

RAFAELA ALVES PEREIRA DA SILVA

**FILOGENIA E TAXONOMIA DE *Dalechampia* COM
ÊNFASE EM *Dalechampia* sect. *Dalechampia*,
Euphorbiaceae**

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Euphorbiaceae**

Tese apresentada ao Programa de Pós-Graduação em Botânica da Universidade Federal Rural de Pernambuco, como parte dos requisitos para obtenção do título de Doutora em Botânica.

Orientadora:

Prof^ª. Dra. Margareth Ferreira de Sales
Dept^o de Biologia, Área de Botânica/UFRPE

Co-orientadores:

Dra. Sarah Maria Athiê-Souza
Prof^o. Dr. Luís Gustavo Rodrigues de Souza

Colaborador:

Dr. Scott Armbruster
Prof^o. Dr. André Laurênio de Melo

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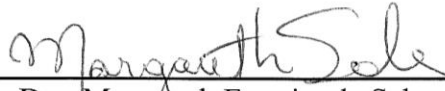
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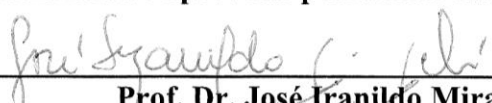
ORIENTADORA:



Profa. Dra. Margareth Ferreira de Sales

Universidade Federal Rural de Pernambuco – UFRPE

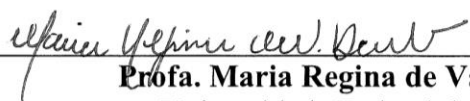
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Prof. Dr. José Iranildo Miranda de Melo

Universidade Estadual da Paraíba – UEPB

Titular



Profa. Maria Regina de Vasconcelos Barbosa

Universidade Federal da Paraíba – UFPB

Titular



Profa. Maria Teresa Buril

Universidade Federal Rural de Pernambuco – UFRPE

Titular



Dr. Jefferson Rodrigues Maciel

Jardim Botânico do Recife – JBR

Titular

Profa. Ariadne do Nascimento Moura

Universidade Federal Rural de Pernambuco – UFRPE

Suplente

Profa. Juliana Santos Silva

Universidade do Estado da Bahia – UNEB

Suplente


Dedico

Ao Espírito Santo de Deus.

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Glória ao Senhor (Aleluia)
Glória ao Senhor (Aleluia)
Autor da minha fé (Aleluia)
Glória ao Senhor...
Paulo César Baruk

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Resumo

SILVA-PEREIRA, Rafaela Alves. Dra. Universidade Federal Rural de Pernambuco. Fevereiro de 2019. Filogenia e taxonomia de *Dalechampia* com ênfase em *Dalechampia* sect. *Dalechampia*, Euphorbiaceae. Dra. Margareth Ferreira de Sales, Dra. Sarah Maria Athiê-Souza, Dr. Luís Gustavo Rodrigues de Souza, Dr. André Laurênio de Melo. Dr. Scott Armbruster

Dalechampia é o único táxon dentro da subtribo Dalechampiinae e ocorre desde a América Central, América do Sul, África, Madagascar até a Ásia, sendo o maior número de espécie registrado para o Brasil. *Dalechampia* é facilmente reconhecido pela sua inflorescência pseudantial, exclusiva na família Euphorbiaceae. No entanto, as espécies de *Dalechampia* são difíceis de serem diferenciadas, principalmente os complexos encontrados em *Dalechampia scandens* e nas subseções *Humiles* e *Triphyllae*. Além disso, os tratamentos infragenéricos propostos por Webster & Armbruster (1991) para a seção *Dalechampia* apresentam alguns problemas em suas delimitações. Nesse sentido, nosso objetivo foi analisar filogeneticamente e revisar *D.* sect. *Dalechampia*. As análises filogenéticas foram conduzidas para as espécies coletadas em campo com a adição dos acessos previamente depositados no *Genbank*. Para a revisão taxonômica foram examinadas mais de 2.000 exsiccatas de herbários internacionais e nacionais além de espécimes coletados em campo. Os resultados são apresentados em 8 manuscritos: 1. No primeiro, são inferidas a origem e dispersão do gênero, assim como sinapomorfias entre espécies africanas e Malgaxes com as neotropicais. Para tanto, foram aplicadas às técnicas de filogenia, biogeografia e evolução de caracteres. 2. No segundo manuscrito é apresentada uma nova classificação infragenérica baseada na filogenia molecular. Neste trabalho, são sinonimizadas as seções *Brevicolumnae*, *Coriaceae* e *Tiliifoliae* à *D.* subsect. *Dalechampia* 3. O terceiro manuscrito é referente à *Dalechampia macrobractea*, uma nova espécie de Euphorbiaceae da África Oriental Meridional, que está aceito no periódico *Systematic Botany*; 4. O quarto manuscrito também é uma espécie nova intitulada *Dalechampia margarethiae*, endêmica do sudeste do Brasil e está aceito no periódico *Systematic Botany*. 5. O quinto manuscrito encontra-se publicado no periódico *Taxon* e trata da tipificação e restabelecimento de *Dalechampia colorata*; 6. O sexto manuscrito é uma sinopse de *Dalechampia* para as espécies do nordeste brasileiro e está submetido no periódico *Biotaneotropica*. 7. No sétimo artigo é trazida a revisão taxonômica para as espécies neotropicais de *Dalechampia* baseada nos resultados do capítulo 1 desta tese; 8. O oitavo é uma revisão taxonômica as espécies de para Madagascar, submetido no Periódico *Systematic Botany*.

Palavras-chave: Dalechampiinae, Biogeografia, molecular, evolução de caracteres

Abstract

SILVA-PEREIRA, Rafaela Alves. Dra. Universidade Federal Rural de Pernambuco. Fevereiro de 2019. Filogenia e taxonomia de *Dalechampia* com ênfase em *Dalechampia* sect. *Dalechampia*, Euphorbiaceae. Dra. Margareth Ferreira de Sales, Dra. Sarah Maria Athiê-Souza, Dr. Luís Gustavo Rodrigues de Souza, Dr. André Laurênio de Melo. Dr. Scott Armbruster

Dalechampia is the unique taxon into subtribe Dalechampiinae and occurs since Central America, South America, Africa, Madagascar and Asia, being the large number registered to Brazil. *Dalechampia* is easily recognized due its pseudanthial inflorescence, exclusively in Euphorbiaceae family. However, the species of *Dalechampia* are difficult to be differentiated, mainly the complexes found in *Dalechampia scandens* and in the subsections *Humiles* and *Triphyllae*. Beyond this, the infrageneric treatments proposed by Webster & Armbruster (1991) to the section *Dalechampia* present some delimitation problems. In this sense, our goal is analyzed phylogenetically and reclassified taxonomically *D.* sect. *Dalechampia*. The phylogenetic analyses were conducted to species collected in the field with addition of access previously deposited in Genbank. To the taxonomic revision were examined more than 2.000 exsiccates from international and national herbaria, beyond specimens collected in the field. The results are presented in 8 manuscripts: 1. In the first one is proposed a new subsection to *Dalechampia* sect. *Dalechampia* which includes African, Madagascar and Asiatic species. In the first one, are inferred the origin and dispersion of the genus, as well as synapomorphies among African, Madagascar and Neotropical species. For this work, were used the techniques of phylogeny, biogeography and character evolution; 2. In the second manuscript is presented a new infrageneric classification based on molecular phylogeny. In this work, are synonymized the section *Brevicolumnae*, *Coriaceae* and *Tiliifoliae* to *D.* subsect. *Dalechampia*; 3. The third manuscript refers to *Dalechampia macrobractea*, a new species from Southern East Africa, which is accepted in the Systematic Botany periodic; 4. The fourth manuscript is also a new species entitled *Dalechampia margarethiae*, endemic of southeast from Brazil, this manuscript is accepted in the Systematic Botany periodic. 5. The fifth manuscript is published in the Taxon Journal and is about the typification and reestablishment of *Dalechampia colorata*; 6. The sixth manuscript is a synopsis to *Dalechampia* Brazilian species from Northeast and is submitted in the Biotaneotropica. 7. In the seventh is a taxonomic revision to Neotropical species of *Dalechampia* based in the results of the chapter 1 of this thesis; 8. The eighth is a taxonomic revision from Madagascar *Dalechampia* species, submitted in the Systematic Botany periodic.

Key-word: Dalechampiinae, Biogeography, molecular, character evolution

1. Introdução

Dalechampia L. (Euphorbiaceae, Plukenetieae) é o único táxon da subtribo Dalechampiinae devido a sua inflorescência em pseudanto, diferente dos demais gêneros em Euphorbiaceae; abrange cerca de 130 espécies e possui distribuição Pantropical (Webster, 1994; Armbruster & al., 1993). São referidas 14 espécies para a América Central, três espécies nas Antilhas, 12 espécies para África, 12 para Madagascar, oito espécies para Ásia e mais de 70 espécies no Brasil, sendo 50 delas endêmicas (Webster, 1994). As espécies de *Dalechampia* ocorrem frequentemente em áreas abertas de matas tropicais secundárias (Armbruster & Webster, 1979, 1982; Armbruster & Steiner, 1992; Maya- L et al. 2016).

Este gênero compreende em maior número espécies trepadeiras, subarbustos eretos a decumbentes e raras lianas (Webster; Armbruster, 1991). Diferencia-se dos demais táxons de Euphorbiaceae por ser o único a apresentar inflorescências do tipo pseudanto com simetria bilateral, formado por duas brácteas grandes e vistosas ou pequenas, estas reduzidas a estípulas, abrigando um pleiocásio estaminado com 4 a quase 50 flores e uma cúpula pistilada com 1-3 flores, podendo ou não apresentar glândulas resiníferas (Leandrii, 1943; Pax & Hoffmann, 1919; Webster; Armbruster, 1991; Armbruster 1996).

Embora as *Dalechampia* apresentem comumente pêlos urticantes nos ramos folhas e frutos, elas têm sido utilizadas em povoados da África, assim como no Brasil, como ervas medicinais. Na Tanzânia, *Dalechampia scandens* var. *cordofana* (Hochst. ex Webb) Müll. Arg. é indicada para o tratamento de indigestão estomacal e dores de cabeça em crianças; No Quênia, as folhas de *D. scandens* var. *hildebrandtii* (Pax) Pax são consumidas como vegetais e na Tanzânia, as raízes são utilizadas em rituais de magia (Burkill, 1985); *D. ipomoeifolia* Benth. é usada tratamento de dores reumáticas em povoados da Etiópia, Uganda e Tanzânia e, no Brasil, há registros do uso medicinal de *D. pernambucensis* Baill. em comunidades do semi-árido bahiano (Schmelzer et al. 2008; Oliveira & Batista, 2014).

Em relação aos tratamentos taxonômicos, o de Pax & Hoffmann (1919) revela a complexidade das relações interespecíficas de *Dalechampia*, uma vez que as chaves de

identificação são inconsistentes e as diagnoses para as seções são superficiais e sobrepõem morfologicamente umas às outras. Webster & Armbruster (1991), com a sinopse para as espécies neotropicais reorganizaram grande parte das seções tratadas por Pax & Hoffmann (1919). Neste trabalho, os autores adotaram uma classificação infragenérica que abrangeu 92 táxons, os quais foram distribuídos em seis seções (*D. sect. Coriaceae* Pax & K. Hoffm., *D. sect. Cremophyllum* Baill., *D. sect. Dalechampia*, *D. sect. Dioscoreifoliae* Pax & K. Hoffm., *D. sec. Rhopalostylis* Pax & K. Hoffm. e *D. sect. Tiliifoliae* G.L. Webster & Armbruster).

Dalechampia sect. Dalechampia destacou-se por ser a maior seção do gênero, subdivida em cinco subseções, compreendendo um total de 53 espécies, distribuídas na região Neotropical desde o México até a Argentina e com maior número de espécies no Brasil (41 spp.). Destas, 22 são endêmicas do país e se encontram distribuídas na mata atlântica, caatinga e cerrado.

Apesar da revisão publicada por Webster & Armbruster (1991), a delimitação de algumas seções bem como a natureza filogenética das mesmas permanecem duvidosas. Os estudos filogenéticos moleculares conduzidos por Armbruster et al. (1998; 2009; 2012), constataram a natureza artificial da seção *Dalechampia*. Contudo, os objetivos de seus estudos eram voltados para a evolução da biologia reprodutiva das espécies e não para a resolução de problemas taxonômicos.

Dessa forma, propõe-se aqui uma nova circunscrição para a seção *Dalechampia* baseada em análises morfológicas e moleculares.

2. Revisão de Literatura

2.1 Histórico do gênero *Dalechampia* L.

Dalechampia foi citado por Plumier (1703) na obra *Plantarum Americanarum Genera*, baseado em *D. scandens* e caracterizado de forma superficial. Linnaeus (1753) estabeleceu definitivamente *Dalechampia* fundamentado na mesma espécie, cujo espécime era proveniente da Índia Ocidental. De acordo com o autor, a espécie poderia ser reconhecida através das folhas trífidas e fruto tricoca hispido.

Lamarck (1786) incluiu 94 famílias botânicas em seu tratamento taxonômico, dentre elas, Euphorbiaceae a qual foi representada, entre outros gêneros, por *Dalechampia* (11 spp.). O autor caracterizou o gênero como ervas de folhas alternas, flores incompletas e axilares, com grandes brácteas involucrais, que abrigam flores envoltas por estruturas foliáceas lanceoladas.

Jussieu (1824), no tratamento taxonômico para os gêneros de Euphorbiaceae, incluiu *Dalechampia* na seção VI, juntamente com *Anthostema* A. Juss., *Euphorbia* L. e *Pedilanthus* Neck. ex Poit., baseando-se principalmente no lóculo 1-ovulado, flores apétalas e monoicas. Contudo, Baillon (1858) não concordou com a inclusão de *Euphorbia* e *Pedilanthus* no mesmo grupo informal de *Dalechampia* em virtude de diferenças notórias em relação às inflorescências.

Baillon (1858) sugeriu a subdivisão do gênero nas seções A, B e *Cremophyllum* Baill. As seções foram fundamentadas na filotaxia, presença ou ausência de estípelas, número de lóculos no ovário e peculiaridades estigmáticas. A seção A era monoespecífica (*D. houlettiana* Baill.), a seção B incluiu 17 espécies e a seção *Cremophyllum* englobava apenas *D. caperonioides* Baill., *D. micrantha* Poepp. e *D. spathulata* (Scheidw.) Baill. (Tabela 1).

Pouco tempo depois, Baillon (1865) incluiu uma nova seção ao conceito de *Dalechampia*, totalizando quatro, as quais compreendiam 23 espécies. Nesta obra, o autor nomeou apenas duas das quatro seções. A primeira seção reuniu seis espécies com folhas compostas, 3-5 folíolos, palmadas; a segunda foi caracterizada por apresentar folhas simples, profundamente palmatilobadas e incluiu quatro espécies; a seção *Cremophyllum*, com 11 espécies, tinha folhas simples, inteiras, geralmente ovais a cordadas e, por fim, a seção *Rhopalostylis* Klotzsch com apenas *D. micrantha*, a qual não foi morfológicamente caracterizada.

Müller (1865-1866), na obra *Linnaea*, foi o primeiro autor a posicionar

Dalechampia em uma tribo, a qual foi chamada de Dalechampieae Müll. Arg. O autor dividiu a tribo em três séries não nomeadas, baseando-se na forma do caule, hábito e formato das folhas, onde foram arranjadas 16 espécies (Tabela 1). A primeira série foi caracterizada pelas espécies com caules eretos e compreendia duas espécies (*D. magnoliifolia* Müll. Arg. e *D. leucophylla* Müll. Arg.). A segunda série, formada pelas espécies de caules escandentes a volúveis, foi subdividida em quatro subséries (A, B, C e D) caracterizadas pela divisão do limbo. Por último, a terceira série era composta por espécies subarborescentes ou de caules procumbentes a ascendentes.

Müller (1866) na obra *Prodromus Systematis Naturalis Regni Vegetabilis*, manteve *Dalechampia* na tribo Dalechampieae, descreveu 47 espécies e dividiu o gênero nas seções *Dalechampia* sect. *Eudalechampia* Müll. Arg. e *D.* sect. *Champadelia* Müll. Arg. (Tabela 1). *Dalechampia* sect. *Eudalechampia* compreendia 50 espécies caracterizadas pela ausência de disco hipógino e, em geral, pelas sépalas pistiladas com tricomas glandulares estipitados. Para esta seção, o autor propôs a subdivisão da seção em sete séries, fundamentando-se, principalmente, no hábito e tipo de folha. No entanto, *D.* sect. *Champadelia* compreendia uma única espécie (*D. houlettiana* Baill.), a qual diferenciava-se da outra seção por apresentar disco hipógino. Müller (1873), na *Flora Brasiliensis*, manteve as duas seções anteriores, entretanto, *Dalechampia* sect. *Eudalechampia* sofreu algumas modificações na composição e caracterização morfológica das seções, reduzindo seu número para 46 espécies. *D.* sect. *Champadelia* permaneceu inalterada.

Pax e Hoffmann (1919) também conservaram *Dalechampia* na mesma tribo e reconheceram 88 espécies. Os autores estabeleceram 11 novas seções para *Dalechampia*, além de *D.* sect. *Cremophyllum* Baill. e *D.* sect. *Champadelia* Müll. Arg., totalizando 13 seções: *Brevipedes* Pax & K. Hoffm., *Champadelia* Müll. Arg., *Caperonoideae* Pax & K. Hoffm., *Cremophyllum* Baill., *Coriaceae* Pax & K. Hoffm., *Dioscoreifoliae* Pax & K. Hoffm., *Guaraniticae* Pax & K. Hoffm., *Humilis* Pax & K. Hoffm., *Leucophyllae* Pax & K. Hoffm., *Rhopalostylis* Pax & K. Hoffm., *Scandentes* Pax & K. Hoffm., *Sylvaticae* Pax & K. Hoffm. e *Triphyllae* Pax & K. Hoffm. As seções foram baseadas no hábito, forma da folha e da sépala pistilada. A seção *Cremophyllum* foi dividida nas séries A e B. A primeira série contendo espécies com inflorescências pedunculadas (*D. spathulata* (Scheidw.) Baill. e *D. magnoliifolia* Müll. Arg.) e, a segunda representada por *D. brevipedunculata* a qual, possui inflorescências subsésseis. Posteriormente, Pax & Hoffmann (1924) transferiram *Dalechampia* para o conceito da

subfamília Crotonoideae juntamente com *Tragia* L., *Hevea* Aubl. e *Jatropha* L., entre outros gêneros. Nesta obra, os autores descreveram nove espécies de *Dalechampia*, mas não caracteriza o gênero como um todo.

Recentemente, Webster & Armbruster (1991) realizaram um estudo sinóptico contendo as espécies neotropicais e propuseram a alteração da circunscrição do gênero através da redução no número de seções de 13 para seis (*D. sect. Coriaceae*, *D. sect. Cremophyllum*, *D. sect. Dalechampia*, *D. sect. Dioscoreifoliae*, *D. sect. Rhopalostylis* e *D. sect. Tiliifolia*) (Tabela 1 e 2). As espécies contidas nas sete seções excluídas por Webster & Armbruster (1991) foram realocadas nessas seis seções supracitadas.

Dentre as seções propostas por Webster & Armbruster (1991), destaca-se *Dalechampia* sect. *Dalechampia* por abrigar o maior número de espécies no Brasil (45 spp.). A seção foi fundamentada em *D. scandens* e subdividida em cinco subseções: *Dalechampia* sect. *Dalechampia* subsect. *Brevipes* (2 spp.), *D. sect. Dalechampia* subsect. *Convolvuloides* (8 spp.), *D. sect. Dalechampia* subsect. *Dalechampia* (12 spp.), *D. sect. Dalechampia* subsect. *Humiles* (15 spp.) e *D. sect. Dalechampia* subsect. *Triphyllae* (15 spp.). As subseções foram caracterizadas principalmente na morfologia das folhas, tamanho e formato das brácteas involucrais, forma das bractéolas estaminadas e quantidade de flores estaminadas e de estames. Webster (1994) reconheceu um pouco mais de 100 espécies para *Dalechampia* e o alocou na subfamília Acalyphoideae, tribo Plukenetieae, subtribo Dalechampiinae.

Tabela 1. Composição de *Dalechampia* e posicionamento de suas espécies nos principais tratamentos.

BAILLON (1858)	MÜLLER (1865-1866)	MÜLLER (1873)	PAX & HOFFMANN (1919)	ARMBRUSTER & WEBSTER (1991)
Seção 1	Tribo Dalechampieae	Tribo Dalechampieae	Sect. <i>Sylvaticae</i>	Sect. <i>Rhopalostylis</i>
<i>D. pentaphylla</i>	Série 1	Sect. <i>Champadelia</i>	<i>D. pentaphylla</i>	<i>D. attenuistylus</i>
<i>D. alata</i>	<i>D. magnoliaefolia</i>	<i>D. houlletiana</i>	<i>D. peckoltiana</i>	<i>D. fragrans</i>
<i>D. triphylla</i>	<i>D. leucophylla</i>	Sect. <i>Eudalechampia</i>	<i>D. sylvatica</i>	<i>D. hastata</i>
<i>D. clausсенiana</i>	Série 2	<i>D. adscendens</i>	Sect. <i>Rhopalostylis</i>	<i>D. liesneri</i>
<i>D. micromeria</i>	<i>D. alata</i>	<i>D. affinis</i>	<i>D. micrantha</i>	<i>D. micrantha</i>
<i>D. houlletiana</i>	<i>D. olfersiana</i>	<i>D. alata</i>	Sect. <i>Leucophylla</i>	<i>D. olympiana</i>
Seção 2	<i>D. sellowiana</i>	<i>D. arciana</i>	<i>D. leucophylla</i>	<i>D. parvibracteata</i>
<i>D. scandens</i>	<i>D. stipulaceae</i>	<i>D. brasiliensis</i>	Sect. <i>Cremophyllum</i>	Sect. <i>Dioscoreifoliae</i>
<i>D. ficifolia</i>	<i>D. variifolia</i>	<i>D. brevipes</i>	<i>D. spathulata</i>	<i>D. alata</i>
<i>D. pernambucensis</i>	<i>D. schizoloba</i>	<i>D. burchelli</i>	<i>D. magnoliifolia</i>	<i>D. juruana</i>
<i>D. granadilla</i>	<i>D. vulpina</i>	<i>D. caperonioides</i>	<i>D. brevipedunculata</i>	<i>D. luetzelburgii</i>
Subsect. <i>Cremophyllum</i>	<i>D. tenuiramea</i>	<i>D. clausсенiana</i>	Sect. <i>Caperonioideae</i>	<i>D. papillistigma</i>
<i>D. spathulata</i>	<i>D. cujabensis</i>	<i>D. convolvuloides</i>	<i>D. francisceana</i>	<i>D. peckoltiana</i>
<i>D. convolvuloides</i>	<i>D. coriácea</i>	<i>D. coriacea</i>	<i>D. caperonioides</i>	<i>D. pentaphylla</i>
<i>D. tiliifolia</i>	<i>D. affinis</i>	<i>D. cuiabensis</i>	Sect. <i>Triphyllae</i>	<i>D. psilogyne</i>
<i>D. cujabensis</i>	Série 3	<i>D. dioscoreifolia</i>	<i>D. Regnellii</i>	<i>D. subintegra</i>
<i>D. arciana</i>	<i>D. humilis</i>	<i>D. glechomaefolia</i>	<i>D. alata</i>	<i>D. sylvestris</i>
<i>D. glecomifolia</i>	<i>D. microphylla</i>	<i>D. goyazensis</i>	<i>D. triphylla</i>	<i>D. violacea</i>
<i>D. coriacea</i>	<i>D. brevipes</i>	<i>D. granadila</i>	<i>D. psilogyne</i>	<i>D. websteri</i>
<i>D. weddelliana</i>		<i>D. humilis</i>	<i>D. clausсенiana</i>	<i>D. arciana</i>
<i>D. leandri</i>		<i>D. ilheotica</i>	<i>D. subintegra</i>	<i>D. megacarpa</i>
<i>D. caperonioides</i>		<i>D. leandrii</i>	<i>D. clematidiofolia</i>	<i>D. canescens</i>
<i>D. francisceana</i>		<i>D. leucophylla</i>	<i>D. hassleriana</i>	<i>D. osana</i>
<i>D. linearis</i>		<i>D. linearis</i>	<i>D. stenosepala</i>	<i>D. shankii</i>
Subsect. <i>Rhopalostylis</i>		<i>D. magnoliaefolia</i>	<i>D. cissifolia</i>	<i>D. uleana</i>
<i>D. micrantha</i>		<i>D. meridionalis</i>	<i>D. panamensis</i>	<i>Albibracteosa</i>
		<i>D. micrantha</i>	<i>D. subternata</i>	<i>D. aristolochiifolia</i>
		<i>D. micromeria</i>	<i>D. indica</i>	<i>D. cujabensis</i>
		<i>D. occidentalis</i>	<i>D. madagascariensis</i>	<i>D. dioscoreifolia</i>
		<i>D. olfersiana</i>	<i>D. olfersiana</i>	<i>D. hutchisoniana</i>

BAILLON (1858)	MÜLLER (1865-1866)	MÜLLER (1873)	PAX & HOFFMANN (1919)	ARMBRUSTER & WEBSTER (1991)
		<i>D. peckoltiana</i>	<i>D. juruana</i>	<i>D. karsteniana</i>
		<i>D. pentaphylla</i>	<i>D. Weberbaueri</i>	<i>D. scottii</i>
		<i>D.</i>	<i>D. galpini</i>	Sect.
		<i>pernambucensis</i>		Cremophyllum
		<i>D. psilogyne</i>	<i>D. pallida</i>	<i>D.</i>
				<i>brevipedunculata</i>
		<i>D. scandens</i>	<i>D. meridionalis</i>	<i>D. magnoliifolia</i>
		<i>D. sellowiana</i>	<i>D. micromeria</i>	<i>D. spathulata</i>
		<i>D. spathulata</i>	<i>D. sewoliana</i>	Sect. Coriaceae
		<i>D. stenosepala</i>	<i>D. burchellii</i>	<i>D. coriacea</i>
		<i>D. stipulacea</i>	<i>D. bangii</i>	Sect. Tiliifoliae
		<i>D. subintegra</i>	<i>D. anomala</i>	<i>D. affinis</i>
		<i>D. tenuiramea</i>	<i>D. heteromorpha</i>	<i>D. fernandesii</i>
		<i>D. tiliaefolia</i>	Sect. Brevipedes	<i>D. ilheotica</i>
		<i>D. triphylla</i>	<i>D. riedeliana</i>	<i>D. tiliifolia</i>
		<i>D. variifolia</i>	<i>D. brevipes</i>	Sect.
				Dalechampia
		<i>D. weddelliana</i>	Sect. Scandentes	Subsect.
			<i>D. stipulacea</i>	Dalechampia
			<i>D. granadilla</i>	<i>D. armbrusteri</i>
			<i>D. variifolia</i>	<i>D. brasiliensis</i>
				<i>D.</i>
			<i>D. brasiliensis</i>	<i>browsbergensis</i>
			<i>D. karsteniana</i>	<i>D. ficifolia</i>
			<i>D. ficifolia</i>	<i>D. grandilla</i>
			<i>D. uleana</i>	<i>D. herzogiana</i>
			<i>D. bidentata</i>	<i>D. magnistipulata</i>
				<i>D.</i>
			<i>D. scandens</i>	<i>pernambucensis</i>
			<i>D. sinuata</i>	<i>D. riparia</i>
			<i>D. herzogiana</i>	<i>D. scandens</i>
			<i>D. tiliifolia</i>	<i>D. stipulacea</i>
			<i>D. ilheotica</i>	<i>D. variifolia</i>
			<i>D. tamifolia</i>	<i>D. viridissima</i>
				Subsect.
			<i>D. ipomocifolia</i>	Convolvuloides
			Sect.	<i>D. arenalensis</i>
			Guaraniticae	<i>D. boliviana</i>
			<i>D. linearis</i>	<i>D.</i>
				<i>convolvuloides</i>
			<i>D. guaranitica</i>	<i>D. denticulata</i>
			<i>D. morifolia</i>	<i>D. hispida</i>
			<i>D. occidentalis</i>	<i>D. leandrii</i>
			<i>D. amambayensis</i>	<i>D. schenckiana</i>
			<i>D. rubrivenia</i>	<i>D. tenuiramea</i>
			<i>D. trichophila</i>	Subsect. Humiles
			<i>D. serrula</i>	<i>D. caperonioides</i>
			<i>D. weddelliana</i>	<i>D. francisceana</i>
			Sect.	<i>D. leucophylla</i>
			Dioscoreifoliae	
			<i>D. dioscoreifolia</i>	<i>D. adscendens</i>

BAILLON (1858)	MÜLLER (1865-1866)	MÜLLER (1873)	PAX & HOFFMANN (1919)	ARMBRUSTER & WEBSTER (1991)
			<i>D. affinis</i>	<i>D. glechomifolia</i>
			<i>D.</i>	<i>D. linearis</i>
			<i>aristolochiifolia</i>	
			<i>D. arciana</i>	<i>D. occidentalis</i>
			<i>D. cujabensis</i>	<i>D. parvula</i>
			<i>D. leandrii</i>	<i>D. rubrivenia</i>
			<i>D. schenckiana</i>	<i>D. serrula</i>
			<i>D. denticulata</i>	<i>D. ulmifolia</i>
			<i>D. convolvuloides</i>	<i>D. weddelliana</i>
			<i>D. boliviana</i>	<i>D. schippii</i>
			<i>D. tenuiramea</i>	Subsect.
				<i>Brevipedes</i>
			<i>D. schotti</i>	<i>D. brevipes</i>
			<i>D. canescens</i>	<i>D. riedeliana</i>
			<i>D. friedrichsthalii</i>	Subsect.
				<i>Triphyllae</i>
			<i>D. chevalieri</i>	<i>D. anomala</i>
			<i>D. bernieri</i>	<i>D. bangii</i>
			<i>Humiles</i>	<i>D. burchellii</i>
			<i>D. adscendens</i>	<i>D. cissifolia</i>
			<i>D. ulmifolia</i>	<i>D. clauseniana</i>
			<i>D. glechomifolia</i>	<i>D. hasleriana</i>
			<i>D. parvula</i>	<i>D. heteromorpha</i>
			Sect. <i>Coriaceae</i>	<i>D. laevigata</i>
			<i>D. coriacea</i>	<i>D. meridionalis</i>
			Sect.	<i>D. micromeria</i>
			<i>Champadelia</i>	
			<i>D. houlettiana</i>	<i>D. olfersiana</i>
				<i>D. regnelli</i>
				<i>D. stenosepala</i>
				<i>D. triphylla</i>
				<i>D. weberbaueri</i>
				<i>Espécies incertae</i>
				<i>D. martiana</i>
				<i>D. ternata</i>

Tabela 2. Alterações nomenclaturais propostas por Webster & Armbruster (1991) para as espécies de *Dalechampia* baseando-se na circunscrição de Pax & Hoffmann (1919).

Pax & Hoffmann (1919)	Webster & Armbruster (1991)
<i>D. sect. Sylvaticae</i>	Seção <i>Dioscoreifoliae</i>
<i>D. spathulata</i> var. <i>amazonica</i>	<i>D. magnoliifolia</i>
<i>D. sect. Scandentes</i>	<i>D. subsect. Dalechampia</i>
<i>D. scandens</i> var. <i>pernambucensis</i>	<i>D. pernambucensis</i>
<i>D. stipulacea</i> var. <i>bogotensis</i>	<i>D. stipulacea</i>
	<i>D. tenuiramea</i>
<i>D. tenuiramea</i> var. <i>cynanchoides</i>	
<i>D. sect. Guarantiticae</i>	<i>D. subsect. Humiles</i>
<i>D. sect. Caperonioides</i>	<i>D. subsect. Humiles</i>
<i>D. sect. Leucophyllae</i>	<i>D. subsect. Humiles</i>
<i>D. linearis</i> var. <i>goyazensis</i>	<i>D. linearis</i>
<i>D. ulmifolia</i> var. <i>grueningiana</i>	<i>D. ulmifolia</i>
<i>D. amambayensis</i>	<i>D. weddelliana</i>
<i>D. morifolia</i>	<i>D. weddelliana</i>
<i>D. trichophila</i>	<i>D. weddelliana</i>
<i>D. sect. Brevipedes</i>	<i>D. subsect. Brevipedes</i>
<i>D. pallida</i>	<i>D. meridionalis</i>
<i>D. micromeria</i> var. <i>angustifolia</i>	<i>D. micromeria</i>
<i>D. crenulata</i>	<i>D. micromeria</i>

2.2 Morfologia de *Dalechampia* L.

3. 1. Hábito, ramos e indumento

Espécies de *Dalechampia* são predominantemente trepadeiras, algumas são lianas (*D. convolvuloides* Lam., *D. coriacea* Klotzsch ex Mull. Arg., *D. ficifolia* Lam., *D. ilheotica* Wawra, *D. stipulacea* Lam. e *D. violacea* Pax & K. Hoffm.), porém podem ser encontradas espécies com hábito subarborescente (apenas nas espécies de *D. subsect. Humiles*) e arbustivo (*Dalechampia* sect. *Cremophyllum*) (Webster & Armbruster, 1991, Silva & Souza, 2009; Pereira-Silva, 2015; Pereira-Silva et al. 2016, dados não publicados). As trepadeiras são mais abundantes e apresentam formas e tamanhos variados nas regiões tropicais (Engel et al. 1998). Segundo Webster & Armbruster (1991) o hábito trepador é aparentemente primitivo e também predominante em *Plukenetia* e *Tragia*. Os ramos são cilíndrico e quanto a coloração podem ser esverdeados a vináceos, não apresentam gavinhas nem lenticelas.

Em relação aos tricomas, estes podem ser de dois tipos bem distintos, unicelular simples e urticante especializado. Os tricomas urticantes, tipicamente encontrados no gênero, podem injetar compostos irritantes na pele e são encontrados em todos os órgãos da planta (Webster & Webster, 1972; Webster & Armbruster, 1991; Armbruster et al. 2009). Em *Dalechampia* encontram-se, mais comumente, os seguintes tipos de indumento: ciliado, glandular, hirsuto, hispido, tomentoso, pubescente e viloso (Pereira-Silva et al. 2016, dados não publicados).

3.2 Folhas

As folhas variam de simples (inteiras a lobadas) a compostas (3-5 folioladas). Inclusive, a variabilidade foliar existente no gênero é importante do ponto de vista taxonômico, uma vez que Webster & Armbruster (1991), utilizaram a divisão do limbo como um dos principais caracteres diagnósticos para delimitar as categorias infragênicas. As folhas inteiras apresentam diversas formas como lineares, obovadas, cordiformes e lanceoladas, além daquelas profundamente lobadas. Nas 3-folioladas, os folíolos são em geral elípticos, sendo o folíolo central com base aguda e os laterais com base assimétrica. Nas espécies neotropicais do gênero, é comum as folhas variarem entre inteiras e lobadas no mesmo indivíduo, e nas espécies Madagascarenses, também

pertencentes à seção *Dalechampia*, podem apresentar folhas simples e compostas no mesmo indivíduo.

