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# ANDERSONIELLA: A NEW GENUS OF NEOTROPICAL MALPIGHIACEAE

CHARLES C. DAVIS,<sup>1,2</sup> LUCAS C. MARINHO,<sup>1,3</sup> AND ANDRÉ M. AMORIM<sup>4</sup>

**Abstract.** Morphological and molecular investigations of the galphimoid clade in the angiosperm family Malpighiaceae revealed that three species previously assigned to *Lophanthera* are more closely allied with *Spachea*. These species are transferred to the newly described genus *Andersoniella* and include *A. hammelii*, *A. marcelae*, and *A. spruceana*, the type species of the genus.

**Keywords:** galphimoid clade, *Lophanthera*, Malpighiales, *Spachea*, taxonomy

**Resumo.** Investigações moleculares e morfológicas no clado galphimioide da família Malpighiaceae revelaram que três espécies previamente associadas ao gênero *Lophanthera* são mais intimamente relacionadas ao gênero *Spachea*. Essas espécies são transferidas para o novo gênero *Andersoniella* e incluem *A. hammelii*, *A. marcelae*, and *A. spruceana*, esta última, a espécie tipo do gênero.

Malpighiaceae are an angiosperm family of trees, shrubs, and vines in tropical and subtropical forests and savannas (Anderson, 2004). They comprise approximately 1,300 species in 77 genera. The majority of their genera and species are found in the New World and typically possess unicellular, two-branched hairs, simple opposite leaves, bilaterally symmetrical flowers with two large oil glands on the abaxial surface of four or all five sepals, five clawed petals, 10 stamens, and a tricarpellate gynoecium with one ovule per locule (Anderson, 2004). The relative floral uniformity in the group (Anderson, 1979; Davis et al., 2014) led earlier researchers to define genera and tribes principally on the basis of fruit morphology (e.g., Niedenzu, 1928; Davis et al., 2001). Numerous phylogenetic investigations over the past two decades, however, have highlighted the problematic nature of this single-character taxonomy (Cameron et al., 2001; Davis et al., 2001, 2004; Davis, 2002; Davis and Anderson, 2010).

These phylogenetic investigations have largely supported, and inspired, extensive taxonomic revisions in the family, especially the recircumscription and description of several genera (Anderson and Davis, 2005a,b, 2006, 2007, 2012, 2013; Anderson, 2011). They also revealed uncertainties about the status of other genera that merit further attention. These uncertainties relate to generic circumscription on morphological grounds, combined with a lack of phylogenetic support, insufficient taxon sampling, or both. In particular, previous efforts revealed the non-monophyly of several genera that still lack proper or more

comprehensive taxonomic treatment, including *Janusia* A. Juss. (and close relatives *Aspicarpa* Rich. and *Gaudichaudia* Kunth), *Lophanthera* A. Juss., *Mascagnia* (Bertero ex DC.) Colla, *Sphedamnocarpus* Planch. ex Benth & Hook. f., and *Tetrapterys* Cav. (Davis and Anderson, 2010). A major goal of our efforts for nearly two decades has been to improve the resolution of the Malpighiaceae phylogeny by comprehensively sequencing representatives of all genera plus a much broader species sampling of the larger and more problematic genera (Davis et al., 2001; Davis and Anderson, 2010). Resolving these uncertainties and evaluating these inferred phylogenies in light of morphology continue to be a major focus of our research and the basis for this taxonomic update.

Here, we focus our efforts on taxonomic delimitation within the galphimoid clade sensu Davis et al. (2001) which comprises four genera whose species are widely distributed across the neotropics: *Galphimia* Cav., *Lophanthera*, *Spachea* A. Juss., and *Verrucularia* A. Juss. In particular, Davis and Anderson (2010) previously identified the genus *Lophanthera* as non-monophyletic using a combination of plastid, nuclear, and morphological data, but opted not to make any formal taxonomic or nomenclatural changes at that time. Ongoing efforts to apply plastid genome data to these questions have reinforced published findings that *Lophanthera* should be recircumscribed. Along these lines, preliminary results combining plastid *matK*, *ndhF*, and *rbcL* data with nuclear ribosomal ITS data (Fig. 1; C. Davis et al., unpubl.) identify a well-supported core *Lophanthera* clade

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<sup>1</sup> Department of Organismic and Evolutionary Biology, Harvard University Herbaria, Harvard University, 22 Divinity Avenue, Cambridge, Massachusetts 02138, U.S.A.

