# EVALUATION OF THE HISPANIOLAN ENDEMIC *GRAFFENRIEDA OTTOSCHULZII* (MELASTOMATACEAE)

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ABSTRACT

The putative Hispaniolan endemic *Graffenrieda ottoschulzii* (syn. = *Miconia ottoschulzii*) was evaluated morphologically and phylogenetically. Morphological data clearly place the species within *Miconia*, as the taxon is missing the dorsal appendage on the connective and capsule fruits of *Graffenrieda* but has the berry fruits of *Miconia*. Phylogenetically *G. ottoschulzii* was resolved as sister to the widespread and mostly South American, *M. pyrifolia*, and we conclude here that the two taxa are conspecific. We provide an updated description of *M. pyrifolia* and lectotypify the names *M. ottoschulzii* and *M. pyrifolia*.

RESUMEN

Se evaluó la morfología y relaciones filogenéticas de *Graffenrieda ottoschulzii* (syn. = *Miconia ottoschulzii*), una especie actualmente considerada endémica a la isla Española. Datos morfológicos claramente localiza la especie dentro del género *Miconia* por sus frutos abayados y falta de apéndices del conectivo y frutos capsulares de *Graffenrieda*. Filogenéticamente *G. ottoschulzii* resultó como especie hermana a la especie mayormente sudamericana, *M. pyrifolia*, and se concluye aquí que sean la misma especie. Se provee una descripción actualizada y se lectotipifica los nombres *M. ottoschulzii* y *M. pyrifolia* .

Key Words: Biodiversity hotspot, Greater Antilles, *Miconia*, phylogenetics, taxonomy

## INTRODUCTION

*Miconia* (Miconieae) is a hyper-diverse genus with over 1900 known species (Michelangeli et al. 2022). Miconieae has been dispersed long distance into the Antilles from continental areas, leading to five major radiations throughout the islands (Majure et al. 2022, 2023). A combination of inter- and intra-island dispersal coupled with sky island speciation (Majure et al. 2022) has likely led to the diversification of Melastomes across the Greater Antilles. However, numerous species that occur on the islands are widespread species of continental origin, and those dispersals have not led to major radiations (see Majure et al. 2022 for a review).

*Graffenrieda ottoschulzii* (Urban & Ekman) Urban & Ekman was first described in 1929 by Urban and Ekman as *Miconia ottoschulzii* Urban & Ekman (Urban 1929), and it was said to have berry fruit, a synapomorphy of tribe Miconieae (Judd et al. 2022). Then in 1931, the taxon was transferred to *Graffenrieda* (Urban 1931), a capsular-fruited genus. This change was apparently based on perceived anther appendages, one on the dorsal and two on the ventral side. Since that time, the species has mostly been considered a *Graffenrieda* endemic to Hispaniola (Liogier 2000). However, Wurdack (1973) seemed to think that the species belonged in *Miconia*, perhaps closely related to or even conspecific with *M. pyrifolia* Naudin.

Based on recent molecular data and morphological comparisons, we also suspected that *Graffenrieda ottoschulzii* was a widespread and mostly continental species of *Miconia*. The main goal of this research was to place material referable to *G. ottoschulzii* phylogenetically and compare morphological characters of the taxon with putative close relatives. We provide an updated description of the species for Hispaniola. This work is part of ongoing research to refine our knowledge of Melastomataceae on Hispaniola.