Na seção *Cremophyllum*, as folhas são distintivas das demais, por serem simples exclusivamente inteiras e lanceoladas, com base atenuada. Nas seções *Dioscoreifoliae* e *Dalechampia* as folhas variam entre simples, lobadas ou compostas. Em *Rhopalostyllis* as folhas são, geralmente, inteiras, preferencialmente cordiformes e raramente 3-lobadas, como em *D. hastata* Webster. Na seção *Coriaceae*, a qual compreende somente *D. coriacea* Klotzsch ex Müll. Arg., as folhas são inteiras, de base truncada a levemente cordada. E, por último, na seção *Tiliifoliae*, as folhas são inteiras ou lobadas de base cordada e ainda podem variar de inteiras a lobadas no mesmo indivíduo.

Nas margens das folhas é comum encontrar glândulas papiliformes ou tricomas glandulares estipitados. Em relação à consistência das folhas, esta pode ser cartácea, membranácea ou coriácea.

Além das estípulas, é válido ressaltar que na base de cada folha das espécies de *Dalechampia* há duas estípelas lineares que podem estar associadas a glândulas ou não (Pereira-Silva, 2015). As estípelas são consideradas importantes para o reconhecimento das espécies de *Dalechampia*, uma vez que podem ser variáveis quanto à presença, consistência entre outros caracteres. São decíduas em *D. micrantha*, *D. aristolochiifolia* e *D. tiliifolia*. Particularmente, na seção *Cremophyllum*, as estípelas tornam-se enrijecidas na maturidade (Webster & Armbruster, 1991). *Tragia* compreende algumas espécies com estípelas decíduas, enquanto que as espécies de *Plukenetia* não apresentam estípelas, mas possuem 1-3 pares de glândulas na base da lâmina (Gillespie & Armbruster, 1997).

3.3 Inflorescência

A inflorescência de *Dalechampia* apresenta uma morfologia única dentro de Acalyphoideae (Gagliard, 2014) e de Euphorbiaceae como um todo (Gillespie & Armbruster, 1997). Sua inflorescência é do tipo pseudanto, o qual é composto por várias flores que imitam uma única flor (Radford et al. 1974). Por apresentar essa peculiaridade morfológica, o pseudanto de *Dalechampia* é considerado único na natureza (Gagliard, 2014). Este é de simetria bilateral com duas brácteas involucrais que abrigam flores pistiladas e estaminadas, as quais são monoclamídeas, além de uma glândula resinífera (Souza et al. 2010; Calaça & Vieira, 2012) (Figura 1).

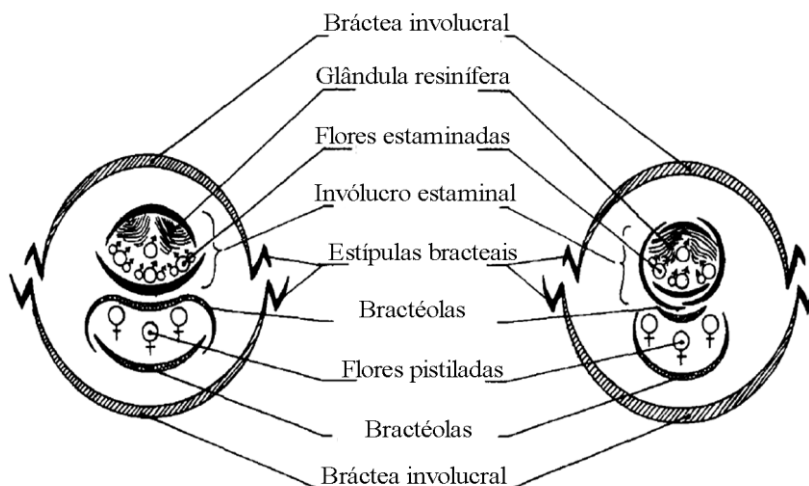


Figura 1. Diagrama da morfologia do pseudanto de *Dalechampia* (Fonte: Webster & Armbruster, 1991. Adaptado).

As brácteas involucrais apresentam diversas formas, tamanhos e cores. Elas variam de ovadas a oblongas, inteiras, 3-5 lobadas ou estipuliformes e seu tamanho é uma das características utilizadas para distinguir algumas das seções do gênero. Em *D. sect. Rhopalostylis*, por exemplo, o tamanho da bráctea é de até 1 cm de comprimento; em *D. sect. Brevicolumnae*, as brácteas involucrais são estipuliformes e medem cerca de 2.5 mm compr. Nas demais seções, a bráctea involucral tem comprimento sempre superior a 1 cm (Armbruster & Webster, 1991). Quanto à coloração, podem ser esverdeadas, esbranquiçadas, róseas, amareladas, púrpuras e violáceas (Webster & Webster, 1972; Cordeiro, 1997; Pereira-Silva et al. 2016).

Nas laterais da base de cada bráctea involucral há um par de estruturas foliáceas (Figura 1), denominadas por Webster & Armbruster (1991) como estípulas bracteais, as quais seriam homólogas àquelas encontradas nas folhas. As estípulas bracteais são razoavelmente variáveis quanto ao formato, podendo ser: lineares, deltóides ou lanceoladas (Pereira-Silva, 2015).

Calaça & Vieira (2012) estudaram a biologia do pseudanto de *Dalechampia* aff. *Triphyla* Lam. e observaram que o pseudanto tem duração média de dez dias e a antese começa com o primeiro movimento de abertura das brácteas involucrais, proporcionando a visita de polinizadores as suas subinflorescências. Primeiramente, o pseudanto encontra-se exclusivamente na fase feminina, que dura cerca de dois dias. Na antese das flores estaminadas, a primeira flor a se abrir é a central, e posteriormente, as demais flores estaminadas se abrem, dando início à fase bissexuada do pseudanto. A viabilidade polínica dessa espécie foi de 92,4%.

Címula estaminada — É formada por um involúcro 2-labiado, de 1-5 bractéolas livres ou conadas, abrigando 7-15 flores estaminadas, com 4 sépalas valvares e curvadas e bractéolas inférteis também chamadas de glândulas resiníferas (Webster & Webster, 1972; Webster & Armbruster, 1991). Essas glândulas são formadas por subunidades, que em conjunto, apresentam um formato escamiforme ou fimbriadas, elas secretam resina ou são apenas aromáticas. A resina secretada pelas glândulas, por sua vez, pode ser amarelada, esverdeada ou esbranquiçada (Webster & Armbruster, 1991). A quantidade de estames varia de 4-75 (Pereira-Silva, 2015) e os grãos de pólen, segundo Punt (1962), são distintos de qualquer outro gênero de Euphorbiaceae. Estes apresentam formato prolato-esferoidal, âmbito circular, com 3-cólpores curtos e estreitos, endoaberturas endocinguladas, com costa, a exina é reticulada, com muros sinuosos e a sexina mais espessa que a nexina (Corrêa et al. 2010).

Címula pistilada— A címula pistilada posiciona-se adjacente à címula estaminada e compreende 3 flores pistiladas protegidas por 1-3 bractéolas. As sépalas variam de 6-12, podendo ser lanceoladas (seção *Rhopalostylis*), pinatífidas ou pinatissectas, geralmente com tricomas glandulares (maioria das espécies neotropicais). As flores pistiladas de *Tragia* assemelham-se às flores pistiladas de *Dalechampia*, *Tragia tabulaemontana* L.J. Gillespie, por exemplo, tem o pedicelo pistilado com aproximadamente 1 mm compr., puberuloso, hirsuto no ápice, com tricomas glandulares nas margens, seis sépalas lanceoladas de até 2 mm compr., com tricomas urticantes e glandulares (Gillespie & Armbruster, 1997). Corroborando com Webster & Armbruster (1991), a flor pistilada de *Dalechampia* também possui similaridades às flores da tribo Plukenetieae. Segundo esses autores, a coluna estilar é um remanescente do gênero *Plukenetia*, mas as sépalas com tricomas urticantes lembram as de *Tragia*. Quanto ao ápice da coluna estilar de *Dalechampia*, estas podem apresentar formatos diferenciados como lobado, cilíndrico, clavado ou discóide. Algumas espécies do gênero apresentam a capacidade de modificar a coloração da coluna estilar, como em *D. erythrostyla* R. A. Pereira-Silva & A. L. Melo (2016), a qual modifica sua coloração de esverdeada para avermelhada após a polinização (Figura 3). E o ovário é sempre 3-locular, 3-carpelar, 1 óvulo por lóculo (Webster & Armbruster, 1991).

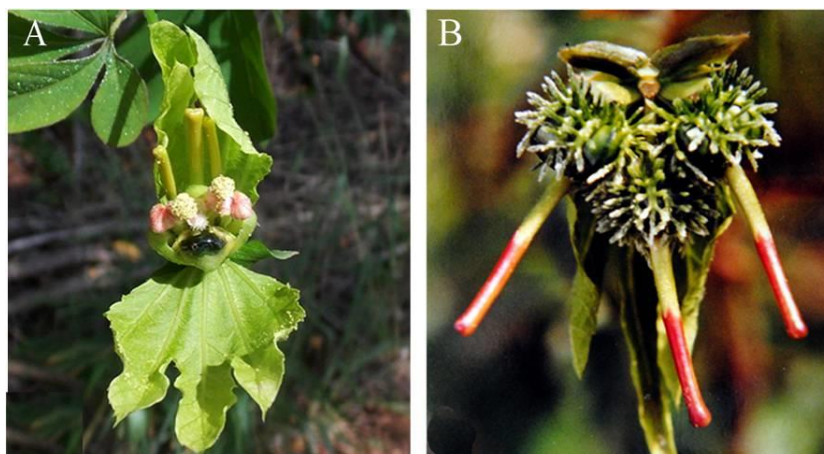


Figura 3. Pseudanto de *Dalechampia erythrostyla*. **A:** Coluna estilar esverdeada, antes da polinização. **B:** Metade superior da coluna estilar avermelhada após a polinização.

3.4 Frutos

Os frutos são tricarpelares e secos, cujos carpelos se dispersam como mericarpos (esquizocárpico). Cada coca apresenta o formato globoso e a deiscência do fruto ocorre através da separação das cocas ao longo da sutura dorsal ou região mediana do carpelo (Silva e Souza, 2009). A coloração é variável entre castanho a esverdeada e, geralmente, são pubescentes e revestidos por tricomas urticantes. Assim como *Dalechampia*, *Tragia* também possui frutos cobertos por tricomas urticantes (Gillespie & Armbruster, 1997).

As brácteas involucrais, estípulas bracteais, sépalas pistiladas e coluna estilar são persistentes no fruto (Pereira-Silva, 2015). O cálice e o pedicelo podem ser acrescentes ao fruto (Webster & Webster, 1972).

3.5 Sementes

As sementes são geralmente globoides, raramente achatadas, ecarunculadas, com testa lisa ou rugosa, com ou sem máculas e de coloração castanha. (Pereira-Silva et al. 2016). Silva & Souza (2009) acrescentaram que a semente é albuminosa com embrião reto e cotilédones finos.

Tokuoka & Tobe (2003) analisaram óvulos e sementes de Acalyphoideae, incluindo na amostragem *D. caperonioides* Baill., *D. scandens* L. e *D. tiliifolia* Lam.. Neste trabalho, os autores comentaram que os óvulos de *Dalechampia* são bitégmicos, com tegumento interno desprovido de feixes vasculares, e as sementes são exotégmicas. Eles ainda complementam que é comum em Acalyphoideae a semente exotégmica com exotégmen paliádico (isto é, com células radialmente alongadas e esclerótica).

2.3 Filogenia de *Dalechampia*

Dalechampia tem sido alvo de diversos estudos filogenéticos morfológicos e moleculares orientados para a compreensão da evolução dos sistemas de polinização e de defesa contra herbívoros (Armbruster 1994; Armbruster & Baldwin 1998; Armbruster et al. 2009; Armbruster et al. 2012). A reconstrução filogenética molecular de *Dalechampia* tem sido baseada em Inferência Bayesiana e Máxima Parcimônia, a partir de sequências do DNA do cloroplasto (cpDNA) e regiões 18S-26S do ribossomo nuclear (ETS e ITS).

Armbruster (1994) conduziu uma análise cladística, baseado em 46 caracteres morfológicos de 25 espécies neotropicais, quatro africanas, além de três exclusivas da ilha de Madagascar. A partir desse trabalho, o autor inferiu que o gênero teve origem nos Neotrópicos ou no Oeste do Gondwana, atual América do Sul, posteriormente colonizou a África e, mais recentemente, Madagascar. Além disso, pode-se constatar que *Dalechampia* originou-se em uma linhagem de espécies com glândula resinífera, contudo, a dispersão delas da África para Madagascar levou ao desaparecimento dessa glândula. O mesmo autor em 1998, baseado em análise molecular, explicou que esse evento se deu devido à falta de polinizadores específicos coletores de resina. Provavelmente, o único polinizador coletor de resina na África (abelhas Megachilidae) tenha falhado ao colonizar Madagascar, favorecendo a outros polinizadores coletores de pólen que devem ter polinizado acidentalmente as *Dalechampia* dessa ilha. Sendo assim, as espécies se adaptaram ao novo sistema de polinização, levando a perda da glândula resinífera, conduzindo a uma evolução diferenciada das espécies e, conseqüentemente, à diversificação do gênero em Madagascar.

Entretanto, em um tempo relativamente curto, Armbruster (2012), identificou uma reversão evolutiva nas espécies do clado de Madagascar, as quais voltaram a apresentar um sistema de polinização especializado (com um ou poucos polinizadores) como os seus ancestrais e não mais generalizado (com vários tipos de polinizadores). Segundo este autor, a seleção natural voltada à especialização pode ser intensa, quando há apenas uma recompensa, como no caso dessas espécies que forneciam apenas o pólen.

Armbruster (1993) comentou que os sistemas de polinização de *Dalechampia* são evolutivamente instáveis e frequentemente apresentam reversões ou paralelismos. Isso provavelmente esteja associado a uma forte pressão seletiva e pré-condições necessárias para responder à seleção natural. As respostas a essas pressões seletivas têm facilitado o desenvolvimento de várias exaptações (i.e. adição ou adaptação para outra função).

Outros estudos moleculares de Armbruster mostraram a evolução de *Dalechampia* a partir de duas características cruciais no gênero, o rearranjo das glândulas resiníferas na címula estaminada e a secreção de resina pelas margens das folhas e estípulas (Armbruster et al. 1997; 2009). Em espécies primitivas de *Dalechampia*, como por exemplo, *D. fragrans* Armbr., as glândulas resiníferas circundam cada flor estaminada, as quais desempenham o papel de proteção das flores contra herbívoros (Figura 4). No entanto, em espécies de *Dalechampia* mais derivadas, a resina atua como uma recompensa ao polinizador e as glândulas são unidas, formadas pela aglomeração de bractéolas resiníferas (Armbruster et al. 1997; 2009) (Figura 4).

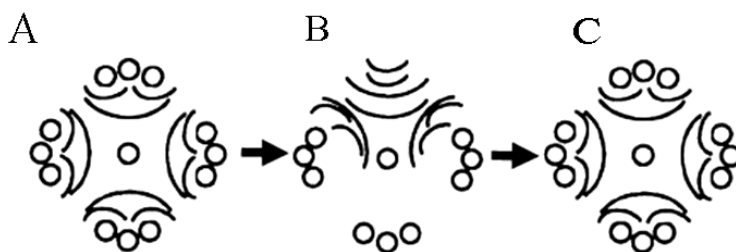


Figura 4. A: Inferência do arranjo ancestral; em B: Mudança da posição da glândula de defesa das flores estaminadas para atração de polinizadores; C: reversão ao estado ancestral da címula estaminada em algumas espécies de *Dalechampia*. (Fonte: Armbruster et al. 2009, Adaptado).

Armbruster et al. (2009) admitiram que o repetido número de reversão para o arranjo ancestral nas flores masculinas e glândulas resiníferas parece ser um fenômeno bastante intrigante na evolução de *Dalechampia* (Figura 4). Os autores relataram que o rearranjo da glândula resinífera para a defesa das flores estaminadas, está associado com a mudança de polinizador por fragrância ou pólen.

No trabalho supracitado, os autores analisaram os padrões macroevolutivos de defesa e polinização do gênero de 81 taxa de 88 populações contemplando algumas espécies das seções *Dalechampia*, *Dioscoreifoliae* e *Rhophalostylis*. Entre os resultados do trabalho, foi verificada a origem independente dos tricomas cristalíferos urticantes nas estruturas vegetativas, os quais surgiram em mais de uma linhagem em diferentes momentos. Essa característica não é exclusiva de *Dalechampia* sendo reportada também para representantes de *Tragia*. Outra similaridade existente entre os dois gêneros supracitados refere-se ao compartilhamento de estruturas florais secretoras de resina triterpênica. De acordo com os autores, essa característica teria uma origem evolutiva comum em *Dalechampia* e *Tragia*. Ao longo da história evolutiva de *Dalechampia*, a

resina passou a desempenhar o papel de recompensa ao polinizador ao invés de atuar na defesa contra herbívoros. Desse modo, outras estratégias de defesa foram desenvolvidas, como o surgimento de glândulas secretoras de resina nas brácteas involucrais para proteger os frutos (como em *D. scandens* L) e em outros órgãos da planta, tais como: margens das estípulas, folhas, brácteas involucrais e sépalas pistiladas (como em *D. stipulacea* Müll. Arg) (Figura 5). Além disso, apareceram tricomas rígidos, como espinhos curtos, nas sépalas pistiladas para a proteção de frutos e, conseqüentemente, das sementes.

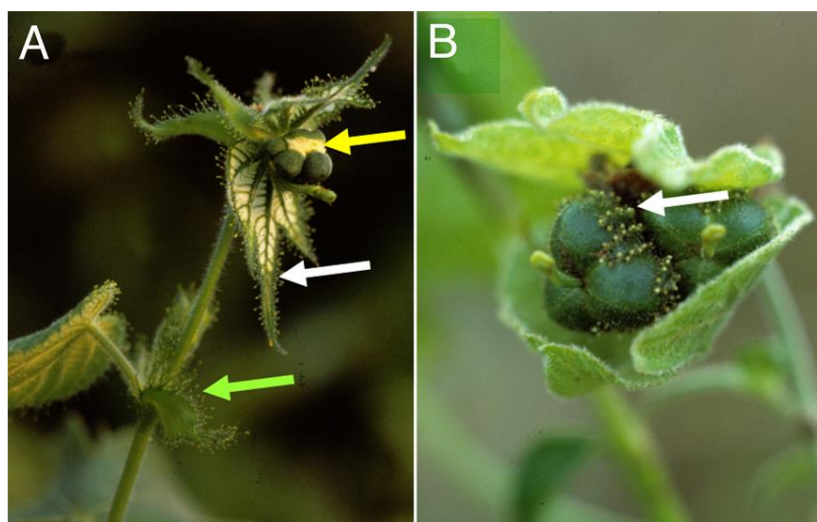


Figura 5. A: *D. stipulacea*, a seta amarela indica a glândula resinífera de coloração amarelada, as setas branca e verde mostram as margens glandulares secretoras de uma mistura de cetonas e álcoois triterpênicos oxigenados presentes nas brácteas involucrais estípulas bracteais e das folhas, respectivamente. **B:** Fruto de *D. scandens* mostrando as glândulas capitadas nas sépalas que secretam uma resina triterpena-oxigenada (Fonte: Armbruster et al. 2009, Adaptado).

De acordo com a topologia da árvore filogenética obtida por Armbruster et al. (2009), as espécies das seções *Dalechampia*, *Dioscoreifoliae* e *Rhopalostylis* emergiram conjuntamente em um mesmo clado, evidenciando o parafiletismo destes táxons. Corroborando com os resultados encontrados por Ambruster (1997), o qual analisou do ponto de vista filogenético morfológico, 22 taxa incluindo pelo menos um representante das principais seções de *Dalechampia*. Neste estudo, as seções *Dioscoreifoliae* e *Rhopalostylis* apareceram como parafilética e, adicionalmente foram descritas três novas espécies (*D. brevicolumnae* Armb., *D. gentry* Armb. e *D. heterobracteae* Armb.), sendo a primeira alocada em uma nova seção, *D. sect. Brevicolumnae* Armb., também proposta pelo autor neste trabalho.

Wurdack et al. (2005) em uma análise molecular de Euphorbiaceae, utilizaram

apenas um representante do gênero, *Dalechampia spathulata* (Scheidw.) Baill. Neste caso, *Dalechampia* emergiu como grupo irmão de *Astrococcus* tornando a subtribo Plukenetiinae parafilética.

Um trabalho mais recente sobre a filogenia molecular e evolução do pólen na tribo Plukenetieae, indicou que *Dalechampia* emergiu primeiramente em uma linhagem divergente e formou um clado irmão pobremente suportado com Plukenetiinae e Tragiinae (Cardinal-McTeague & Gillespie, 2016).

3. Referências bibliográficas

ARMBRUSTER, W. S.; WEBSTER, G. L. Pollination of two species of *Dalechampia* (Euphorbiaceae) in Mexico by euglossine bees. **Biotropica**, v. 11: 278-283, 1979.

ARMBRUSTER, W. S.; WEBSTER, G. L. Divergent Pollination Systems in Sympatric Species of South American *Dalechampia* (Euphorbiaceae). **The American Midland Naturalist**, v. 108, 2, 325-337, 1982.

ARMBRUSTER, W. S. Evolution of plant pollination systems: hypotheses and tests with the neotropical vine *Dalechampia*. **Evolution**, 47, n. 5, 1480-1505, 1993.

ARMBRUSTER, W.S. Cladistic Analysis and Revision of *Dalechampia* Sections *Rhopalostylis* and *Brevicolumnae* (Euphorbiaceae). **Systematic Botany**, v. 21, n. 2, p. 209-235, 1996.

ARMBRUSTER, W. S.; BALDWIN, B. G. Switch from specialized to generalized pollination. **Nature**, v. 394, 632 p. 1998.

ARMBRUSTER, W. S.; LEED, J.; BALDWIN, B. G. Macroevolutionary patterns of defense and pollination in *Dalechampia* vines: Adaptation, exaptation, and evolutionary novelty. **PNAS**, v. 106 n. 43, p. 18085–18090, 2009.

ARMBRUSTER, W. S.; LEE, J.; EDWARDS, M. E., BALDWIN, B. G. Floral paedomorphy leads to secondary specialization in pollination of Madagascar *Dalechampia* (Euphorbiaceae). **Evolution**, v. 67 n. 4, p. 1196–1203, 2012.

BAILLON, H. **Étude générale du groupe Euphorbiacées**, Librairie de Victor Masson, 698 p. 1858.

BAILLON, H. Recueil d'observations botaniques/redige par le Dr. H. Baillon. **Adansonia**, v. 1, p. 309-317, 1865.

Burkill, H.M. The useful plants of west tropical Africa, 1985.

CALAÇA, P. S. S. T.; VIEIRA, M. F. Biologia do pseudanto de *Dalechampia* aff. *triphyllo* Lam. (Euphorbiaceae) e sua polinização por abelhas (Apidae, Meliponina). **Revista Brasileira de Biociências**, v. 10, n. 3, p. 303-308, 2012.

CORDEIRO, I. *Dalechampia purpurata* Cordeiro (Euphorbiaceae), a new species from Chapada Diamantina, Bahia, Brazil. **Kew Bulletin**, v. 53, v. 2. 1997.

CORREA, A. M. S.; BARROS, M. A. V. C.; CAPELATO, M. S. F. S.; PREGUN M. A.; RASO, P. G.; CORDEIRO, I. Flora polínica da Reserva do Parque Estadual das Fontes do Ipiranga (São Paulo, Brasil). **Hoenea**, v. 37, n. 1, 53-69, 2010.

ENGEL, V. L.; FONSECA, R. C. B.; OLIVEIRA, R. E. Ecologia de lianas e o manejo de fragmentos florestais. **Série Técnica IPEF**, v. 12 n. 32, p. 43-64, 1998.

GAGLIARDI, K. B. **Estudo Ontogenético da redução floral em Euphorbiaceae e das estruturas secretoras associadas: anatomia e evolução**. Dissertação de Mestrado, Universidade de São Paulo, São Paulo, 37 f., 2014.

GILLESPIE, L. J.; RMBRUSTER, W, S. A Contribution to the Guianan Flora: *Dalechampia*, *Haemutostemon*, *Omphalea*, *Pera*, *Plukenetia*, and *Tragia* (Euphorbiaceae) with Notes on Subfamily Acalyphoideae. **Smithsonian Institution Press**, Washington, D.C. 52p. 1997.

JUSSIEU, A. **De Euphorbiacearum generibus medicisque earumdem viribus tentamen**. Didot, Paris 1824.

LAMARCK, J. B. A. P. M. Euphorbiaceae. **Encyclopédie Méthodique**, Botanique 2: 258. 1786.

LEANDRI J. D. Contribution a L'étude des Euphorbiacées de Madagascar (III). **Notulae Systematicae. Herbarium du Museum de Paris**, 11: 35-46, 1943.

LINNAEUS, C. Exhibentes plantas rite cognitatas, ad genera relatas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas. **Species plantarum**, v. 2, 1054 p., 1753.

MAYA-L., C. A.; SECCO, SILVA, R..A. P.; SALES, M. F. *Dalechampia* in **Lista de Espécies da Flora do Brasil**. Jardim Botânico do Rio de Janeiro, 2013. Disponível em: <<http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB17549>> Acesso em: 01 de outubro de 2016.

MÜLLER, J. *Euphorbiaceae*. **Linnaea**, v. 34, p. 219-224, 1865-1866.

MÜLLER, J. *Euphorbiaceae*. In: DE CANDOLLE, A. P. (ed) **Prodromus Systematis Naturalis Regni Vegetabilis**, v. 15, n. 2, p. 189-1273, 1866.

MÜLLER, J. A. Família Euphorbiaceae. Classificação segundo a Flora Brasiliensis. **Flora Brasiliensis**, v. 11, p. 633-664, 1873.

MELO-BATISTA, A. A.; OLIVEIRA, C. R. M. Plantas utilizadas como medicinais em uma comunidade do semiárido baiano: saberes tradicionais e a conservação ambiental, **Enciclopédia Biosfera**, Centro Científico Conhecer - Goiânia, v.10, n.18, p. 2014.

PAX, F.; HOFFMANN, K. Euphorbiaceae-Dalechampieae. In: **Das Pflanzenreich. Regni vegetabilis conspectus** (A. Engler, ed.), Leipzig, 147 (helf 12): 1-59, 1919.

PAX, F.; HOFFMANN, K. Euphorbiaceae- *Crotonoideae-Acalypheae-Acalyphinae*. In: **Engler, Das Pflanzenreich. Regni vegetabilis conspectus** (A. Engler, ed.), Leipzig, 147 (helf 85) IV, 191-193, 1924.

PEREIRA-SILVA, R. A. **Dalechampia L. (Euphorbiaceae, Acalyphoideae) em Pernambuco, Brasil**. Dissertação de mestrado, Universidade Federal Rural de Pernambuco, Recife, 115 f., 2015.

PEREIRA-SILVA, R. A., ATHIÊ-SOUZA, S. M.; SECCO, R. S.; MELO, A. L.; SALES, M. F. **Dalechampia (Acalyphoideae, Euphorbiaceae) em Pernambuco (Brasil)¹**, 2016. (no prelo).

PLUMIER, P. C. **Nova Plantarum Americanarum Genera**, p.1-186 p, 1703.

PUNT, W. Pollen morphology of the Euphorbiaceae with special reference to taxonomy. **Wentia**, v. 7: 1-116, 1962.

RADFORD, A. E.; DICKISON, W. C.; MASSEY, J. R. **Vascular plant systematic**. Harper & Row Publishers, New York, 891p, 1974.

RODRIGUES A S. **As tribos Dalechampieae Müll. Arg. e Manihoteae Melchior (Euphorbiaceae) no Distrito Federal, Brasil**. Dissertação de Mestrado, Universidade de Brasília, 115 f., 2007.

SCHMELZER, G. H.; SCHMELZER, G.H.; GURIB-FAKIM, A. **Medicinal plants I**,

Plant Resources of Tropical Africa, 2008.

SILVA, A. C.; SOUZA, L. A. Morphology and anatomy of the developing fruit and seed of *Dalechampia stipulacea* Müll. Arg. (Euphorbiaceae). **Maringá**, v. 31, n. 4, p. 425-432, 2009.

SOUZA, L.A.; SILVA, A. C.; MOSCHETA, I. S. Morphology and anatomy of flowers of *Dalechampia stipulacea* Müll.Arg. (Euphorbiaceae). **Acta Botánica Venezuelica**, v. 33, n.1, p. 103-117, 2010.

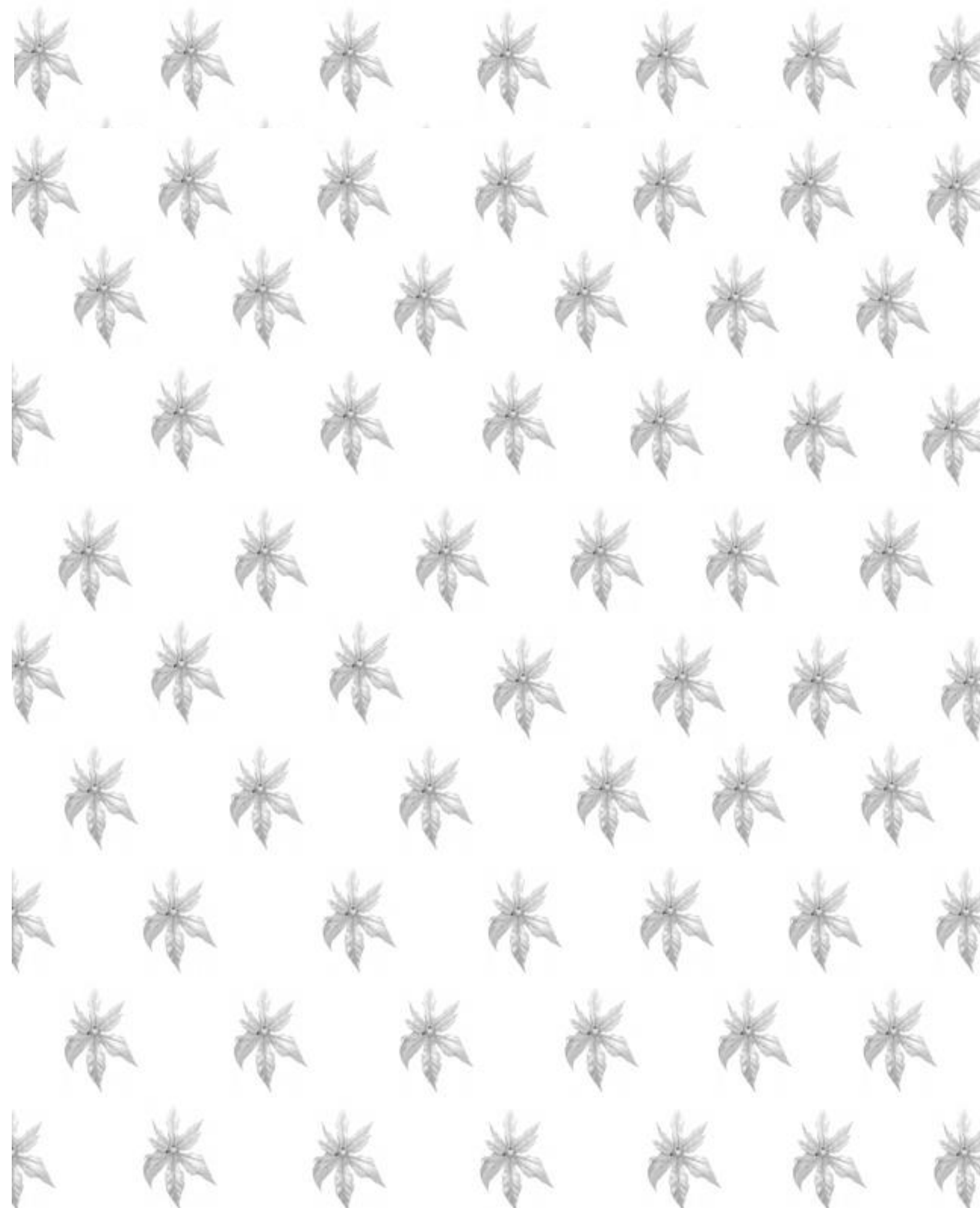
TOKUOKA, T.; TOBE, H. Ovules and seeds in Acalyphoideae (Euphorbiaceae): structure and systematic implications. **Journal of Plant Research**, v. 116, p. 355 - 380, 2003.

WEBSTER, G. L.; WEBSTER, B. The morphology and relationships of *Dalechampia scandens* (Euphorbiaceae). **American Journal of Botany**, v. 59, n 6, p. 573-586 1972.

WEBSTER, G. L.; ARMBRUSTER, W. S. A synopsis of the neotropical species of *Dalechampia* (Euphorbiaceae). **Botanical Journal of the Linnean Society**, v. 105, p. 137-177, 1991.

WEBSTER, G. L. Classification of the Euphorbiaceae. **Annals of the Missouri Botanical Garden**, v.81, p. 3-32, 1994.

Manuscrito 1



**Phylogeny, Biogeography and Character
Evolution of *Dalechampia* with special focus in the
section *Dalechampia***

**Rafaela Alves Pereira-Silva^{1,5}, Luiz Gustavo Rodrigues Souza², Lucas Costa², Sarah
Maria Athiê-Souza¹, André Laurênio de Melo³, Jefferson Rodrigues Maciel⁴ &
Margareth Ferreira de Sales¹**

Artigo a ser submetido

Taxon

Phylogeny, Biogeography and Character Evolution of *Dalechampia* with special focus in the section *Dalechampia*

Rafaela Alves Pereira-Silva^{1,5}, Luiz Gustavo Rodrigues Souza², Lucas Costa², Sarah Maria Athiê-Souza¹, André Laurênio de Melo³, Jefferson Rodrigues Maciel⁴ & Margareth Ferreira de Sales¹

¹*Programa de Pós-Graduação em Botânica, Departamento de Biologia, Universidade Federal Rural de Pernambuco, 52171-900, Dois Irmãos, Recife, PE, Brazil*

²*Laboratório de Citogenética e Evolução vegetal, Universidade Federal de Pernambuco, 50670-420, Cidade Universitária, Recife, PE, Brazil*

³*Unidade Acadêmica de Serra Talhada, Universidade Federal Rural de Pernambuco, 56909-535, Serra Talhada, PE, Brazil*

⁴*Jardim Botânico do Recife, 50791-540, Curado, Recife, PE, Brazil*

⁵Author for correspondence: *Rafaela Alves Pereira-Silva; rafaela.news@hotmail.com*

Short title: New subsection of *Dalechampia* sect. *Dalechampia*

Abstract Molecular phylogeny and estimates of divergence times in *Dalechampia* were assessed using a molecular clock approach. A character evolution analysis was also conducted to compare morphological similarities among species distributed in South America, Africa, and Madagascar. Phylogenetic relationships were analyzed from a taxonomic point of view. Our analyses indicated that the crown node of *Dalechampia* is estimated to date to the Paleocene-Eocene (53.95 Mya), with its center of origin in South America. The African clade (including the Asian species *D. bidentata* and *D. elongata*) originated ca. 20 Mya, while the Madagascar clade is even more recent (~10 Mya), suggesting ancient, long distance dispersal events. Regarding the phylogenetic analyses, *D. sect. Dalechampia* is not monophyletic, comprising species from both Africa and Madagascar. Additionally, character evolution indicated more synapomorphies shared between these species with *D. sect. Dalechampia* than with others sections in the group.