<sup>2</sup> Corresponding author: [cdavis@oeb.harvard.edu](mailto:cdavis@oeb.harvard.edu)

<sup>3</sup> Departamento de Biologia, Universidade Federal do Maranhão, Avenida dos Portugueses 1966, Bacanga, 65080-805, São Luís, Maranhão, Brazil; [lc.marinho@ufma.br](mailto:lc.marinho@ufma.br)

<sup>4</sup> Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz, Km 16 Rodovia Ilhéus-Itabuna, 45662-900, Ilhéus, Bahia, Brazil; [amorim.uesc@gmail.com](mailto:amorim.uesc@gmail.com)

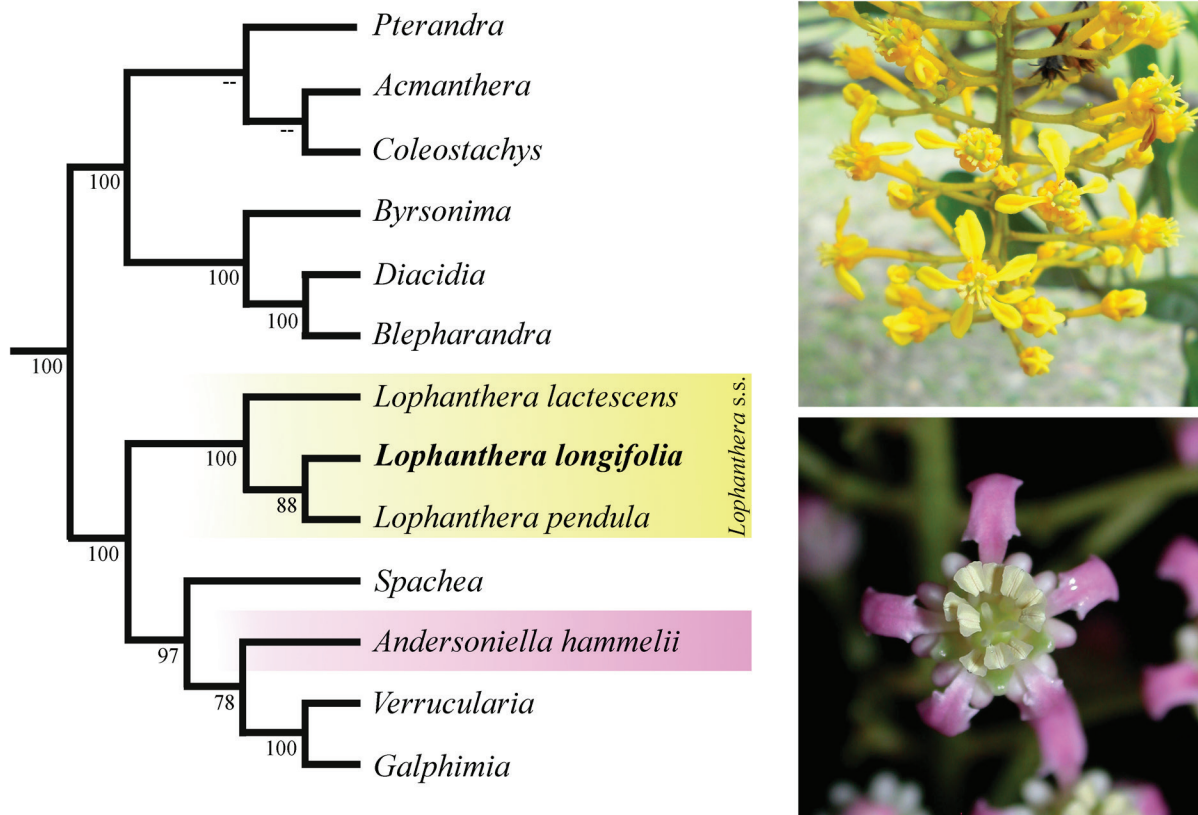


FIGURE 1. Phylogenetic tree showing the placement of *Andersoniella* and *Lophanthera* s. str. in the galphimioid clade of Malpighiaceae. Name in boldface indicates the type species of the genus *Lophanthera*. Bootstrap values are given above branches. The majority rule consensus tree shown here is summarized from a larger phylogenetic analysis of Malpighiaceae using combined plastid *matK*, *ndhF*, and *rbcL*, and nuclear ITS; all genes were sequenced for all taxa (C. Davis et al., unpubl.). Voucher for *Andersoniella hammelii* sequenced: *Schatz 1034*, MICH.

