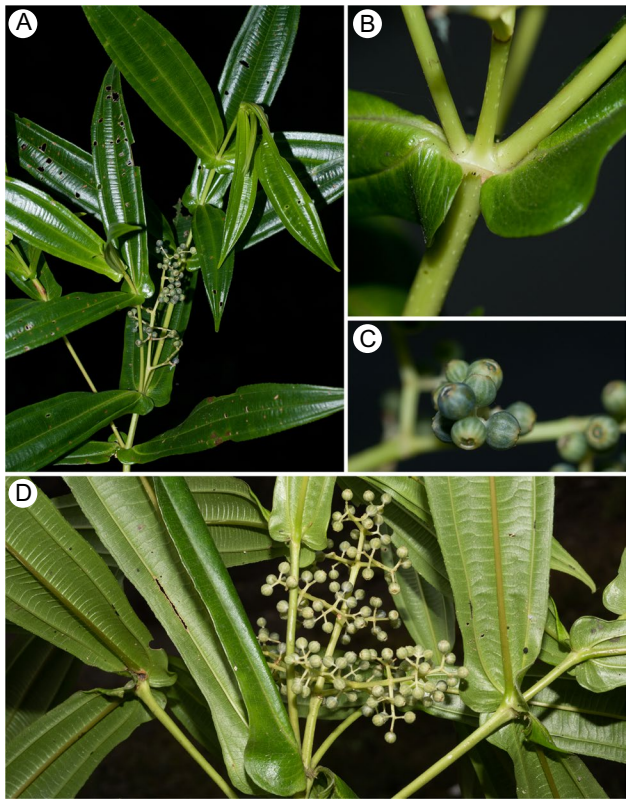

Fig. 2. **A.** General habit. **B.** Auriculate leaf base and nodal appendages. **C.** Fruit. **D.** Habit showing adaxial leaf surface, veins, and fruiting inflorescence. (A-C from *Michelangeli 1944*, NY and D from *Angulo 16*, NY).

ovary 3-locular, inferior, top portion projecting upward, obtusely conical, slightly convex, with ridges, ovules present; style 1.8–3.7 mm long, straight, glabrous, drying dark brown to black, stigma peltate, 0.7–0.8 mm wide. Berry 1.1–1.9 mm × 1.2–1.7 mm, globose, glabrous, green flushed with white when young with longitudinal pale white/yellow stripes in vivo and dark

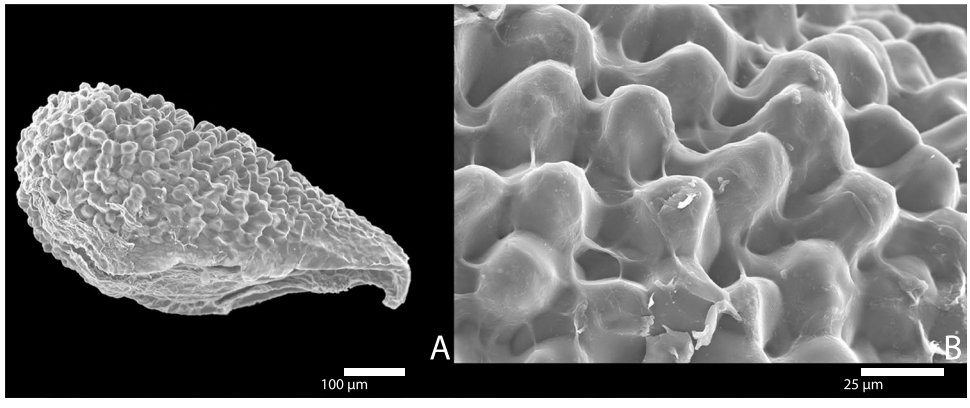

Fig. 3. Seeds of *M. burkeae*. **A.** Lateral view. **B.** Detail of testa. (A and B from *Calatayud 4572*, NY).

brown to black with longitudinal ridges when dry. Seeds numerous. 0.55–0.68 mm × 0.24–0.28 mm on dorsal view and 0.24–0.29 mm wide on lateral view; lateral and antiraphal sides ovoid, the highest point towards the chalazal side; raphal side ovate, ca 70% the length of the seed, ventrally expanded toward the micropylar side; cells arranged in an irregular pattern; the testa cells on the antiraphal and lateral sides tuberculate, anticlinal walls deeply concave and channeled, the periclinal walls convex.

Distribution.—Humid montane forest, 1500–2800 m, in the Department of Cusco, provinces of La Convención, Calca, and Paucartambo (Fig. 4).

Phenology.—Flowering from April to June and collected in fruit from April to November.

Etymology.—The epithet is an homage to Dr. Janelle Burke, who has contributed substantial work and time to the advancement of understanding Andean *Miconia*, particularly the dioecious ones.