Key-words: Molecular clock, Euphorbiaceae, divergence, synapomorphies

■ INTRODUCTION

Dalechampia L. is a monophyletic genus in Euphorbiaceae (Armbruster & al. 2009) and comprises ca. 130 species (Armbruster & al., 1993). Most species are twining vines, or rare subshrubs, with Pantropical distributions. Morphologically, the species differ from other genera in the family by having: i) a pseudanthium with two involucre bracts, comprising a pistillate cymule of 1–3 flowers; ii) a staminate cymule of 4-almost 50 staminate flowers; and, iii) a resiniferous gland adjacent to the staminate flowers (except in the Madagascar species) (Armbruster & Baldwin, 1998; Webster & Armbruster, 1991; Pereira-Silva & al. 2016; Mendes & al. 2018). *Dalechampia* species occur preferentially in secondary areas of moist or dry forests, and their leaves are usually covered with stinging hairs (Armbruster & Miziray, 1987). The Neotropical species were organized into six sections by Webster & Armbruster (1991), highlighting the section *Dalechampia* that is subdivided into five subsections. Other section (*Brevicolumnae*) was later added by Armbruster (1996). Some African and Madagascar species were treated by Pax & Hoffmann (1919) in sections together with Neotropical species, although the circumscription proposed by Webster & Armbruster (1991) was restricted to the Neotropical region.

Previous cladistic analyses based on morphological characters suggested the origin of the genus in South America or Gondwana, with one or two dispersal events to Africa and later to Madagascar (Armbruster, 1994). Armbruster & Mziray (1987) considered four hypotheses for the current distribution of *Dalechampia*: (1) recent long-distance dispersal of species among the continents; (2) migration across mid-to high-latitude land bridges during the Tertiary when those latitudes had subtropical climates; (3) a nearly continuous western Gondwana distribution in the mid- to late Cretaceous, disrupted by subsequent continental drift; and, (4) the distribution of primitive *Dalechampia* in South America, Africa and Madagascar, followed by extinction of primitive species in Africa and a second migration via higher latitudes of more derived species between South America, Africa, and Asia. Armbruster (1994) considered two other probable hypotheses: the rafting of land masses, or migration across higher latitudes.

We tested that latter hypothesis by estimating divergence times for the genus and by reconstructing its historical biogeography using molecular data available from Armbruster & al. (2009) for plastid (*trnK*) and nuclear (ITS1-5.8S-ITS2 and ETS loci) DNA. We also examined character evolution to evaluate similarities shared among species from the Neotropical region, Africa, Madagascar, and Asia. In the light of those results, we discuss here the dispersal hypothesis of *Dalechampia* distribution and the morphological relationship among *Dalechampia* sect. *Dalechampia* with other groups in the genus based on character evolution analysis.

MATERIALS AND METHODS

Plant material

The sections *Brevicolumnae* (1 species of 1), *Coriaceae* (1 species of 1), *Dalechampia* (14 species of 53, including specimens of the subsections *Dalechampia*, *Convolvuloides*, *Humiles*, and *Triphyllae*), *Dioscoreifoliae* (4 species of 26), *Rhopalostylis* (2 species of 7), *Cremophyllum* (1 species of 3), and *Tiliifoliae* (2 species of 3) were analyzed (Table 1). Other species of the subfamily Acalyphoideae were included as outgroups, including *Plukenetia volubilis* L. or *Tragia volubilis* L. (maximum likelihood and Bayesian inference) or *Blumeodendron kurzii* (Hook. f.) J.J. Sm. ex Koord. & Valetton, *Macaranga trichocarpa* (Rchb. f. & Zoll.) Müll. Arg., and *Mallotus philippensis* (Lam.) Müll. Arg. (molecular clock and BioGeoBEARS analyses).

Specimens, collection sites, and GenBank accession numbers of the plastid and nuclear loci are available at Ambruster & Baldwin (1998), Ambruster & al. (2009), and van Welzen et al. (2014).

Phylogenetic analyses

For the phylogenetic analyses we aligned the DNA sequences of the plastid spacer (*trnK* intron/partial *matK*) and 18S–26S nuclear ribosomal ETS and ITS (ITS1–5.8S–ITS2) using Clustal W (Larkin & al., 2007), available on Geneious 11.1.4 (<http://www.geneious.com>, Kearse & al., 2012). The maximum likelihood (ML) and Bayesian inference (BI) searches were performed with *trnK*, ETS, and ITS regions, both separately and as combined datasets. The iLD test did not identify incongruences in the datasets ($p = 1$). The most appropriate model of sequence evolution for each region was determined using Akaike information criteria (AIC), as implemented in the jModelTest 0.1.1 program (Guindon & Gascuel, 2003; Darriba & al., 2012). Evolutionary models were determined for each subregion as follows: GTR+ I+G for ITS, GTR for *trnK*, and ETS and GTR+I+G for concatenated regions. ML analysis and bootstrap support calculations (1000 replicates) were performed using FastTree (Price & al., 2010), available on Geneious; BI searches were performed using Mr. Bayes v. 3.1.2 (Ronquist & Huelsenbeck, 2003) under a partitioned model as implemented on CIPRES Science Gateway V.3.1 (www.phylo.org). The analyses were conducted for two independent runs and for 10,000,000 generations, sampling every 1000 trees. Tracer v. 1.7 (Rambaut & al., 2018) was used to ensure that the Markov chains had reached stationary and to determine the appropriate number of ‘burn-in’ runs for analysis. Posterior probabilities (PP) were estimated by constructing a 50% majority-rule consensus tree with the sampled trees. Trees were visualized using FigTree v. 1.3.1 (Rambaut, 2009).

Character evolution

To reconstruct the evolution of morphological characters in *Dalechampia* we analyzed herbarium specimens from ALCB, BHCB, BM, CEN, CEPEC, CESJ, CVRD, EAC, ESA, FUEL, FURB, G, HEPH, HVASF, HUEFS, IAC, IPA, INPA, K, LINN, P, PACA, PEL, PEUFR, RBR, SJRP, SP, TEPB, and UB (abbreviations according to Thiers, 2014). We scored eight taxonomically informative characters for the species:

‘type of leaves’; ‘apex of stylar column’; ‘margin of pistillate sepals’; ‘glandular trichomes on the margins of pistillate sepals’; ‘connation of staminate bracteole’; ‘shape of staminate bracts’; and ‘resiniferous gland’ (Table 1) extracted from the analyses of herbarium specimens, protologue descriptions, other literature sources (Webster & Armbruster, 1982; Webster, 1989; Gillespie & Armbruster, 1994; Armbruster, 1996; Pereira-Silva & al., 2015), and field collections.

Ancestral state reconstruction of *Dalechampia* species was performed using Mesquite v.2.75 (Maddison & Maddison, 2011). The ‘trace character history’ function was used with the 50% majority-rule consensus tree from the BI analyses (*trnK* + ETS + ITS combined dataset). The ancestral state was inferred using ML under the Markov k-state one-parameter (Mk1) model, in which all changes are equally probable. Most morphological characters of *Dalechampia* were treated as binaries.

Divergence time estimates

Molecular clock analysis was performed to interpret the biogeography of the genus *Dalechampia*. Divergence time estimates were performed in BEAST v.1.8.3. (Drummond & al., 2012), fixing the tree topologies of the Bayesian analyses. Uncorrelated relaxed lognormal clock (Drummond & al., 2006) and Yule-process speciation models (O’Connell, 1993) were applied. Two independent runs of 10,000,000 generations each were performed, sampling every 1,000 generations. In order to verify the effective sampling of all parameters and to assess the convergence of independent chains, we examined their posterior distributions in Tracer v.1.7 (Rambaut & al., 2018); the MCMC sampling was considered sufficient at effective sampling sizes (ESS) larger than 200. After removing 25% of the samples as burn-in, the independent runs were combined and a maximum subgenus-credibility (MCC) tree was constructed using TreeAnnotator v.1.8.2. (Drummond & al., 2012). Calibrations were performed using secondary calibrations, based on van Welzen & al. (2014), which determined the divergence of the genera *Blumeodendron* (Müll. Arg.) Kurz, *Macaranga* Thouars, and *Mallotus* Lour. at 83.47 Mya based on: (i) New Zealand fossils of leaves, flowers, fruits, and pollen from the Oligocene/Miocene (31–15 Ma, Lee & al., 2010); (ii) African fossils closely related to *Macaranga kilimandscharica* Pax (Oligocene; between 32–22 Ma, Tanai 1989); (iii) the fossil species *Mallotus hokkaidoensis* Tanai, described from the Middle Eocene (48.6–27.3 Ma, Tanai, 1989, 1990) from Japan.

Ancestral Range and Biogeographic Event Estimations

To investigate the historic biogeography of *Dalechampia*, we employed a model-based likelihood approach implemented in the R package BioGeoBEARS (Matzke, 2013). First, the maximum credibility tree yielded by BEAST was pruned to exclude the species used as the outgroup (*Blumeodendron kurzii*, *Macaranga trichocarpa*, and *Mallotus philippensis*) using the function `drop.tip`, implemented in the R package `phytools`. The remaining species were coded as present or absent in four discrete areas: the Neotropics (A), Africa (B), Madagascar (C), or Asia (D) (Supplementary Table 1).

We used the pruned maximum credibility tree for ancestral range estimation to test likelihood implementations of three different biogeographic models in BioGeoBEARS. The DEC model treats dispersal and extinction as anagenetic events (modeled as free parameters) and sympatry, subset sympatry, and vicariance as cladogenetic events (modeled as fixed parameters) (Ree & Smith, 2008). The DIVA model is similar, but it allows widespread vicariance as a possible cladogenetic event (Ronquist, 1997). The BAYAREA model assumes that cladogenetic events are not accompanied by changes in geographic areas (Landis & al., 2013). Each of these models was also tested with the addition of the free parameter j , which treats jump dispersal as a cladogenetic event and has been shown to improve model likelihood (Matzke, 2014). We compared the results of the models with and without the parameter j using likelihood ratio tests; the model weights were calculated under the Akaike information criterion (AIC). In order to measure the numbers of dispersal, vicariance, and sympatry events, we conducted 100 stochastic mapping replicates under the best model yielded by BioGeoBEARS. Each stochastic map represents a possible biogeographic history considering the chosen model and the estimated parameters (Duplin & al., 2016).

■ RESULTS

Phylogenetic analyses

Our analyses indicated that *Dalechampia* sect. *Dalechampia* is non-monophyletic with the inclusion of the sections *Brevicolumnae* (monospecific section, *D. brevicolumna*), *Coriaceae* (monospecific section, *D. coriacea*), and *Tiliifoliae* (*D. affinis* and *D. tiliifolia*). The group was divided in three main clades. Clade I, , was well supported (pp = 1), showing *D. parvifolia* (an African species) as a sister group of the

Madagascar species. Clades II and III are comprised of only Neotropical species (see Fig. 1). Clade II included representatives of other sections (*Brevicolumnae*, *Coriaceae*, and *Tiliifoliae*), and was composed of 12 species (*D. brownsbergensis*, *D. coriacea*, *D. armbrusteri*, *D. ficifolia*, *D. convolvuloides*, *D. arenalensis*, *D. magnistipulata*, *D. affinis*, *D. tiliifolia*, *D. brevicolumna*, *D. pernambucensis*, and *D. scandens*). Clade III is composed exclusively of *D. sect. Dalechampia* species that show the most morphological diversity and comprise representatives of four subsections of *D. sect. Dalechampia*: *Dalechampia*, *Convolvuloides*, *Triphyllae*, and *Humiles*, represented by: *D. aff. hispida*, *D. viridissima*, *D. heteromorpha*, *D. denticulata*, *D. triphylla*, *D. caperonioides*, and *D. stipulacea*. Clade IV is composed of the sections *Cremophyllum*, *Dioscoreifoliae*, and *Rhopalostylis*, and is a sister group of *Dalechampia* section clade (Fig. 1).

Character evolution

Type of leaves. — Compound leaves appeared isolated in few species in our sampling, with simple leaves being the common ancestral trait (with 0.75 probability) according to proportional likelihood (Fig. 2 A). Compound leaves are very common in the section *Dioscoreifoliae*, but appear in *D. sect. Dalechampia* subsection *Triphyllae*, (represented here by only one species, *D. triphylla*).

Apex of stylar column.—The most probable ancestral condition according to proportional likelihood was 0.51, for cylindrical or slender apex of stylar column (Fig. 2 B). This character evolved independently in most representatives of the clade I and in species of *Dalechampia sect. Dioscoreifoliae* (*D. aff. sylvestris*, *D. peckoltiana*, and *D. luetzelburgii*, in clade III), although apex lobed or dilated was shared between *D. capensis* and *D. trifoliata* from Africa and the Neotropical region.

Margin of pistillate bracteole with glandular trichomes. — This character appeared with a proportional likelihood of 0.51 (Fig. 2 C), occurring independently in only one species from Madagascar, two from Africa, and in some species of the subsection *Dalechampia* (*D. armbrusteri*, *D. scandens*, *D. humilis*, *D. denticulata*, and *D. stipulacea*).

Margin of pistillate sepals. — The ancestral margin of pistillate sepals was reconstructed as lobed (proportional likelihood= 0.50); the transition to entire margins occurred in *D. elongata* (from Africa), *D. brevicolumna* (French Guiana), and *D. heteromorpha* (Central America), and was shared with species of *Dioscoreifoliae* section as a divergent character (Fig. 2 D).

Glandular trichomes on the margins of pistillate sepals. — Glandular trichomes along the margins of pistillate sepals appearing on most lobed sepals was reconstructed (proportional likelihood=0.59) as the most probable character in the *Dalechampia* section (Fig. 2 E). Glandular trichomes are common on the lobed margins of pistillate sepals, and glandular trichomes never appear on entire margins.

Connation of staminate bracteole. — Staminate bracteoles connate or bilabiate are the most probable ancestral characters in *D.* sect. *Dalechampia* (proportional likelihood=0.52). The staminate bracts are free, however, in Madagascar species, but not concave or rigid as in *D.* sect. *Dioscoreifoliae* (Fig. 2 F). Those bracts are completely fused at the base in African species, except in *D. bidentata* (where they are free, as with Madagascar species).

Shape of staminate bracts. — The most probable ancestral character was rigid and concave (proportional likelihood 46%), although most species show planar staminate bracts (Fig. 2 G).

Resiniferous gland. — Resiniferous glands occur in most species (proportional likelihood=0.97), with Madagascar taxa being divergent, however, as they are glandless (Fig. 2 H).

Dating inferences and biogeographical patterns

Figure 3 presents the results of the molecular clock, with secondary calibrations based on van Welzen & al. (2014). In our analysis, the crown node of *Dalechampia* (Fig. 3) is estimated as being from the Paleocene–Eocene era (53.95 Mya). The approach therefore suggests that the divergence of clades I and II was ca. 20 Mya, and that the divergence of the Madagascarian subclade was even more recent (~ 10 Mya) (Fig. 3).

BioGeoBEARS was applied to the chronogram resulting from BEAST analysis (Fig. 3), and the results indicated a higher value of log likelihood for three parameters (DEC+j, LnL= -21.78) showing jump speciation (i.e., dispersal between non-adjacent areas) as an important pattern in the range variation of *Dalechampia* (15.37% of the total number of events, in contrast to 0.04% for vicariance). The most probable ancestral areas for the stem and crown nodes of clades II, III, and IV are in South America (Fig. 3). The ancestral range of the crown node in clade I has a high probability of being from Africa, but subsequent nodes show a shift from Africa to Madagascar. The first (South America to Africa) and second (Africa to Madagascar) shift are estimated to date from the late

Miocene (21.99 Mya) and middle Miocene (11.80 Mya) respectively.

■ DISCUSSION

Phylogenetic and biogeographic relationships of *Dalechampia*

We report here for the first time that *Dalechampia* sect. *Dalechampia* is non-monophyletic. The topology observed, with clade I divided in two main subclades (Neotropical and the second comprising species from Asia, Africa and Madagascar), corroborates previous studies (Armbruster & Baldwin, 1998; Armbruster & al., 2009, 2012). The genus probably originated in South America in the Paleocene–Eocene era (53.95 Mya), with posterior long distance dispersal to Africa and subsequently to Madagascar, and posterior from Africa to Asia.

Armbruster & Miziray (1987) and Armbruster (1994) proposed the dispersal hypothesis to explain the disjunct intercontinental distribution of the group, and a previous study had suggested that two evolutionary radiations occurred in *Dalechampia*, first giving rise to advanced species in Africa, and then more “primitive” species in South America and Madagascar as a result of the second radiation (Armbruster & Miziray, 1987). According to Armbruster & Miziray (1987), three hypotheses could explain that distribution: i) relatively long-distance dispersal across ocean barriers; ii) distribution in adjacent high-latitude landmasses (North America-Beringia-Asia, or North America-Europe) that had tropical climates in the mid-Eocene; iii) or the breakup, by continental drift, of a previously continuous distribution in western Gondwanaland.

The rafting of landmasses or migration across higher latitudes were considered by Armbruster (1994) to be the most probable hypotheses. According to that author, if the initial dispersal across the continent to Asia had occurred by migration in the early- or mid-Tertiary period under a subtropical climate, herbivore butterfly would allow that dispersal. Even if the initial dispersal had occurred during the parting of the continents in the Cretaceous, herbivore butterfly could still have been a possible dispersal mechanism, although not as probable as the first.

Long distance dispersal became the mainstream explanation for disjunctions between landmasses separated by ocean barriers (Christenhusz & Chase 2012; Yoder & Nowal 2006). Many representative examples of disjunctions between Neotropics and Africa are found in Bromeliaceae, Rapateaceae, Malvaceae, and other plant families (Dick & al., 2007; Christenhusz & Chase 2012; Givnish & al., 2004; Renner, 2004), and distinct

geographic distributions and disjunctions have been noted in other taxa of Euphorbiaceae (Richardson & al., 2004; Narbona & al., 2005; Manns & al., 2013; Van Welzen & al., 2014). All of those examples of long distance dispersal are coherent with our results, thus putting *Dalechampia* in the centre of a growing body of evidence for colonization and biotic interchange between the Neotropics and the Paleotropics. *Dalechampia* experienced diversification following its colonization of new biomes, however, different from many examples of long distance dispersal (Gillespie & Armbruster, 1997) –with that colonization being accompanied by morphological and pollination syndrome changes and the acquisition of new adaptations to occupy available niches, as shown by our results.

Malagasy colonization by *Dalechampia* also follows the same pattern as previously recorded in literature as, according to the Theory of Island Biogeography, Africa is the main source of the floristic elements that colonized Madagascar (Bauret & al., 2018, Bacon & al., 2016). Our results indicate that *Dalechampia* colonized Madagascar from an African source at approximately 12 Mya. The timing of this event is also coherent with the growing body of evidence concerning African-Malagasy biotic interchanges that hypothesize long distance dispersal rather than vicariant events – despite the Gondwana origins of Madagascar (Yoder & al., 2006; Janssens & al., 2016).

Afro-Asian disjunctions are well documented by hundreds of examples in the genera of several plant families (Brenan, 1978; de Wilde & al., 2011). Recent molecular advances show that many of those examples are related to long-distance dispersal events with the same pattern seen with *Dalechampia* in our results. Vicariance is the best explanation for groups dated older than the mid-Miocene (Ali & Aitchison, 2008; Conti & al., 2002; Su & Saunders, 2009). The explanation for Afro-Asia disjunctions in young lineages like *Dalechampia*, however, lies in likely long distance-dispersal events (Li & al., 2009; Bouétard & al., 2010).

Most taxa of the Euphorbiaceae family disperse by explosive dehiscence (Webster, 2014) of very dry fruits that spread their seeds only short distances (Van Welzen & al., 2014). The seeds of *Euphorbia boetica* and *E. nicaeensis*, for example, were dispersed maximum distances of only 8 and 5 m respectively (Narbona & al. 2005). In *Dalechampia*, the fruit valves split apart during dehiscence and the seeds are thrown from the columella, reaching distances of 1-6 meters (Armbruster 1992). According to Armbruster (1982), the dispersal of *Dalechampia* seeds seem to be exclusively by capsule dehiscence (without excluding the effects of gravity and/or moving water).

The fruits of *Euphorbia boetica* Boiss. and *E. nicaeensis* All. disperse well across bodies of water. Narbona & al. (2005) suggested birds as probable dispersal agents, as the glandular hairs on the fruits act as extra floral nectary rewards. The glandular trichomes present along the margins of persistent pistillate sepals on the fruits of *Dalechampia*, however, secrete oxygenated-triterpene resins that protect the ovules and developing seeds from insects (Armbruster & al., 2009). Additionally, many species of the genus have glochidial spines on the pistillate sepals that protect the seeds before dispersal (probably from birds and mammals) (Armbruster & al., 2009), and do not appear attractive to dispersal agents as would arils and caruncles (Armbruster, 1982).

How then can long distance dispersal in *Dalechampia* be explained? As the continents were quite distant from each other, a bird dispersal hypothesis might be most probable, as suggested for *E. boetica* and *E. nicaeensis*. Another possibility could be that the involucre bracts acted as alate structures facilitating fruit dispersal by wind or flotation.

Even with the division of the genus between Africa and the neotropics, most *Dalechampia* species continued to share morphological characters such as: habit (commonly twining vines), shape of the involucre bracts (3-lobed), shape of the resiniferous bractlets, and the secretion of resins. *Dalechampia parvifolia* appeared as a sister to subclade I. According to Armbruster & Miziray (1987), *D. cf. parvifolia* is a common vine of northern Tanzania that produces resin as a pollinator reward, and it shares floral morphologies and pollination aspects with Neotropical species – which suggests that those characters are plesiomorphies or they share similarities due to their relationships by long distance dispersal.

Many African species are very similar to *Dalechampia scandens* (a species that originated in West Indian and is very common in Brazil), which caused botanists to create erroneous varieties (such as *D. scandens* var. *cordofana* (Hochst. Ex Webb) Müll. Arg., *D. scandens* var. *hildebrandtii* Pax, *D. scandens* var. *natalensis* (Mull. Arg) Pax & K. Hoffm., and *D. scandens* var. *parvifolia* Lam.) and for *D. capensis* Sond. and *D. macrobractea* Pereira-Silva & Armbruster, these were usually identified as *D. scandens* L., as well as one species from Madagascar (*D. scandens* var. *pseudoclematis* Baill). According to Testo & al. (2018), the existence of morphological similarities between Old World and New World species is due to convergence, in which species become adapted to similar habitats. The taxonomies of those taxa remain unresolved, and have been the source of considerable contemplation by Armbruster & Steniner (1992).

The most morphologically distinct species treated here was *Dalechampia trifoliata* (African species) in the clade I (Fig 1). It differs from all of the other *Dalechampia* mainly by having only one pistillate flower (vs. three pistillate flowers in the *Dalechampia* genus). In contrast to other African species, *D. trifoliata* has involucre bracts entire, rarely 3-fid (vs. always 3-lobed), axis of the stylar column widely thickened (vs. slender or thick), and glandular trichomes absent on the pistillate sepals (vs. present, except in *D. galpinii*).

Madagascar species, on the other hand, reveal divergent characters, and the earliest lineages in clade I. Armbruster & Baldwin (1998) indicated that after the colonization of Madagascar from Africa, the species of *Dalechampia* from that island lost their resiniferous glands due a lack of specific pollinators. Consequently, those species were incidentally pollinated by pollen-feeding animals and adapted without those glands. The clade I is a sister clade of Neotropical species, and is very closely related to *D.* section *Dalechampia* in most of its characters.

Character evolution

Dalechampia presented an ancestry with entire leaves, with compound leaves being a derived character occurring only in an isolated species in the cladogram (although most species have lobed leaves). The apex of the stylar column is an important characteristic within *Dalechampia* that has been used to differentiate species and sections, from Baillon (1858) through Pax & Hoffmann (1919) and in the last taxonomic treatment proposed by Webster & Armbruster (1991). Our results suggest that the ancestral apex of the stylar column varied between cylindrical, slender, lobed, or dilated with a proportional likelihood of 0.51 and surprisingly sharing that characteristic with species of *D.* sect. *Dioscoreifoliae*, which suggests that some species from Madagascar are derived from members of *D.* sect. *Dioscoreifoliae*.

The glandular trichomes present on pseudanthium structures (as on the margins of the pistillate bracteole and sepals) reveal an evolution of their defense systems. The margins of the pistillate sepals are used to characterize groups into subsections of *Dalechampia*, with most species having lobed margins, with a very common presence of glandular trichomes on lobed sepals. The glandular trichomes present on the pistillate sepals secrete oxygenated-triterpene resins serving to defend the developing fruits (Armbruster & al., 2009). The opposite (pistillate sepals with entire margins, without glandular trichomes), however, as seen in species such as *D. caperonioides* (Central of Brazil), *D. brevicolumna* (French Guiana), *D. heteromorpha* (Central America), and *D.*

elongata (African), confer a synapomorphy with clade IV composed of members of *Cremophyllum*, *Dioscoreifoliae*, and *Rhopalostylis*.

The connation of staminate bracteoles can vary greatly in *Dalechampia*, and the proportional likelihood of that possible ancestral character was 0.52 for either connate or bilabiate. The shapes free and connate, or fused only at the base, emerged later in the evolution of the genus. Free bracts appeared as homoplastic, occurring in all Madagascar species represented in this phylogeny as well as in clade IV. The species of *Dioscoreifoliae* section in that clade have staminate bracts concave and rigid (vs. planar and not rigid in Madagascar species). Armbruster & Webster (1991) reported concave and rigid bracts as relatively primitive, together with a lacerate shape of the resiniferous gland.

Dalechampia species have resiniferous glands as an ancestral characteristic, with the absence of this gland appearing only in isolated species in Madagascar and in *D. hastata* and *D. heterobracteata* (species from the *Rhopalostylis* section). The glands of species from *Rhopalostylis* are sparsely and obscurely resiniferous (Webster & Armbruster, 1991). Mendes & al. (2018), analyzing the species from northern Brazil, however, reported that *D. hastata* and *D. heterobracteata* were glandless, and similar to species from Madagascar.

The reason for the lack of glands in *D. hastata* and *D. heterobracteata* is unknown, but the Madagascar species may have lost them due the lack of a specific pollinator (Armbruster and Baldwin, 1998). It is possible, however, that the losses of resiniferous glands were independent in Madagascar species and in *D. hastata* and *D. heterobracteata*. Species from Africa and Asia, however, share specific morphological characters and unique biogeographical histories that are confirmed by the presence of resiniferous glands and posterior colonization by dispersal from Africa to Madagascar and Asia.

Phylogenetic analyses and evolutionary reconstructions of morphological characters indicated that *Dalechampia* species from Neotropics, Africa (including Madagascar), and Asia belong to section *Dalechampia*. As well as species from other sections, such as *Brevicolumnae*, *Coriaceae* and *Tiliifoliae*, indicating that the current infrageneric circumscription in the section *Dalechampia* do not reflect monophyletic groups and should be revised.

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■ LITERATURE CITED

- Ali, J.R., & Aitchison, J.C.** 2008. Gondwana to Asia: plate tectonics, paleogeography and the biological connectivity of the Indian sub-continent from the Middle Jurassic through latest Eocene (166–35 Ma). *Earth-Sci. Rev.* 88: 145–166. <https://doi.org/10.1016/j.earscirev.2008.01.007>
- Armbruster, W.S. & Mziray, W.R.** 1987. Pollination and Herbivore Ecology of an African *Dalechampia* (Euphorbiaceae): Comparisons with New World Species. *Biotropica* 19: 64–73.
- Armbruster, W.S, Leed, J. & Baldwin, B.G.** 2009. Macroevolutionary patterns of defense and pollination in *Dalechampia* vines: Adaptation, exaptation, and evolutionary novelty. *PNAS* 106: 18085–18090.
- Armbruster, W.S & Baldwin, B.G.** 1998. Switch from specialized to generalized pollination. *Nature* 394: 632.
- Bacon, C.D., Simmons, M., Archer, R.H., Zhao, L.C. & Andriantiana, J.** 2016. Biogeography of the Malagasy Celastraceae: Multiple independent origins followed by widespread dispersal of genera from Madagascar. *Mol. Phylogenetics Evol.* 94: 365–382.
- Bauret, L., Field, A.R., Gaudeul, M., Selse, M.A. & Rouhan, G.** 2018. First insights on the biogeographical history of *Phlegmariurus* (Lycopodiaceae), with a focus on Madagascar. *Mol. Phylogenetics Evol.* 127: 488–501.
- Bouetard, A., Lefeuvre, P., Gigant, R., Bory, S., Pignal, M., Besse, P. & Grisoni, M.** 2010. Evidence of transoceanic dispersal of the genus *Vanilla* based on plastid DNA phylogenetic analysis. *Mol. Phylogenetics Evol.* 55: 621–630.
- Brenan, J.P.** 1978. Some aspects of the phytogeography of tropical Africa. *Ann. Mo. Bot. Gard.* 65: 437–478.

- Conti, E., Eriksson, T., Schönenberger, J., Sytsma, K.J. & Baum, D.A.** 2002. Early Tertiary out-of-India dispersal of Crypteroniaceae: evidence from phylogeny and molecular dating. *Evolution* 56: 1931–1942.
- Christenhusz, M.J. & Chase, M.W.** 2012. Biogeographical patterns of plants in the Neotropics—dispersal rather than plate tectonics is most explanatory. *Bot. J. Linnean Soc.* 171: 277–286.
- Darriba, D., Taboada, G.L., Doallo, R., Posada, D.** 2012. jModelTest 2: more models, new heuristics and parallel computing. *Nature Methods* 9(8): 772.
- de Wilde, J.J., Hughes, M., Rodda, M. & Thomas, D.C.** 2011. Pliocene intercontinental dispersal from Africa to Southeast Asia highlighted by the new species *Begonia afromigrata* (Begoniaceae). *Taxon* 60: 1685–1692.
- Dick, C.W., Bermingham, E., Lemes, M.R. & Gribel, R.** 2007. Extreme long-distance dispersal of the lowland tropical rainforest tree *Ceiba pentandra* L. (Malvaceae) in Africa and the Neotropics. *Mol. Ecol.* 16: 3039–3049.
- Drummond, A.J., Ho S.Y.W., Phillips M.J. & Rambaut A.** 2006. Relaxed phylogenetics and dating with confidence. *PLoS Biology* 4: e88.
- Drummond, A.J., Suchard, M.A., Xie, D. & Rambaut, A.** 2012. Bayesian phylogenetics with BEAUT and BEAST 1.7. *Mol. Phylogenetics Evol.* 29: 1969–1973.
- Dupin, J., Matzke, N.J., Sarkinen, T., Knapp, S., Olmstead, R., Bohs, L. & Smith, S.** 2016. Bayesian estimation of the global biogeographic history of the Solanaceae. *J. Biogeogr.* 44: 887–899.
- Guindon, S. & Gascuel, O.** 2003. A simple, fast and accurate method to estimate large phylogenies by maximum-likelihood". *Systematic Biology* 52: 696-704.
- Givnish, T.J., Millam, K.C., Evans, T.M., Hall, J.C., Chris Pires, J., Berry, P.E. & Sytsma, K.J.** 2004. Ancient vicariance or recent long-distance dispersal? Inferences about phylogeny and South American–African disjunctions in Rapateaceae and Bromeliaceae based on *ndh F* sequence data. *Int. J. Plant Sci* 165: S35–S54.
- Janssens, S.B., Groeninckx, I., Petra, J., Verstraete, B., Smets, E.F. & Desein, S.** 2016. Dispersing towards Madagascar: Biogeography and evolution of the Madagascan endemics of the Spermaceae tribe (Rubiaceae). *Mol. Phylogenetics Evol.* 95: 58–66.
- Kearse, M., Moir, R., Wilson, A., Stones-Havas, S., Cheung, M., Sturrock, S.,**

- Buxton, S., Cooper, A., Markowitz, S., Duran, C., Thierer, T., Ashton, B., Mentjies, P., & Drummond, A.** (2012). Geneious Basic: an integrated and extendable desktop software platform for the organization and analysis of sequence data. *Bioinformatics*, 28(12), 1647-1649.
- Landis, M.J., Matzke, N.J., Moore, B.R. & Huelsenbeck, J.P.** 2013. Bayesian analysis of biogeography when the number of areas is large. *Syst. Biol.* 62: 789–804.
- Larkin, M.A., Blackshields, G., Brown, N.P., Chenna, R., McGettigan, P.A., McWilliam, H. & Thompson, J.D.** 2007. Clustal W and Clustal X version 2.0. *Bioinformatics* 23: 2947–2948.
- Lee, D.E., Bannister, J.M., Raine, J.I. & Coran, J.G.** 2010. Euphorbiaceae: Acalyphoideae fossils from early Miocene New Zealand: *Mallotus-Macaranga* leaves, fruits, and inflorescence with in situ Nyssapollenites endobalteus pollen. *Rev. Palaeobot. Palynol.* 163: 127–138.
- Li, Y., Dressler, S., Zhang, D. & Renner, S.S.** 2009. More Miocene dispersal between Africa and Asia - the case of *Bridelia* (Phyllanthaceae). *Syst. Bot.* 34: 521–529.
- Matzke, N.J.** 2013. BioGeoBEARS: BioGeography with Bayesian (and Likelihood) Evolutionary Analysis in R Scripts. R package, version 0.2.1.
- Maddison, W. P. and D.R. Maddison.** 2011. Mesquite: a modular system for evolutionary analysis. Version 2.75. Available at <http://mesquiteproject.org>.
- Matzke, N.J.** 2013. BioGeoBEARS: BioGeography with Bayesian (and Likelihood) Evolutionary Analysis in R Scripts. R package, version 0.2.1, published July 27, 2013 at: <http://CRAN.R-project.org/package=BioGeoBEARS>
- Matzke, N.J.** 2014. Model selection in historical biogeography reveals that founder-event speciation is a crucial process in island clades. *Syst. Biol.* 63: 951–970.
- Mendes J.C.R.** 2018. *Dalechampia* L. (Euphorbiaceae) na Amazônia brasileira. Masters dissertation. Universidade Federal Rural da Amazônia e Museu Paraense Emílio Goeldi, 129 p.
- O'Connell, N.** 1993. Yule process approximation for the skeleton of a branching process. *J. Appl. Probab.* 30: 725–729.
- Pax, F. & Hoffman, K.** 1919. Euphorbiaceae–Dalechamptieae. Pp. 1–59 in Engler, H.G.A. (ed.), *Das Pflanzenreich. Regni vegetabilis conspectus*, IV. 147. XII (Heft 68), Leipzig: Engelmann.
- Pereira-Silva R.A, Athiê-Souza, S.M, Secco, R.S., Melo, A.L. & Sales M.F**

Dalechampia (Acalyphoideae, Euphorbiaceae) em Pernambuco (Brasil).
Rodriguesia, no prelo.

