

Distimake (Convolvulaceae) expanded: five additional species from the Neotropics and Eastern Africa

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Abstract: Seven nomenclatural novelties in the genus *Distimake* Raf. are here proposed: five species, two from the Neotropics and three from Eastern Africa, which were *incertae sedis* following revisionary work of *Merremia* Dennst. ex Endl. s.l., are here combined in *Distimake* based on recent taxonomic and phylogenetic progress; and two nomenclatural novelties are proposed. *Distimake candeoi* (A. Terracc.) A.R.Simões, comb. nov., *D. discoidesperma* (Donn. Sm.) Petrongari, A.R.Simões & Sim.-Bianch., comb. nov., *D. gorinii* (Chiov.) A.R.Simões, comb. nov., and *D. gregorii* (Rendle) A.R.Simões, comb. nov., are combined with support from molecular phylogenetic analysis, and *Distimake platyphyllus* (Verdc.) Petrongari & A.R.Simões, comb. nov., is combined based on morphological traits. *Distimake pavonii* (Hallier f.) Petrongari, comb. nov. takes priority over *Distimake macdonaldii* (S.Valencia & Mart.Gord.) A.R.Simões & Staples, syn. nov., and *Distimake tuberosus* (L.) A.R.Simões & Staples now includes *Merremia grandidentata* (C.H.Thomps.) Staples & A.R.Simões and its basionym as new synonyms. Thus, *Distimake* is here expanded from 46 to 51 currently accepted species.

Keywords: Climber, new combinations, new synonyms, phylogenetics, taxonomy

Introduction

The informally called “Merremioids”, previously recognised as tribe Merremieae, are a group of ten genera and c. 120 species in family Convolvulaceae. Tribe Merremieae was systematically challenging

for the lack of clear synapomorphies for the group and especially for the unclear delimitation of its largest genus *Merremia* Dennst. ex Endl. (a commonly called “dustbin”). A comprehensive morphological, phylogenetic and palynological study demonstrated the polyphyly of the “tribe” and of *Merremia* s.l. (Simões *et al.*, 2015; Simões & Staples, 2017) and resulted in the re-circumscription of several monophyletic genera, in which c. 70% of the species could be confidently classified: *Merremia* s.s., *Daustinia* Buriel & A.R.Simões, *Camonea* Raf., *Decalobanthus* Ooststr., *Distimake* Raf., *Hewittia* Wight & Arn., *Hyalocystis* Hallier f., *Operculina* Silva Manso, *Remirema* Kerr, and *Xenostegia* D.F.Austin & Staples. However, these studies were not conclusive, either for incomplete or conflicting data, for which 44 species have remained placed in *Merremia* s.l., pending more in-depth studies to be reclassified (Simões & Staples, 2017; POWO, 2024). Recent systematic research focusing on American and Asian taxa, have contributed to the correct generic placement of 14 of these unplaced species in *Distimake* and *Decalobanthus* (Petrongari *et al.*, 2018; Simões & More 2018; Simões *et al.*, 2020; Tamboli *et al.*, 2021; Pisuttimarn *et al.*, 2023), additionally one Central African was species assigned to *Distimake* in the course of the preparation of a floristic treatment for the region (Mwanga-Mwanga *et al.*, 2022),

leaving 34 species of *Merremia* s.l. of yet doubtful generic placement. Ongoing phylogenetic and taxonomic studies focusing on Eastern Africa and Tropical America have allowed to now confidently assign five more species to *Distimake* and recognise new synonyms among currently described species. This demonstrates the need for the integration of molecular and morphological evidence to continue to re-classify the yet generically unassigned species in *Merremia* s.l.

Material and Methods

Specimen and literature examination

This study is based on the observation of the type and other relevant specimens, over the course of several years, through in-person visits, access to digital collections, or material loaned from the following herbaria (abbreviations according to Thiers, 2024 updated continuously): BM, BR, COI, COL, FI, FT, G, K, LE, MA, MEXU, MO, P, R, RB and SP; including digital collections through JSTOR Global Plants website (www.plants.jstor.org/) and Global Biodiversity Information Facility (GBIF; www.gbif.org/), complemented by consultation of relevant taxonomic literature.

Molecular phylogenetic analysis

Novel genetic data was generated for four species: *Merremia candei* (A.Terracc.) Sebsebe, *M. discoidesperma* (Donn.Sm.) O'Donell, *Merremia gorinii* Chiov. and *Merremia gregorii* Rendle, with samples collected from herbarium specimens, in a total of 16 novel DNA sequences first published here (Appendix I). Total genomic DNA was extracted from approximately 0.1 g of dried leaf material extracted from herbarium specimens (see Appendix I for voucher specimen information) using a modification of the CTAB micro-extraction method (Doyle & Doyle, 1987), in which the aqueous phase from the chloroform precipitation was cleaned using Qiagen DNeasy kit and otherwise following the protocol as described in Carine *et al.* (2004). Plastid DNA barcoding region *matK* (matK390f-matK1326r,