(100% BP; hereafter *Lophanthera* sensu stricto [s. str.]), which includes the type species of the genus [*L. longifolia* (Kunth) Griseb.]. In contrast, the Mesoamerican species *Lophanthera hammelii* W. R. Anderson is more closely related to the genera *Galphimia*, *Verrucularia*, and *Spachea*. In light of these investigations, combined with new insights into the morphology of these groups, we newly describe this *Lophanthera* segregate as the genus *Andersoniella*.

**Andersoniella** C. Davis & Amorim, *gen. nov.* TYPE: *Andersoniella spruceana* (Nied.) C. Davis & Amorim ( $\equiv$  *Lophanthera spruceana* Nied.).

Species of *Andersoniella* differ from species of *Lophanthera* s. str. by their petal color (pink or white to pink vs. vivid yellow), dorsal surface of petal (rounded, smooth, or if carinate only slightly in the claw vs. keeled or carinate), cocci dorsum (smoothly rounded vs. keeled), and ventral areole of cocci (broad and flat vs. very narrow); and from species of *Spachea* in their leaves with persistent glands found only on the abaxial surface (vs. glands on both surfaces), bisexual flowers (vs. functionally unisexual flowers), anthers winged (vs. unwinged), and stigma minute and apical (vs. stigma large and reniform or bilobed).

Small- to medium-sized shrubs or trees, stems densely or loosely sericeous to glabrate, hairs copper-colored to reddish when present, lenticels present or not. Lamina abaxially  $\pm$  persistently sericeous with hairs initially dense on midrib, bearing 2–3(–5) impressed glands restricted to abaxial surface, glands borne singly along midrib, or in pairs on opposite side of midrib, rarely several small glands borne in a row along each side, lamina adaxially glabrate or sparsely sericeous on midrib; petiole densely and  $\pm$  persistently sericeous to glabrate, eglandular (but sometimes glands on decurrent base of lamina seeming to be on apex of petiole); stipules intrapetiolar, narrowly or distinctly triangular, abaxially sericeous, adaxially sericeous proximally to glabrescent, completely connate or free at apex. Inflorescence terminal, rarely axillary, pendent, rarely erect, with a pair of sterile and much-reduced leaves at base or not, thyrses composed of cincinni of 1–3(–4–5) bisexual flowers, axis loosely to densely sericeous like stems; bracts triangular, abaxially sericeous, eglandular; primary and secondary peduncles loosely sericeous, smaller or bigger than pedicels, bearing 2 bracteoles borne slightly below its apex; bracteoles like bract but smaller, eglandular or bearing 1(–2) gland(s), gland sessile or bearing a spatulate apical (peltate?) extension terminating in a discoid gland.



Pedicel loosely sericeous. Sepals bearing glands or not, slightly revolute in anthesis, rarely sericeous or glabrescent on both sides but occasionally bearing a few hairs along margin, lateral sepal eglandular, biglandular or 2 adjacent sepals bearing a single gland each, glands white, ellipsoidal, anterior sepal eglandular or biglandular; glands distally free from sepals and slightly reflexed. Petals generally pink (white to pink in *A. spruceana*), glabrous, dorsally rounded, smooth or slightly carinate on claw, nearly entire or minutely denticulate; posterior petal (the “flag”) different from lateral 4 petals, more erect and with a slightly longer and thicker claw. Stamens 10, all fertile, filaments straight, free or slightly connate only at very base, glabrous; anthers  $\pm$  alike, with membranous wings, connective widest at base on apex. Gynoecium glabrous or densely sericeous, bi- or tricarpellate; ovary glabrous to densely sericeous, all locules fertile; styles 2–3, subulate, long, slightly incurved at apex; stigma minute and apical. Fruit schizocarpic, breaking apart into 2 or 3 dry, 1-seeded cocci, cocci separating from a pyramidal base, glabrous to thinly sericeous, narrowly or irregularly ovoid, dorsally smoothly rounded, not or only obscurely carinate at apex; ventral areole broad and flat.