***Additional specimens examined.*—PERU. Cusco:** Prov. La Convención, Santa Ana, Tunquimayo, 13°03'S 72°56'W, 2800 m, 13 Jun 2003 (♂, fl), *Suclli* et al. *970* (NY, CUZ); Echarati, Campamento III alrederores, 12°58′51"S 72°32′58"W, 2120 m, 5 Nov 2004 (♀, fl, fr), *Salinas* et al. *7270* (F); Santa Ana, Poromate, 12°55'S 72°37'W, 2118 m, 16 Jun 2003 (♂, fl), *Calatayud* et al. *1479* (NY, CUZ); Quellouno, Abra de Yavero, 56°28′43"S 72°29′00"W, 2301 m, 22 Sep 2007 (fr), *Calatayud* et al. *4572* (NY, CUZ);

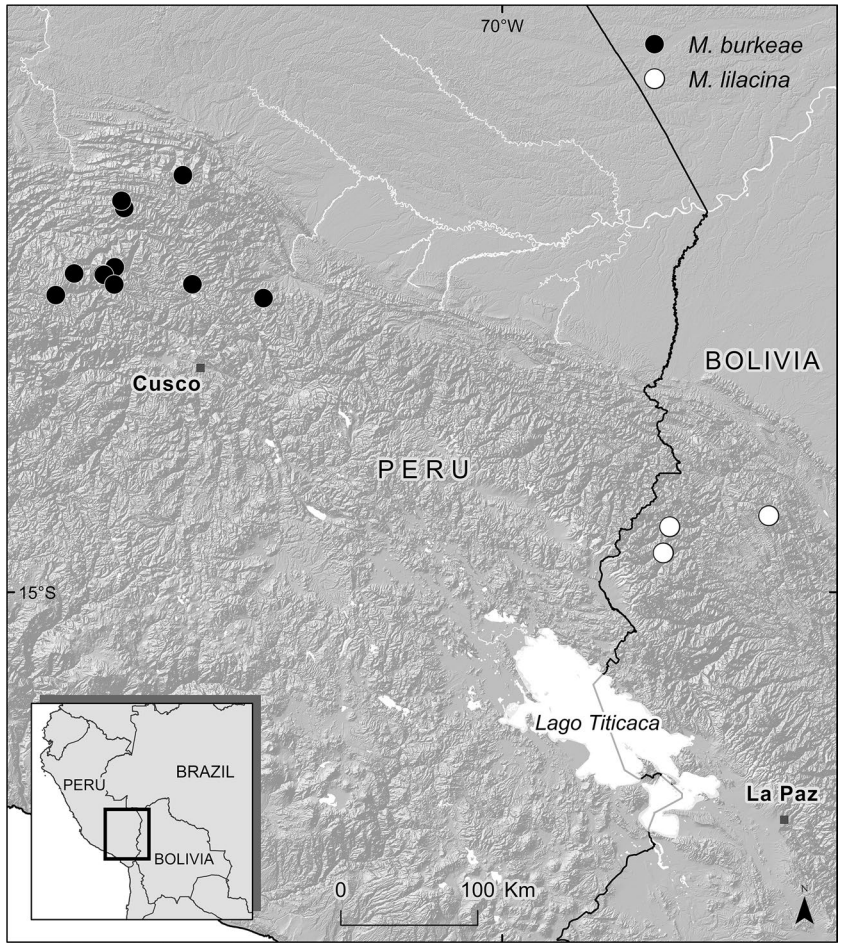

FIG. 4. Distribution of *M. burkeae* (solid circles) and *M. lilacina* (open circles).

Huayopata, Balconpata, 12°52"01'S 72°32′46"W, 2200 m, 21 April 2004 (fr), *Calatayud* et al. *2339* (NY); Maranure, Mesa Pelado, 12°54′46"S 72°37′24"W, 2500 m, 5 May 2006 (bud), *van der Werff* et al. *21,369* (NY, CUZ); Santa Ana, Tunquimayo, Parque alta, rumbo a Puncuyoc, 12°54′31"S 72°48′45"W, 2400 m, 21 Nov 2005 (fr) *Suclli* et al. *2841* (NY, CUZ). Prov. Paucartambo, Challabamba, Carretera Paucartambo-Pillcopata, 13°4′12.6"S 71°34′6.4"W, 1567 m, 15 Jun 2012 (fr), *Michelangeli* et al. *1944* (NY); Kosñipata, carretera Paucartambo-Pillcopata, 13°9′27.9"S 71°35′36.43"W, 2341 m, 18 Jun 2022 (fr), *Angulo* et al. *16* (NY, MO, USM). Prov. Calca, Yanatile, Estrella, 12°25′50"S 72°30′05"W, 1567 m, 21 Oct 2005 (fr), *Suclli* et al. *2681* (NY); Yanatile, 12°58;46"S 72°02′09"W, 2400–2500 m, 7 Jun 2007 (bud), *Huamantupa 9534* (NY, CUZ).

Discussion

Based on its ventrally inclined oblong-obovate anthers with a single wide apical pore, *M. burkeae* would be assigned to section *Cremanium* under Cogniaux's (1891) system. *Miconia burkeae* is distinguished by its sulcate-quandrangular stems with nodal appendages, sessile membranaceous 5-plinerved leaves with an auriculate base, 5-merous unisexual flowers, 4-locular thecae, 3-locular ovary, and peltate stigma on pistillate plants (Fig. 1). The unisexual flowers of *M. burkeae* retain vestigial organs (i.e., reduced style and stigma in staminate plants and relatively smaller stamens with collapsed anthers absent of pollen in pistillate plants), consistent with some other dioecious species of *Miconia* section *Cremanium*.