## MATERIALS AND METHODS

***DNA extraction, sequencing and phylogenetic reconstruction.—***DNA from recently collected *G. ottoschulzii* (*Majure 9287*) from the Cordillera Central was extracted using a modified CTAB method (see Neubig et al. 2014). Whole genomic DNA was sent to Rapid Genomics for library preparation and sequencing on the

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Illumina HiSeqX platform using the genome skimming method (Straub et al. 2012). Raw reads were assembled to loci used by Gavrutenko et al. (2020), the plastid intergenic spacers *psbK–psbI* and *accD–psaI*, as well as nuclear ribosomal ITS and ETS. Assembled loci were then aligned using MAFFT (Katoh & Standley 2016) with data of 779 species of *Miconia* from Gavrutenko et al. (2020) as a test run to see where *Graffenrieda ottschulzii* was resolved in the phylogeny. Phenetically similar species, such as *M. pyrifolia* Naudin and *M. cinnamomifolia* DC., were also included in the analysis. After an initial test for placement with *G. ottoschulzii* resolved as closely related to *M. pyrifolia* and *M. rubiginosa* (Bonpl.) DC., we then reduced the dataset to 20 taxa composed of close relatives (see Fig. 1). Phylogenetic analyses were carried out using RAxML (Stamatakis 2014) undertaking 1000 rapid bootstrap pseudoreplicates under the GTR+G model of molecular evolution to evaluate the placement of *G. ottoschulzii*. Our datasets are trees are available on Figshare (10.6084/m9.figshare.27038431).

***Morphological evaluation.—***Morphological characters were evaluated based on herbarium specimens at the University of Florida Herbarium (FLAS), including those generated from recent fieldwork in the Cordillera Central of the Dominican Republic. Vegetative and reproductive materials were measured based on Judd (2007). Data on plant size were compiled from herbarium specimens. Floral measurements were taken from rehydrated samples using boiling water mixed with a detergent. The revised description was supplemented and compared to the description in La Flora de la Española (Liogier 2000), as well as the flora of the Venezuelan Guayana (Berry 2000). *Graffenrieda ottoschulzii* was also compared morphologically with *Miconia pyrifolia* and other phenetically similar species, such as *M. cinnamomifolia, M. kappleri* Naudin, and *M. phaeophylla* Triana (Wurdack 1970) based on type specimens seen in JSTOR Plants (plants.jstor.org).

## RESULTS

Based on the results of our phylogenetic and morphological study, we conclude that *G. ottoschulzii* is conspecific with the widespread *Miconia pyrifolia*. *Graffenrieda ottoschulzii* was recovered unresolved within a clade (bs=70) composed of *M. pyrifolia* and *M. rubiginosa* (Fig. 1), the latter another widespread continental species that also occurs in the Cordillera Central of Hispaniola (Liogier 2000). A phenetically similar species, *M. cinnamomifolia* was resolved in the sister clade to *M. pyrifolia* and *M. rubiginosa*. Morphological evaluation of *G. ottoschulzii* in comparison with *M. pyrifolia* showed significant overlap in phenetic similarity, exhibiting the same indumentum, inflorescence structure and floral features, as well as the nodal line. However, *G. ottoschulzii* differs from *M. cinnamomifolia* in lacking the nodal flange of the latter species, and from *M. phaeophylla* by the glabrescent stems and inflorescences. *Miconia phaeophylla* is densely pubescent on the stem and inflorescence and apparently lacks a nodal line. *Miconia kappleri*, appears to be a glabrate form of *M. phaeophylla*, as was also mentioned by Wurdack (1970) and similarly lacks the nodal line of *M. pyrifolia*. *Miconia rubiginosa* is phenetically very dissimilar to either *M. pyrifolia* or *M. ottoschulzii*, forming a shrub to 4 m tall versus a tree up to 25 m tall. Stem, leaf and inflorescence surfaces are densely covered in short-stalked stellate hairs, while both *G. ottoschulzii* and *M. pyrifolia* are mostly glabrous along most surfaces, except for stellate to globular stellate hairs at stem nodes and sparse stellate hairs along the upper and lower leaf surfaces, especially on young leaves.