**Eponymy:** this genus honors William R. Anderson (1942–2013), friend and life-long student of Malpighiaceae. For nearly 25 years, Bill served as our closest mentor, guiding us in the beauty and intellectual pursuits of this fascinating plant family. For those who knew him, he set a high bar and shared his time and comments generously and often candidly. He has been an inspiration to us and is deeply missed.

**Distribution:** *Andersoniella* occurs in Central America (Nicaragua and Costa Rica) and southward to northwest South America in the Amazon region (Colombia and the Brazilian state of Amazonas).

Species of *Andersoniella* can be recognized by the presence of 2–3(–5) impressed glands on each side of the midrib or in pairs on the abaxial surface of the lamina (Fig. 2A), thyrsoid inflorescences composed of 1–3(–4–5) flowered cincinni, flowers bisexual (Fig. 2E), sepals distally free from the petals and slightly reflexed (Fig. 3C), pink or white to pink petals, dorsally rounded, smooth or slightly carinate on the claw, posterior petal differentiated from the 4 lateral petals, more erect and with a slightly longer and thicker claw, gynoecium bi- or tricarpellate; coccus dorsally smoothly rounded (Fig. 3D), ventral areole broad and flat.

*Andersoniella* is closely related to *Spachea*, *Galphimia*, and *Verrucularia*. Despite its closer relationships to *Galphimia* and *Verrucularia*, *Andersoniella* shows a greater morphological affinity with *Spachea*. Shared features of members of *Andersoniella* and *Spachea* include glands on the lamina, 1(–2) bracteole(s) bearing a discoid gland, petals white to pink, and a bi- to tricarpellate gynoecium. Species of *Andersoniella* are clearly distinguished from members of *Spachea* in their laminae with glands present only on the abaxial surface (vs. glands on both sides of lamina), bisexual (vs. unisexual) flowers, anthers with wings (vs. anthers unwinged), and stigma minute and apical (vs. stigma large and reniform or bilobed).

*Andersoniella* differs from *Galphimia* and *Verrucularia* in the presence of glands on the abaxial lamina surface, borne singly along midrib, or in pairs on opposite side of the midrib (vs. glands absent in *Verrucularia* or borne on the margin near or at the base, or on the petiole as in *Galphimia*), sepals generally with oil glands (vs. sepals without oil glands in *Galphimia*), petals pink or white to pink (vs. petals yellow to reddish in *Galphimia* and yellow in *Verrucularia*), the posterior petal unequal (vs. the posterior petal hardly differentiated from the lateral 4 petals in *Galphimia* and *Verrucularia*), anthers  $\pm$  alike, with membranous wings (vs. anthers subequal, unwinged in *Galphimia* and alike, or with vesicular outgrowths in *Verrucularia*).

In addition to the characters outlined in our diagnosis, we can include geographical distribution to distinguish species of *Andersoniella* from species of *Lophanthera* s. str. Species of *Lophanthera* s. str. are distributed in South America, east of the Andes, while *Andersoniella* occurs in Central America southward to northwestern South America in the Amazon region (*A. spruceana*). Geographical distribution and habitat are also useful in distinguishing species of *Andersoniella* from species of *Galphimia* and *Verrucularia*. Among species in the galphimoid clade genera, *Galphimia* species are the most widely distributed and most strongly associated with dry habitats. The majority of *Galphimia* species are found in dry forests of Mexico extending south to Central America, with a few species reaching the Amazon basin, Bolivia, and southern/eastern Brazil to northern Argentina (Anderson, 2007). The distribution of *Verrucularia* species is restricted by soil and altitude. *Verrucularia* has only two species disjunctly distributed between the *Chapada Diamantina*, in the Brazilian state of Bahia, and *Serra do Aracá*, in the Brazilian state of Amazonas. Species in this genus inhabit waterways in high rocky outcrops.

***Andersoniella hammelii*** (W.R. Anderson) C. Davis & Amorim, *comb. nov.*

Basionym: *Lophanthera hammelii* W.R. Anderson, *Brittonia* 35(1): 37, f. 1–2. 1983. TYPE: COSTA RICA. Provincia de Heredia: Finca La Selva, OTS Field Station on Río Puerto Viejo just E of its junction with Río Sarapiquí, elev. about 100 m, Rafael’s point on the river, about 300 S  $\times$  1300 E m grid, 1 August 1980 (fl. and fr.), *B. Hammel* 9397 (Holotype: MICH; Isotypes: DUKE, F).