Cuénoud *et al.*, 2002) was amplified using PCR conditions, as described in Hollingsworth *et al.* (2009). The plastid *rps16* (*rps16x2F2-trnK* (UUU), Shaw *et al.*, 2007) and the *trnL* intron (primers C/D, Taberlet *et al.*, 1991) regions were amplified using PCR cycling conditions described in Shaw *et al.* (2007). Newly generated DNA sequences were edited using Sequencher[®] version 5.4.6 (DNA sequence analysis software, Gene Codes Corporation, Ann Arbor, MI USA) and added to previously published sequences of nuclear (*ITS*) and chloroplast regions (*matK*, *trps16* and *trnL-F*) generated— from Simões *et al.* (2015), Tamboli *et al.* (2021) and Pissutimarn *et al.* (2023), compiled into a supermatrix. The dataset consisted of 78 ingroup species, represented by 87 accessions and two outgroup species (*Aniseia martinicensis* (Jacq.) Choisy and *Iseia luxurians* (Moric.) O'Donell), with the following coverage for each genetic marker: *ITS*, 47 accessions; *trnL* intron, 71 accessions; *matK*, 68 accessions; and *rps16*, 72 accessions (Appendix I). Six species were represented by multiple accessions. All sequences were aligned using the MAFFT (Kato & Standley, 2013) plugin in Mesquite version 3.61 (Maddison & Maddison, 2019), and alignments manually fine-tuned in Mesquite following guidelines by Kelchner (2000). The alignments of *ITS* and *rps16* contained several indels and were aligned by subsequent iterations of manual adjustment of the alignment, Bayesian inference (see below) and inspection of phylogenetic trees for deviating branch lengths or phylogenetic position of species. Regions in *ITS* and *rps16* that could not be aligned unambiguously were excluded prior to analysis. Presence / absence of eleven indels in the alignment of *rps16* was coded as binary characters following the simple indel coding method of Simmons & Ochoterena (2000). The four alignments, *matK* (597 positions), *rps16* (938 positions), *trnL* intron (390 positions) and *ITS* (585 positions) were analysed separately using Bayesian phylogenetic inference, performed with MrBayes 3.2.7 (Ronquist *et al.*, 2012), available at the CIPRES portal in San Diego, CA, USA

(<http://www.phylo.org/portal2>; Miller, *et al.*, 2010). For all analyses, DNA substitution models and phylogenetic parameters (topology, branch lengths etc.) were estimated simultaneously using a reversible jump Markov chain Monte Carlo sampler (so-called model-jumping, Huelsenbeck *et al.*, 2004). Initially, the MCMC chain was run for 20 million generations, with four simultaneous runs and four chains per run, with default values for the acceptance rates of the proposal mechanisms. The temperature of the heated chains was decreased compared to the default value (0.05 instead of 0.1) to reduce the number of outlier topologies. Parameters were sampled every 1000th generation. Convergence diagnostics were assessed using the sump command in MrBayes and by evaluating the ESS values of the analysis parameters using Tracer, and accessory program to BEAST (Drummond & Rambaut, 2007). After having reached convergence, maximum clade credibility trees were generated using the accessory programs LogCombiner and TreeAnnotator (Drummond & Rambaut, 2007). Maximum clade credibility trees for the individual markers were compared to detect possible incongruences among the topologies. As no well-supported incongruences were encountered, the alignments were subsequently concatenated for further joint analysis. The total length of the alignment was 2521 positions and consisted of five partitions (the four DNA sequence alignments and the indel partition). Each partition was allowed to have its own substitution model. For the indel partition, the Mk model (Lewis, 2001) was applied. All settings of the Bayesian analyses and methods for inspecting convergence, were as described above, including the reversible jump Markov chain Monte Carlo sampler to account for uncertainty in the DNA substitution model. The convergence statistics after Bayesian inference demonstrated strong convergence of the four runs. ESS values for all parameters, as estimated using Tracer, were in the several thousand for each run individually and in the tens of thousands for the combined runs.

The values of PSRF (Potential Scale Reduction Factor; Gelman & Rubin, 1992) convergence diagnostic for all parameters, as produced by the sump command in MrBayes, equalled 1.0. The analysis sampled 12 different substitution models with a model probability above 0.05. The maximum clade credibility tree after Bayesian inference of concatenated nuclear and chloroplast genes (*ITS*, *matK*, *rps16* and *trnL* intron) is presented in Figure 1; significantly supported nodes (posterior probabilities ≥ 0.95) are marked with a black circle.