- Price, M.N., Dehal, P.S. & Arkin, A.P.** 2010. FastTree 2—approximately maximum-likelihood trees for large alignments. *Plos One* 5: 9490.
- Ree, R.H.; Smith, S.A.** 2008. Maximum likelihood inference of geographic range evolution by dispersal, local extinction, and cladogenesis. *Syst. Biol.* 57: 4–14.
- Renner, S.** 2004. Plant dispersal across the tropical Atlantic by wind and sea currents. *Int. J. Plant Sci* 165: S23–S33.
- Ronquist, F.** 1997. Dispersal-vicariance analysis: a new approach to the quantification of historical biogeography. *Syst. Biol.* 46: 195–203.
- Rambaut, A.** 2006. FigTree, version 1.0. Available at <http://evolve.zoo.ox.ac.uk/beast>.
- Rambaut, A., Drummond, A.J., Xie, D., Baele, G. & Suchard, M.A.** 2018. Posterior summarisation in Bayesian phylogenetics using Tracer 1.7. *Systematic Biology* syy032. doi:10.1093/sysbio/syy032.
- Ronquist, F. & Huelsenbeck, J. P.** 2003. MRBAYES 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* 19: 1572-1574.
- Särkinen, T.E., Newman, M.F., Maas, P.J., Maas, H., Poulsen, A.D., Harris, D.J., Richardson, J.E., Clark, A., Hollingsworth, M. & Pennington, R.T.** 2007. Recent oceanic long-distance dispersal and divergence in the amphi-Atlantic rain forest genus *Renealmia* L.f (Zingiberaceae). *Mol. Phylogenetics Evol.* 44: 968–980.
- Su, Y.C. & Saunders, R.M.** 2009. Evolutionary divergence times in the Annonaceae: evidence of a late Miocene origin of *Pseuduvaria* in Sundaland with subsequent diversification in New Guinea. *BMC Evol. Biol* 9: 153.
- Tanai, T.** 1989. The Revision of the so-called “Alangium” leaves from the Paleogene of Hokkaido. *Bull. Natl. Sci. Mus. Tokyo* 15: 121–149. **Tanai, T.** 1990. Euphorbiaceae and Icacinaceae from the Paleogene of Hokkaido. *Bull. Natl. Sci. Mus. Tokyo* 16: 91–118.
- Thiers, B.** 2014 [continuously updated] Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden’s Virtual Herbarium, New York. <http://sweetgum.nybg.org/ih/>. (Accessed 15 Ago 2018).
- Van Welzen, P.C., Strijk, J.S., van Konijnenburg-van Cittert, J.H., Nucete, M. & Merckx, V.S.** 2014. Dated phylogenies of the sister genera *Macaranga* and *Mallotus* (Euphorbiaceae): congruence in historical biogeographic patterns. *Plos One* 9: 85713.

- Webster, G.L. & Armbruster, W.S.** 1991. A synopsis of the neotropical species of *Dalechampia* (Euphorbiaceae). *Bot. J. Linn. Soc.* 105: 137–177.
- Yoder, A.D. & Nowak, M.D.** 2006. Has vicariance or dispersal been the predominant biogeographic force in Madagascar? Only time will tell. *Annu. Rev. Ecol. Evol. Syst.* 37: 405–431.

Fig. 1 Bayesian inference (BI) majority-rule consensus topology of combined plastid spacer (trnK intron/partial *matK*) and nuclear 18S–26S and nuclear ribosomal ETS and ITS (ITS1-5.8S-ITS2) data for the genus *Dalechampia*. Inserts in the figure illustrate part of pseudanthium; the first shows the absence of resiniferous glands in species from Madagascar, and the second the presence of resiniferous glands in the staminate cymules present in Neotropical, African, and Asian species. Numbers above the lines represent the Bayesian posterior probabilities.

Fig. 2. Ancestral state reconstruction of morphological characters for *Dalechampia*. The reconstruction model used was that of maximum likelihood under the Markov k-state one-parameter (Mk1), in Mesquite software. Ancestral state reconstruction was estimated using the 50% majority-rule topology obtained by Bayesian analysis of the plastid and nuclear datasets. In **A**: Type of leaves; **B**: Apex of stylar column; **C**: Margin of pistillate bracteole with glandular trichomes; **D**: Margin of pistillate sepals; **E**: Glandular trichomes on the margins of pistillate sepals; **F**: Connation of staminate bracteole; **G**: Shape of staminate bracts; **H**: Resiniferous gland.

Fig. 3. Biogeographic inferences recovered from the BioGeoBEARS analyses of dated phylogenies of *Dalechampia*. Range shifts are indicated above the pie charts. Long distance dispersal hypotheses explaining the arrival of *Dalechampia* in Africa, in Madagascar, and then in Asia, are shown on the map. SA = South America; AF = Africa; MA = Madagascar; AS = Asia.

Table 1. List of the characters examined and their coding state.

Morphological features	Coding states
1. Type of leaves	(0) Simple leaves; (1) Compound leaves
2. Apex of stylar column	(0) Slender or cylindrical; (1) Lobed or dilated
3. Margin of pistillate bracteole with glandular trichomes	(0) Absent; (1) Present; (2) Not applicable
4. Margin of pistillate sepals	(0) Entire; (1) Lobed
5. Glandular trichomes on the margins of pistillate sepals	(0) Absent; (1) Present
6. Connation of staminate bracteole	(0) Free; (1) Connate or bilabiate; (2) Fused at base only
7. Shape of staminate bracts	(0) planar; (1) Rigid and concave
8. Resiniferous gland	(0) Absent; (1) Present

Table 2. Distribution of species and Genbank accession numbers.

Species	Geographic distribution	Genbank accession numbers		
		<i>trnK</i>	ITS1-5.8S-ITS2	ETS
Sect. <i>Brevicolumnae</i>				
<i>D. brevicolumna</i>	Neotropics	GQ463909.1	GQ463776.1	GQ463830.1
Sect. <i>Coriaceae</i>				
<i>D. coriacea</i>	Neotropics		GQ463801.1	GQ463849.1
Sect. <i>Dalechampia</i>				
<i>D. aff. hispida</i>	Neotropics	GQ463919.1	GQ463787.1	GQ463837.1
Subsect. <i>convolvuloides</i>				
<i>D. arenalensis</i>	Neotropics	GQ463923.1	GQ463793.1	GQ463842.1
<i>D. denticulata</i>	Neotropics	GQ463911.1	GQ463778.1	
<i>D. convolvuloides</i>	Neotropics	GQ463910.1	GQ463777.1	
Subsect. <i>Dalechampia</i>				
<i>D. armbrusteri</i>	Neotropics		GQ463800.1	GQ463848.1
<i>D. brownsbergensis</i>	Neotropics	GQ463847.1	GQ463799.1	GQ463847.1
<i>D. ficifolia</i>	Neotropics	GQ463832.1	GQ463780.1	GQ463832.1
<i>D. magnistipulata</i>	Neotropics	GQ463918.1	GQ463786.1	GQ463836.1
<i>D. pernambucensis</i>	Neotropics	GQ463843.1	GQ463794.1	
<i>D. scandens</i>	Neotropics		GQ463795.1	
<i>D. stipulacea</i>	Neotropics	GQ463846.1	GQ463798.1	
<i>D. viridissima</i>	Neotropics		GQ463795.1	
Subsect. <i>humiles</i>				
<i>D. caperonioides</i>	Neotropics		GQ463783.1	
<i>D. humilis</i>	Neotropics	GQ463912.1	GQ463779.1	GQ463831.1
Subsect. <i>triphyllae</i>				
<i>D. heteromorpha</i>	Neotropics		GQ463791.1	
<i>D. triphylla</i>	Neotropics		GQ463790.1	
Clade I				
<i>D. parvifolia</i>	Africa		GQ463827.1	GQ463878.1

<i>D. volubilis</i>	Africa	GQ463948.1		
<i>D. aff. capensis</i>	Africa	GQ463951.1	GQ463823.1	GQ463873.1
<i>D. galpinii</i>	Africa	GQ463949.1		GQ463871.1
<i>D. trifoliata</i>	Africa	GQ463950.1		GQ463872.1
<i>D. ipomoeifolia</i>	Africa		GQ463817.1	GQ463866.1
<i>D. chlorocephala</i>	Madagascar	GQ463935.1	GQ463806.1	GQ463854.1
<i>D. subternata</i>	Madagascar		GQ463808.1	GQ463856.1
<i>D. bernieri var. denisiana</i>	Madagascar		KP794424.1	
<i>D. clematidifolia</i>	Madagascar	GQ463940.1		GQ463859.1
<i>D. tamifolia</i>	Madagascar		GQ463815.1	GQ463864.1
<i>D. aff. bernieri</i>	Madagascar	GQ463939.1		
<i>D. decaryi</i>	Madagascar	GQ463933.1		GQ463852.1
<i>D. bidentata</i>	Asia	GQ463953.1	GQ463825.1	GQ463875.1
<i>D. elongata</i>	Asia	GQ463952.1	GQ463824.1	GQ463874.1

Sect. *Rhopalostylis*

<i>D. hastata</i>	Neotropics	GQ463886.1	GQ463744.1	
<i>D. heterobracteata</i>	Neotropics	GQ463891.1		

Sect. *Cremophyllum*

<i>D. magnoliifolia</i>	Neotropics	GQ463907.1		
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Sect. *Dioscoreifoliae*

<i>D. aff. sylvestris</i>	Neotropics	GQ463898.1	GQ463758.1	
<i>D. luetzelburgii</i>	Neotropics	GQ463899.1	GQ463759.1	
<i>D. peckoltiana</i>	Neotropics		GQ463761.1	

Sect. *Tiliifoliae*

<i>D. affinis</i>	Neotropics	GQ463932.1	GQ463803.1	GQ463851.1
<i>D. tiliifolia</i>	Neotropics	GQ463931.1	GQ463931.1	GQ463850.1

Table 3. Morphological data matrix for *D.* sect. *Dalechampia* and the outgroup *P. volubilis* and *T. volubilis*

Species	Characters and states							
	1	2	3	4	5	6	7	8
<i>D chlorocephala</i>	0	0	0	1	1	0	0	0
<i>D subternata</i>	0	0	0	1	1	0	0	0
<i>D bernieri var denisiana</i>	0	0	0	1	1	0	0	0
<i>D clematidifolia</i>	1	0	0	1	1	0	0	0
<i>D tamifolia</i>	0	0	0	1	1	0	0	0
<i>D aff bernieri</i>	0	0	0	1	1	0	0	0
<i>D decaryi</i>	0	0	1	1	1	0	0	0
<i>D parvifolia</i>	0	0	1	1	1	2	0	1
<i>D volubilis</i>	0	1	0	1	1	2	0	1
<i>D capensis</i>	0	1	1	1	1	2	0	1
<i>D galpini</i>	0	0	0	1	0	2	0	1
<i>D bidentata</i>	1	0	0	1	1	0	0	1
<i>D elongata</i>	1	0	0	0	0	?	?	?
<i>D trifoliata</i>	1	1	0	1	0	1	0	1
<i>D ipomoeifolia</i>	0	0	0	1	0	2	0	1
<i>D brownsbergensis</i>	0	1	0	1	1	1	0	1
<i>D coriacea</i>	0	1	0	1	1	1	1	1
<i>D armbrusteri</i>	0	1	1	1	1	1	1	1
<i>D ficifolia</i>	0	1	0	1	1	1	0	1
<i>D convolvuloides</i>	0	1	0	1	1	1	1	1
<i>D arenalensis</i>	0	1	0	1	1	1	0	1
<i>D magnistipulata</i>	0	0	0	1	1	1	0	1
<i>D affinis</i>	0	1	0	1	1	2	0	1
<i>D tiliifolia</i>	0	1	0	1	1	2	0	1
<i>D brevicolumna</i>	0	0	0	0	0	0	0	1
<i>D pernambucensis</i>	0	1	0	1	1	1	0	1
<i>D scandens</i>	0	1	1	1	1	1	0	1
<i>D humilis</i>	0	1	1	1	1	1	0	1
<i>D aff hispida</i>	0	1	0	1	1	1	0	1

<i>D viridissima</i>	0	1	0	1	1	1	0	1
<i>D heteromorpha</i>	0	0	?	0	0	1	0	1
<i>D denticulata</i>	0	1	1	1	1	1	0	1
<i>D triphylla</i>	1	0	?	1	?	1	0	1
<i>D caperonioides</i>	0	0	0	1	1	1	0	1
<i>D stipulacea</i>	0	0	1	1	1	1	0	1
<i>D aff sylvestris</i>	1	0	0	0	0	0	1	1
<i>D luetzelburgii</i>	1	0	0	0	0	0	1	1
<i>D peckoltiana</i>	1	0	0	0	0	0	1	1
<i>D hastata</i>	0	1	0	0	0	0	0	0
<i>D heterobractea</i>	0	1	?	0	0	0	0	0
<i>D pentaphylla</i>	1	0	0	0	0	0	1	1
<i>D magnoliifolia</i>	0	1	?	0	0	0	1	1
<i>T volubilis</i>	0	0	3	0	0	3	2	0
<i>P volubilis</i>	0	1	3	0	0	3	2	0

Supplementary Table 1. Localization codes for presence (1) and absence (0) of *Dalechampia* species used on the BioGeoBears analysis.

Species	Regions			
	Neotropics	Africa	Madagascar	Asia
<i>D. chlorocephala</i>	0	0	1	0
<i>D. subternata</i>	0	0	1	0
<i>D. bernieri</i> var. <i>denisiana</i>	0	0	1	0
<i>D. clematidifolia</i>	0	0	1	0
<i>D. tamifolia</i>	0	0	1	0
<i>D. aff. bernieri</i>	0	0	1	0
<i>D. decaryi</i>	0	0	1	0
<i>D. parvifolia</i>	0	1	0	0
<i>D. volubilis</i>	0	1	0	0
<i>D. capensis</i>	0	1	0	0
<i>D. galpini</i>	0	1	0	0
<i>D. bidentata</i>	0	0	0	1
<i>D. elongata</i>	0	1	0	1
<i>D. trifoliata</i>	0	1	0	1
<i>D. ipomoeifolia</i>	0	1	0	0
<i>D. brownsbergensis</i>	1	0	0	0
<i>D. coriacea</i>	1	0	0	0
<i>D. arnbrusteri</i>	1	0	0	0
<i>D. ficifolia</i>	1	0	0	0
<i>D. convolvuloides</i>	1	0	0	0
<i>D. arenalensis</i>	1	0	0	0
<i>D. magnistipulata</i>	1	0	0	0
<i>D. affinis</i>	1	0	0	0
<i>D. tiliifolia</i>	1	0	0	0
<i>D. brevicolumna</i>	1	0	0	0
<i>D. pernambucensis</i>	1	0	0	0
<i>D. scandens</i>	1	0	0	0
<i>D. humilis</i>	1	0	0	0
<i>D. aff. hispida</i>	1	0	0	0

<i>D. viridissima</i>	1	0	0	0
<i>D. heteromorpha</i>	1	0	0	0
<i>D. denticulata</i>	1	0	0	0
<i>D. triphylla</i>	1	0	0	0
<i>D. caperonioides</i>	1	0	0	0
<i>D. stipulacea</i>	1	0	0	0
<i>D. aff. sylvestris</i>	1	0	0	0
<i>D. luetzelburgii</i>	1	0	0	0
<i>D. peckoltiana</i>	1	0	0	0
<i>D. hastata</i>	1	0	0	0
<i>D. heterobractea</i>	1	0	0	0
<i>D. pentaphylla</i>	1	0	0	0
<i>D. magnoliifolia</i>	1	0	0	0

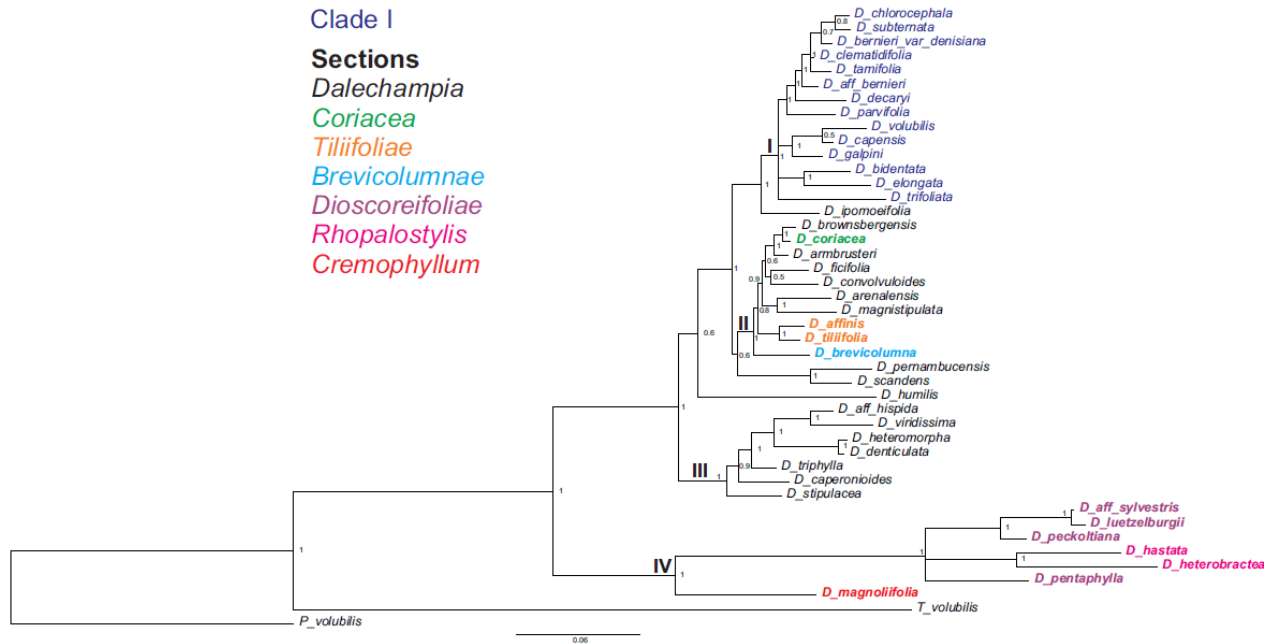


Fig. 1 Bayesian inference (BI) majority-rule consensus topology of combined plastid spacer (trnK intron/partial *matK*) and nuclear 18S–26S and nuclear ribosomal ETS and ITS (ITS1–5.8S–ITS2) data for the genus *Dalechampia*. The new subsection *Africanae*, within the section *Dalechampia*, is highlighted in bold. Inserts in the figure illustrate part of pseudanthium; the first shows the absence of resiniferous glands in species from Madagascar, and the second the presence of resiniferous glands in the staminate cymules present in Neotropical, African, and Asian species. Numbers above the lines represent the Bayesian posterior probabilities.

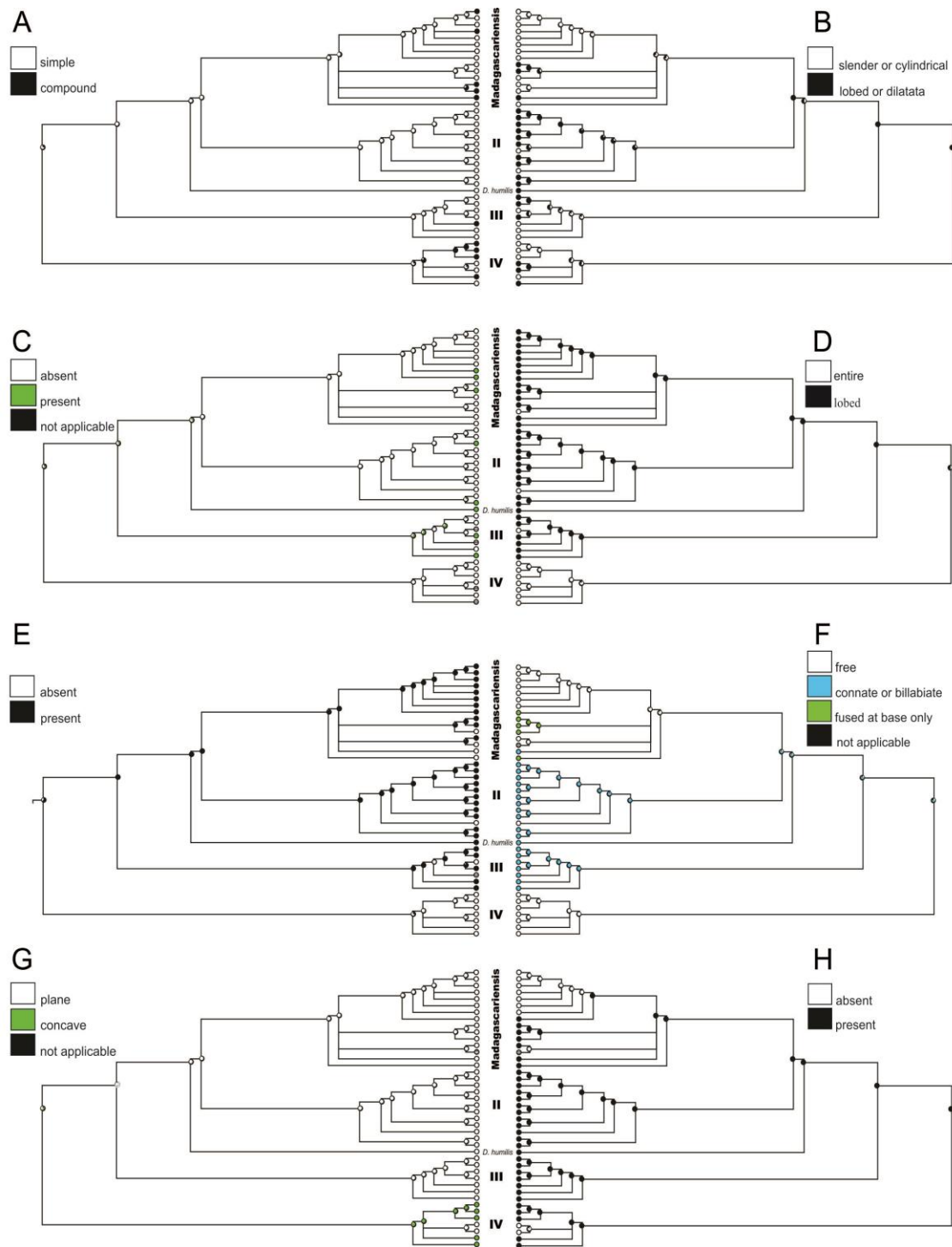


Fig. 2. Ancestral state reconstruction of morphological characters for *Dalechampia*. The reconstruction model used was that of maximum likelihood under the Markov k-state one-parameter (Mk1), in Mesquite software. Ancestral state reconstruction was estimated using the 50% majority-rule topology obtained by Bayesian analysis of the plastid and nuclear datasets. In **A**: Type of leaves; **B**: Apex of stylar column; **C**: Margin of pistillate bracteole with glandular trichomes; **D**: Margin of pistillate sepals; **E**: Glandular trichomes on the margins of pistillate sepals; **F**: Connation of staminate bracteole; **G**: Shape of staminate bracts; **H**: Resiniferous gland.

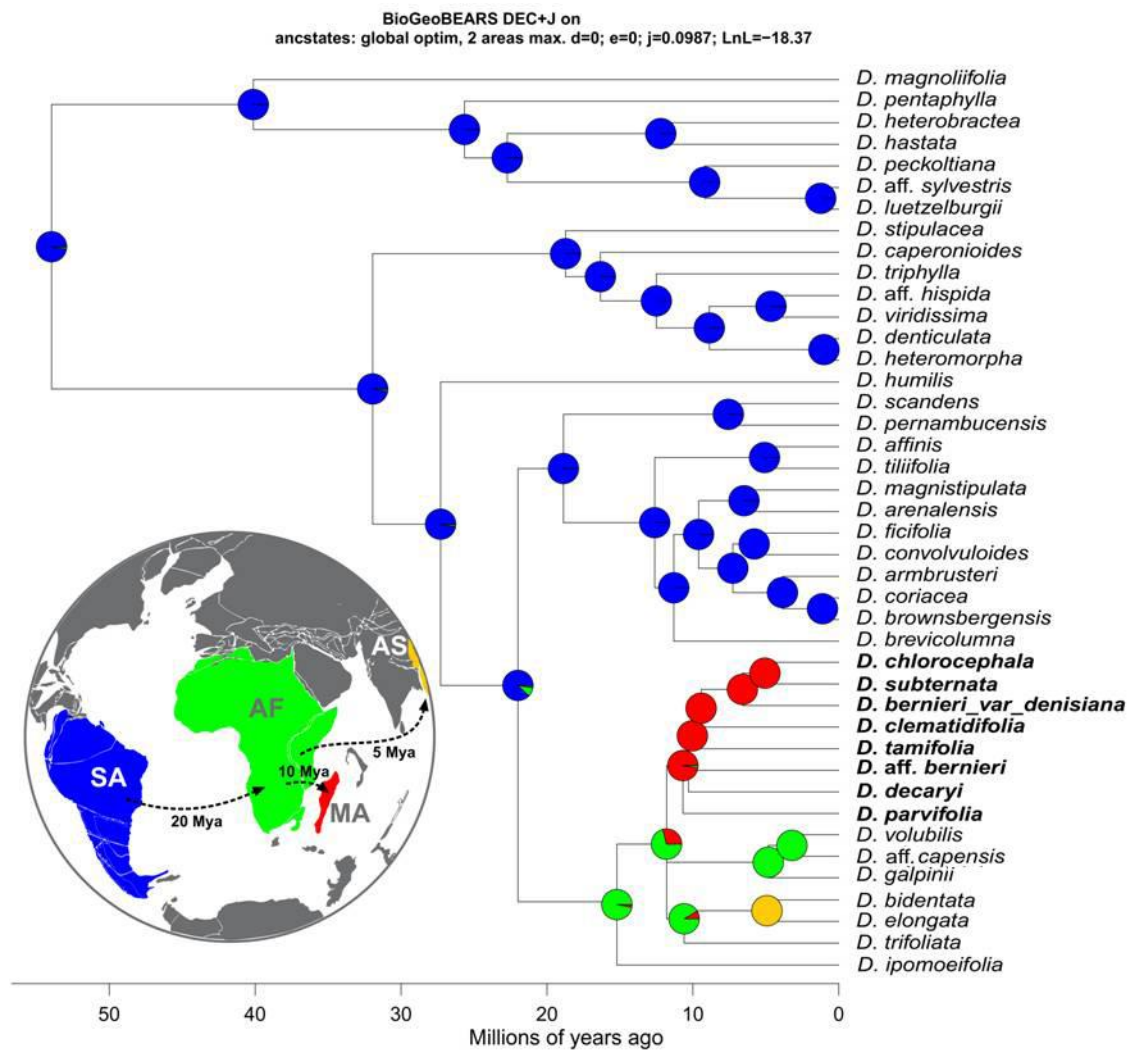
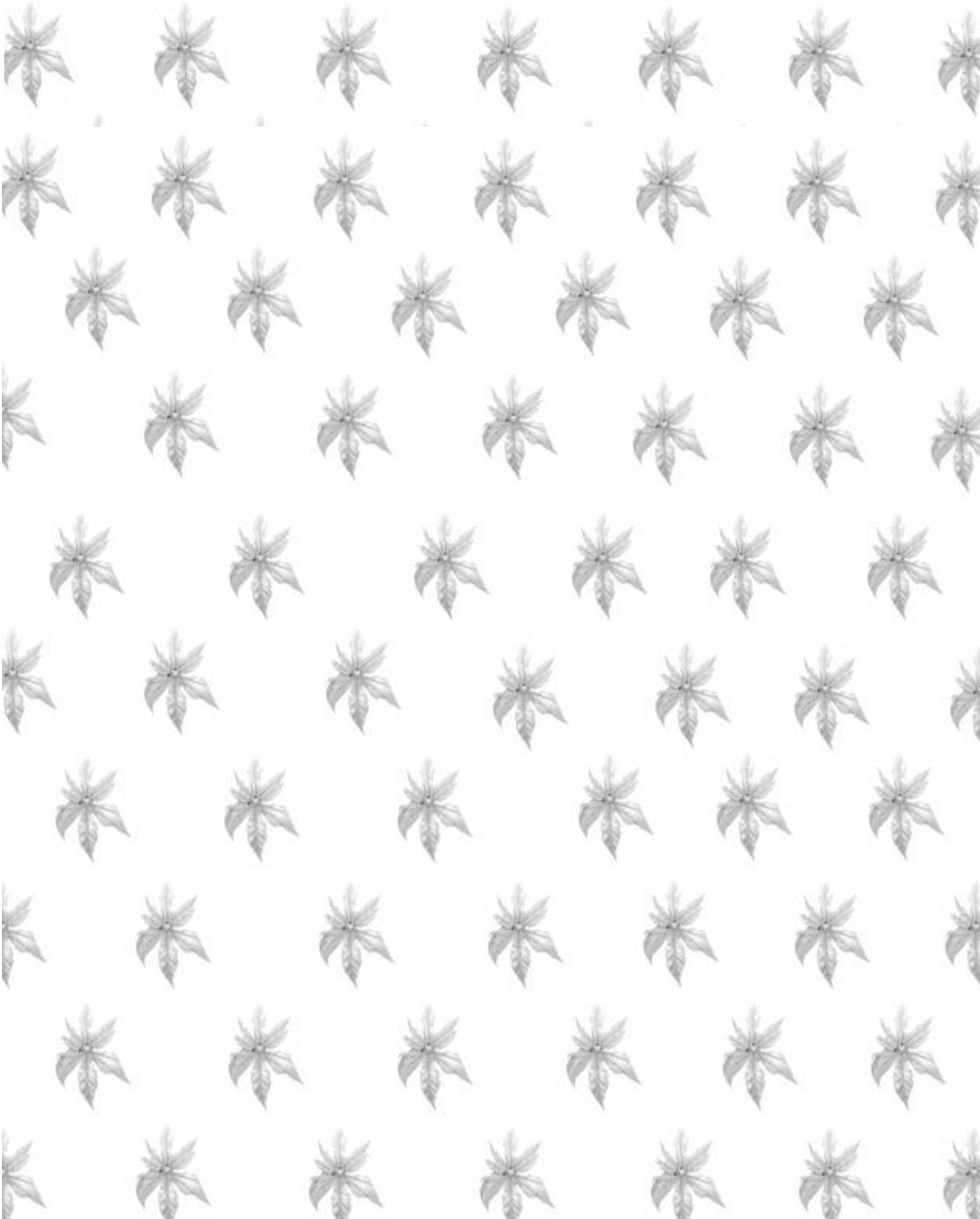


Fig. 3. Biogeographic inferences recovered from the BioGeoBEARS analyses of dated phylogenies of *Dalechampia*. Range shifts are indicated above the pie charts. Long distance dispersal hypotheses explaining the arrival of *Dalechampia* in Africa, in Madagascar, and then in Asia, are shown on the map. SA = South America; AF = Africa; MA = Madagascar; AS = Asia.

Manuscrito 2



**Molecular phylogeny of *Dalechampia*
sect. *Dalechampia* (Euphorbiaceae)
reveals a new infrageneric classification**

Rafaela Alves Pereira-Silva, Gustavo Souza, Sarah Maria Athiê-Souza,
André Laurênio de Melo, Margareth F. Sales, and W. Scott Armbruster

Artigo a ser submetido

Systematic Botany

PEREIRA-SILVA ET AL.: PHYLOGENY OF *D.* SECT. *DALECHAMPIA*

Molecular phylogeny of *Dalechampia* sect. *Dalechampia* (Euphorbiaceae) reveals a new infrageneric classification

Rafaela Alves Pereira-Silva,^{1,5} Gustavo Souza², Sarah Maria Athiê-Souza,¹ André Laurênio de Melo,³ Margareth F. Sales,¹ and W. Scott Armbruster⁴

¹Programa de Pós-Graduação em Botânica, Departamento de Biologia, Universidade Federal Rural de Pernambuco, 52171-900, Recife, PE, Brazil.

²Laboratório de Citogenética e Evolução vegetal, Universidade Federal de Pernambuco, 50670-901, Cidade Universitária, Recife, PE, Brasil.

³Unidade Acadêmica de Serra Talhada, Universidade Federal Rural de Pernambuco, 56909-535, Serra Talhada, PE, Brazil.

⁴School of Biological Sciences, University of Portsmouth, Portsmouth, PO1 2DY, UK; Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska 99775, USA.

⁵Author for correspondence (rafaela.news@hotmail.com)

Abstract— *Dalechampia* is a genus in most climbing, rare subshrubs from Pantropical region and is easily recognized due its pseudanthium with unique morphology within Euphorbiaceae family. The actual taxonomic treatment by Webster & Armbruster (1991) present some problems as character overlay among the section. Here we present new infrageneric phylogeny of the genus *Dalechampia* based on two plastid (*matK-trnK* and *trnL-F*) and one nuclear ribosomal (ITS1-5.8S-ITS2) loci, with dense sampling including 40% of the section *Dalechampia* species and discussion of its subsections relationships. Our results reveal that the current classification mainly of *Dalechampia* sect. *Dalechampia* needs to be revised. The most sections in the genus (*Brevicolumnae*, *Coriaceae*, *Dalechampia*, *Dioscoreifoliae*, *Rhopalostylis* and *Tiliifoliae*) are non-monophyletic. We are proposing that the sections *Brevicolumnae*, *Coriaceae* and *Tiliifoliae* might be included in the section *Dalechampia* as clades that should be in the future better available. The sections *Dioscoreifoliae* and *Rhopalostylis* might be synonymized; only the section *Cremophyllum* emerged as monophyletic, as well as the clade *Tamifoliae*, which is being considered as a new subsection for Africa, Madagascar and Asia *Dalechampia* species.

Keywords—pseudanthium, Plukenetieae, phylogenetics.

Introduction

The pantropical twining vines and subshrubs genus *Dalechampia* L. (Plukenetieae, Euphorbiaceae) includes almost 130 species among which approximately 90 occur in the tropical Americas (Armbruster et al. 1993, Webster, 2014). Their species are morphologically distinct because they present inflorescence in pseudanthium, with two involucral bracts, sometimes stipuliforms, a pistillate cymule with 1–4 pistillate bracts, accommodating 1–3 pistillate flowers with 6–12 sepals, beside there is staminate cymule with 1–5 bracts, involving four to almost 50 staminate flowers (Webster, 1994, 2014, Webster & Armbruster 1991). Beyond this, there are the glands, which produces resin, or, in few cases, aromatic compounds, occurring in the most of *Dalechampia*, except to the Madagascar species.

The *Dalechampia* species can offer, as reward, to their bee's pollinators the resin, pollen or aromatic compounds (Armbruster 1994). Large bees as *Eulaema* Lepeletier, 1841 and *Eufriesea* Cockerell, 1908 are exclusively of species that offer large amounts of resin, by the other hand smaller bees as *Hyphantidium* Scott, 1859 and *Trigona* Jurine, 1807 are exclusively of species that offer smaller amount of resin. The distance between resin gland, stigmas and anthers influence the bees that collect and/or deposit pollen, which hence be the pollinator (Armbruster 1993).