Miconia burkeae is most similar to *Miconia lilacina* (Triana, 1871:129) and *Miconia opacifolia* (Macbride, 1929:184), both species of section *Cremanium*. *Miconia burkeae* and *M. lilacina* both share sessile leaves, acuminate leaf tips, and a terminally branched panicle, but differ in leaf shape, venation, and flower size. In the flowers of *Miconia lilacina*, the hypanthium (at anthesis) is 1.35–1.7 mm long to the torus, and 0.8–1.3 mm wide at the torus. Similarly, *Miconia burkeae* and *M. opacifolia* share sessile membranaceous leaves, acuminate leaf tips, and terminal branched panicles, but *Miconia opacifolia* differs by its lanceolate abaxially scabrous leaves, undulate-denticulate margins (vs. inconspicuously serrulate), bi-pored anthers, cordate leaf bases, and lacking nodal appendages on stems. The reproductive system of both *M. lilacina* and *M. opacifolia* is likely dioecious, as indicated by visual observation of possible pistillate flowers on the type specimen of *M. lilacina* and staminate flowers on the type specimen of *M. opacifolia*. However, this cannot be confirmed until more flowering specimens, including representatives of the opposite sex, are collected. All three species are restricted to Andean cloud forests > 1500 m. *Miconia burkeae* and *M. opacifolia* are both known only from Peru, but their distributions do not overalap, since *M. opacifolia* is found much farther to the north in Huanuco Region. *Miconia lilacina* is known only from the Yungas of Bolivia.

Miconia section *Cremanium* contains nearly all the documented occurrences of non-hermaphroditic sexual reproductive systems in Melastomataceae aside from reports of dioecy in *M. stenophylla* (section *Chaenopleura*; Almeda & Dorr, 2006) and *M. mazatecana* (section *Amblyarrhena*; de Santiago Gómez, 2010), and gynodioecy in *M. galeiformis* (section *Chaenopleura*; Burke & Michelangeli, 2013). A few species in the genera *Astronia* and *Lijndenia* have an androdioecious system (Bremer, 1982; Stone, 2017; Mancera, 2017). A preliminary list by Almeda and Dorr (2006) identified 37 dioecious species within *Miconia*. Later, new species descriptions have documented seven more (de Santiago Gómez, 2010, 2012; Burke & Michelangeli, 2013, 2018; de Santiago Gómez & Michelangeli, 2016), bringing the current total to 45 dioecious species out of the total ~ 1900 species of *Miconia*. Dioecious members of *Miconia* section *Cremanium* are largely geographically disjunct: 32 are restricted to the Andes, two are endemic to Mexico, one is endemic to the Caribbean, and the remaining seven are widespread among the Neotropics. The species described here, along with others such as *M. neei* and *M. dimorphotheca*, retain vestigial styles and ovaries that are reduced in size compared to pistillate counterparts (Burke & Michelangeli, 2013, 2018), while species such as *M. paucartembensis* and *M. portogallensis* have lost almost all traces of a gynoecium in staminate plants (de Santiago Gómez & Michelangeli, 2016; Burke & Michelangeli, 2018). Dioecy has evolved independently in nearly half of angiosperm plant families and offers several advantages such as outcrossing and sex-specific specialization of reproductive functions (Darwin, 1877; Renner, 2014). Despite this, the system is rare in flowering plants (6% species, 7% genera), with a large portion of species concentrated in entirely dioecious speciose

clades and the others distributed among families and genera with both dioecious and non-dioecious species (Renner, 2014). Whether dioecy is an "evolutionary dead-end" remains an ongoing debate (e.g., Heilbuth, 2000; Käfer et al., 2014, 2017), and further work is needed using lineages with diverse environmental and evolutionary histories, such as *Miconia* section *Cremanium*, to understand what makes some dioecious lineages successful and others not.

Acknowledgements

We thank Bobbi Angell for providing the line drawings and Liz Gjieli (NYBG GIS Lab) for the distribution map. This research was partially funded by the National Science Foundation NSF-DEB-0818399, DEB-2001357, DEB-2002270) and the Maxwell-Hanrahan Foundation. Field work in Peru was carried out under authorization by the Servicio Nacional Forestal y de Fauna Silvestre (SERFOR) (0637-2011-AG-DGFFS-DGEFF; RDG N° 091-2020-MINAGRI-SERFOR-DGGSPFFS; RD-000166-2021-DGGSPFFS-DGSPF). We thank Janelle Burke, William Farfan, Diego Paredes, Carrie Tribble, Léo-Paul Dagallier, Malu Ore Rengifo, and Jose Carlos Enriquez Quizpe for assistance in the field and Sebastian Riva and Asuncion Cano for logistical assistance in Peru. Abel Monteagudo and Carmen Ulloa Ulloa provided images of specimens from the CUZ and MO herbaria, respectively.

Declarations

The authors have no competing interests to declare.

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