Results and Discussion

Of the species targeted as potentially belonging in *Distimake*, four have been included in the molecular phylogenetic analyses: *Merremia candeani* (A.Terracc.) Sebsebe, *M. discoidesperma* (Donn. Sm.) O'Donnell, *M. gorinii* Chiov., and *M. gregorii* Rendle. *Distimake* was recovered as a maximally supported clade (pp = 1.0), with the four species nested within this clade, confirming the hypothesis that these unplaced species of *Merremia s.l.* should, indeed, be transferred to this genus (Fig. 1)

Merremia discoidesperma is nested in a strongly supported clade (pp = 0.98) with *Distimake austinii* (J.A. McDonald) A.R. Simões & Staples, *D. tuberosus* (L.) A.R. Simões & Staples and *D. cielenis* (J.A. McDonald) A.R. Simões & Staples, the species with which it shares: suffruticose, twining or trailing habit, leaves simple, sepals oblong to lanceolate, a large golden-yellow glabrous corolla, without red center, fruit indehiscent, membranaceous, globose, bearing large seeds covered in short black hairs (Fig. 1). This clade is sister to a clade with moderate support (pp = 0.74) that includes the remaining species of *Distimake*. Due to the exceptional morphology, namely simple leaves and golden-yellow corollas, which are rare in *Distimake*, *M. discoidesperma* has been previously hypothesised to belong in genus *Decalobanthus* instead (Staples 2022), in the absence of molecular phylogenetic evidence to test this placement. The present molecular phylogenetic results contest this hypothesis and

propose the classification in *Distimake* instead. Thus, despite the morphological autapomorphies that distinguish this species from others in the *Distimake*, it does present sepals appressed to the corolla tube (characteristic of *Distimake*, viz convex in *Decalobanthus*), and a translucent indehiscent fruit and seeds covered in short black hairs, neither known to occur in any other species of *Decalobanthus*, but shared with several species of *Distimake*, namely *D. tuberosus* which these results suggest as closely related to this species. Thus, *Decalobanthus* is geographically restricted to SE Asia, with no representatives in the American continent; the clade in which *M. discoidesperma* is resolved is mostly distributed in North/Central America (with the exception of *D. tuberosus*, which is a widespread ornamental species), which is congruent with the natural distribution of *M. discoidesperma* also.

Within this, the species *Merremia candeoi*, *M. gorinii* and *M. gregorii* are resolved in a smaller clade that also includes *Distimake ampelophyllus* (Hallier f.) A.R. Simões & Staples, *D. dimorphophyllus* (Verdc.) A.R. Simões & Staples and *D. guerichii* (A. Meeuse) A.R. Simões & Staples (Fig. 1). These species are mostly restricted to Ethiopia, Somalia and Northern Kenya. Although the species delimitation in this group is intricate (Verdcourt, 1970; Demissew, 2001; Thulin, 2006), the generic placement of these recognized species in *Distimake* is here proposed, in the face of the morphological and molecular phylogenetic evidence, and therefore we here propose their transfer to this genus.

Additionally, *Merremia platyphylla* (Fernald) O'Donell is a climber endemic from Mexico with white, scented, nocturnal flowers, a combination of characters that is shared with *Distimake palmerii* (S. Watson) A.R. Simões & Staples, also endemic from Mexico and combined previously into the *Distimake* by Simões and Staples (2017). Here, we recognize that this taxon should also be included in *Distimake* as this species shares the diagnostic

morphological traits for *Distimake*, namely for being: climbing herbs; leaves 5–7 palmately dissected; flower buds acute; sepals appressed to the corolla tube, never convex, with an acuminate apex; corolla white to yellow, completely glabrous; stigmas bi-globose and fruit a 4-valved capsule.

Taxonomic treatment

Distimake candeoi (A. Terracc.) A.R. Simões, **comb. nov.** *Sopubia candei* A. Terracc., Boll. Soc. Bot. Ital. 1892: 424. 1892. *Ipomoea candei* (A. Terracc.) Chiov., Racc.: 92. 1935. *Merremia candei* (A. Terracc.) Sebsebe, Kew Bull. 56(4): 936. 2001. *Type*: ETHIOPIA, [Somali Region], Campi di Gerar-Amaden, [42°40'–43°20'E 06°10'–7°10'N], 04.1891, *E. Baudi di Vesme* & *G. Candeo s.n.* (holo FT [FT002752!]).

Merremia pedata (Choisy) Hallier f. var. *gracilis* Hallier f., Bull. Herb. Boissier 6: 538. 1898. *Merremia semisagitta* (Griseb. ex Peter) Dandy subsp. *semisagitta* var. *gracilis* (Hallier f.) Verdc., Kew Bull. 24(1): 174. 1970. *Type*: SOMALIA, Abdallah [presumably the water hole El Abdallah about 69 km. W. slightly N. of Beled Weyn (Verdcourt 1970)], 1891, *C. Keller* 234 (holo Z [Z-000054592, digital image!]).

Ipomoea stenophyton Chiov., Fl. Somala: 231, t. 25. 1929. *Type*: SOMALIA, Migiurtini, coast and dunes at Hafun, 30.01.1924, *N. Puccioni* & *G. Stefanini* 32 (holo FT [FT002753!]).

Distribution: Ethiopia, Somalia, and Kenya.

Notes: Here we accept the correction of the epithet done by Thulin (2006), and added information about the *Sopubia candei* holotype based on the map of the expedition of Baudi di Vesme and Candeo (Vedova, 1893).