**Distribution:** *Andersoniella hammelii* occurs from Nicaragua south to Costa Rica (Anderson, 1983).

***Andersoniella marcelae*** (W.R. Anderson) C. Davis & Amorim, *comb. nov.*

Basionym: *Lophanthera marcelae* W.R. Anderson, *Acta Bot. Mex.* 109: 37. 2014. TYPE: COLOMBIA. Chocó: Región del (Bajo) Río Baudó, 6 February 1967 (im. fl.), *H. P. Fuchs, L. Zanella & J. H. Torres R.* 21771 (Holotype: COL).

**Distribution:** *Andersoniella marcelae* occurs in the Chocó region of Colombia, on the western side of the Andes (Anderson, 2014).

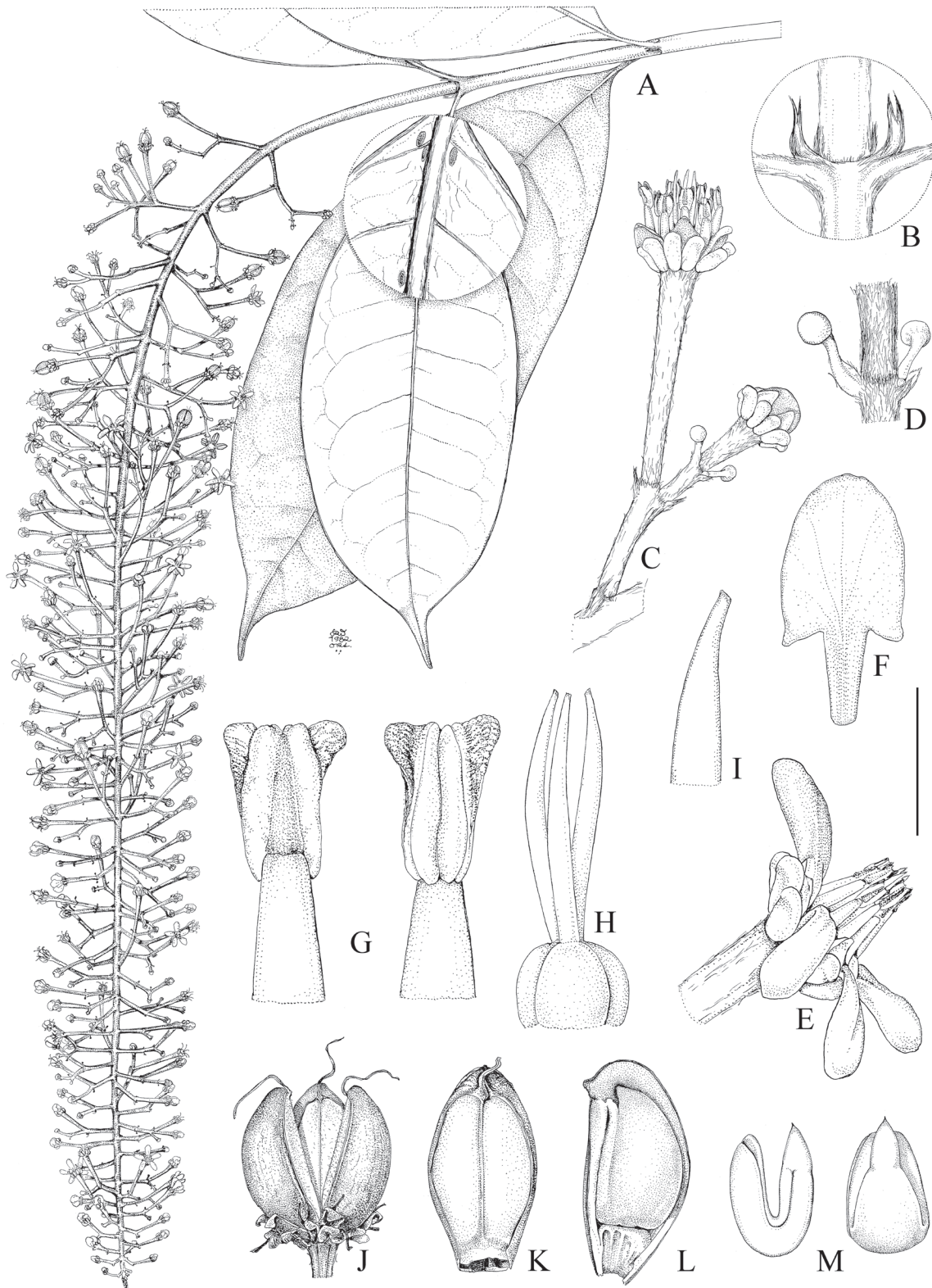


FIGURE 2. Morphology of *Andersoniella hammelii* (W.R. Anderson) C. Davis & Amorim. **A**, flowering branch; **B**, stem node magnification to show stipules; **C**, 2-flowered cincinnus; **D**, bracteole glands; **E**, flower, side view, posterior banner petal upright; **F**, banner petal, adaxial view; **G**, anthers, abaxial view (left) and adaxial view (right); **H**, gynoeceium; **I**, distal portion of style; **J**, fruit; **K**, single mericarp, adaxial view; **L**, mericarp in longitudinal section, with seed; **M**, embryos, side view (left) and abaxial view (right). Scale-bar equivalents: **A**, 3 cm (6 mm); **B**–**C**, 6 mm; **D**, 3 mm; **E**, 4 mm; **F**, 3 mm; **G**, 1 mm; **H**, 1.4 mm; **I**, 0.7 mm; **J**, 5 mm; **K**–**M**, 3.3 mm. **A**–**B** based on *Grayum 2231A*, DUKE; **C**–**M** based on *Hammel 9397*, MICH. Drawn by Karin Douthit.





FIGURE 3. *Andersoniella hammelii* (W.R. Anderson) C. Davis & Amorim. **A**, flowering branch, detail showing the distal part of the inflorescence; **B**, floral buds; **C**, flower, front view, posterior petal upright; **D**, immature fruits. Photos by O. Vargas, from the *Florula Digital de La Selva*.