Dalechampia was described by Linnaeus in 1753 and has since been the subject of some monographs, among which the most noteworthy are those published in the 19th century (Baillon 1858, Müller 1865, 1873) and the beginning of the 20th century (Pax & Hoffmann 1919), the latter being the most complete treatment for the genus. The most recent taxonomic treatment was proposed by Webster & Armbruster (1991) for the neotropical species and treated 92 taxa placed in six section: *D. sect. Coriaceae* Pax & K. Hoffm., *D. sect. Cremophyllum* Baill., *D. sect. Dalechampia*, *D. sect.*

Dioscoreifoliae Pax & K. Hoffm., *D. sect. Rhopalostylis* Pax & K. Hoffm. and *D. sect. Tiliifoliae* G.L. Webster & Armbruster; *Dalechampia brevicolumna* was published as a new species and placed in a new subsection *Brevicolumnae* Armbruster (Armbruster, 1997). Subsequently, Armbruster (1994) has updated this number to almost 120 species.

Morphological and molecular phylogenetic studies suggest the monophyly of the genus. However, some of its sections (e.g. *D. sect. Dalechampia* and *D. sect. Dioscoreifoliae*) have been shown to be artificial and have emerged as paraphyletic (e.g. Armbruster 1997; Armbruster et al. 2009; Pereira-Silva et al. data unpublished). In addition, poorly sampled groups such as *D. sect. Dalechampia* reveal the need for further study in the phylogenetic relationships of Neotropical species. *Dalechampia* sect. *Dalechampia* stands out as the largest section of the genus, comprising 59 species included into five subsections (*Brevipedes*, *Convolvuloides*, *Dalechampia*, *Humiles*, *Tamifoliae* and *Triphyllae* (Webster & Armbruster, 1991; Pereira-Silva, data unpublished) and distributed in the Neotropical region from Mexico to Argentina, with the highest number of species in Brazil (45 spp.) (Webster & Armbruster 1991; Pereira-Silva et al. 2016).

Since the positioning of Pax & Hoffman (1919), Webster & Armbruster (1991) reorganized the sections and subsections to Neotropical species. However, the intensification of the taxonomic studies involving *Dalechampia* revealed some novelties (Pereira et al., 2016, 2018) showing that the group demanded greater deepening from the point of view of taxonomic knowledge. Previous molecular and morphologically-based phylogenetic analyses (Armbruster 1997), including data from floral evolution and pollination system (Armbruster et al. 2009) and biogeography (Armbruster 1994), have been conducted for the genus. However, none of these studies clearly delimits monophyletic clades nor synthesizes morphological diversity across *D. sect.*

Dalechampia as a whole.

Here we present a new phylogenetic analysis that samples the full morphological diversity and nearly the entire geographical range of the genus *Dalechampia*. This analysis is based on three plastid loci and the nuclear ribosomal ITS region, providing improved resolution and support over (Armbruster et al. 2009). We use this densely sampled phylogenetic analysis to propose a new sectional classification of the *Dalechampia*, in which we recognize five clades (one of these corresponding to the new section *Tamifoliae*), provide new or emended section/subsection descriptions, a key to section and, for sections where no further ambiguity as to species placements exists, the new nomenclatural adjustments for species as required.

MATERIAL AND METHODS

A total of 108 specimens and 71 species, representing 56% of all species of the genus *Dalechampia* and all seven sections were sampled. DNA was extracted (following Doyle & Doyle 1987) from field-collected silica-dried leaves for samples of the species *D. brasiliensis* Lam., *D. caperonioides* Baill., *D. leandrii* Baill., *D. linearis* Baill., *D. pernambucensis* Baill., *D. guaranitica* Pax & F. Hoffm., *D. tiliifolia* Lam., *D. violacea* Pax & F. Hoffm. and *D. weddelliana* Baill. When possible, multiple individuals per species from different localities were sampled. In addition, previously published sequences of other *Dalechampia* species (Armbruster & Baldwin, 1998; Armbruster et al. 2009) were downloaded from GenBank [<http://www.ncbi.nlm.nih.gov>]. *Plukenetia volubilis* L. (GQ463738) and *Tragia volubilis* L. (GQ463956) were included as outgroup.

Were analysed sequences from three plastid loci (*matK*, *trnK-matK* and *trnL-F*) and one nuclear (ITS1-5.8S-ITS2). Primers for *trnK-matK* were identical to those used

in Armbruter et al. (2009). PCR amplification was carried out in 50 μ L reaction volumes with 2 μ L DNA, 1.0 μ L of Taq polymerase and 1 μ L primers. Thirty-five PCR cycles were performed at 95°C for 3 min, 95°C for 1 min, and 72°C for 2 min for *trnL-F*. For *trnK-matK* were performed at 94° for 5 min, 94° for 30 sec, and 72° for 30 sec. And for ITS 95° for 5 min, 95° 1 min, 72° for 1 min. For *trnK-matK* primer, were not performed. All of the PCR products were visualized on agarose gel. Successfully amplified products were cleaned using isopropanol 75% (Big Dye vs.2). Amplifying primers were used for sequencing.

The sequences for both regions were aligned using the Geneious 11.1.4. We used JModelTest to select the optimal nucleotide substitution model for the each region using the Akaike Information Criterion (Posada, 2008). The GTR+G substitution model were employed for the concatenated data. Were performed using FastTree (Price et al. 2010) for each region and Bayesian Inference (BI), both available on Geneious. The analysis was conducted for two independent runs and for 5,000,000 generations, sampling every 1000 trees. Trees were visualized using FigTree v1.3.1 (Rambaut 2009).

RESULTS

Statistics for analyses and general information for cpDNA and ITS regions are summarized in Table 1. The analyses of each individual loci resulted are poorly resolved topologies (data not shown). Therefore, the results are based on the BI topology of the combined dataset (Fig. 1).

Table 1. Summary statistics for the aligned molecular data.

Characteristic	ITS	<i>matK</i>	<i>trnL-F</i>	<i>trnK</i> (partial <i>matK</i>)
Number of taxa	101	10	15	56
Aligned length (bp)	703	453	986	494
Variable characters	421	23	93	56
Informative characters (%)	331 (4.69%)	9 (5.07%)	34 (9.43%)	21 (11.33%)

Our results indicate that *Dalechampia* sect. *Dalechampia* is non-monophyletic by the position of representatives of *D.* sect. *Brevicolumnae*, *D.* sect. *Coriaceae* and *D.* sect. *Tiliifoliae* among their species. The section *Dalechampia* clade was formed by five subclades (one of them composed by the new subsection *Tamifoliae*). *Tamifoliae* is a monophyletic subsection (PP= 0.99), composed by species from Africa and Madagascar (*D. bernieri* var. *denisiana* Leandri, *D. bidentata* Blume, *D. clematidifolia* Bojer ex Baill., *D. chlorocephala* Denis, *D. decaryi* Leandri, *D. elongata* Craib, *D. galpinii* Pax, *D. ipomoeifolia* Benth., *D. parvifolia* Lam., *D. subternata* Müll. Arg., *D. tamifolia* Lam. and *D. volubilis* E. Mey. ex Baill.). This subsection is discussed in Pereira-Silva et al. (2019).

The subclade named as *Dalechampia* present a low support (PP=0.56) is being composed in large number by species from *D.* subsect. *Dalechampia* (Fig 1). This is paraphyletic for the insertion of sections *Brevicolumnae* (monospecific section, *D. brevicolumna* Armbr., lightly in pink), *Coriaceae* (monospecific section, *D. coriacea* Klotzsch ex Müll. Arg., in yellow) and *Tiliifoliae* (*D. tiliifolia* Lam. and *D. affinis* Müll. Arg., 2 of 4 species in blue). *Dalechampia schippii* Standl. has fallen outside of the subsection *Humiles* and appeared also in this clade *Dalechampia* (fig. 1). The clade also

includes species from subsections *Convolvuloides* (*D. leandrii* Baill., *D. schenckiana* Pax & K. Hoffm., *D. arenalensis* Armbr. and *D. convolvuloides* Lam.).

The subclade Scandentes (PP=1) is composed by *D. pernambucensis* Baill. and *D. scandens* L. The subclade Triphyllae has a good support (PP=0.9) comprising species of the subsection *Convolvuloides* (*D. hispida* Poepp. and *D. denticulata* C. Wright ex Griseb., 2 lighted in red), subsection *Dalechampia* (*D. viridissima* G.L. Webster and *D. stipulacea* Müll. Arg., 2 in green), subsection *Triphyllae* (*D. cissifolia* Poepp., *D. heteromorpha* Pax & K. Hoffm. and *D. triphylla* Lam., 3 in gray) and *Dalechampia caperonioides* Baill. from subsection *Humiles* (in purple).

The last clade is the Cremophyllum-Dioscoreifolieae-Rhopalostylis clade, which contains the bulk of the species this three *Dalechampia* sections, and can be broken down into two clades: the Dioscoreifolieae-Rhopalostylis subclade (pp=0.8), and Cremophyllum subclade (pp=1). Dioscoreifolieae-Rhopalostylis subclade comprise the species of the *D. sect. Dioscoreifolieae* and *D. sect. Rhopalostylis*, being the species of *Rophalostylis* divided in two lineages. This clade is resolved as sister (pp=1) to the Cremophyllum subclade, which includes species of the subsection *Cremophyllum*, with a *D. spathulata* clade sister to *D. magnoliifolia*.

DISCUSSION

Here we present the most comprehensively sampled and well-resolved phylogeny of the genus *Dalechampia* sect. *Dalechampia* published to date. Wide and representative taxon sampling, combined with use of a more variable plastid DNA sequence locus, has yielded better phylogenetic resolution than in previous studies (Armbruster & Baldwin, 1998; Armbruster et al. 2009; Armbruster et al. 2012). Our analyses support the non-monophyly of the section *Dalechampia*, which were grouped

in the same clade species of the sections *Brevicolumnae*, *Coriaceae* and *Tiliifoliae*. A Bayesian Tree estimated from analyses of cpDNA (3_ *trnK* introns/partial *matK*) and 18S–26S nuclear ribosomal ETS and ITS sequences data has indicated previously the non-monophyly of these sections (Armbruster et al. 2009). However, the taxonomy point of view never was discussed in the light of molecular phylogeny.

The most subsections of the section *Dalechampia* (*Brevicolumnae*, *Coriaceae*, *Dalechampia*, *Dioscoreifoliae*, *Rhopalostylis* and *Tiliifoliae*) are non-monophyletic. *Dalechampia* and *Triphyllae* subclades were the most complex clades, including species apparently non-related from the morphological point of view. Armbruster et al. (2009) also identified these morphologically heterogeneous clades and discussed this relationship based on floral characteristics associated with pollination syndromes and lines of defense against herbivores (e.g nocturnal closure of involucre bracts, presence or absence of resiniferous bractlets, resin secretion by pistillate sepals, spines on pistillate sepals, resin secretion by stipules leaves and bracts, and color of involucre bracts). However, we have no morphological synapomorphies that allow us to formalize all these subclades as subsections, suggesting that these species need to be studied in more detail with other tools (biochemistry, anatomy, ecology etc.). The genus *Dalechampia* seems to be influenced by ecological evidences (see Armbruster & Webster 1981) such as pollination syndromes, suggesting that a more detailed analysis of pollinator types may indicate ecological synapomorphies for some of these clades.

Tamifoliae subclade - The monophyly of subsection *Tamifoliae* is supported by the following synapomorphies: staminate bracteole not concave, connate or free, shape of gland and secretion of resin and for Madagascar species the resin gland is absent (Pereira-Silva et al. 2019). This group differently from the others included in *D.* sect.

Dalechampia is characterized also by having lost the resiniferous glands laminar, which are often found in section *Dalechampia* (see Armbruster & Baldwin, 1998; Pereira-Silva et al., 2019). Considering that this lineage has its monophyly strongly supported (Pereira-Silva et al. 2019) admit that this is a new subsection of the section *Dalechampia*.

Dalechampia subclade - This group is phylogenetically low supported and unsupported by morphological synapomorphies, needing to be better investigated. Their species comprises a high morphological diversity as seen in the shape of involucral bracts stipuliforms and not stipuliforms, resiniferous gland lacerate, fimbriate and laminar, and number of pistillate sepals six to 12. According to our results it is possible infer that species of the *Brevicolumnae*, *Coriaceae* and *Tiliifoliae* treated as *Dalechampia* sections by Webster & Armbruster (1991) belong to a unique monophyletic section *Dalechampia*.

Scandens subclade - The species present in this subclade lack morphological synapomorphies, although it is strongly sustained. However, their species are close related morphologically and ecologically, once they are twining vines with 3-lobed leaves and involucral bracts, pistillate sepals 9–12 pinnatifid and share the same pollinator. *Dalechampia pernambucensis* is pollinated by *Hiphantidium* and *D. scandens* by *Euglossa*, and mainly by *Hypantidium* (Armbruster & Webster, 1981; Armbruster, 1993).

Triphyllae subclade - the species of this group are phylogenetically closely related even though dramatically different morphologically in habit, type of leaves and shape of pistillate sepals. However, 50% of these species (e.g. *D. aff. cissifolia*, *D. caperonioides*, *D. heteromorpha* and *D. triphylla*) have confirmed *Hypantidium* bees as pollinator (Armbruster 1993; Armbruster & Webster 1982) and only *Euglossa* to

Dalechampia stipulacea (Armbruster et al., 2009). This clade suggest that there is a pattern of escalation in defensive systems, as already confirmed to Armbruster et al., (2009), these species are grouped in a crescent number of lines of defense for or against herbivores. *Dalechampia caperonioides* present only two lines of defense while *D. stipulacea* is the most derived in the group with eight lines of defense (as the presence of stipitate glands, which secretes oxygenated triterpene alcohols, present in the margins of leaves, involucre bracts, bracteoles and pistillate sepals on flower and fruits). Morphologically, it is remarkable in these species mainly due the quantity of glandular trichomes in *Dalechampia stipulacea* comparing to other species in the genus and the rarity of this kind of trichomes in *Dalechampia caperonioides* (Pereira-Silva et al. 2019, in press; Gillespie & Armbruster, 1997). However, while *Dalechampia cissifolia*, *D. heteromorpha* and *D. denticulata* share the same number of lines of defense (7), other species present less number of lines of defense, suggestion reversals into this group (See Armbruster et al., 2009). Our data show that the *Triphyllae* subsection, in its present circumscription, is not monophyletic. The transfer of *D. caperonioides*, *D. denticulata*, *D. hispida*, *D. stipulacea* and *D. viridissima* to the *Triphyllae* subsection would make the group monophyletic, however this proposal does not make morphological sense.

Humiles subclade – This group emerged as a well resolved clade (PP=1) which grouped most of the species in the Humiles (except *D. caperonioides* and *D. schippii*). This subsection is compound by species restrict to Savannah from South America. All of them are subshrubs, with leaves simple, entire and with involucre bracts, pinkish, yellowish or greenish to reddish. *Dalechampia schippii* was placed previously in the subsection *Humiles* in the taxonomic treatment by Webster & Armbruster (1991) due to its subshrub habit. However, the phylogeny indicated that *D. schippii* (a subshrubs from Belize and adjacent to Guatemala) is sister to *D. arenalensis* (a twining vine from Costa

Rica of the subsection *Convolvuloides*) (fig. 1, in the clade *Dalechampia*) with high support (PP=0.96), both from Central America and pollinated by *Euglossine* bees, which are very common and important pollinators to neotropical plants (Armbruster & Webster, 1979). Whose male bees can cross long distances in a short period of time (Pokorny et al. 2014) and studies have suggested that their foraging ranges contribute to long-distance gene flow among isolated populations (Armbruster & Webster, 1979, Opedal et al, 2017). *Humiles* is considered a supported subsection by the exclusion of those two-abovementioned taxons. However, it was subsampled in the present work. For this reason, we have decided not to treat this group as a subsection. This distinct lineage suggest that a new taxonomic delimitation is necessary for these species.

Cremophyllum-Dioscoreifoliae-Rhopalostylis clade - The section *Dioscoreifoliae* together with *Rhopalostylis* share four staminate bracteoles separated, being more decussate in *Dioscoreifoliae*. The *Dioscoreifoliae* section is characterized mainly by leaves lobed, unlobed or compound, 5–6 pistillate sepals, and the gland secretes resin or aromatic compound. In the clade (*Dioscoreifoliae* and *Rhopalostylis*) is most pollinated by *Eulaema* Lepeletier, 1841, *Euglossa* and *Trigona* Jurine, 1807 all belonging to Apidae (Armbruster & Webster, 1981; Armbruster 1993), in addition, male euglossine bees also collect volatile compounds (Armbruster & Webster, 1979). *Dalechampia websteri*, for example, is visited by resin collectors as *Euglossa*, *Hypanthidium* and *Trigona*. However, the distance between the gland and stigmas are relatively large, thus only the larger bees as *Euglossa* effect pollination regularly (Armbruster, 1984). Our results suggest that *Dioscoreifoliae* and *Rhopalostylis* should be brought together in a single *Dalechampia* section.

The clade *Cremophyllum* is composed by three species (*Dalechampia brevipedunculata*, *D. magnoliifolia* and *D. spathulata*) sensu Webster & Armbruster

(1991), but here was sampled two of them (*D. magnoliifolia* and *D. spathulata*), with high supported values (PP=1). According Webster & Armbruster (1991) the section *Rhopalostylis* is considered the most basal group, characterized by leaves unlobed and the entire involucral bract are small, less than 8 mm long.

Taxonomic implications.— Our phylogenetic analyzes revealed the need to change the infrageneric classification established by Webster & Armbruster (1991) for *Dalechampia* and also suggested a rearrangement of the subsections of *Dalechampia* sect. *Dalechampia* admitted by these authors. According to our new circumscription, *Dalechampia* begins to compose threesections (*Dalechampia*, *Cremophyllum* and *Diocoreifoliae*) instead of seven as it has been accepted so far. Regarding to the subsections of *D. sect. Dalechampia* we propose, for while, to consider as formal sections only the new subsection *Tamifoliae*. The other paraphyletic subgenus can not be solved with simple changes, which suggests that the group needs to be better studied.

Historically, Pax & Hoffmann (1919) placed some species from Africa, Malagasy, and Asia among 13 sections (*Sylvaticae* Pax & Hoffm., *Rhopalostylis* (Klotzsch) Pax & Hoffm., *Leucophyllae* Pax & Hoffm., *Cremophyllum* (Scheidw.) Baill., *Caperonioideae* Pax & Hoffm., *Triphyllae* Pax & Hoffm., *Brevipedes* Pax & Hoffm., *Scandentes* Pax & Hoffm., *Guaraniticae* Pax & Hoffm., *Dioscoreifoliae* Pax & Hoffm., *Humiles* Pax & Hoffm., *Coriaceae* Pax & Hoffm. and *Champadelia* Müll. Arg.) within *Dalechampia*, although not all African, Malagasy, and Asian species were addressed in that monograph. Additionally, the treatments proposed for *Dalechampia* by Webster & Armbruster (1991) and Armbruster (1996) were restricted to Neotropical species.

Our phylogenetic results showed species from the above mentioned regions (Table 3) emerging as a monophyletic group within the clade of the *Dalechampia* section. In

that sense, the expansion of *Dalechampia* sect. *Dalechampia* is proposed here through the inclusion of a new subsection comprising species from Africa, Madagascar, and Asia. The monophyly of the subsection *Tamifoliae* is morphologically supported by the following synapomorphies: staminate bracteole not concave, connate, or bilabiate; gland shape; and resin secretion. The secretion of resin is absent only in Madagascar species.

***Dalechampia* L.**, Species Plantarum, 1054. 1753. TYPE: *Dalechampia scandens* L.

Dalechampia* sect. *Cremophyllum (Scheidweiler) Baill., Etude du Groupe des Euphorbiacées: 487 (1858). *Cremophyllum* Scheidweiler, Bulletin de l'Académie Royale des Sciences et Belles-lettres de Bruxelles, 9(1): 23 1842. TYPE: *Cremophyllum spathulatum* Scheidweiler (= *Dalechampia spathulata* (Scheidweiler) Baill.

Dalechampia* sect. *Dalechampia Webster & Armbruster, Botanical Journal of the Linnean Society 105: 137-177. 1991. TYPE: *Dalechampia scandens* L.

Twining vines, lianas or subshrubs. Leaves alternate, entire, simple or compound 3–5 lobed, or 3–5-foliolate, with two stipels in the base, usually associate to glands, margins of leaves with papiliforms glands sparsely or with glandular trichomes. Petiole short or long, with a pair of petiolar stipules, rare with parastipules. Pseudhantium axillary, sometimes terminal, with two pairs of bracteal stipules on base. Two involucre bracts, entire, 3-5-lobed, 3-toothed or stipuliforms. Pleiochasium staminate and pistillate cymule locate in the center of inflorescence; resiniferous glands compound by a cluster of bracteoles. The staminate cymule is compound by 2-lipped, connate or free bracts with a row of 7–15 staminate flowers. These flowers present 4–6 sepals, free, lanceolate; stamens 5–100. Pistillate cymule is compound by bracts 1–4 with 1–3 pistillate flowers. These flowers present 6–12 sepals free, entire, pinnatifid or pinnatisect; ovary globose, 3–locular, 3–carpellate, 1 ovule per locule; styler column greenish, rare reddish, apex lobed, capitate, crateriform, slender, or discoid. Seeds ecarunculate, ellipsoid to round and usually smooth.

Subseccion *Tamifoliae* Pereira-Silva, R.A. subsect. nov.– **Type:** *D. tamifolia* Lam., Encycl. 2: 256. 1786. Madagascar, Without local, without date, *M. Poivre 16926* (holotype P!).

Differs from the other subsections of *Dalechampia* sect. *Dalechampia* by having pistillate cymule (1–)3-flowered, staminate pleiochasium with 4–50 flowers and subtended by 1–5 bracteoles, with or without resiniferous gland.

Twining vines or lianas. Leaves alternate, simple and/or compound with margins serrate, sinuate, dentate, or entire. Petiole short or long, with a pair of petiolar stipules. Pseudanthium axillary or terminal, bisexual, with two involucral bracts, each subtended by a pair of stipules. Staminate pleiochasium 4–50 flowers; subtended by 1–5 bracteoles, free, bilabiate or completely connate, with or without resiniferous glands. Staminate flowers with 4–6 sepals, valvate, free, lanceolate; stamens 5–93, borne on a column or dome-shaped receptacle, anthers dehiscing longitudinally. Pistillate cymule (1–)3-flowered, with involucl of distinct bracteoles. Pistillate flowers with 6–12 sepals, free, lanceolate or ovate, entire, pinnatifid or pinnatisect; ovary globose, 3-locular, 3-carpellate, 1 ovule per locule; stylar column cylindrical to clavate, tip lobed, capitate, crateriform, slender, or discoid. Capsule 3-lobed. Seeds globose or apiculate, usually smooth and with macules.

Dalechampia* sect. *Dioscoreifoliae Pax & Hoffmann, in A. Engler (Ed.), Das Pflanzenreich, IV. 147. XII (Heft 68): 45 (1919). TYPE: *Dalechampia dioscoreifolia* Poeppig.

Dalechampia sect. *Rhopalostylis* Pax & Hoffmann in A. Engler (Ed.), Das Pflanzenreich, IV, 147. XII (Heft 68): 7 (1919). TYPE: *Dalechampia micrantha* Poeppig. **syn. nov.**

CONCLUSIONS

Dalechampia sect. *Dalechampia* differ significantly from any previous treatment been monophyletic by insertion of *Brevicolumnae*, *Coriaceae* and *Tiliifoliae* sections. Additionally, we only accept two subsections in the *Dalechampia* sect. *Dalechampia*.

The new subsection *Tamifoliae* was previously described by Pereira-Silva et al., (2019) as having been the only monophyletic group among the subclades. The other subsection is *Dalechampia* on which all the subsections proposed by Webster & Armbruster (1991). For the subclades *Dalechampia*, *Triphyllae*, *Scandentes* and *Humiles*, we suggest more investigations such as anatomical, karyotypic and palynological studies, for a better understanding.

We also considered the possibility of the *D.* sect. *Dioscoreifoliae* and *Rhopalostylis* being synonymized in the future and ensure the monophyly of *Cremophyllum*.

LITERATURE CITED

- Armbruster, W. S.; Webster, G. L.** Pollination of two species of *Dalechampia* (Euphorbiaceae) in Mexico by euglossine bees. *Biotropica*, v. 11: 278-283, 1979.
- Armbruster, W. S.; Webster, G. L.** Divergent Pollination Systems in Sympatric Species of South American *Dalechampia* (Euphorbiaceae). *The American Midland Naturalist*, v. 108, 2, 325-337, 1982.
- Armbruster, W. S.** 1993. Evolution of plant pollination systems: hypotheses and tests with the neotropical vine *Dalechampia*. *Evolution* 47: 1480–1505.
- Armbruster, W. S.** 1994. Early evolution of *Dalechampia* (Euphorbiaceae): Insights from phylogeny, biogeography, and comparative ecology. *Annals of Missouri Botanical Garden* 81: 302–316.
- Armbruster, W. S.** 1997. Exaptations link evolution of plant-herbivore and plant pollinator interactions: a phylogenetic inquiry. *Ecological Society of America* 78: 1661–1672.
- Armbruster, W.S & Baldwin, B.G.** 1998. Switch from specialized to generalized

pollination. *Nature* 394: 632.

Armbruster, W.S, Leed, J. & Baldwin, B.G. 2009. Macroevolutionary patterns of defense and pollination in *Dalechampia* vines: Adaptation, exaptation, and evolutionary novelty. *PNAS* 106: 18085–18090.

Armbruster, W. S.; Lee, J.; Edwards, M. E., Baldwin, B. G. 2012. Floral paedomorphy leads to secondary specialization in pollination of Madagascar *Dalechampia* (Euphorbiaceae). *Evolution*, v. 67 n. 4, p. 1196–1203.

Bachman, S., J. Moat, A.W. Hill, J. Torre & B. Scott. 2011. Supporting red list threat assessments with GeoCAT: Geospatial conservation assessment tool. *ZooKeys* 150: 117–126.

Baillon, H. 1858. Étude générale du groupe Euphorbiacées, Librairie de Victor Masson, 698 p.

Gillespie, L. J.; Armbruster, W.S. 1997. A Contribution to the Guianan Flora: *Dalechampia*, *Haemutostemon*, *Omphalea*, *Pera*, *Plukenetia*, and *Tragia* (Euphorbiaceae) with Notes on Subfamily Acalyphoideae. Smithsonian Institution Press, Washington, D.C. 52p.

IUCN. 2010. The IUCN red list of threatened species. Version 2010.4. <http://www.iucnredlist.org/> (last accessed May 2018).

Müller Argoviensis, J. 1873. Euphorbiaceae. Pp. 1–752 in von Martius, C.F.P. (ed.), *Flora Brasiliensis* vol. 11, Munich: Botanisches Garten.

Opedal, Ø. H., Falahati-Anbaran, M., Albertsen, E., Armbruster, W. S., Pérez-Barrales, R., Stenøien, H. K., & Pélabon, C. 2017. Euglossine bees mediate only limited long-distance gene flow in a tropical vine. *New Phytologist*, 213(4): 1898–1908.

Pax, F. & Hoffman, K. 1919. Euphorbiaceae–Dalechampieae. Pp. 1–59 in Engler,

H.G.A. (ed.), *Das Pflanzenreich. Regni vegetabilis conspectus*, IV. 147. XII (Heft 68), Leipzig: Engelmann.

Pereira-Silva, R. A., S. M. Athiê-Souza, R. S. Secco, A. L. Melo & M. F. Sales.

2016. *Dalechampia erythrostyla* (Euphorbiaceae), a new species from Northeastern Brazil. *Systematic Botany* 41: 989–995.

Price, M.N., Dehal, P.S. & Arkin, A.P. 2010. FastTree 2—approximately maximum-

likelihood trees for large alignments. *Plos One* 5: 9490.

Ree, R.H.; Smith, S.A. 2008. Maximum likelihood inference of geographic range evolution by dispersal, local extinction, and cladogenesis. *Syst. Biol.* 57: 4–14.

Posada, D. 2008. jModelTest: phylogenetic model averaging. *Molecular biology and evolution*, 25(7): 1253–1256.

Rambaut, A. 2009. FigTree v1. 3.1: Tree figure drawing tool.

Thiers, B. 2018. [continuously updated]. Index Herbariorum: A global directory of public herbaria and associated staff. New York: New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/ih/>.

Webster, G.L. & Armbruster, W.S. 1991. A synopsis of the neotropical species of *Dalechampia* (Euphorbiaceae). *Bot. J. Linn. Soc.* 105: 137–177.

Webster, G. L. 1994. Classification of the Euphorbiaceae. *Annals of the Missouri Botanical Gardens* 81: 3–32.

Webster G. L 2014. Euphorbiaceae. Pp. 51–216 in *Flowering Plants. Eudicots. The Families and Genera of Vascular Plants* vol 11, ed. K. Kubitzki Springer-Verlag Berlin Heidelberg.

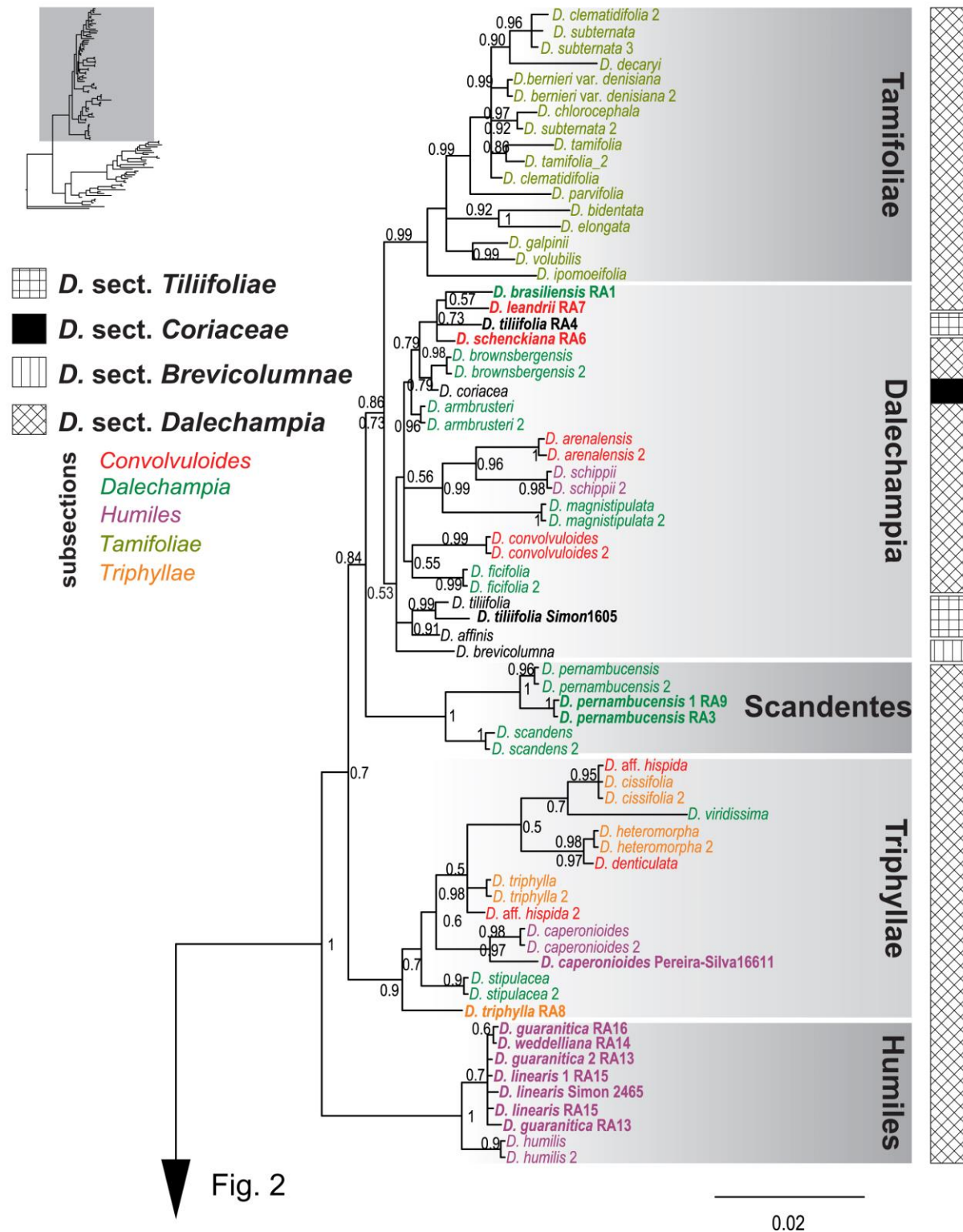
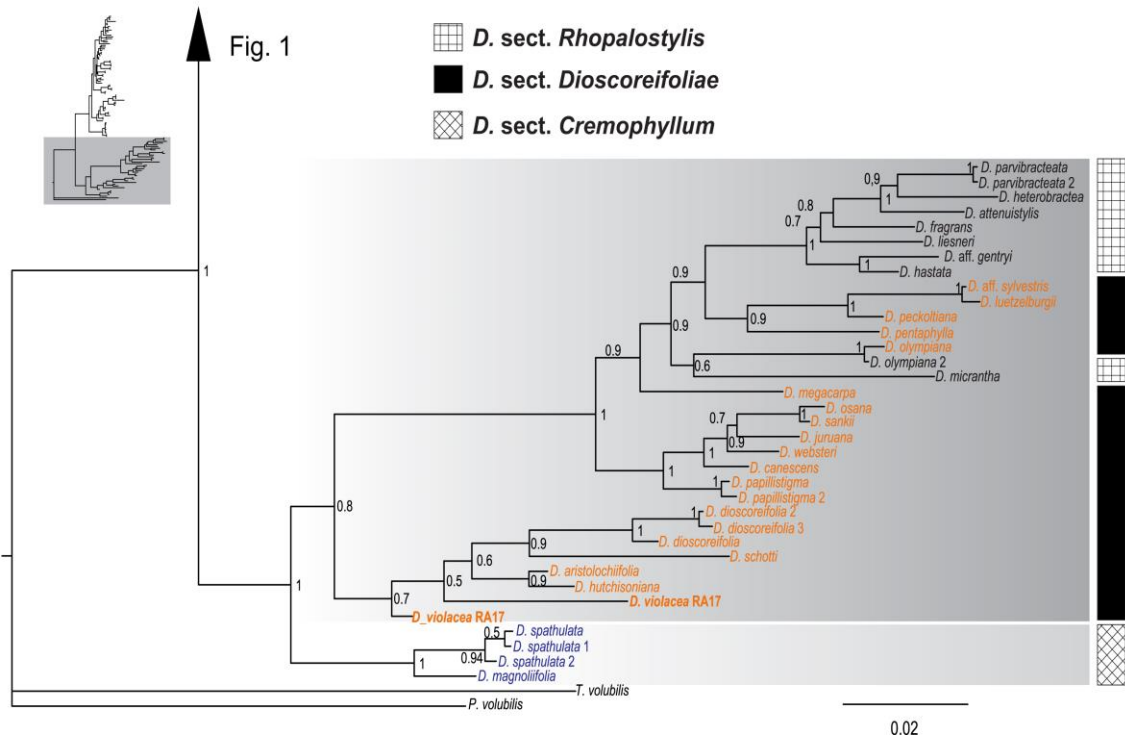


Fig. 2

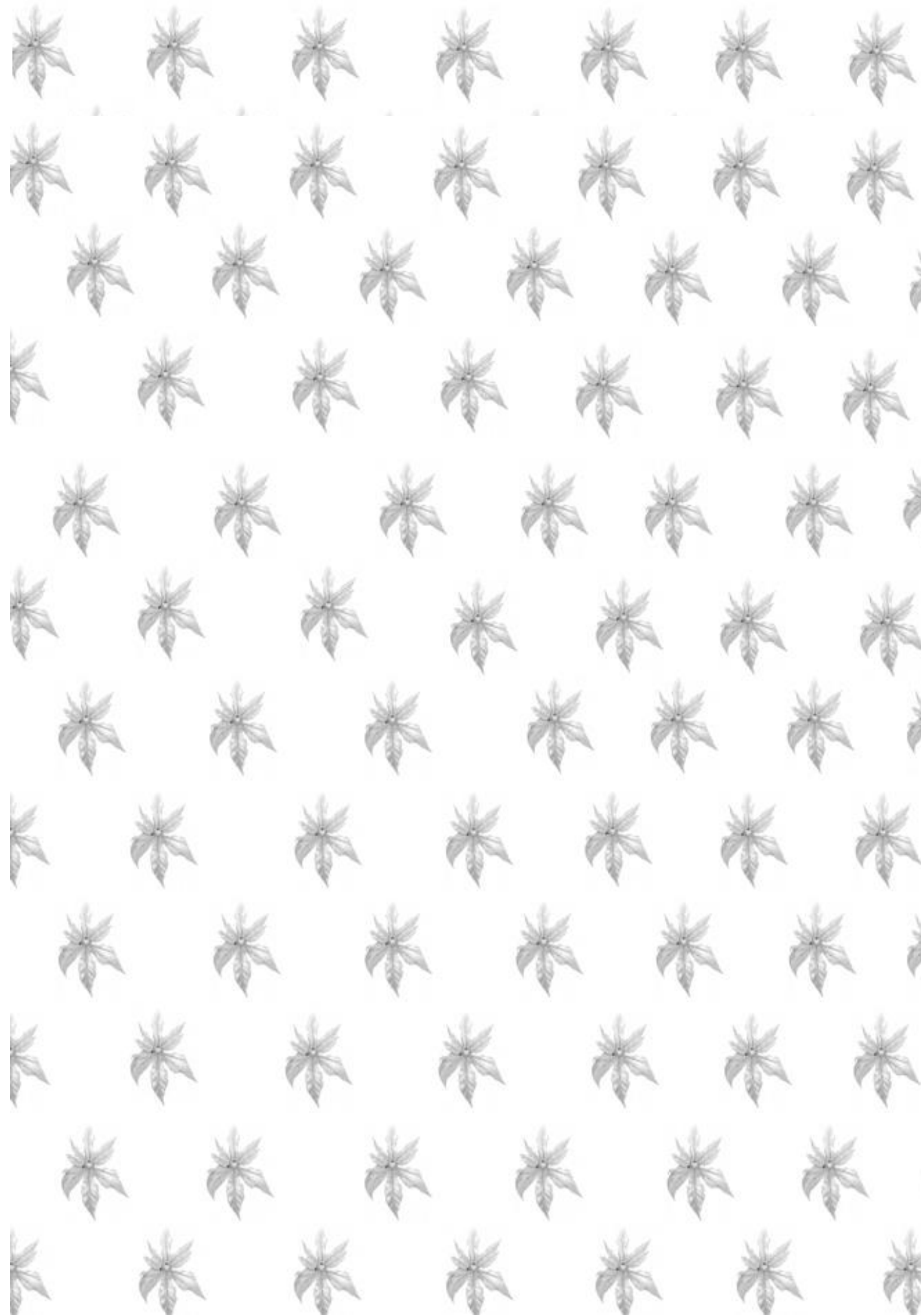
Figure 1. Phylogeny based on the majority-rule consensus tree from the BI analysis of the combined cpDNA dataset of *matK*, *trnK-matK* and *trnL-F* and nuclear ITS1-5.8S-ITS2. The numbers branches are posterior probabilities (PP) values.