Distimake discoidesperma (Donn.Sm.) Petrongari, A.R. Simões & Sim.-Bianch., **comb. nov.** *Ipomoea discoidesperma* Donn.Sm., Bot. Gaz. 14: 27. 1889. *Operculina discoidesperma* (Donn.Sm.) House, Muhlenbergia 5: 68. 1909. *Merremia discoidesperma* (Donn.Sm.) O'Donell, Lilloa 6: 495. 1941. *Lectotype* (Step I O'Donell, 1941, pg. 495,

step II designated here): GUATEMALA, **Alta Verapaz**, Pansamalá, alt. 3800 ft., 6.1885, *H. von Tuerckheim* 744 (US [US00111388, digital image!]; isolect: US [US00111389, digital image!]).

Operculina populifolia Hallier f., Symb. Antill. 7: 342. 1912. *Lectotype* (Staples et al., 2020: 131): CUBA, *s.d.*, *C. Wright* 3083 (MO [MO-150302, digital image!]) [the duplicates of *Wright* 3083 are

not isolecto as they have been mounted mixed with *Operculina hamiltonii* (G. Don) D. F. Austin & Staples in most of herbaria (GH, NY apud. Staples et al., 2020)].

Distribution: Costa Rica, Guatemala, Nicaragua, Cuba, Dominican Republic, Haiti, and Chiapas Province in Mexico, in wet and mixed forest.