## DISCUSSION

Phylogenetic analysis of *G. ottoschulzii* clearly places the taxon within *Miconia*, and as a close relative of *M. pyrifolia* and *M. rubiginosa*. Morphological evaluation of specimens of *G. ottoschulzii* phenetically overlap with *M. pyrifolia*, but *M. rubiginosa* is very dissimilar in pubescence and plant size. Other phenetically similar taxa, such as *M. cinnamomifolia, M. kappleri* and *M. phaeophylla* are morphogically distinguishable from *M. pyrifolia* based on the characters mentioned above, and *M. cinnamomifolia* is resolved in a sister clade to *M. pyrifolia* and *M. rubiginosa*. Vegetative and reproductive features of *G. ottoschulzii* and *M. pyrifolia* are essentially totally overlapping and do not allow for distinguishing the two taxa. Thus, we consider them to be conspecific in agreement with Wurdack (1973), who thought they were likely the same taxon. Apparently, Goldenberg et al. (2013) thought these two species were conspecific, as they gave Hispaniola as part of the distribution of

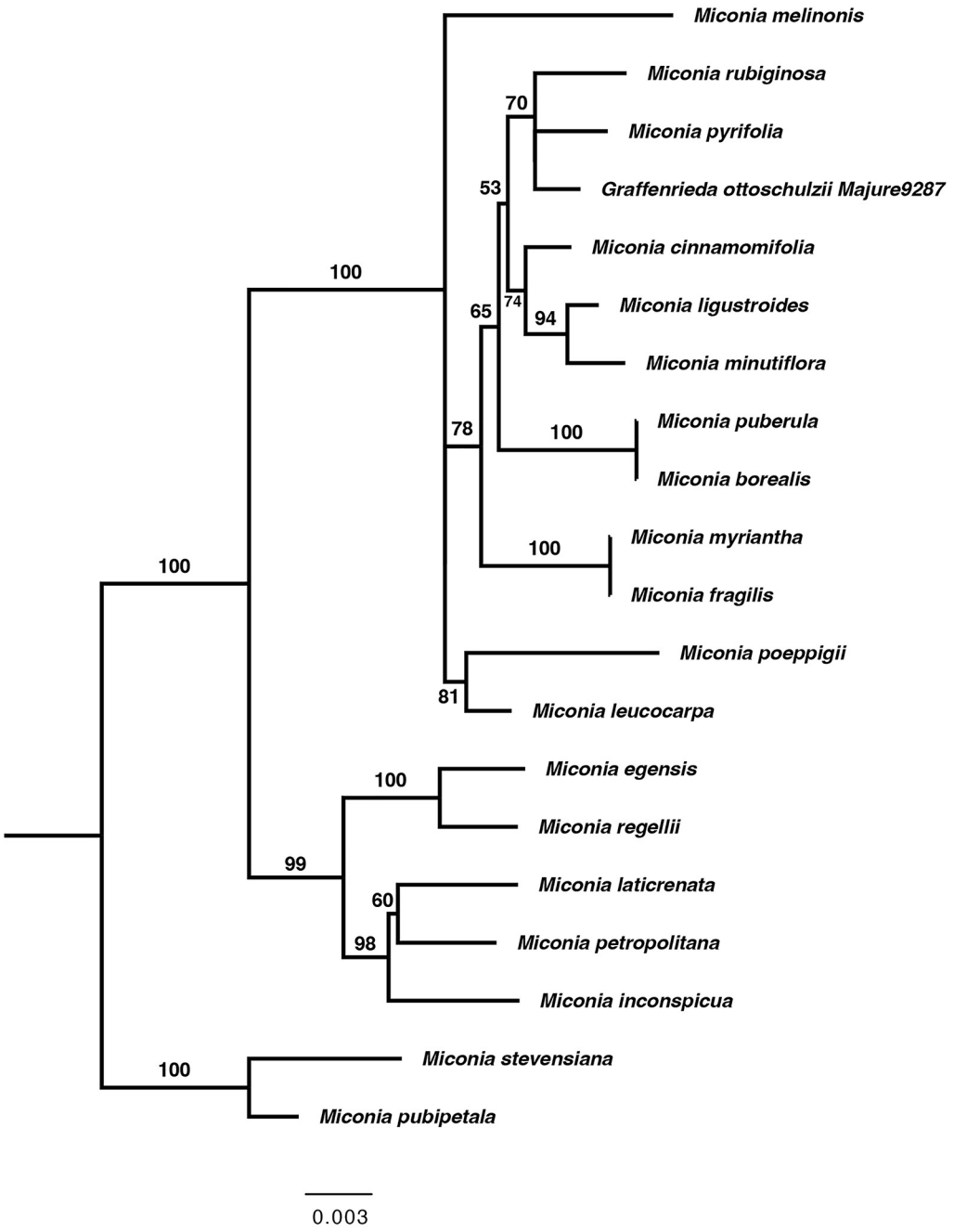


Fig. 1. Maximum likelihood phylogeny of the clade containing *Miconia pyrifolia* and relatives. *Graffenrieda ottoschulzii* (*Majure 9287*, FLAS) was resolved in a clade with *M. pyrifolia* (*Caddah 612*, NY) and *M. rubiginosa*. Bootstrap values are given above branches.

*M. pyrifolia*, but they did not consider the name *M. ottoschulzii* in synonymy, which they still considered a species of *Graffenrieda* at the time. Wurdack (1973) mentioned a slight morphological difference in the calyx lobes of the type of *M. pyrifolia* from Bahia (*Blanchet 3412*), with that material showing regularly-lobed calyces, while material from Venezuela, Guayana and Hispaniola showing irregular lobes from the tearing of the calyx during anthesis. If that character were significant, then perhaps *M. ottoschulzii* could be recognized apart from *M. pyrifolia*. The material of *M. pyrifolia* used here was from the Amazonian distribution of *M. pyrifolia* s.l. (*Caddah 612*), which would fit into the latter distribution from the Guayanan Shield, Amazonia and Hispaniola. We currently lack sufficient data based on the two morphotypes of *M. pyrifolia* s.l. to determine if they should be regarded as separate species. It is clear that more in depth systematic work is needed to tease apart relationships among these phenetically similar species to provide more refined species delimitations in this complex, especially with regards to *M. cinnamomifolia, M. kappleri* and *M. phaeophylla*, the latter two species not sampled phylogenetically here.

Given the case of *G. ottoschulzii* considered here to be conspecific with *Miconia pyrifolia*, the only true members of *Graffenrieda* currently known from Hispaniola are *G. chyrsandra* Triana in Haiti (also known from Cuba) and *G. barahonensis* Urb., which is only known from the type (*Fuertes 346*) collected near Barahona, Dominican Republic (Liogier 2000). Below we provide a brief, taxonomic treatment, including a revised description of *M. pyrifolia*. *Miconia pyrifolia* is yet another example of a widespread continental species that has been dispersed into the Greater Antilles (see Majure et al. 2022).

## TAXONOMIC TREATMENT

**Miconia pyrifolia** Naudin, Ann. Sci. Nat., Bot. Ser. 3, 16:164. 1851. *Acinodendron pyrifolium* (Naudin) Kuntze Revis. Gen. Pl. 2:952. 1891. Type. BRAZIL. Bahia: Igreja Velha. *Blanchet 3412* (Lectotype **designated here:** P, MNHN-P-P01168005), (isolectotypes: BR, BR0000005210749; C, C10014833; F, F0063822F, F0063823F; G, G00353760, G00353756; GDC, G00317164; K, K000536087; NY, NY00229339; P, MNHN-P-P01168003, MNHN-P-P01168004; US, US00121154). We lectotypify this name with the type at P, as Naudin (1851) did not specify a repository for the type, and he worked at P. So, presumably the type would have been deposited at that institution.