Cont. Figure 1.

Table 1. Summary statistics for the aligned molecular data.

Characteristic	ITS	<i>matK</i>	<i>trnL-F</i>	<i>trnK</i> (partial <i>matK</i>)
Number of taxa	101	10	15	56
Aligned length (bp)	703	453	986	494
Variable characters	421	23	93	56
Informative characters (%)	331 (4.69%)	9 (5.07%)	34 (9.43%)	21 (11.33%)



***Dalechampia macrobractea*, a New Species
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Africa**

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Armbruster

Artigo aceito

Systematic Botany

***Dalechampia macrobractea*, a New Species of Euphorbiaceae from Southern East
Africa**

**Rafaela Alves Pereira-Silva,¹ Sarah Maria Athiê-Souza,^{1,5} Peter B. Phillipson,² André
Laurênio de Melo,³ Margareth F. Sales,¹ and W. Scott Armbruster⁴**

¹Programa de Pós-Graduação em Botânica, Departamento de Biologia, Universidade
Federal Rural de Pernambuco, 52171–900, Recife, PE, Brasil.

²Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A

³Unidade Acadêmica de Serra Talhada, Universidade Federal Rural de Pernambuco, 56909-
535, Serra Talhada, PE, Brazil.

⁴School of Biological Sciences, University of Portsmouth, Portsmouth, PO1 2DY, UK;
Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska 99775, USA.

⁵Author for correspondence (sarah_athie@yahoo.com.br)

Abstract—*Dalechampia macrobractea* is a new species of Euphorbiaceae described from Tanzania and Zambia, Africa. It is similar to *D. capensis* due having the deeply lobed leaves and 3-lobed involucre bracts, but differs from this species in the size and shape of leaves, number of pistillate bracteoles and absence of glandular trichomes on the margin of the pistillate bracteoles. We place it in *Dalechampia* sect. *Dalechampia* because the staminate involucre is 2-lipped and the laminar staminate bracteoles are entire. Illustrations and comments about its geographical distribution and habitat are also provided.

Keywords—*Dalechampia* sect. *Dalechampia*, paleotropics, Plukenetieae, taxonomy.

Dalechampia L. (Euphorbiaceae, Plukenetieae) is a pantropical genus comprising about 130 species, all of which are twining vines, erect or decumbent herbs, subshrubs or very rarely shrubs, usually with stinging trichomes and pseudanthial inflorescences composed of two involucre bracts, a staminate pleiochasium of 4–50 staminate flowers, and a pistillate cymule of 1–3 pistillate flowers and generally 1–3 bracteoles (Pax and Hoffman 1919; Webster and Armbruster 1991; Webster 1994; Pereira-Silva et al. 2016). The center of *Dalechampia* diversity is in South and Central America, with approximately 100 species (Armbruster and Mziray 1987; Armbruster 1994). Other species can be found throughout the lowland tropics of Asia (ca. 10 species), continental Africa (ca. 12 species) and Madagascar (ca. 12 species) (Armbruster and Mziray 1987; Armbruster, 1994; Armbruster unpubl. observation), where taxonomic studies of the genus are scarce.

Progress in understanding the taxonomy of *Dalechampia* has been slow but progressive and mainly oriented to the systematic study of neotropical species. The current infrageneric taxonomic concept of *Dalechampia* dates back to Webster and Armbruster (1991) who treated only the neotropical species included by them in six sections: *D.* sect. *Coriaceae* Pax & K. Hoffm., *D.* sect. *Cremophyllum* Baill., *D.* sect. *Dalechampia*, *D.* sect. *Dioscoreifoliae* Pax & K. Hoffm., *D.* sect. *Rhopalostylis* Pax & K. Hoffm., and *D.* sect. *Tiliifoliae* G.L. Webster & Armbruster (see also Armbruster 1988). Morphological and molecular phylogenetic studies (e.g. Armbruster 1997; Armbruster et al. 2009) suggest the paraphyly of *Dalechampia* sect. *Dalechampia* and *D.* sect. *Dioscoreifoliae* but the monophyly of all paleotropical species.

The African and Madagascan species have been moderately well studied in terms of ecology and reproduction, although these studies also attempted to address questions about floral evolution and biogeographic history (e.g. Armbruster and Mizray 1987; Armbruster and Steiner 1992; Armbruster 1993; Armbruster et al. 1993; Armbruster 1994; Armbruster and Baldwin 1998; Armbruster et al. 2009; Armbruster et al. 2012; Plebani et al. 2015).

Considering that the *Dalechampia* of Africa are largely neglected in comprehensive taxonomic studies (but see Radcliffe-Smith 1987, 1996, and taxonomic notes in Armbruster and Steiner 1992), we started a synoptic study of the African species (in progress), and one of the results is the discovery and description of a new species, *Dalechampia macrobractea*, which is formally described in this study. Following Webster and

Armbruster (1991) treatment, *D. macrobractea* can be included into *D. sect. Dalechampia* because the new species shares with the other species of the section the following characters: 2-lipped staminate involucels and entire, and laminar staminate bracteoles.

During a revision of *Dalechampia sect. Dalechampia* being carried out by the first author, over 200 African specimens were examined, including most type and historical collections, deposited in the RGB Kew herbarium (K). Other European herbaria were visited (BM, G, and P) but no specimens of *Dalechampia* from Africa were found (acronyms follow Thiers 2018).

We observed that exsiccates previously placed in *D. capensis* (Radcliffe-Smith 1987, 1996) or misidentified *in schedule* as *D. scandens* by *H. M. Richards* (about 10 collection) based on specimens collected during an expedition to the Northern Rhodesia (currently recognized as two countries, Tanzania and Zambia) in 1955, were morphologically very different from other African *Dalechampia* species.

TAXONOMIC TREATMENT

Dalechampia macrobractea Pereira-Silva & Armbruster, sp. nov. TYPE: TANZANIA. Kipili, Tanganyika, 3200 m, 1 Feb. 1950 (fl), A. A. Bullock 2376 (holotype K! sheet 1, isotype K! sheet 2).

The new species is similar and probably related to *Dalechampia capensis*, by virtue of the deeply lobed leaves sometimes being 5-lobed and the involucral bracts being 3-lobed in the latter species. However, the new species differs from this and other African taxa by having leaves that are nearly always deeply 5-lobed with 4–11 cm long and in the absence of glandular trichomes in the margin of pistillate bracteoles.

Twining vines, stems 3–5 mm diam, terete, brownish, villous to pubescent; trichomes ca. 1 mm long. Leaves alternate, deeply-lobed; petiole 2–6 cm long, brownish; petiolar stipule ca. 4 × 1 cm, lanceolate, base truncate, margin entire, ciliate, glabrescent; leaf blade 4–11 × 4–12 cm, deeply 5-lobed; lobe 4–11 × 1–2.5 cm, elliptic to lanceolate, base cordate to asymmetric, apex acute, margin entire to moderately dentate, with glandular trichomes sparsely, adaxial surface glabrescent, abaxial surface pubescent mainly on the veins; venation eucamptodromous, primary veins 5; stipels ca. 2 mm long, linear, inconspicuous,

persistent, associate with glands. Inflorescence a bisexual pseudanthium, axillary, solitary, 5–11 cm long, peduncle ca. 5.5 × 15 cm long, pubescent to densely pubescent; involucre bracts 2.5–4 × 2–4 cm, 3-lobed, elliptic to lanceolate, persistent, base truncate, yellowish, with green veins, lobe acute at apex, margin dentate, surface glabrous to sparsely pubescent, mainly on the veins, primary veins 6–8; bracteal stipule 4–5 × 1–1.5 mm, lanceolate, base truncate, apex acute, margin entire to ciliate, without glandular trichomes, adaxial surface glabrescent, abaxial surface pubescent. Staminate pleiochasium with 2 bracteoles bilabiate, 8-flowered, peduncle 3–4 mm long; staminate bracteoles 3–4 × 6 mm, oblong to transversely oblong, connate with entire margins lacking glandular trichomes, glabrous; gland composed of numerous resiniferous bractlets, ca. 2.5 × 6 mm, yellowish, laminar, with entire margins, isolated beside of the staminate flowers. Resin secreted yellow, over all the resiniferous bractlets. Staminate flowers 4–5 mm long; sepals 4, 2–3 mm long, lanceolate, yellowish-green; stamens 8–19; bithecate anthers. Pistillate cymule 3-flowered, sub-sessile, glabrous; pistillate bracteoles 1–3, 2–3 × 2.5–4 mm, widely ovate to very widely ovate, margin irregular to ciliate, without glandular trichomes. Pistillate flowers 0.7–1.1 cm long, pedicel sub-sessile; sepals 6–9, free, ca. 1.5 × 1 mm, pinnatifid, glabrous, margin with glandular trichomes sparse; ovary 1–1.5 × 1 mm, trilocular; glabrous to glabrescent stylar column greenish, brownish in the upper half of its length, stigma slightly lobed. Fruit not seen. Seeds ca. 3 × 3 mm, ovoid and apiculate, smooth, macules brown. Figure 1.

Etymology—The specific epithet is a reference to the length of involucre bracts 5–11 cm long (vs. 2–8 cm long in the other African *Dalechampia* species).

Distribution and Habitat—*Dalechampia macrobractea* is currently known from southern East Africa, specifically southwestern Tanzania and northeastern Zambia (Fig. 2). Zambia, where the holotype was collected, was part of the British colony called Rhodesia, and later Northern Rhodesia. The species is recorded in various environments, from dense woodland, roadsides, climbing over long grass and shrubs, to rocky environment or near water bodies. Some of specimens were found next to the Lake Tanganyika. It grows in deep, sandy soil at altitudes ranging from 850 m to 3,200 m.

Phenology—Flowering occur from December to April; fruits were not seen.

Paratypes—**Tanzania**. NKASI DISTRICT: 15 km on Kipili – Namanyere road, 7°28'S,

30°42'W, 850 m, 5 Mar. 1994 (fl), *S. Bidgood et al.* 2657 (K). UFIPA DISTRICT: Kalambo Falls, Tanzania side, 1200 m, 13 Feb. 1965 (fl), *H. M. Richards* 19666 (K); Lake Tanganyika, lake shore, 2600 m, 15 Feb. 1971 (fl), *M. Sanane* 1545 (K); Kawa Falls, near Northern Rhodesia border, 1500 m, 30 Dec. 1956 (fl), *H. M. Richards* 7392 (K). **Zambia:** MBALA DISTRICT: Road Mpui Abercorn, close to Mpui, 1830 m, 7 Dec. 1954 (fl), *H. M. Richards* 3553 (K). MBEYA DISTRICT: Issi River Gorge, Abercorn, 1200 m, 6 Jan. 1963 (fl), *H. M. Richards* 17517 (K). Northern Rhodesia, Abercorn-Mpulungu Road, by Magasi Stream, 4000 ft, 5 Apr. 1955 (fl), *H. M. Richards* 5316 Woodland Lunzua above Kafakula village, 3100 m, 5 Mar. 1955 (fl), *H. M. Richards* 4804 (K).

DISCUSSION

Dalechampia macrobractea is one of the most beautiful species of *Dalechampia* from Africa. The lobes of the involucre bracts are elongate, especially in the lower bract; the peduncles are quite long, and the styles are the longest of all African *Dalechampia* species. It was first collected in 1950 by Bullock (#2376) and the most recent one by Richard (#5316) in 1955. Although the plant has a reasonable number of collections in two different countries, the species described here remained for 68 years without being recognized in any publications as a new entity of *Dalechampia*. According to Bebbier et al. (2010), estimated that the average time for publication of a new species can take up to four decades after its first collection. During the last 68 year, the specimens have been erroneously identified as *D. capensis* or *D. scandens*. The long delay for the recognition of *D. macrobractea* is probably due to the lack of published taxonomic studies of African species by specialists on this group. Generalist botanists had a notion of the group in which such a species fit, but the lack of knowledge of the boundaries between African species resulting from the scarcity of taxonomic treatments for this continent is responsible for errors in identifications. Continuing taxonomic studies on the same taxon increase the probability of recognition of new species (Bebber et al. 2010), thus justifying the expansion of taxonomic studies on *Dalechampia* in Africa.

Dalechampia macrobractea is here recognized by its leaves deeply 5-lobed, elliptic to lanceolate, 3-lobed involucre bracts, lack of staminate flowers "above" the resiniferous gland (opposite side from the majority of flowers), and absence of glandular trichome on

the pistillate bracteoles.

The new species is morphologically similar to *D. capensis* and because of this the collections of *D. macrobractea* have been treated as *D. capensis* due to sharing 5-lobed leaves. However, *D. macrobractea* differs from *D. capensis* (Tab. 1) in the lobes being more deeply and consistently 5-lobed, these lobes being elliptic to lanceolate, 4–11 cm long (vs. 3–5 not deeply lobed leaves, lobes obovate, 2.5–4 cm long in *D. capensis*), margin of lobe entire to moderately dentate (vs. very dentate), connate staminate bracts with entire margins lacking glandular trichomes (vs. apparently two bracts in staminate involucrel having irregular margins bearing glandular trichomes), the resiniferous gland is not surrounded on both sides by staminate flowers (vs. resiniferous gland located in the middle of staminate flowers), absence of glandular trichomes in the margin of pistillate bracteoles (vs. presence of glandular trichomes in the margin of pistillate bracteole); in addition, the glandular trichomes present on the pistillate sepals are sparse (vs. abundant).

Dalechampia scandens (sensu Radcliffe-Smith 1987, 1996; but see Armbruster and Steiner 1992) does not closely resemble the new species, but the first collection of *D. macrobractea* was identified as this species. *Dalechampia macrobractea* differs in having deeply 5-lobed leaves, that are elliptic to lanceolate (vs. 3–5 lobed, obovate in *D. scandens*), peduncle 5.5–15 cm long (vs. 2–7 cm long), pistillate bracteoles widely ovate to very widely ovate (vs. reniform) (Tab. 1).

Following the classification proposed by Webster and Armbruster (1991), *D. macrobractea* belongs in *Dalechampia* sect. *Dalechampia* because the staminate involucrel comprises a single fused 2-lipped bract and laminar staminate bractlets with entire margins. This placement is confirmed by molecular studies (Armbruster et al. 2009), assuming (reasonably) that *D. macrobractea* is most closely related to the other African taxa that it resembles.

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AUTHOR CONTRIBUTIONS

RAPdS was responsible for the independent rediscovery of the, description, writing of the description and morphological comparison with other species in the discussion and elaboration of the distribution map of *Dalechampia macrobractea*. SMAS was responsible for writing the paper. PBP contributed with information on the locations where the specimens were collected. ALM contributed for the manuscript review and name choice. MFdS contributed to the correction, discussion of the results and research funding. WSA contributed to the interpretation of the results and revision of the manuscript.

LITERATURE CITED

- Armbruster, W. S. 1988. A new species, section, and synopsis of *Dalechampia* (Euphorbiaceae) from Costa Rica. *Systematic Botany* 13: 303–312.
- Armbruster, W. S. 1993. Evolution of plant pollination systems: hypotheses and tests with the neotropical vine *Dalechampia*. *Evolution* 47: 1480–1505.
- Armbruster, W. S. 1994. Early evolution of *Dalechampia* (Euphorbiaceae): Insights from phylogeny, biogeography, and comparative ecology. *Annals of Missouri Botanical Garden* 81: 302–316.
- Armbruster, W. S. 1997. Exaptations link evolution of plant-herbivore and plant pollinator interactions: a phylogenetic inquiry. *Ecological Society of America* 78: 1661–1672.
- Armbruster, W. S., M. Edwards, J. Hines, R. Mahunnah, and Munyenyembe. 1993. Evolution and pollination of Madagascan and African *Dalechampia*. *Research & Exploration* 9: 460–474.
- Armbruster, W. S. and B.G. Baldwin. 1998. Switch from specialized to generalized pollination. *Nature* 394: 632.
- Armbruster, W. S., J. Lee, and B. G. Baldwin. 2009. Macroevolutionary patterns of defense and pollination in *Dalechampia* vines: Adaptation, exaptation, and evolutionary

- novelty. *Proceedings of the National Academy of Sciences* 106: 18085–18090.
- Armbruster, W. S., J. Lee, M. E. Edwards, and B. G. Baldwin. 2012. Floral paedomorphy leads to secondary specialization in pollination of Madagascar. *Evolution* 67: 1196–1203.
- Armbruster, W. S. and Mziray, W. S. 1987. Pollination and herbivore ecology of an African *Dalechampia* (Euphorbiaceae): Comparisons with new world species. *Biotropica* 19: 64–73.
- Armbruster, W. S. and K. E. Steiner. 1992. Pollination ecology of four *Dalechampia* species (Euphorbiaceae) in northern Natal, South Africa. *American Journal of Botany* 79: 306–313.
- Bebber, D. P., M. A. Carine, J. R. I. Wood, A. H. Wortley, D. J. Harris, G. T. Prance, G. Davidse, J. Paige, T. D. Pennington, N. K. B. Robson, and R. W. Scotland. 2010. Herbaria are a major frontier for species discovery. *Proceedings of the National Academy of Sciences of the United States of America* 107: 22169–22171.
- Pax, F. and K. Hoffman. 1919. Euphorbiaceae-Dalechampieae. Pp. 43–44 in *Das Pflanzenreich. Regni vegetabilis conspectus* 147 (helf 12), ed. A. Engler. Leipzig: Engelmann.
- Pereira-Silva, R. A., S. M. Athiê-Souza, R. S. Secco, A. L. Melo, and M. F. Sales. 2016. *Dalechampia erythrostyle* (Euphorbiaceae), a new species from Northeastern Brazil. *Systematic Botany* 41: 989–995.
- Plebani, M., O. Imanizabayo, D. M. Hansen, W. S. Armbruster. 2015. Pollination ecology and circadian patterns of inflorescence opening of the Madagascan climber *Dalechampia* aff. *bernieri* (Euphorbiaceae). *Journal of Tropical Ecology* 31: 99–101
- Radcliffe-Smith, A. 1987. *Euphorbiaceae (part 1)*, *Flora of Tropical East Africa*, ed. A. A. Rotterdam, Netherlands: Balkema.
- Radcliffe-Smith, A. 1996. *Euphorbiaceae, Flora Zambesiaca, vol. 9*. Richmond, UK: Royal Botanic Gardens, Kew.
- Thiers, B. 2018. [continuously updated]. Index Herbariorum: A global directory of public herbaria and associated staff. New York: New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/ih/>.
- Webster, G. L. and W. S. Armbruster. 1991. A synopsis of the neotropical species of

Dalechampia (Euphorbiaceae). *Botanical Journal of the Linnean Society* 105: 137–177.

Webster, G. L. 1994. Classification of the Euphorbiaceae. *Annals of the Missouri Botanical Gardens* 81: 3–32.

TABLE 1. Comparison of characters of *Dalechampia macrobractea* and the most related species.

Morphological character	<i>D. capensis</i>	<i>D. macrobractea</i>	<i>D. scandens</i>
Leaf division	3–5 not deeply lobed	Exclusively deeply 5-lobed	3-lobed, rare 5-lobed
Leaf size	2.5–4 cm long	4–11 cm long	3–9 cm long
Peduncle size	2.5–4 cm long	5.5–15 cm long	2–7 cm long
Involucral bracts division	3-lobed	3-lobed	3-lobed
Size of pseudhantium	3.5–6 cm long	5–11 cm long	4–5.5 long
Number of Staminate bracteole	1	2	1
Position of resiniferous glands	Midle of staminate flowers	Isolated	Isolated
Pistillate bracteole shape	Oblong to widely oblong	Widely ovate to very widely ovate	Reniform
Pistillate bracteole margin	Ondulate	Irregular to ciliate	entire
Glandular trichomes in pistillate bracteole	Present	Absent	Absent
Number of pistillate sepals	7–10	6–9	7–10
Apex of styler column	Dilated	Moderately lobed	Slightly crateriform

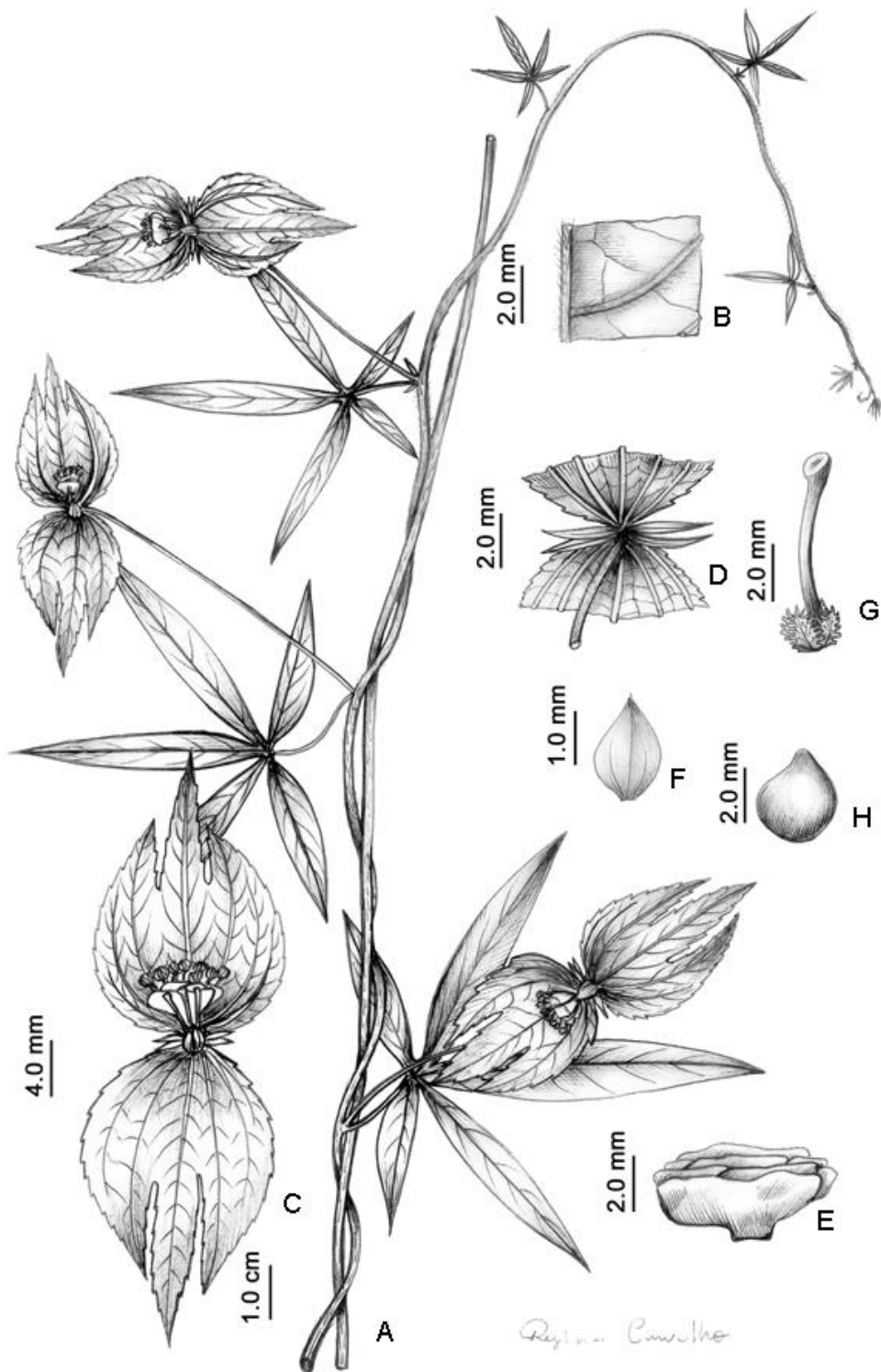
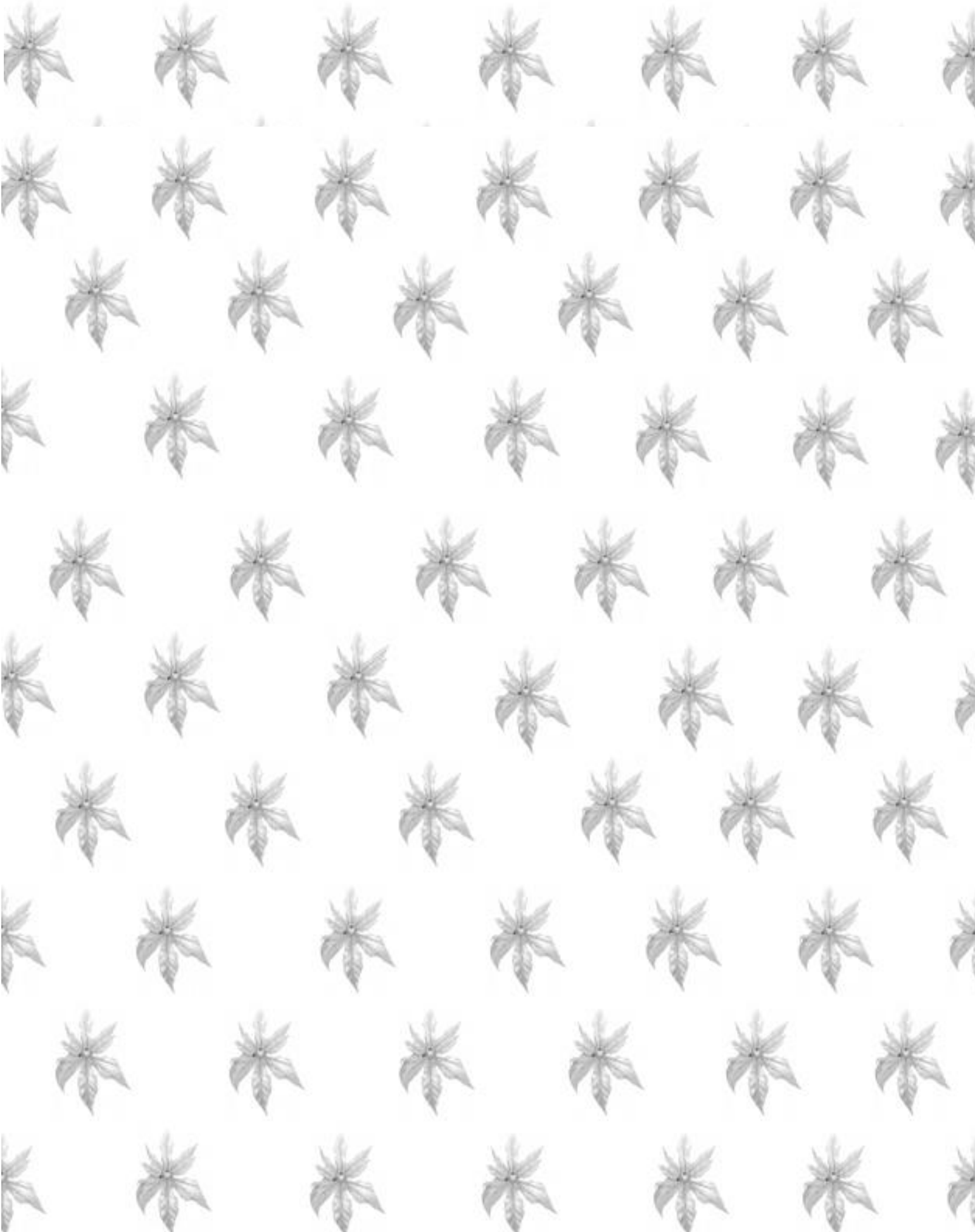


FIG. 1. *Dalechampia macrobractea*. A. Habit. B. Abaxial surface of the leaf. C. Pseudanthium. D. Bracteal stipule. E. Resiniferous gland. F. Pistillate bracteole. G. Pistillate flower. H. Seed ovoid and apiculate.



FIG. 2. Distribution of *Dalechampia macrobractea* in Tanzania and Zambia, Africa.

Manuscrito 4



Dalechampia margarethiae
**(Euphorbiaceae) a new species from
Southeastern Brazil**

Rafaela Alves Pereira-Silva, Sarah Maria Athiê-Souza, André
Laurênio de Melo & W. Scott Armbruster

Artigo aceito

Systematic Botany

***Dalechampia margarethiae* (Euphorbiaceae) a new species from Southeastern
Brazil**

**Rafaela Alves Pereira-Silva,^{1,4} Sarah Maria Athiê-Souza,¹ André Laurênio de
Melo,² and W. Scott Armbruster³**

¹Programa de Pós-Graduação em Botânica, Departamento de Biologia, Universidade
Federal Rural de Pernambuco, 52171–900, Recife, PE, Brasil.

²Unidade Acadêmica de Serra Talhada, Universidade Federal Rural de Pernambuco,
56909-535, Serra Talhada, PE, Brazil.

³School of Biological Sciences, University of Portsmouth, Portsmouth, PO1 2DY,
United Kingdom; Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska
99775

⁴Author for correspondence (rafaela.news@hotmail.com)

Abstract—A new species of *Dalechampia* from Southeastern Brazil, belonging to *Dalechampia* sect. *Dioscoreifoliae*, is described and illustrated here. *Dalechampia margarethiae* is a twining vine occurring exclusively in Espírito Santo state. Its pseudanthia are similar to those of *D. peckoltiana* and *D. pentaphylla*, but it differs in a set of important characters such as shape of styles tip, openness of staminate flowers, color of resin, and shape of leaves.

Keywords—*Dioscoreifoliae*, Acalyphoideae, Espírito Santo, taxonomy.

Dalechampia L. (Plukenetieae, Dalechampiinae) is one of the most morphologically diverse genera of Euphorbiaceae and occurs in the tropical regions of every continent except Australia (Webster 1994). Despite the great morphological variation, *Dalechampia* can be easily recognized by the pseudanthial inflorescence subtended by two, often colorful, involucre bracts. The pseudanthium comprises a staminate pleiochasium with four to about 50 staminate flowers and a separate subinflorescence of 1–3 pistillate flowers (Pax & Hoffman 1919; Armbruster et al. 1993; Webster 2014). The most recent work to Neotropical species was published by Webster and Armbruster (1991).

More than 70 of the ca. 130 species of *Dalechampia* occur in Brazil, most of which are endemic to this country (ca. 50 spp.) (Webster 1994). The Brazilian species of *Dalechampia* can be found widely distributed across the country, although the Southeastern region contain, notably, the largest number of species (34 spp.). The diversity of the genus is relatively well distributed among the main phytogeographic domains, with 32 species in the Savannah, 31 in the Atlantic Forest, 27 in Amazonia, and 14 in the Caatinga (Maya-L et al. 2016).

Müller (1874) produced a complete taxonomic treatment of *Dalechampia* for Brazil including approximately 50 species. Since then, additional studies on the genus in the country have been restricted to local floras (Alves 1998; Sales et al. 1998; Barbosa et al. 2006; Rodrigues 2007; Maya-L 2008; Pereira-Silva et al. in press) and descriptions of new species (Webster 1989; Webster 1991; Armbruster 1996; Cordeiro 1997; Pereira-Silva et al. 2016).