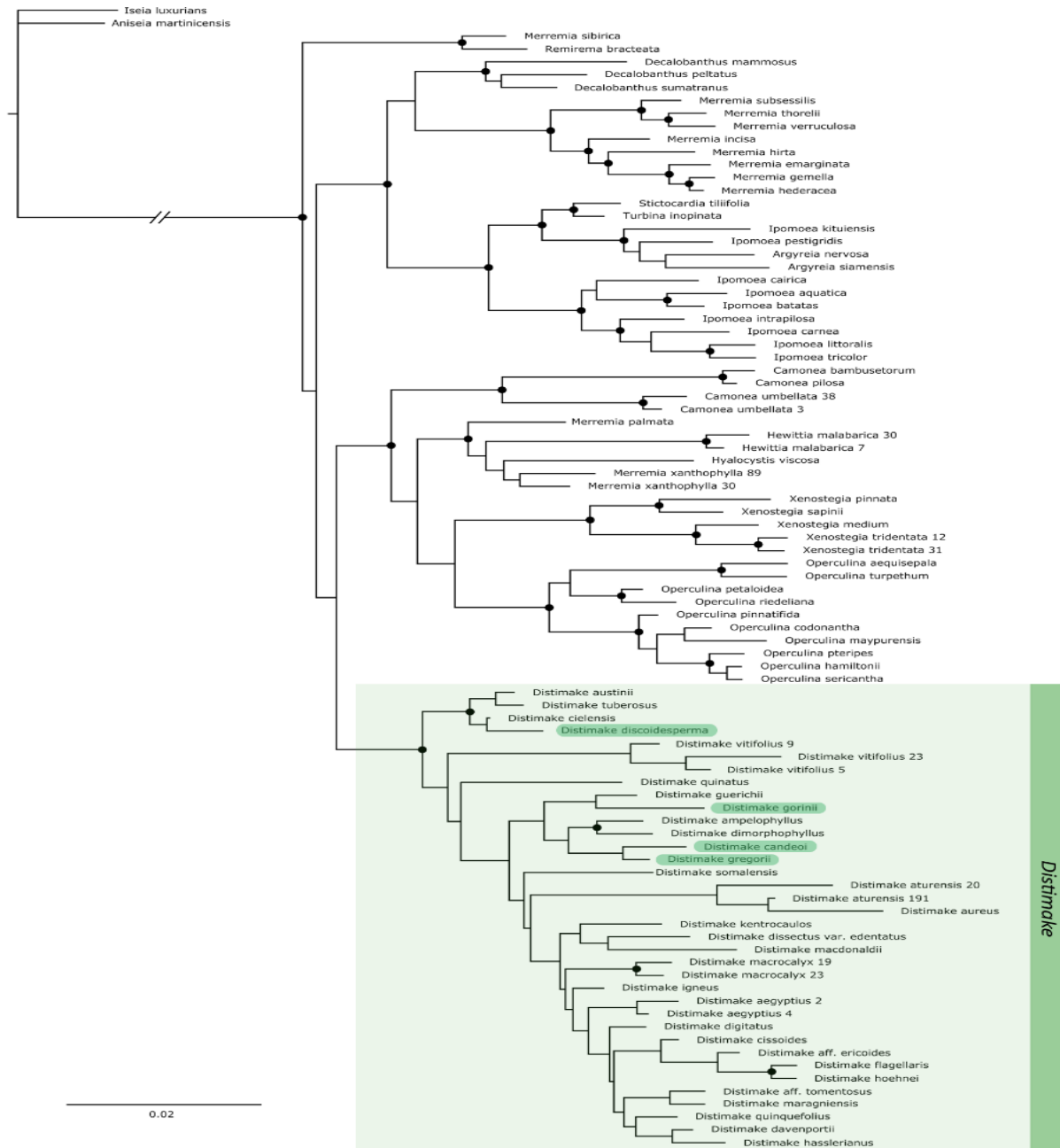


Fig. 1. Maximum clade credibility tree after Bayesian inference of concatenated nuclear and chloroplast genes (ITS, *matK*, *rps16* and *trnL* intron), showing the position of *Distimake discoidesperma*, *D. gorinii*, *D. candeoi* and *D. gregorii*. Significantly supported nodes (posterior probabilities ≥ 0.95) are marked with a black circle.

Notes: Tropicos (<http://www.tropicos.org>) states that the lectotype of *Ipomoea discoidesperma* was designated by Standley and Williams (1970). However, O'Donell (1941) had already inadvertently lectotypified the name since he cited as type only one of the two syntypes provided in the protologue of *I. discoidesperma*. There is a need for a second-step lectotypification, since there are two specimens for this collection at US herbarium, both of which were seen by O'Donell, as he cited in the examined material list (O'Donell, 1941). We select the specimen [US00111388] as the lectotype, since it has more reproductive elements (flowers and fruits).

Distimake gorinii (Chiov.) A.R.Simões, **comb. nov.** *Merremia gorinii* Chiov., Fl. Somalia 2: 324. 1932. *Type:* SOMALIA, Chisimaio, presso lonti, rive del Giuba, 1.1927, *P.Gorini* 184 (holo FT [FT0022755!]; iso EA [EA000001196, digital image!]).

Merremia cliffordii Hutch. & E.A.Bruce, Bull. Misc. Inform. Kew 1941(2): 163. 1942. *Type:* SOMALIA, Duwi, 44°15'E 10°05'N, 3500m, 19.10.1932, *J.B.Gillett* 4367 (holo K [K000097226!, K000097227!]; iso FT [FT002754!], P[P00434238!]).

Distribution: Southeast Ethiopia, Somalia, and Northern Kenya.

Distimake gregorii (Rendle) A.R.Simões, **comb. nov.** *Merremia gregorii* Rendle, J. Bot. 34: 39. 1896. *Type:* KENYA, Golbanti, Tana River plains, February 1893, *J.W.Gregory s.n.* (holo BM [BM000930460!]).

Distribution: Somalia, Kenya, and Tanzania.

Distimake pavonii (Hallier f.) Petrongari, **comb. nov.** *Operculina pavonii* Hallier f., Bot. Jahrb. Syst. 16: 550. 1893. *Merremia pavonii* (Hallier f.) D.F. Austin & Staples, J. Arnold Arbor. 67: 264. 1986. *Type:* Nova Hispania [MEXICO], *s.d.*, [*Sessé & Mociño Expedition*] *s.n.* [herb. Pavón 354] (holo G [G00227280!]; iso MA [MA22345!]).

Merremia macdonaldii S. Valencia & Mart. Gord., **syn. nov.**, Anales Inst. Biol. Univ. Nac. Autón.

México, Bot. 66: 108. 1995. *Distimake macdonaldii* (S. Valencia & Mart. Gord.) A.R. Simões & Staples, Bot. J. Linn. Soc. 183: 574. 2017. *Type:* MEXICO, Guerrero, Municipio Eduardo Neri, La Yesera, 12.3 km al N de Zumpango del Río, 17°42'30"N 99°30'0"W, *M.R.Monroy de la Rosa* 545 (holo FCME, *n.v.*; isot FCME, *n.v.*; MEXU, *n.v.*).

Distribution: Mexico, narrow endemic from Estado of Guerrero in a tropical decidual forests.

Notes: During the studies of collection in G herbarium, we were able to analyse the holotype of *Operculina pavonii* (1893), a taxon considered unplaced by Staples (2017) and recognize that it was the same taxon as *Merremia macdonaldii* (Valencia and Martínez, 1995). According to the principle of priority of the International Code of Nomenclature (Turland *et al.*, 2018) the epithet "pavonii" must be used for this taxon, and here we are combining it to genus *Distimake*.

Although the label on the holotype and Hallier's work assigns its collection to Pavón, this collection is from the Sessé & Mociño Expedition to Nueva España and was part of the particular collection inherited by the Pavón family and sold by them to Edmond Bossier in the 19th Century (Rodríguez-Nozal, 1994).

Distimake platyphyllus (Fernald) Petrongari & A.R.Simões, **comb. nov.** *Ipomoea palmeri* var. *platyphylla* Fernald, Proc. Amer. Acad. Arts 33: 90. 1897. *Operculina platyphylla* (Fernald) House, Bull. Torrey Bot. Club 33: 502. 1906. *Merremia platyphylla* (Fernald) O'Donell, Lilloa 6: 513. 1941. *Lectotype* (designated here): MEXICO, Acapulco, high valleys among the mountains, 1.1895, *E. Palmer* 415 (GH [GH00054525 digital image!]; isolecto F [F0054860F digital image!]; K [K000612907!]; MO [MO-152711 digital image!]; MO-152712, digital image!]; NY [NY00319126, digital image!]; US [US00111434, digital image!]).