*Miconia ottoschulzii* Urb. & Ekman, Ark. Bot. 22A:39. 1929. *Graffenrieda ottoschulzii* (Urb. & Ekman) Urb. & Ekman Ark. Bot. 23A:15. 1931. Type. DOMINICAN REPUBLIC. Azua Province: Cordillera Central, Las Lagunas, 13 Apr 1926, *Ekman H6360* (**Lectotype designated here:** S, S05-3276), (isolectotypes: NY, NY00658675; US, US00120808). Note. The holotype at B was undoubtedly destroyed in the allied bombings of WWII, thus, we designate a lectotype for the name. We chose the specimen at S, given that was the home institution of Ekman. Likewise, a lectotype is necessary given that two collections were cited by Urban, *Ekman H6360* and *Sintenis 6408*. We have not seen the *Sintenis* specimen, which Urban (1929) stated was sterile. **U.S.A. Puerto Rico:** in sylva primaeva ad Isabon, *Sintenis 6408* (n.v.; Urban 1929).

Large tree, 4–25 m tall, bark dark, reddish-brown, young branchlets quadrangular to rectangular in cross section with age, with longitudinal grooves near nodes, indumentum of stellate, globular stellate and dendritic hairs at nodes, covering vegetative buds and in leaf axils. Nodes 3.5–8.5 cm apart, nodal lines present and conspicuous. Leaves simple, opposite, and decussate. Leaf blades 9.5–20.5 × 4–8.5 cm, oblong-ovate and often slightly falcate, apex acuminate, base acute to oblique, margin entire, blades thin-chartaceous, dark green (oxidizing to black after collection). Venation acrodromous, secondary veins 4, spaced 1.25–3 cm from midvein; percurrent perpendicular tertiary veins spaced 4–6 mm apart; adaxial leaf surface with sparse, stellate to globular stellate trichomes, druse crystals present, primary veins discretely raised or embedded in blade tissue, secondary and tertiary veins lying flat (non-impressed), abaxial surface with sparse rufescent stellate to globular stellate trichomes, with dense druse crystals, primary and secondary veins raised, tertiary lying flat, petiole 1.3–2.5 cm long with sparse stellate to globular stellate hairs. Inflorescences terminal, 5-many ordered, cyme 8.5–14 × 8–13 cm, the axes often with stellate to globular stellate hairs, as well as dendritic hairs at the nodes; peduncle 2.3–3.75 cm long, pedicles 0.9–1.1 mm long, bracteoles 0.2 × 0.4 mm or nearly obsolete. Hypanthium 1.5 × 1.25 mm, regularly 12 ridged, glabrous. Flowers actinomorphic, 5-merous. Calyces 5 lobed, calyptrate, irregularly opening, sepals with 2 lobes frequently fused (making merosity appear 4), 1.5 × 1.75 mm, glabrous, calyx teeth to 0.1 mm long. Sepals caducous during fruit development, leaving circumscissle scar at the hypanthium apex. Petals white, 2.4–2.6 × 1.1–1.4 m, obovate-oblong,

glabrous, with minutely papillose margins. Stamens 10, isomorphic, to 7.2 mm long, filament 5.3 mm long, anthers cream, oblong, the apex with 2 gaping, terminal pores almost coalescent, with a prominent anther skirt at base, thecae 1.9 mm long. Style 4.25 mm long, fluted and broadening apically, clavate. Ovary 3-locular, truncate, and glabrous. Berries globose, 4.5 mm in diameter, black.

***Distribution and ecology.—***Known on Hispaniola mostly from the Cordillera Central, but also from the Cordillera Septentrional and Los Haitises in the western Dominican Republic. Urban (1931) cited Petites-graines, Haiti, but we have seen no specimens from Haiti for this species. This species also has been reported for Puerto Rico, and in South America from Bolivia, Brazil, Guyana, Peru, Suriname, and Venezuela (Berry 2000). Axelrod (2011) considered the one report of *Graffenrieda ottoschulzii* from Puerto Rico by Urban (1929) and Britton & Wilson (1930) to be dubious, and we likewise have seen no specimens of it from the island. It occurs in moist, evergreen lowland to lower montane forests, 100–1000m in the Dominican Republic and has been collected alongside *Alchornea latifolia* Sw., *Brunellia comocladifolia* Bonpl., *Buchenavia capitata* (Vahl) Eichler, *Carapa guianensis* Aubl., *Chusquea abeitifolia* Griseb., *Henriettea fascicularis* (Griseb.) M. Gómez, *Miconia berteroi* (DC.) Judd & Ionta, *M. hispaniolica* Judd & Majure, *M. prasina* (Sw.) DC., *M rubiginosa, M. umbellata* (Mill.) Judd & Ionta, *Mora abbottii* Rose & Leonard, *Ormosia krugii* Urb., *Pharus lappulaceus* Aubl., *Prestoea montana* Hook.f., and *Vitex petitia* Bramley.