During the preparation of the taxonomic monograph of *Dalechampia* sect. *Dalechampia*, one new species from Espírito Santo state located in the southeast region

of Brazil were recognized: *D. margarethiae*. This new species increases to 11 the number of *Dalechampia* species recorded from Espírito Santo.

In the present manuscript, we provide a morphological description of this new species, including its geographical distribution, habitat, conservations status, and illustrations.

MATERIALS AND METHODS

This study is based on field collections and analysis of specimens deposited at the CEPEC and MBML herbaria (acronyms following Thiers (2017)). Morphological data were obtained from observations of dried material using a stereomicroscope (Leica EZ4), as well as flowers and fruits fixed in alcohol. We follow Webster and Armbruster (1991) for descriptive terminology, and Radford et al. (1974) and Hickey (1973) for general morphological terminology. The conservation status categories were assessed following IUCN (2010) and the extent of occurrence (EEO) and area of occupancy (AOO) were estimated using GeoCAT (Bachman et al. 2011). The present study is registered in the National System of Genetic Resource Management and Associated Traditional Knowledge (SisGen) under number A1278C4.

TAXONOMIC TREATMENT

Dalechampia margarethiae Pereira-Silva & Armbruster, sp. nov. TYPE: BRAZIL.

Espírito Santo: Cariacica, Reserva Biológica Duas Bocas, floresta na beira da estrada para a localidade de Alegre, 20°18'9"S, 40°28'55"W, 500 m, 16 Feb. 2008 (fl), A. M. A. Amorim et al. 7149 (holotype MBML 033809!; isotype: CEPEC 125.843!).

Dalechampia margarethiae can be recognized by its entire, cordiform leaves, white involucre bracts that are deeply 3–5-lobed (upper 3, lower 5), staminate columns (elongated receptacles bearing stamens) not accrescent after anthesis, staminate sepals opening only slightly rather than reflexed, style cylindrical, tip moderately down-curved, staminate involucre of four free decussate bracts, resiniferous gland with apical margins fimbriate, and clear resin. Four free staminate bracts, staminate flowers 5–6, stamens 17–35 and resin-producing glands comprising fimbriate bractlets justifies the inclusion of this species in *Dalechampia* sect. *Dioscoreifoliae*.

Twining vine; flowering stem 2–3 mm diam, cylindrical, greenish, sparsely pubescent. Leaves alternate, simple, petiolate; petiole 2–3.5 cm long, up to 1 mm diam, pubescent; petiolar stipule ca. 3 mm long, linear-lanceolate, acute, entire; leaf blade 6–7 × 3–5 cm, cordiform, base cordate, apex acuminate, margin serrate, membranaceous, adaxial surface glabrous; abaxial surface pubescent along the veins; venation eucamptodromous, primary veins 7; stipels 2–2.2 mm long associated with smaller clustered glands. Inflorescence a bisexual pseudanthium, axillary, solitary, 6–6.5 cm long, peduncle 3–5 cm long; involucre bracts 3–3.5 × 2–3 cm, 3–5 lobed, lobe acute at apex, white, margin denticulate with glandular trichomes, chartaceous; bracteal stipules 0.9–1.2 × 3–4 cm, deltoid, apex acute, entire, glabrous to glabrescent on both surfaces. Staminate pleiochasium of 4 free bracts, decussate and concave, with 7–8 flowers, peduncle ca. 2 × 1–1.2 mm, pubescent; staminate bracts deltoid (beside the gland transversely oblong), 6–7 × 6–6.5 mm, glabrous; gland composed of numerous resiniferous bractlets, 4–5 × 1–2 mm, whitish, oblong, fleshy, apex margin fimbriate, glabrous. The resin secreted is whitish. Staminate flowers 5–6 mm long; columns not

accrescent after anthesis, sepals 4, slightly open, deltoid, ca. 2×1 –1.5 mm, whitish, stamens 17–35; anthers bithecate, rimose, prominent connective. Pistillate cymule 3-flowered, sessile; pistillate bractlets 1, ovate, ca. 6×3 mm, glabrous, no ciliate, eglandular. Pistillate flower 1–1.1 cm long, sessile; sepals 6, free, 2.5–3 cm long, lanceolate, entire, eglandular, glabrous; ovary ca. 1×1 mm, trigonous, pubescent; stylar column 9 – 10×0.6 – 0.8 mm, longitudinal bands ca. 6 mm long, style cylindrical, apex moderately down-curved. Capsule, 3-lobed, greenish, not measured. Involucral bracts and pistillate sepals seem to be deciduous in fruit. Seeds not seen.

Etymology—The specific epithet refers to the professor of the Universidade Federal Rural de Pernambuco, Margareth Ferreira de Sales, an important Euphorbiaceae systematist in Brazil. Her work with this family began almost 20 years ago, especially with representatives from the northeastern region of Brazil. She is an important trainer of human resources and has already contributed to recruitment of approximately 15 taxonomists mainly in Euphorbiaceae.

Distribution and Habitat—*Dalechampia margarethiae* is known only from Southeastern Brazil specifically in Espírito Santo state, collected only in the municipalities of Cariacica and Santa Teresa. The species is represented by few, small populations and apparently limited to Atlantic Forest, generally in areas at elevation below 500 m.

Phenology—Flowering specimens were collected from February to May and fruiting specimens were found only on January.

Conservation—According to the IUCN red list criteria (IUCN 2001), this species is designated as Endangered (EN), since the extent of occurrence (EOO) estimated is less than 5,000 km² and the area of occupancy (AOO) is less than 500 km². One of the populations occurs within the limits of Reserva Biológica Duas Bocas, a protected area

in Espírito Santo. However, because we do not know if the other collected populations are in legally protected areas, we consider that the species may be under severe threat.

Paratypes—Brazil. ESPÍRITO SANTO: Santa Teresa, estrada para o cruzeiro, 8 May 1984 (fl), *R.M. Piziolo* 52 (MBML); Santa Teresa, estrada para o Canaã, 4 Dec. 1985 (veg), *J. M. Vimercat* 322 (MBML).

DISCUSSION

Dalechampia margarethiae is recognized by its entire, cordiform leaves, involucre bracts white, usually deeply 5-lobed, staminate columns not elongating beyond the sepal tips after anthesis, staminate sepals slightly open, style tip moderately down-curved, cylindrical, staminate involucre of four free decussate bracts, resiniferous gland with apex margin fimbriate and white resin. This species is similar to *D. peckoltiana* and *D. pentaphylla*, both species having much wider distributions than the new species, because they share styles being cylindrical, fimbriate resiniferous gland, six entire pistillate sepals. However, *D. margarethiae* is differentiated from *D. peckoltiana* by the entire leaves (vs. 3-foliolate), white, deeply usually 5-lobed involucre bracts (vs. albido-virides, 3-lobed involucre bracts in *D. peckoltiana*), resiniferous gland hirsutous (vs. glabrous), resin white (vs. resin yellowish), pistillate sepals sparsely hirsutous (vs. glabrous), moderately down-curved at the apex of style (vs. straight at the apex), staminate sepals slightly open (vs. widely open) at anthesis (Table 1). The new species also differ from *D. pentaphylla* by having leaves entire (vs. 5-foliolate), bracteal stipules 0.9–1.2 × 3–4 cm, deltoid, glabrous to glabrescent, (vs. 1.4–1.5 × 6 mm, widely deltoid, chartaceous), resiniferous bractlets 1–2 mm wide (vs. 1–1.1 cm wide) (Table 1).

Webster and Armbruster (1991) placed the Neotropical species of *Dalechampia* (92

spp.) in the sections *Coriaceae* Pax & K. Hoffm., *Cremophyllum* Baill., *Dalechampia*, *Dioscoreifoliae* Pax & K. Hoffm., *Rhopalostylis* Pax & K. Hoffm. and *Tiliifoliae* G.L. Webster & Armbruster. Following this classification, *Dalechampia margarethiae* belongs to *D.* sect. *Dioscoreifoliae*. This is configured as the second largest section inside *Dalechampia*, with 24 species and is characterized by staminate pleiochasium of 4 free bracts, staminate bractlets deeply laciniate, staminate flowers 4–16, stamens usually 12 or more, staminate bractlets usually aggregated into a distinct gland producing resin and seeds smooth to rugulose. In addition, Webster and Armbruster (1991) distributed the 24 species in five informal groups (defined as Groups 1 – 5) which are differentiated mainly by division of leaves (range from lobed to unlobed), shape of stylar column, number and margins of pistillate sepals, and texture of seeds. Therefore, *D. margarethiae* fits into the concept of this section due the 4 free bracts, staminate flowers 5–6, stamens 17–35 and resin-producing glands and would be included in the Group 2 because of leaves unlobed, stylar column slender, apex not dilated and pistillate sepals entire. However, the characteristics of the pseudanthium are so similar to those of *D. pentaphylla*, *D. peckoltiana*, and *D. luetzelburgii*, and because now know that leaf shape is evolutionarily labile in *Dalechampia*, the most likely affiliation of *D. margarethiae* is with sect. *Dioscoreifoliae* Group 1. The discovery of this species actually argues strongly for merging Groups 1 and 2.

Key to *Dalechampia margarethiae* and other species from Southeast from Brazil

1. Leaves compound.....2
2. Leaves 5-foliolate; bracteal stipules 1.4–1.5 cm long.....*D. pentaphylla*
- 2'. Leaves 3-foliolate; bracteal stipules 0.3–1.2 cm long.....3
3. Involucral bracts moderately 3-lobed; pistillate sepals 12 pinnatifid; apex of stylar column moderately peltate.....*D. clauseniana*

- 3'. Involucral bracts deeply 3-lobed; pistillate sepals 6 entire; apex of stylar column cylindrical.....4
4. Involucral bracts albido-virides; bracteal stipules 1–1.3 cm long; ovary pubescent; stylar column glabrescent, 1.4–1.5 cm long; pistillate bracteoles glabrous, ciliate.....*D. peckoltiana*
- 4'. Involucral bracts whitish; bracteal stipules ca. 8 mm long; ovary vellutinos; stylar column pubescent, 1.2–1.3 cm long; pistillate bracteoles pubescent, no ciliate.....*D. luetzelburgii*
- 1'. Leaves simple.....4
4. Leaves unlobed.....5
5. Involucral bracts 3-cuspidate.....*D. ilheotica*
- 5'. Involucral bracts unlobed or 3–5 lobed.....6
6. Leaves membranaceous with cordate base; involucral bracts 3–5 lobed, 6–6.5 cm long.....*D. margarethii*
- 6'. Leaves coriaceous with rounded base; involucral bracts unlobed ca. 3 cm long.....*D. arciana*
- 4' Leaves 3-lobed or varying between 3-lobed to unlobed in the same individual.....7
7. Leaves exclusively 3-lobed.....8
8. Presence of capitate glandular trichomes in the margins of leaves and involucral bracts.....*D. stipulacea*
- 8'. Absence of capitate glandular trichomes in the margins of leaves and involucral bracts.....9
9. Involucral bracts velutinous with prominent vein; stylar column crateriform.....*D. ilheotica*
- 9'. Involucral bracts pubescent; stylar column lobed, clavate to discoid or slightly

- lobed.....10
10. Liana; leaves chartaceous to coriaceous; bracteal stipule oblong....*D. ficifolia*
- 10' Twining vine; leaves membranaceous; bracteal stipule linear....*D. brasiliensis*
- 7'. Leaves varying between 3-lobed to unlobed in the same individual....*D. ilheotica*

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AUTHOR CONTRIBUTIONS

RAPdS was responsible for the independent rediscovery of the, description, writing of the description and morphological comparison with other species in the discussion, key and table, elaboration of the distribution map and name choice. SMAS was responsible for writing the paper and manuscript formatting. ALM contributed for the manuscript review. WSA contributed to the interpretation of the results and revision of the manuscript.

LITERATURE CITED

- Alves, M.V. 1998. Checklist das espécies de Euphorbiaceae Juss. ocorrentes no semi-árido Pernambucano, Brasil. *Acta Botanica Brasilica* 12: 485–495.

- Armbruster, W. S., M. Edwards, J. Hines, R. Mahunnah, and Munyenyembe. 1993. Evolution and pollination of Madagascan and African *Dalechampia*. *Research & Exploration* 9: 460–474.
- Bachman, S., J. Moat, A.W. Hill, J. Torre, and B. Scott. 2011. Supporting red list threat assessments with GeoCAT: Geospatial conservation assessment tool. *ZooKeys* 150: 117–126.
- Barbosa, M. R. V., C. Sothers, S. Mayo, C. Gamarra-Rojas, and A. C. Mesquita. 2006. Checklist das Plantas do Nordeste Brasileiro: Angiospermas e Gymnospermas. Ministério da Ciência e Tecnologia.
- Cordeiro, I. 1997. *Dalechampia purpurata* Cordeiro (Euphorbiaceae), a new species from Chapada Diamantina, Bahia, Brasil. *Kew Bulletin* 53: 467–470.
- Hickey, L. J. 1973. Classification of the Architecture of Dicotyledonous Leaves. *American Journal of Botany* 60: 17–33.
- IUCN. 2010. The IUCN red list of threatened species. Version 2010.4. <http://www.iucnredlist.org/> (last accessed May 2018). Maya-L, C. A and I., Cordeiro 2008. Revisão dos gêneros de lianas da família Euphorbiaceae s.s para o estado de São Paulo. Relatório de apresentação final para a Rede Latinoamericana de Botânica (RLB08-P04).
- Maya-L., C. A, R. S. Secco, R. A. P. Silva and M. F. Sales. 2013. *Dalechampia* in Lista de Espécies da Flora do Brasil. Rio de Janeiro: Jardim Botânico do Rio de Janeiro, 2013. Available in: <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB17549>. (last accessed May 2018).
- Müller Argoviensis, J. 1874. Euphorbiaceae, Dalechampieae. Pp. 633–664 in *Flora Brasiliensis* vol. 2, eds. C.F.P. Martius and A. W. Eichler. F. Fleisher, Leipzig.
- Pax, F. and K. Hoffmann, 1919. Euphorbiaceae-Dalechampieae. Pp. 43–44 in Das

- Pflanzenreich. Regni vegetabilis conspectus 147 (helf 12), ed. A. Engler. Leipzig: Engelmann.
- Pereira-Silva, R. A., S. M. Athiê-Souza, R. S. Secco, A. L. Melo and M. F. Sales. 2016. *Dalechampia erythrostyla* (Euphorbiaceae), a new species from Northeastern Brazil. *Systematic Botany* 41: 989–995.
- Radford A. E., W. C. Dickison, and J. R. Massey. 1974. Vascular plant systematic. Harper & Row Publishers, New York, 891p.
- Rodrigues A. S. 2007. As tribos Dalechampieae Müll. Arg. e Manihoteae Melchior (Euphorbiaceae) no Distrito Federal, Brasil. M.S.thesis.. Brasília: Universidade de Brasília..
- Sales, M. F., S. J. Mayo, and M. J. N. Rodal. 1998. Plantas vasculares das florestas serranas de Pernambuco: um checklist da flora ameaçada dos Brejos de Altitude Pernambuco, Brasil. Recife, Universidade Federal Rural de Pernambuco, 130 pp.
- Thiers, B. 2018. [continuously updated]. Index Herbariorum: A global directory of public herbaria and associated staff. New York: New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/ih/>.
- Webster G. L. 2014. Euphorbiaceae. Pp. 51–216 in *Flowering Plants. Eudicots. The Families and Genera of Vascular Plants* vol 11, ed. K. Kubitzki Springer-Verlag Berlin Heidelberg.
- Webster, G. L. and W. S. Armbruster. 1991. A synopsis of the neotropical species of *Dalechampia* (Euphorbiaceae). *Botanical Journal of the Linnean Society* 105: 137–177.
- Webster, G. L. 1994. Classification of the Euphorbiaceae. *Annals of the Missouri Botanical Gardens* 81: 3–32.

Table 1. Comparisons of morphological characters of *Dalechampia margarethiae* and similar species.

Morphological characters	<i>D. arciana</i>	<i>D. luetzelburgii</i>	<i>D. margarethiae</i>	<i>D. peckoltiana</i>	<i>D. pentaphylla</i>
Leaves	Entire	3-foliolate	Entire	3-foliolate	5-foliolate
Base of leaf	Rounded	Asymmetric	Cordate	Asymmetric	Acute
Consistence of leaf	Coriaceous	Membranaceous	Membranaceous	Membranaceous	Membranaceous
Shape of involucre bracts	Entire	Deeply 3-lobed	Deeply 3–5 lobed	Deeply 3-lobed	Deeply 3–5-lobed
Color of involucre bracts	Greenish	Whitish	White	Albido-virides	Albido-virides
Long of involucre bracts	3 cm long.	ca. 7 cm long	6–6.5 cm long	7–9 cm long	ca. 9 cm long
Bracteal stipule	ca. 3 x 2 mm	8 x 2–3 mm	0.9–1.2 x 0.3–0.4 cm	1–1.2 x 0.25–0.3 cm	1.4–1.5 x 0.6 cm
Pistillate bracteole	Sparsely hispidulous, ciliate	Pubescent, no ciliate	Glabrous, no ciliate	Glabrous, ciliate	Glabrous, ciliate
Ovary	Sericeous	Vellutinos	Pubescent	Pubescent	Glabrous
Size of stylar column	1.5 x 0.5 mm	1.2–1.3 x 0.05 cm	9–10 x 0.6–0.8 mm	1.6–1.8 x 0.5–0.8 cm	2 x 1.2–1.5 mm
Apex of stylar column	Erect	Erect	Moderately curved	Erect	Moderately curved
Width of resiniferous bractlets	ca. 2 mm	Not seen	1–2 mm	2–2.5 mm	1–1.1 cm
Staminate column	Not accrescent after sepals open	Not seen	Not accrescent after sepals open	Accrescent after sepals open	Not accrescent after sepals open

Staminate sepals	Slightly open	Not seen	Slightly open	Widely open	Widely open
Resin color	White	Not seen	White	Yellowish	Yellowish

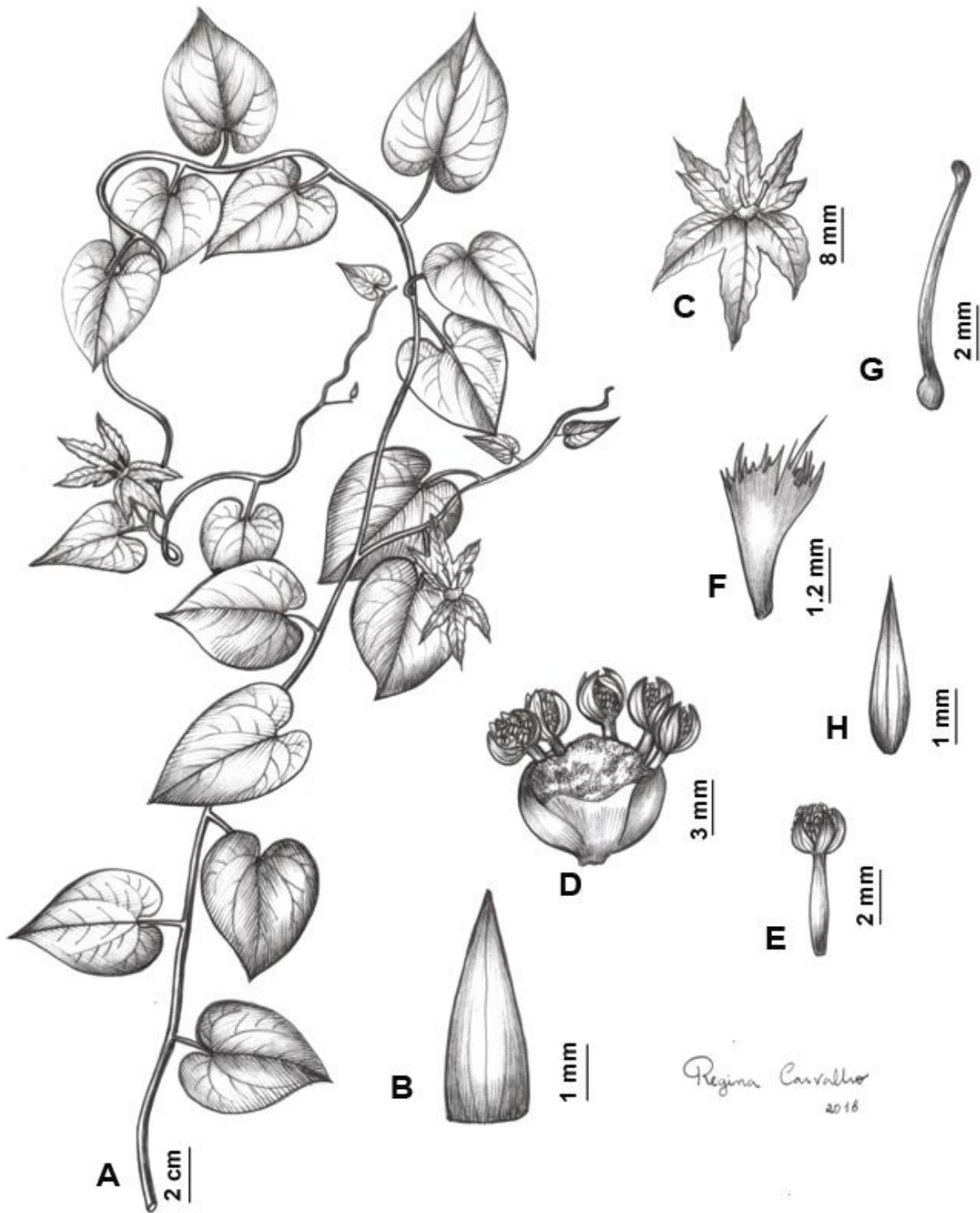


Fig. 1. *Dalechampia margarethiae*. A. Habit. B. Bracteal stipule. C. Pseudanthium. D. Staminate cymule. E. Staminate flower. F. Resiniferous bractlet. G. Pistillate flower. H. Pistillate sepal.

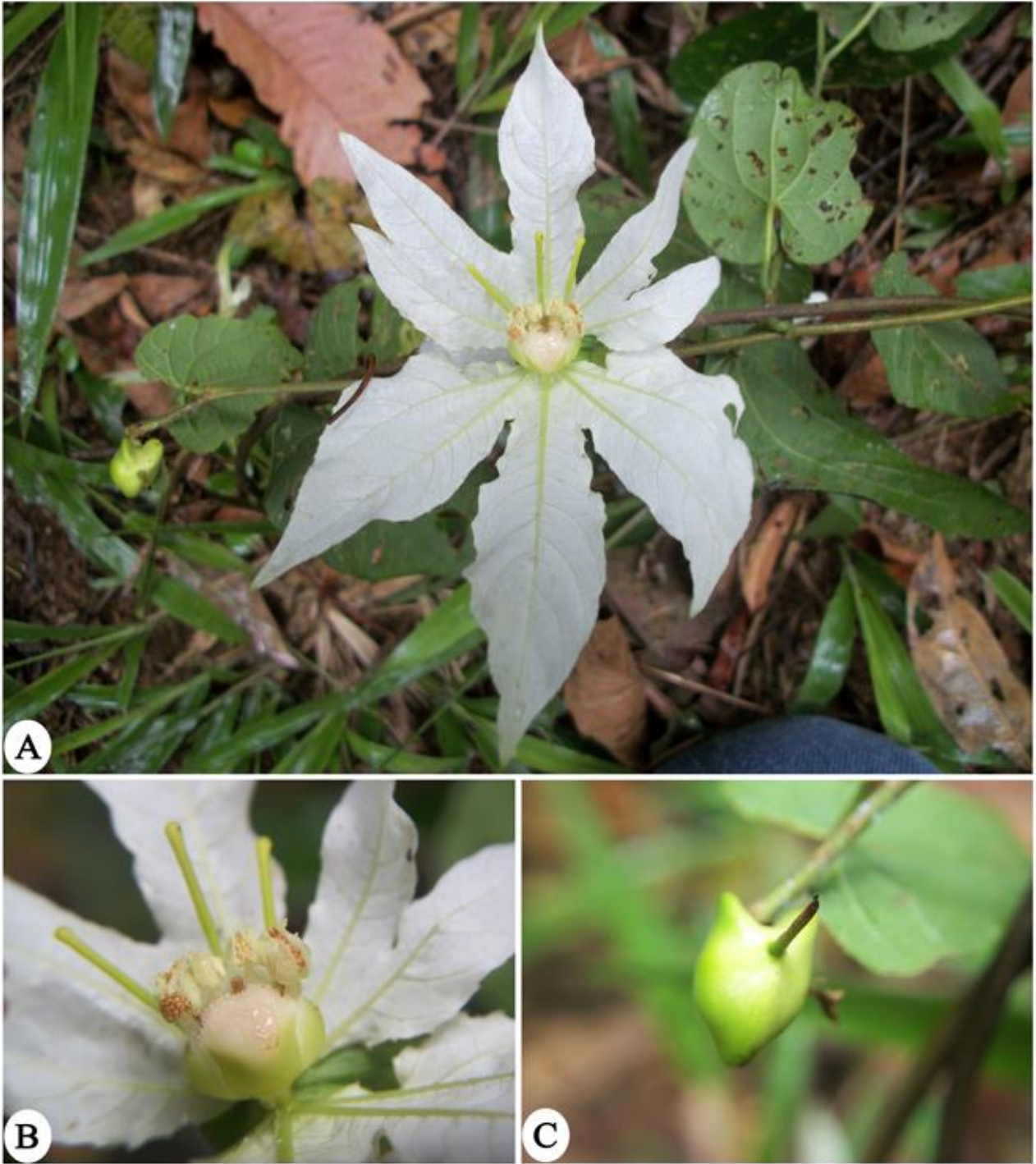


Fig. 2. *Dalechampia margarethiae*. A. Branch with pseudanthium and fruit. B. Pseudanthium with detail of staminate cymule and pistillate flowers. C. Fruit.

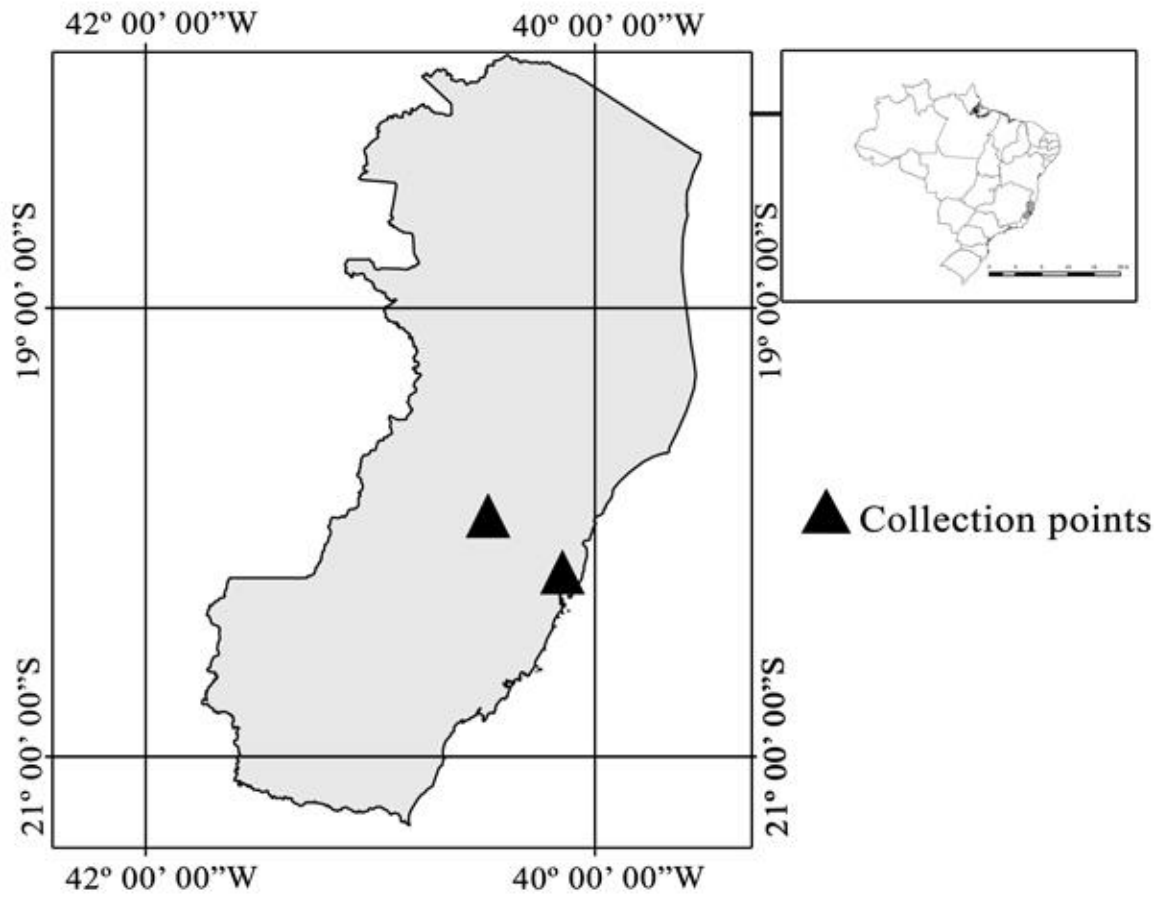
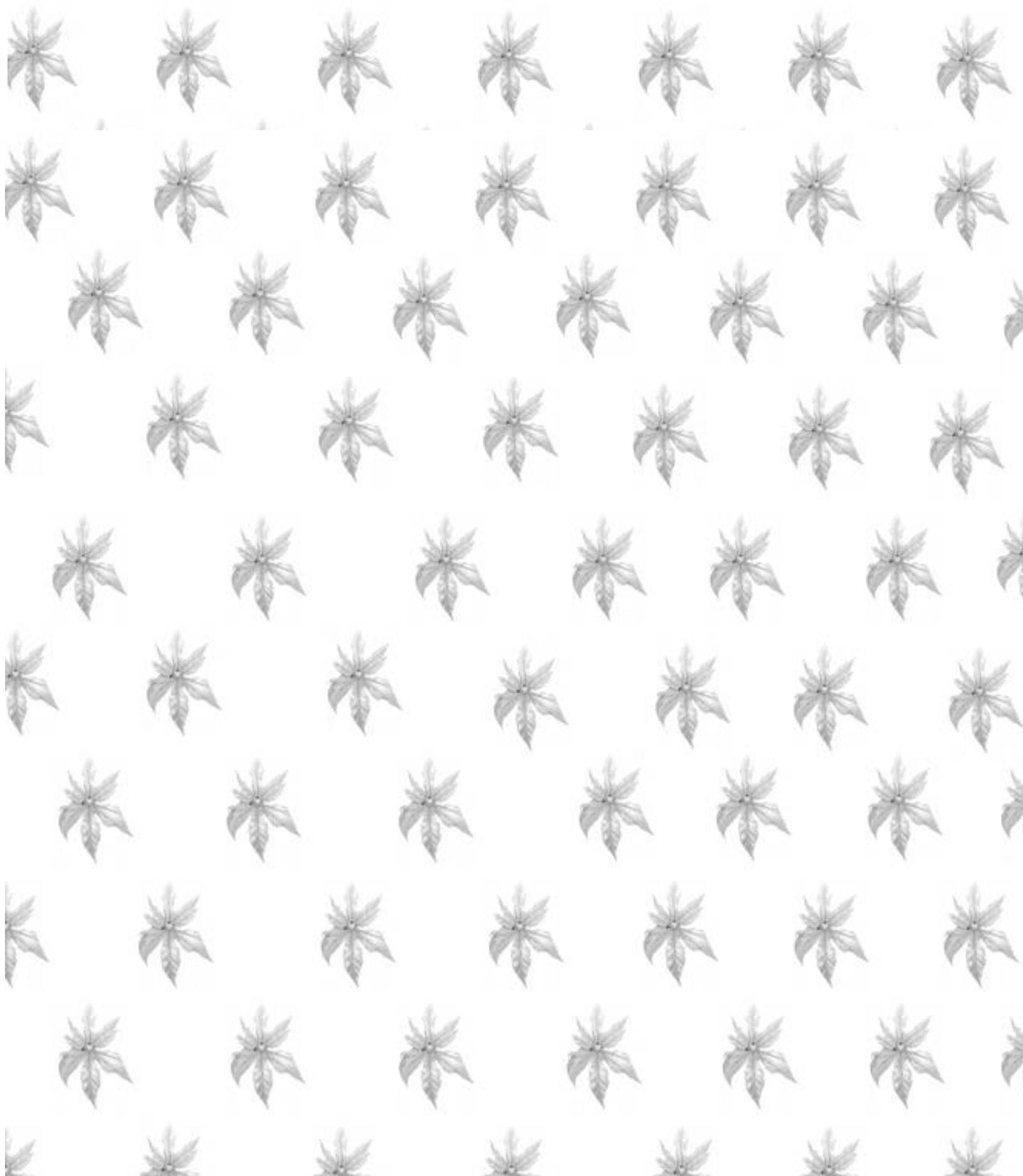


Fig. 3. Geographical distribution of *Dalechampia margarethiae* in Espírito Santo, Brazil.



Typification and reestablishment of the Linnaean name *Dalechampia colorata* (Euphorbiaceae)

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Taxon

Typification and reestablishment of the Linnaean name *Dalechampia colorata* (Euphorbiaceae)

Rafaela Alves Pereira-Silva,¹ Sarah Maria Athiê-Souza,¹ W. Scott Armbruster,² André Laurênio de Melo³ & Margareth Ferreira de Sales¹

¹ Programa de Pós-graduação em Botânica, Departamento de Biologia, Universidade Federal Rural de Pernambuco, 52171-900, Recife, PE, Brazil

² School of Biological Sciences, University of Portsmouth, Portsmouth, PO1 2DY, U.K.; and Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska 99775, U.S.A.

³ Unidade Acadêmica de Serra Talhada, Universidade Federal Rural de Pernambuco, 56909-535, Serra Talhada, PE, Brazil

Author for correspondence: Sarah Maria Athiê de Souza, sarah_athie@yahoo.com.br

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Abstract Revisionary studies of *Dalechampia* sect. *Dalechampia* have revealed the need to lectotypify *D. colorata* and that it represents a distinct species rather than a synonym of *D. tiliifolia*. *Dalechampia karsteniana* is interpreted to be a synonym of *D. colorata*.

Keywords Dalechampiinae; nomenclature; Plukenetieae; taxonomy

■ INTRODUCTION

Dalechampia L. is the only genus in subtribe Dalechampiinae (Euphorbiaceae: Plukenetieae). The morphology of the inflorescences is unique in the Euphorbiaceae as they are pseudanthial and each comprises two involucre bracts, a staminate pleiochasium with 4 to almost 50 staminate flowers and 1- to 3-pistillate flowers (Pax & Hoffman, 1919; Webster & Armbruster, 1991; Pereira-Silva & al., 2016). The genus is pantropical and contains about 130 species, with a center of diversity in tropical South America (Armbruster & al., 1993). Brazil hosts more than 70 species and is considered the be the most species-rich area for the genus (Webster, 1994; Maya-Lastra & al., 2015).