Distribution: Mexico, endemic from Southwestern region in tropical deciduous forest.

Distimake tuberosus (L.) A.R.Simões & Staples, Bot. J. Linn. Soc. 183(4): 577. 2017. *Ipomoea tuberosa*

L., Sp. Pl. 1: 160. 1753. *Convolvulus tuberosus* (L.) Spreng., Syst. Veg., ed. 16 [Sprengel] 1: 591. 1824. *Batatas tuberosa* (L.) Bojer, Hortus Maurit.: 226. 1837. *Operculina tuberosa* (L.) Meisn., Fl. Bras. 7: 212-213. 1869. *Merremia tuberosa* (L.) Rendle, Fl. Trop. Afr. [Oliver et al.] 4(2.1):104. 1905. *Lectotype* (designated by Austin, 1975): "Habitat in Jamaica", s.d., s.coll. s.n. (LINN [LINN-HL219-4, digital image!]).

Ipomoea grandidentata C.H.Thomps., Trans. Acad. Sci. St. Louis 20: 18. 1911, **syn. nov.** *Merremia grandidentata* (C.H.Thomps.) Staples & Simões, Phytologia 97: 222. 2015. *Type*: UNITED STATES, **Missouri**, St. Louis, cultivated in Missouri Botanical Garden, plant 232/07/1 Oct.-Nov. 1908, C.H. Thompson s.n. (MO n.v.).

Distribution: Widespread with a Pantropical distribution, first as ornamental, and later escaping and naturalizing in edge of forests; probably the natural range is in Mexico and in the Caribbean Islands (Austin, 1998).

Notes: We are considering *Ipomoea grandidentata* as a new synonym of *Distimake tuberosus*. This species was described in 1911 based on a cultivated plant in the Missouri Botanical Garden, St. Louis, received in late 1906, which seeds that came from Torreon-Mexico. It is described as a robust twiner, with stems more than 15 m long, tuberous roots, and a bright chrome-yellow corolla. Its anthers do not dehiscence spirally, and it has irregular, slightly palmatifid leaves. The latter two characters does not, but all the other characters overlap with *D. tuberosus* and we believe that the specimen cultivated in St. Louis belongs to *D. tuberosus*, albeit with abnormal growth. We are synonymizing this overlooked/unplaced name (Staples et al., 2015; Staples, 2017) here. Concerning the original material, Thompson (1911) states that specimens are deposited in herbarium MO, but we have not been able to find any online specimen matching Thompson's description.

Conclusion

During taxonomic studies of species currently placed in *Merremia* s.l., three species African species and two American species were identified as potentially belonging in the tropically widespread genus *Distimake* due to the presence of all or some of the following diagnostic characters for the genus: palmately 5–7 lobed or compound leaves; sepals oblong to lanceolate, flat, with an acuminate or mucronate apex; corolla completely glabrous, white or yellow; and pollen tri-colpate. Molecular phylogenetic analysis has confirmed the position of *M. candei*, *M. discoidesperma*, *M. gorinii*, and *M. gregorii* in *Distimake*. For *M. platyphylla*, although molecular phylogenetic evidence is not yet available, the morphology confidently corroborates the inclusion in this genus.

The current expansion of the delimitation of *Distimake* raises the species diversity of the genus to 51 species, being the largest genus segregated from the polyphyletic *Merremia* s.l., and also the one with the most widespread distribution. Ongoing revisionary studies of the "African Merremioids" (*Hewittia*, *Hyalocystis*, *Xenostegia* and *Merremia* p.p.) will address the next frontier of generic rearrangements among the remaining fragments of *Merremia* s.l. in East Africa and should bring further clarity to the intricate taxonomy of this group.

Introduction of nuclear genome and whole plastome sequences in phylogenetic analyses of Convolvulaceae (Eserman et al., 2014; Simões et al., 2022; Zuntini et al., 2024) have demonstrated success in resolving deeper relationships in the family, as for example the placement of the genera *Decalobanthus*, *Merremia* and *Distimake* within the family, although sampling within genera has been limited. Generation of additional genomic data at species level, particularly in the complex "African Merremioids" group, seems to be an adequate avenue to be explored, to help classify the unplaced species of *Merremia* s.l. and better understand the relationships within this group, for which few nuclear or chloroplast loci have so far proved inefficient.

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Appendix I. Details of the DNA sequences of *Distimake* used for the present study.