***Phenology.—***Collected mid-March with developing inflorescences, in early bud in May, and with older flowers in October. We consider that the species is likely flowering and fruiting throughout the year, although, flowering time seems to be very short over a period of about three days, as mentioned by Ekman (Urban 1931).

Specimens examined (*Miconia pyrifolia*): **BRAZIL. Amazonas.** Mun. Manaus. Reserva Florestal Adolpho Ducke. 9 Jul 2009, *Caddah 612* (NY). **Mato Grosso:** Muns. Sinop, 0.5 km W of BR163, on road to Porto dos Gauchos (MT220), 22 Sep 1985, *Thomas 3938* (FLAS). Muns. Sinop & Colider, along BR080, ca. 94 mi E of jct. with BR 163, 3 Oct 1985, *Thomas 4181* (FLAS). **HISPANIOLA: DOMINICAN REPUBLIC. Prov. Duarte:** Cordillera Septentrional. Reserva Científica Loma Quita Espuela. El Valle, en las márgenes del Rio el Valle. V19°22′N, 70°09′ Oeste, 550 m, 13 de Ago 1993, *García et al. 5119* (FLAS, JBSD). **Prov. El Seibo:** Los Haitises, El Seibo, 16 Mar 1986, *Mejía et al. 1754* (FLAS, JBSD, NY, S). **Prov. Hato Mayor:** Cordillera Central, Sabana de la Mar, rain forest, acid soil, toward Caño Hondo, 4 July 1930, *Ekman H15558* (S). **Prov. Monseñor Nouel:** Loma Quimbamba, Rincón de Yuboa, Bonao, 22 Apr 1969, *Liogier 14896* (NY); La Manaclita, ca. 10 mi S of La Vega, 25 Jun 1969, *Liogier 15836* (NY). **Prov. Puerto Plata:** Cordillera Central, La Cumbre, 13 Feb 1929, *Ekman H11555* (NY, S). **Prov. Santo Domingo:** Cordillera Central, La Cumbre, in forest, 300 m, 5 May 1929, *Ekman H12381* (FLAS, S). **Prov. Santiago Rodríguez:** Cordillera Central, al sur de Monción y La Leonor, bajando desde Las Lagunas de Cenobí, en la unión del Río Cenobí y Cenobicito, 19.262047°N, –71.257845°O, 23 Apr 2022, *Majure et al. 9287* (FLAS, JBSD, NY), **Prov. Sánchez Ramírez. Valle del Cibao:** Municipio Cotuí, en la propiedad del negocio minero Rosario Dominicana Inc., 18°57N′, 70°12′Oeste, 400 m, 20 abr 1989, *Zanoni et al. 42203* (FLAS, JBSD, NY). **SURINAME. Moengo:** 4.2 km E of primary jct. of Moengo, then 4.7 km S along logging road. 05.55602°N, –54.38046°W, 65 m, 5 Aug 2022, *Majure et al. 9481* (BBS, FLAS).

Specimens examined (*Miconia cinnamomifolia*): **BRAZIL:** 1827, *Martius s.n.* (GDC, G00311256).

Specimens examined (*Miconia kappleri*): **SURINAME:** Feb. 1844, *Kappler 1675* (S, S05-3604).

Specimens examined (*Miconia phaeophylla*): **PERU:** In monte Campana, prope Tarapoto, Peruviae orientalis, Aug 1856, *Spruce 4861* (GDC, G00317452).

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