***Andersoniella spruceana*** (Nied.) C. Davis & Amorim, *comb. nov.*

Basionym: *Lophanthera spruceana* Nied., *Arbeiten Bot. Inst. Königl. Lyceums Hosianum Braunsberg* 5: 30. 1914. TYPE: BRAZIL. Amazonas: prope Panuré ad Rio Uaupés, October 1852–January 1853 (fl.), *R. Spruce* 2518/2632 (Holotype: B $\dagger$ ; Lectotype, here designated: BR; Isolectotypes: BM, C, E, G [2 sheets], K [2 sheets], NY, P [2 sheets]).

**Distribution:** *Andersoniella spruceana* occurs in the eastern Andes from Colombia eastward to the Brazilian Amazon (Anderson, 1983). It is the only species of the genus *Andersoniella* that occurs in sympatry with *Lophanthera* s. str.

Because the holotype at B was destroyed during World War II, we designate the duplicate at BR, annotated by Niedenzu, as the lectotype. This specimen was annotated by Bruce MacBryde as “lectotype” in 1970; however, MacBryde never published his choice.

TAXONOMIC KEY FOR THE SPECIES OF *ANDERSONIELLA* (FIRST PROVIDED AS *LOPHANTHERA* BY ANDERSON [2014])

- 1a. Gynoecium densely sericeous; bracteole gland, when present, sessile and covering much of the abaxial surface of the bracteole; stipules 1.5–3.0 mm long, connate their whole length; northwestern Amazonia (Brazil and Colombia) . . . . . *A. spruceana*
- 1b. Gynoecium glabrous; bracteole gland, when present, terminal and peltate; stipules 3–6 mm long, at least partially connate but often distally distinct . . . . . 2
- 2a. Gynoecium tricarpetate; calyx bearing 10 abaxial glands; anther wings 0.2–0.4 mm wide, widest distally; Costa Rica and Nicaragua . . . . . *A. hammelii*
- 2b. Gynoecium bicarpetate; calyx bearing 0–2 abaxial glands; anther wings 0.10–0.15 mm wide and of uniform width; Colombia (Chocó) . . . . . *A. marcelae*

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