Species	Voucher	ITS	trnC-D	matK	rps16
<i>Aniseia martinicensis</i> 109A	FRI 70036 (KEP)	KP261943	KP236600	KR024890	KR025033
<i>Iseia luxurians</i> 111A	Simoes 66 (BM)	KP261945	KP236642	KR024939	KR025076
<i>Argyreia nervosa</i> 155A	SBG 20031385 (SING)	KP261913	KP236608	KR024898	KR025041
<i>Argyreia siamensis</i> 156A	Staples 1412 (SING)	KP261914	KP236609	KR024899	KR025042
<i>Camonea vitifolia</i> 5B	Pisuttimarn 232 (KKU)	-	-	-	OQ127254
<i>Camonea vitifolia</i> 9B	Pisuttimarn 257 (KKU)	-	-	OQ091931	OQ127255
<i>Camonea vitifolia</i> 23A	Staples 1330 (BM)	KP261964	KP236701	KR0245000	-
<i>Decalobanthus mammosus</i> 20A	Staples 1351 (BM)	KP261987	-	KR024972	KR025104
<i>Decalobanthus peltatus</i> 59A	SAN 152851 (SAN)	KP261989	KP236677	-	-
<i>Decalobanthus sumatranus</i> 45A	Amb. & Arifin 1682 (L)	KP261986	KP236611	KR024904	KR025045
<i>Distimake aegyptius</i> 2F	submitted to GenBank				
<i>Distimake aegyptius</i> 4A	Simões 17 (BM)	KP261965	KP236643	KR024941	KR025078
<i>Distimake aff ericoides</i> 11F	Petrongari 71 (SP)	-	-	OQ091932	-
<i>Distimake aff tomentosus</i> 31F	Petrongari 108 (SP)	-	-	-	OQ127256
<i>Distimake ampelophyllus</i> 40A	Festo <i>et al.</i> 2645 (K)	KP261972	KP236645	KR024943	KR025079

Species	Voucher	ITS	trnC-D	matK	rps16
<i>Distimake aturensis</i> 20A	Irwin et al. 26053 (MO)	KP261974	-	-	-
<i>Distimake aturensis</i> 191A	Whitefoord 2330 (BM)	KP261974	KP236646	-	-
<i>Distimake aureus</i> 42A	Wiggins 5591 (A)	KP261975	-	KR024944	-
<i>Distimake austinii</i> 1A	McDonald s.n. (BM)	KP261983	-	KR024945	KR025080
<i>Distimake cielensis</i> 9A	McDonald s.n. (BM)	KP261976	KP236651	-	KR025085
<i>Distimake cissoides</i> 26A	Staples 1318 (BM)	KP261977	KP236652	KR024951	KR025086
<i>Distimake davenportii</i> 32A	A.R. Bean 23827 (BRI)	KP261966	KP236610	-	KR025045
<i>Distimake digitatus</i> 4F	P 25079 (MO)	KP261908	-	-	-
<i>Distimake dimorphophyllus</i> 102A	Ensermu & Wondafrash 2816 (ETH)	KP261978	KP236654	KR024953	KR025087
<i>Distimake dissectus</i> var <i>edentatus</i> 50A	Nee & Chavez 48899 (MO)	KP261982	KP236657	KR024957	KR025091
<i>Distimake flagellaris</i> 7F	Petrongari 25 (SP)	-	-	OQ091933	-
<i>Distimake guerichii</i> 104A	Simões 44 (BM)	KP261979	KP236662	KR024962	KR025096
<i>Distimake hasslerianus</i> 60A	Petrongari 37 (SP)	-	OQ127261	OQ091934	-
<i>Distimake hoehnei</i> 16F	Pastore 254 (SP)	-	-	OQ091935	-
<i>Distimake igneus</i> 148A	J.G.Carvalho-Sobrinho 3017 (HUEFS)	KP262010	KP236706	KR0245006	
<i>Distimake kentrocaulos</i> 21A	Simões 9 (BM)	KP261998	KP236668	KR024968	KR025102
<i>Distimake macdonaldii</i> 63A	Ludlow & Diego 229 (MEX)	-	KP236671	KR024970	KR025103
<i>Distimake macrocalyx</i> 19A	Simões 7 (BM)	-	OQ127262	OQ091936	-
<i>Distimake macrocalyx</i> 23F	Petrongari 45 (SP)	-	-	OQ091937	OQ127257
<i>Distimake maragniensis</i> 47A	Anderson et al. 35274 (MO)	KP261908	KP236653	KR024952	-
<i>Distimake quinatus</i> 37A	McDonald 3270 (BRI)	KP262002	KP236683	KR024983	KR025113
<i>Distimake quinquefolius</i> 10A	Simões 10 (BM)	KP262003	KP236684	KR024984	KR025114
<i>Distimake somalensis</i> 78A	Thesiger s.n. (BM)	KP261971	KP236689	KR024988	-
<i>Distimake tuberosus</i> 83A	Simões 4 (BM)	KP261967	KP236692	-	KR025118
<i>Ipomoea aquatica</i> 112A	FRI 70037 (FRIM)	KP261915	KP236616	KR024912	KR025049
<i>Ipomoea batatas</i> 113A	Staples 1461 (SING)	-	KP236617	KR024913	KR025050
<i>Ipomoea cairica</i> 114A	Staples 1399 (SING)	KP261916	KP236618	-	KR025051
<i>Ipomoea carnea</i> 115A	SBG 19971190 (SING)	KP261917	KP236619	KR024914	KR025052
<i>Ipomoea intrapilosa</i> 120A	Simões 52 (BM)	KP261922	KP236626	KR024922	KR025059
<i>Ipomoea kituiensis</i> 134A	Sebsebe, Carine, Simões, Wege & Ermias 6958 (BM)	KP261923	KP236627	KR024923	KR025060
<i>Ipomoea littoralis</i> 121A	SAN 152892 (SAN)	KP261924	KP236628	KR024924	KR025061
<i>Ipomoea pestigridis</i> 125A	SBG 20100015 (SING)	KP261928	KP236632	KR024929	KR025066
<i>Ipomoea tricolor</i> 130A	Simões 19 (BM)	KP261936	KP236640	KR024937	KR025074

Species	Voucher	ITS	trnC-D	matK	rps16
<i>Merremia candei</i> IDM058	submitted to GenBank				
<i>Merremia discoidesperma</i> 49A	Breedlove 50934 (MO)	-	-	KR024954	KR025088
<i>Merremia emarginata</i> 16A	Staples 1335 (BM)	KP261993	KP236659	KR024958	KR025092
<i>Merremia gemella</i> 24A	Staples 1333 (BM)	KP261994	KP236661	KR024960	KR025094
<i>Merremia gorinii</i> IDM064	submitted to GenBank				
<i>Merremia gregorii</i> IDM066	submitted to GenBank				
<i>Merremia hederacea</i> 29A	Simões 26 (BM)	KP261995	KP236664	KR024964	KR025098
<i>Merremia hirta</i> 3A	Simões 44 (BM)	KP261996	KP236665	KR024965	KR025099
<i>Merremia incisa</i> 33A	Courie 1234b (BRI)	KP261997	KP236667	KR024967	KR025101
<i>Merremia palmata</i> IDM002	submitted to GenBank				
<i>Merremia sibirica</i> 190A	Forrest 11314 (BM)	KP262004	KP236688	KR024987	-
<i>Merremia subsessilis</i> 80A	Staples 1456 (SING)	KP261990	-	KR024990	-
<i>Merremia thorelii</i> 28A	Staples 1324 (BM)	-	KP236691	KR024991	KR025117
<i>Merremia verruculosa</i> 11A	Staples 1320 (BM)	KP261991	KP236700	KR024999	KR025125
<i>Merremia xanthophylla</i> IDM030	submitted to GenBank				
<i>Operculina aequisejala</i> 13A	Simoes 14 (BM)	KP262008	KP236703	KR0245003	KR025127
<i>Operculina codonantha</i> 22A	Simões 8 (BM)	KP262009	KP236705	KR0245005	-
<i>Operculina hamiltonii</i> 92A	Simões 59 (BM)	KP262011	KP236707	KR0245007	KR025129
<i>Operculina maypurensis</i> 64A	Groger & Llamozas 1145 (MO)	-	KP236673	KR024973	KR025105
<i>Operculina petaloidea</i> 6A	Staples 1372 (BM)	KP262012	KP236708	KR0245009	-
<i>Operculina pinnatifida</i> 94A	Dwyer 1455 (BM)	KP262013	KP236709	KR0245010	KR025130
<i>Operculina pteripes</i> 95A	Wiggins & Rollins 398 (A)	-	KP236710	KR0245011	-
<i>Operculina riedeliana</i> 164A	SBG 20080996 (SING)	-	KP236711	KR0245013	KR025132
<i>Operculina sericantha</i> 96A	Evanst et al. 2695 (MO)	-	KP236713	KR0245014	
<i>Operculina turpethum</i> 97A	Simoes 18 (BM)	KP262015	KP236714	KR0245015	KR025133
<i>Remirema bracteata</i> 15A	Staples 1338 (BM)	KP262007	KP236716	KR0245018	KR025135
<i>Stictocardia tiliifolia</i> 168A	Staples 1400 (SING)	KP261941	KP236719	KR0245021	KR025138
<i>Turbina inopinata</i> 180A	Simoes 57 (BM)	KP261942	KP236720	KR0245022	KR025139
<i>Xenostegia medium</i> IDM036	Bidgood et al. 1528 (BR)	-	OQ127264	OQ091940	OQ127259
<i>Xenostegia pinnata</i> 25A	Simões 15 (BM)	KP261959	KP236678	KR024978	KR025109
<i>Xenostegia sapinii</i> 74A	Breyne 3197 (BR)	-	KP236685	-	-
<i>Xenostegia tridentata</i> 12A	FRI 70040 (KEP)	KP261953	KP236725	-	KR025142
<i>Xenostegia tridentata</i> 31A	Simões 16 (BM)	KP261958	-	KR0245031	KR025150