Webster & Armbruster (1991) published the most recent systematic treatment of neotropical *Dalechampia*. In that work the authors proposed an infrageneric classification that recognized six sections: *D.* sect. *Coriaceae* Pax & K.Hoffm., *D.* sect. *Cremophyllum* Baill., *D.* sect. *Dalechampia*, *D.* sect. *Dioscoreifoliae* Pax & K.Hoffm., *D.* sect. *Rhopalostylis* Pax & K.Hoffm. and *D.* sect. *Tiliifoliae* G.L.Webster & Armbruster (see also Armbruster, 1988). As part of research into *D.* sect. *Dalechampia* carried out by the first author, all names were investigated and their typification evaluated. During this process we discovered that *D. colorata* L.f., which was described by Linnaeus filius (1782) had not be typified. Here we present the typification of this name and address its status as a distinct species rather than a synonym of *D. tiliifolia* Lam. In addition, *D. karsteniana* Pax. & K.Hoffm. is interpreted as synonymous with *D. colorata*.

■ MATERIALS AND METHODS

This study was based on literature review, observations of specimens in the field, analyses of approximately 70 specimens, including most types and historical collections belonging to following herbaria (see Appendix 1): BHCB, EAC, ESA, G, HVASF, INPA, IPA, K, LINN, P, PEUFR, SP, TEPB and UB. We also analyzed the contemporaneous illustrations associated with the *Mutis* expedition (image available at <http://www.rjb.csic.es/icones/mutis/paginas/laminadibujo.php?lamina=4650>). Morphological data were obtained from observations of dried material under a stereomicroscope (Leica EZ4), as well as from flowers and fruits fixed in alcohol. Descriptive terminology follows Webster & Armbruster (1991).

■ TYPIFICATION OF *DALECHAMPIA COLORATA*

Linnaeus (1753) described *Dalechampia* for a single species, *D. scandens* L., that had been collected in Martinique. Later, Linnaeus filius (1782) described *D. colorata* based on an unnumbered José Celestino Mutis specimen collected in Colombia. In the protologue, Linnaeus filius (1782: 421) characterized *D. colorata* with a short diagnosis “DALECHAMPIA foliis integerrimis ... Similis *D. scandenti*, sed folia quidem triloba, verum integerrima, minusque profunde divisa, nec serrata. *Involucrum* magis oblongum, petalodes f. coloratum, nec basi cordatum aut viride” (DALECHAMPIA entire leaves ... Like *D. scandens*, but leaves are indeed 3-lobed, entire, and less divided or serrate. The involucre bracts more oblong, petaloid, coloured, not with cordate base or green). In addition, the locality cited was “Nova

Granada”, which likely corresponds to modern Colombia, as Mutis was based in Bogotá (Mendoza, 1909).

According to Linnaeus filius (1782), *Dalechampia colorata* was similar to *D. scandens* and characterized by 3-lobed leaves and 3-lobed involucral bracts. However, Webster & Armbruster (1991) reduced *D. colorata* into synonymy with *D. tiliifolia* Lam., which was included in *D. sect. Tiliifoliae*. The latter section is circumscribed to comprise species with simple, chartaceous leaves that are either lobed or unlobed, involucral bracts over 1 cm long, staminate involucels that are 2-lipped, with four lobes (3+1) and connate at the base, resiniferous bractlets that are lacerate or distally toothed, 8- to 12-staminate flowers, and styles that have a distinctly dilated tip (Webster & Armbruster, 1991). More recently, however, Govaerts & al. (2016) have treated *D. colorata* as a synonym of *D. scandens*, probably due to superficial similarities including the three lobed leaves and 3-lobed involucral bracts previously noted by Linnaeus filius (1782), the synonymy published by Pax & Hoffman (1919), and taxonomic notes on the Mutis specimen published by Blanco Fernández de Caleyá & del Valle Stervinou (2009).

Webster & Armbruster (1991) cited a specimen collected by Mutis (*Mutis 4128*) at US (barcode 00096457) as belonging to the type collection of *Dalechampia colorata*. The US specimen is labelled *D. colorata* and was apparently collected in the correct geographic region. In the Real Jardín Botánico (MA), which houses the largest part of Mutis’s collection from the Royal Botanic Expedition of the “Virreinato de Nueva Granada (Colombia, Ecuador and Venezuela)” (<http://www.rjb.csic.es/jardinbotanico/jardin/index.php?Cab=109&SubCab=187&Pag=195>), there are also two specimens. These bear the inscription mentioned in the protologue of *D. colorata* (e.g.,

indicating that the specimens were collected during the same expedition in Nueva Granada by Mutis). Both the specimens at MA and the specimen at US, however, do not match the original description (see Table 1). Specifically they conflict the protologue of *D. tiliifolia* in having entire to moderately 3-dentate involucral bracts and vellutinous indument. Given the conflict with the protologue, these specimens cannot serve as the type and in fact, they correspond to *D. tiliifolia*.

As part of our search for additional original material we located an unnumbered Mutis collection from Nova Granada that is morphologically compatible with the protologue of *Dalechampia colorata* in the Linnaean Herbarium (LINN). This material comprises two sheets labelled probably by Linnaeus filius “*Dalechampia colorata*” (LINN 1138-1, LINN 1138-2), and both have a narrowly triangular involucral stipule. One of the specimens (LINN 1138-2) bears the handwritten number “41”; this number was not mentioned in the protologue and it is not clear whether it was added later by a curator or researcher. Below we select LINN 1138-2 as the lectotype because it includes reproductive material, and perfectly matches the original description of the taxon in having 3-lobed leaves, and 3-lobed and oblong involucral bracts, that are magenta and do not have a cordate base.

■ TAXONOMIC STATUS OF *DALECHAMPIA COLORATA*

Based on our examination of the the lectotype of *Dalechampia colorata* it represents a species morphologically distinct from both *D. scandens* and *D. tiliifolia*. *Dalechampia*

Table 1. Comparison of the type of *D. colorata* to *D. karsteniana* and species with which *D. colorata* has been treated as synonymous.

Morphological character	<i>D. colorata</i> L.f.	<i>D. karsteniana</i> Pax & K.Hoffm.	<i>D. scandens</i> L.	<i>D. tiliifolia</i> Lam.
Shape of leaves	Exclusively 3-lobed	Exclusively 3-lobed	Exclusively 3-lobed	Entire to 3-lobed
Dimensions of involucre stipules	8–10 × 3 mm	1.7–7 × 3–4 mm	4–7 × 1–2 mm	3.5–4 × 1.5–1.7 mm
Shape of bracteal stipule	Narrowly triangular	Narrowly triangular	Lanceolate	Linear
Shape of involucre bracts	3-lobed, rarely 4- to unlobed	Shallowly 3-lobed to unlobed	3-lobed	Entire to moderately 3-dentate
Number of main veins at involucre bracts	7	7	5	7–8
Involucre bracts colour	Magenta	Magenta	Cream-coloured	Pale greenish
Timing of bract abscission	Early	Early	Late	Late
Staminate involucre (bracts)	4 free	4 free	2-lipped	2-lipped (2+3 lobes)
Colour of staminate sepals	Pink	Pink	Pale green	Pale Green
Shape of stigma	Peltate	Peltate	Moderately crateriform	Crateriform to discoid
Stigma colour	Green	Green	Green	Green
Shape of pistillate sepals	Laciniate (3 lobes)	Laciniate (3–5 lobes)	Pinnatifid	Pinnatifid
Number of pistillate sepals	6	6	8–12	10–12
Glandular trichomes in pistillate sepals	Absent	Absent	Present	Present
Bractlets of resiniferous glands	Deeply fimbriate	Deeply fimbriate	Entire and laminar	Shallowly laciniate
Ovary indument	Velutinous	Velutinous	Pubescent	Hispid-hirsute

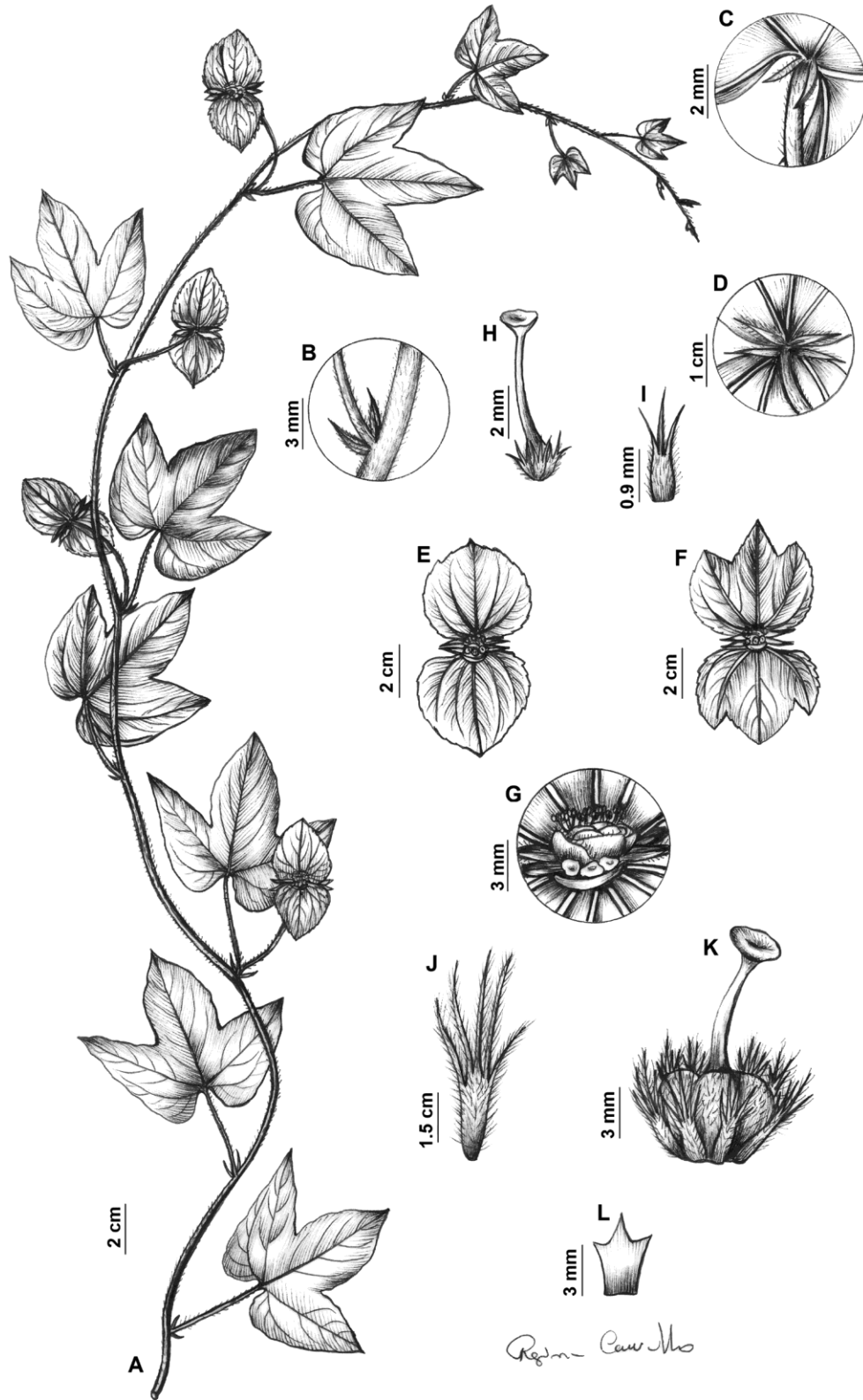


Fig. 1. *Dalechampia colorata* L.f. **A**, Habit; **B**, Petiolar stipules; **C**, Foliar stipules; **D**, Involucral stipule at base of the bract; **E**, Pseudanthium with entire involucre bracts; **F**, Pseudanthium with 3-lobed involucre bracts; **G**, Detail of staminate and pistillate cymules; **H**, Pistillate flower with peltate stylar tips; **I**, 3-fid pistillate sepals; **J**, 5-fid pistillate sepals; **K**, Fruit with persistent style and sepals; **L**, Fragment of resiniferous bractlets. – A–I, drawn from Tracey 463 (K); J–L, drawn from E. André 1797 (K). Drawn by Regina Carvalho.

colorata is characterized by 3-lobed leaves, a narrowly triangular bracteal stipule, magenta involucre bracts, four free staminate involucel, pink staminate sepals, a peltate stigma, six lacinate pistillate sepals with three lobes, bractlets of resiniferous glands that are deeply fimbriate and a velutinous ovary. In Colombia, this species is popular known as “Flor de mariposa” or “Butterfly flower” (Pax & Hoffmann, 1919). A tabular summary of the differences between the species and the taxa with which has previously been considered a synonym is presented in Table 1.

Dalechampia colorata, *D. scandens* and *D. tiliifolia* all have 3-lobed leaves (*D. tiliifolia* can vary from 3-lobed to entire leaves on the same specimen) and green stigmas. However, *D. colorata* differs from the other two species in multiple morphological aspects such as the colour, shape of the bracts, number of the main veins and surface texture of the involucre bracts. The pseudanthium of *D. colorata* is magenta (vs. cream-coloured in *D. scandens* and pale greenish in *D. tiliifolia*). Its involucre stipules are narrowly triangular (vs. lanceolate in *D. scandens*, and linear in *D. tiliifolia*). The number of the main veins at the bract base is seven in *D. colorata* (vs. five in *D. scandens* and seven to eight in *D. tiliifolia*). *Dalechampia colorata* has glabrous involucre bracts and sparsely pubescent veins (vs. villose in *D. scandens* and velutinous in *D. tiliifolia*). *Dalechampia colorata* has four separated staminate involucellar bracts (vs. connate and 2-lipped staminate involucellar bracts in *D. scandens* and *D. tiliifolia*). Another difference we found when comparing the staminate flowers of the three species refers to the sepal colour. *Dalechampia scandens* and *D. tiliifolia* have pale green sepals while in *D. colorata* they are pink. Considering the pistillate flowers, *D. colorata* is distinguished from the other two species by the shape of stigma, number and margin of the sepals, and presence of glandular trichomes. *Dalechampia colorata* has a peltate stigma (vs. moderately crateriform in *D. scandens* and crateriform to discoid in *D. tiliifolia*), 6 pistillate sepals (vs. 8–12 in *D. scandens* and 10–12 in *D. tiliifolia*) that are 3- to 5-parted and lacinate, and lack glandular trichomes (vs. present in *D. scandens* and *D. tiliifolia*). Finally, the ovary of *D. colorata* is velutinous (vs. pubescent in *D. scandens* and hispid-hirsute in *D. tiliifolia*). Additionally, *D. colorata* may be distinguished from the other two species by different times of bract abscission. Specifically, *D. colorata* bracts are early-deciduous (prior to fruit development) as opposed to late-deciduous (after fruit development) in both *D. scandens* and *D. tiliifolia*.

Once we recognized that the lectotype of *Dalechampia colorata* represented a distinct species, we carried out a search of the accepted species of *Dalechampia* to determine whether it matched any currently recognized taxon. Our search revealed that the lectotype was conspecific with type of *D. karsteniana* Pax & K. Hoffm. Both types have narrowly triangular bracteal stipules, green and peltate stigmas, six pistillate sepals, velutinous ovaries, pink staminate sepals, four free staminate bracts, and deeply fimbriate bractlets in the resiniferous gland. As *D. karsteniana* is a much younger name, it is treated as a junior synonym of *D. colorata* here. Below we typify *D. colorata*, place *D. karsteniana* in synonymy and provide a description of *D. colorata* based on the specimens examined (Appendix 1).

***Dalechampia colorata* L.f., Suppl. Pl.: 421. 1782 – Lectotype (designated here):** Colombia, Nova Granada, *J.C. Mutis s.n.* (LINN No. 1138-2!; isolectotype: LINN No. 1138-1!). = *Dalechampia karsteniana* Pax & K. Hoffm. in Engler, Pflanzenr. IV. 147. XII. (Heft 68): 30. 1919, **syn. nov.** – Lectotype (designated by Webster & Armbruster in Bot. J. Linn. Soc. 105: 155. 1991): Colombia, Bogota, Nueva Granada, between Mesa and Magdalena, 800 m, 1851–1857, *J. Triana 3557* (P barcode P00587443!; isolectotypes G barcode G00237307!, K!).

Description. – Twining vines, branches villous. Leaves alternate, simple, 3-lobed, membranaceous to chartaceous; petiole 2–2.5 cm long, densely pubescent; petiolar stipule 3–5 × 1 cm, lance-ovate, base truncate, margin entire, glabrescent, associated to glands at base. Lobes of the leaves 6.5–10 × 5.5–8 cm, ovate to elliptical, base cordate, apex acute, margin entire to slightly sinuate, adaxial surface hispid and abaxial surface pubescent, sparsely glandular trichomes, primary veins 5; stipels 2–3 × 0.5 mm, linear, pubescent, associated with glands at the base and one glandular trichome at the apex. Pseudanthium, axillary, 5–9 cm long; peduncle ca. 7 cm long, villous, involucre bracts 4–4.5 cm long, 3-lobed, rarely 4- to unlobed, magenta, base slightly attenuate to rounded, lobes with apex acute, margin sinuate to entire, glabrous and sparsely pubescent on the veins, stipitate glandular trichomes absent, primary veins 7; involucre stipule at base of bract 8–10 × 3 mm, narrowly triangular, base truncate, apex acute, margin entire, ciliate, adaxial and abaxial surfaces glabrescent. Staminate pleiochasium of 4 free bracts, decussate and concave, with ca. 6 flowers, sessile; staminate bracts very widely ovate, 5–7 × 5–7 mm, glabrescent, margin ciliate; gland composed of numerous resiniferous bractlets, 3–4 × 1–2 mm, margin deeply fimbriate. Staminate flowers 2–3 mm long; sepals 4, lanceolate, ca. 2 × 2 mm, pink; stamens 27–35. Pistillate cymule 3-flowered, sessile; pistillate bracteole 1, depressed ovate, ca. 5 × 8 mm, entire, moderately ciliate. Pistillate flowers 4–9 mm long, sessile; sepals ca. 6, 1–2 × 1 mm, 3- to 5-parted and lacinate velutinous, stipitate glandular trichomes absent; ovary ca. 2 × 2 mm, velutinous, stylar column 4–9 × 0.5 mm, stigma peltate, green. Fruit a capsule, 4–10 × 6–10 mm, 3-lobed, dark brown, velutinous, sepals accrescent, 3–7 mm long. Seeds not seen. (Fig. 1)

■ AUTHOR CONTRIBUTIONS

RAPdS: Ph.D. student reviewing *Dalechampia* sect. *Dalechampia* who generated data and visited Brazilian and international herbaria. SMA-S: co-advisor of the first author and who conceived the idea and structured the manuscript; contributed to the writing of the text and interpretation of the results. WSA: specialist in *Dalechampia*, contributed to the revision of the text, to the interpretation and discussion of the results. ALdM: collaborator of the thesis of the first author, contributed with the correction of the manuscript. MFdS: advisor of the first author and expert in Euphorbiaceae in Brazil, has contributed to the correction, discussion of the results and research funding. — RAPdS, rafaela.news@hotmail.com; SMA-S, <https://orcid.org/0000-0002-6090-981X>; WSA, <https://orcid.org/0000-0001-8057-4116>,

wsarmbruster@alaska.edu; ALdM, andrelaurenio@yahoo.com.br; MFdS, <https://orcid.org/0000-0002-9587-1209>, mfsales65@hotmail.com

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■ LITERATURE CITED

- Armbruster, W.S.** 1988. A new species, section, and synopsis of *Dalechampia* (Euphorbiaceae) from Costa Rica. *Syst. Bot.* 13: 303–312. <https://doi.org/10.2307/2419294>
- Armbruster, W.S., Edwards, M., Hines, J., Mahunnah, R. & Munyenembe.** 1993. Evolution and pollination of Madagascan and African *Dalechampia*. *Res. & Explor. (Washington)* 9: 460–474.
- Blanco Fernández de Caleyá, P. & Valle Stervinou, A.D.** 2009. *Herbarium Mutisianum*. Madrid: Real Jardín Botánico, CSIC.
- Govaerts, R., Fernández Casas, F.J., Baker, C., Carter, S., Davies, S., Esser, H.-J., Gilbert, M., Hoffmann, P., Radcliffe-Smith, A., Steinmann, V., Van Welzen, P. & Whitmore, T.** 2016. World checklist of Euphorbiaceae. Facilitated by the Royal Botanic Gardens, Kew. Published on the internet: <http://apps.kew.org/wcsp/> (accessed 20 Feb 2016). <https://doi.org/10.5962/bhl.title.824>
- Linnaeus, C.** 1753. *Species plantarum*, vol. 2. Holmiae [Stockholm]: impensis Laurentii Salvii. <https://doi.org/10.5962/bhl.title.669>
- Linnaeus, C. [filius]** 1782 (“1781”). *Supplementum plantarum*. Brunsvigae [Brunswick]: impensis orphanotrophei. <https://doi.org/10.5962/bhl.title.555>
- Maya-Lastra, C.A., Secco, R., Sales M.F. & Silva, R.A.P.** 2015. *Dalechampia*. In: Lista de Espécies da Flora do Brasil. Rio de Janeiro: Jardim Botânico do Rio de Janeiro. <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB17549> (accessed 18 Oct 2016).
- Mendoza, D.** 1909. *Expedición Botánica de José Celestino Mutis al Nuevo Reino de Granada y Memorias Ineditas de Francisco José de Caldas*. Madrid: Librería General de Victoriano Suárez. <https://doi.org/10.5962/bhl.title.36983>
- Pax, F. & Hoffman, K.** 1919. Euphorbiaceae–Dalechampiaeae. In: Engler, H.G.A. (ed.), *Das Pflanzenreich*, IV. 147. XII. (Heft 68). Leipzig: Engelmann.
- Pereira-Silva, R.A., Athié-Souza, S.M., Secco, R.S., Melo, A.L. & Sales, M.F.** 2016. *Dalechampia erythrostyla* (Euphorbiaceae), a new species from northeastern Brazil. *Syst. Bot.* 41: 989–995. <https://doi.org/10.1600/036364416X694116>
- Webster, G.L.** 1994. Classification of the Euphorbiaceae. *Ann. Missouri Bot. Gard.* 81: 3–32.
- Webster, G.L. & Armbruster, W.S.** 1991. A synopsis of the neotropical species of *Dalechampia* (Euphorbiaceae). *Bot. J. Linn. Soc.* 105: 137–177. <https://doi.org/10.1111/j.1095-8339.1991.tb00202.x>

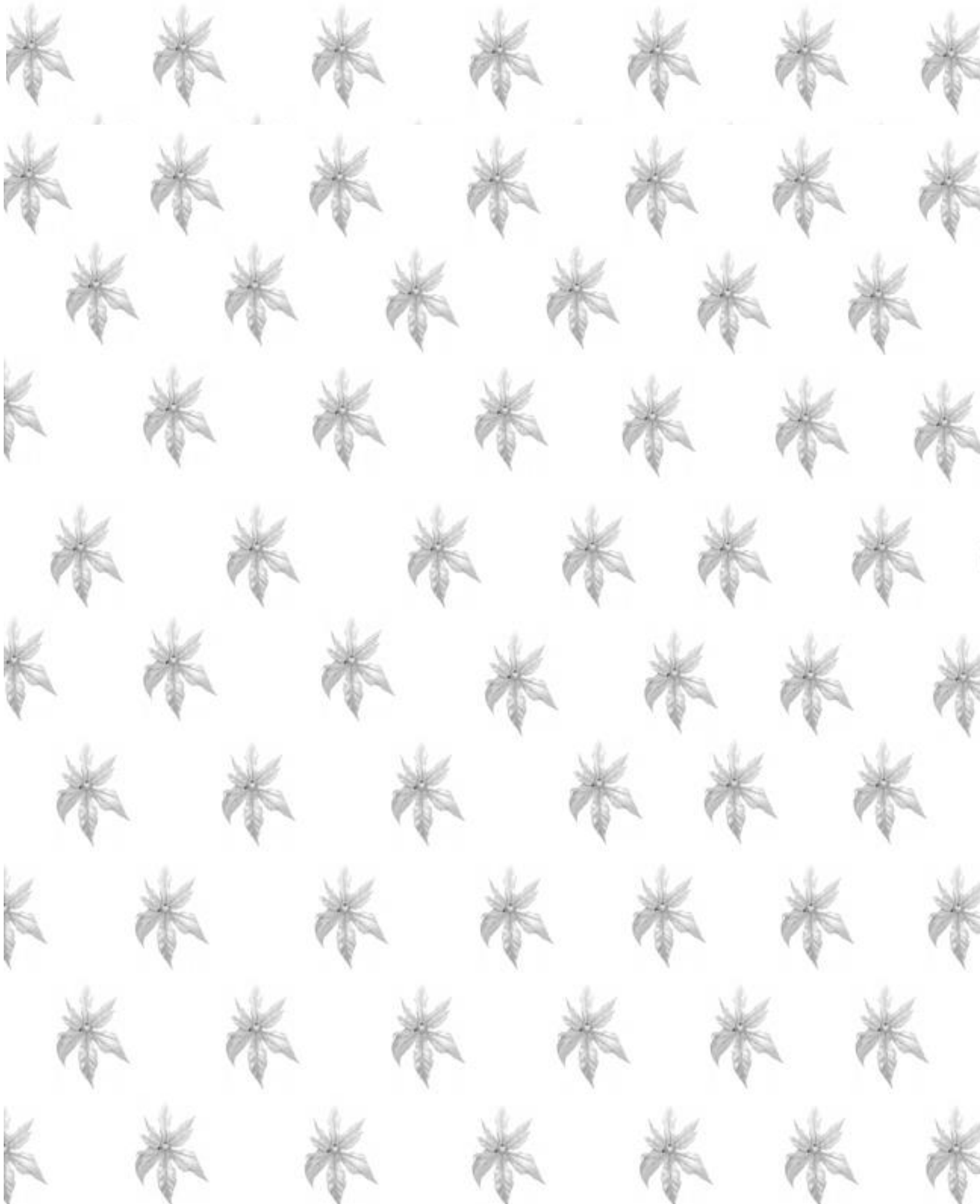
Appendix 1. Voucher information for the additional reference

specimens used in this study. Taxon name, country and/or locality,

collector(s), collection number and herbarium

Dalechampia colorata L.f.: Colombia, Cundinamarca, *Mrs. Tracey 463* (K); without locality, *E. André 1797* (K).
Dalechampia tiliifolia Lam.: French Guiana without collector *201* (K); Peru, *J. Jussieu s.n.* (P00674013); Brazil, Acre, *W.A. Rodrigues s.n.* (INPA); Rio Branco, *M. Almeida & L. Lima s.n.* (INPA); Ilha do Amapá, *R.C. Oliveira & al. 1752* (UB); Amazonas, Manaus, *G.T. Prance & al. s.n.* (INPA); Ceará, Ubajara, *A. Fernandes & P. Gibbs s.n.* (EAC); Crato, *A. Fernandes & E. Nunes s.n.* (EAC); Maranhão, *E. Nunes & P. Martins s.n.* (EAC); Loreto, *G. Eiten & L.T. Eiten 10657* (K); Chapadinha, *E. Nunes & Castro, A.J. s.n.* (EAC); Espírito Santo, *J.C. Lopes & al. 201* (ESA); Goiás, *M.L. Fonseca & al. 2418* (SP); Mato Grosso, *G.F. Árbocz & N.M. Ivanauska 3982* (ESA); Juara-Alta Floresta, *M. Macedo & S. Assumpção s.n.* (BHCB); Mato Grosso, *J. Ratter & al. 1861* (UB); Rio Areões, *J.A. Ratter & J.F. Filho 3399* (K); Pará, *I.L. Amaral & al. 1128* (UB, K); Serra dos Carajás, *C.R. Sperling & al. 5819* (K); Pernambuco, *E.P. Heringer & al. 1005* (IPA); Piauí, *F.C. Silva 17* (K); Rio de Janeiro, *M. Glaziou 11536* (K); Roraima, *L.O.A. Teixeira & al. 511* (INPA); Boa Vista, *B.L. Stannard & M.G.M. Arrais 643* (K); Rondônia, *C.A. Cid & al. 4300* (K); without locality, *G. Gardner s.n.* (K); without locality, *Gardner s.n.* (K). *Dalechampia scandens* L.: Brazil, Amazonas, without collector *s.n.* (INPA 1546A); Manaus, *W.A. Rodrigues s.n.* (INPA); Bahia, *I. Cordeiro 4768* (TEPB); Barra, *L.P. Queiroz 4768* (TEPB); Ceará, *D. Araújo & J.T.B. Jorge 1389* (HVASF); General Sampaio-RPPN Francly Nunes, *M.F. Moro & al. 99* (EAC); Caridade, *A. Fernandes s.n.* (EAC); Santa Quitéria, *J. Paula-Souza 11123* (ESA); Mato Grosso, *J.A. Lombardi & A. Salino 1677* (BHCB); Juruena, *V.C. Souza & al. 18722* (ESA); Minas Gerais, *H.S. Irwin & al. 23195* (K); Januária, *J.A. Lombardi & A. Salino 1677* (BHCB); São Paulo, *V.B. Zipparro 2504* (BHCB); Eldorado, *A. Oriani & al. 580* (ESA); Pará, *T.M.S. 7* (INPA); Pernambuco, Caruaru, *A.M.S. Reis & al. 26* (PEUFR); Itamaracá, *R.A. Pereira-Silva & L. Lima-Santos 5* (PEUFR); Moreno, *M.J. Silva 27* (PEUFR); Ouricuri, *V.C. Lima 50* (PEUFR, IPA); Pesqueira, *M. Correia, G.M. Souza & I. Andrade 194* (PEUFR); Petrolândia, *M.J. Silva 507* (PEUFR); São Vicente Férrer, *M.A.F. Lucena & M. Oliveira 65* (PEUFR); Serrambi, *Santos & Souza 60* (PEUFR); Tamandaré, *J.R.R. Cantarelli & al. 258* (PEUFR); Salgueiro, *J.R. Maciel & al. 1261* (HVASF); Roraima, *J.A. Ratter & al. 5392* (K); Rio de Janeiro, *Glaziou 13191* (K); without locality, *Thomas 720* (G); von Santo Domingo, *Provincia Barahona, P. Fuertes 266* (G).

Manuscrito 6



***Dalechampia* (Euphorbiaceae,
Acalyphoideae): synopsis of species from
Northeast Brazil**

Rafaela Alves Pereira-Silva, Sarah Maria Athiê-Souza, André
Laurênio de Melo & Margareth Ferreira de Sales

Artigo submetido

Biotaneotropica

***Dalechampia* (Euphorbiaceae, Acalyphoideae): synopsis of species from Northeast Brazil**

Abstract

A synopsis of the *Dalechampia* from Northeastern Brazil is presented here, with discussions of their diagnostic features. The study was based on the analysis of herbarium material (including historical collections and types), specimens collected in the field, and bibliographic documentation. Twenty-nine species distributed among five sections were recognized, 20 of them endemic to Brazil. Most of the species are found in Caatinga and Atlantic Forest vegetation. A key for species identifications is provided, together with illustrations, and information on their geographic distributions and conservation statuses.

Key-words: Dalechampiinae, Flora, Plukenetieae, taxonomy

***Dalechampia* (Euphorbiaceae, Acalyphoideae): sinopse das espécies do Nordeste do Brasil**

Resumo

Uma sinopse da *Dalechampia* do Nordeste do Brasil é apresentada aqui com uma discussão sobre as características diagnósticas. O estudo foi baseado na análise de materiais de herbário (incluindo coleções históricas e tipos), espécimes coletados durante o trabalho de campo, além de documentação bibliográfica. Vinte e nove espécies distribuídas em cinco seções foram reconhecidas, 20 delas endêmicas no Brasil. A maioria das espécies está distribuída na Caatinga e na Mata Atlântica. Uma chave para a identificação de espécies é fornecida juntamente com ilustrações, informações sobre as distribuições geográficas e status de conservação.

Palavras-chave: Dalechampiinae, Flora, Plukenetieae, Taxonomia

Introduction

Dalechampia L. comprises approximately 130 species distributed pantropically, 90 of which are found in the tropical Americas, with its center of diversity being in South America (Armbruster et al. 1993). Brazil stands out for its diversity of species, with 72 taxa widely disseminated throughout the country in different vegetation types (Maya-Lastra et al. 2015). Southeastern Brazil holds 47.2% of the country's *Dalechampia* diversity (34 spp.), although Bahia State (located in the northeastern region) has the largest number of species (23 spp.), followed by the states of Minas Gerais and São Paulo, with 20 species each (both in the southeastern region), and Amazonas State (northern region) with 19 species. Neotropical savanna (Cerrado) and Atlantic Forest regions hold the largest numbers of genera (32 and 31 respectively), while the northeastern region holds 29 species, representing 39% of the species richness of the country. The Caatinga and Atlantic Forest phytogeographic domains concentrate the highest representivity of *Dalechampia* (Flora do Brasil 2020, under construction).

The inflorescences and flowers of *Dalechampia* provide the best morphological features for characterizing the genus. The inflorescence is a pseudanthium, distinguishable from the other genera of Euphorbiaceae by having two large involucre bracts varying in color from whitish, yellowish-greenish, pink, to magenta; those bracts can be entire, 3-lobed, to deeply 3–5-lobed, and are inserted below a pistillate cymule of 1–3 flowers, with staminate pleiochasium that can range from 4 to almost 50 flowers (Pax & Hoffman 1919, Webster & Armbruster 1991, Webster 2014, Pereira-Silva et al. 2018). Most species have resiniferous secretory glands, or emit volatile aromatic compounds from the staminate subflorescence (Armbruster & Webster 1982, 1991). From a vegetative point of view, they are mostly herbaceous and climbing plants. Subshrub species are occasionally encountered, but almost exclusively in central-western Brazil (Pax & Hoffmann 1919, Webster & Armbruster 1991, Flora do Brasil 2020, under construction). The leaves can be extremely variable within a single species, and even on the same individual (Webster & Armbruster 1991).

The treatment by Webster & Armbruster (1991), which included the South American species of *Dalechampia*, is still the most recent and most complete. Although those authors did not provide descriptions of the species, they detailed morphological aspects and rearranged the sections and subsections. Some floristic studies involving

Dalechampia (or part of the genus) have been conducted in Brazil (Alves 1998, Sales et al. 1998, Maya-Lastra 2015, Barbosa et al. 2006, Rodrigues 2007, Sático & Roque 2008, Pereira-Silva et al. 2015, Pereira-Silva et al. 2016, Souza et al. 2016), although they have been limited in scope and have not covered the entire northeastern region. *Dalechampia* diversity in northeastern Brazil is relevant, being the third highest richest region of the country (28 spp.), behind only the southeast (34 spp.) and central-west (30 spp.). Additionally, the northeastern region holds three of the four ecosystems with high representivities for the genus (Atlantic Forest, Cerrado, and Caatinga). Bahia, the state with the highest recorded number of *Dalechampia* species in Brazil, is inserted in that region. At least six new occurrences (*D. fernandesii* Webster, *D. armbrusteri* Webster, *D. viridissima* Webster, *D. allemi* Webster, *D. purpurata* Cordeiro, and *D. erythrostyle* R. A. Pereira-Silva & A. L. Melo) have been discovered in Bahia in recent decades (as well as *D. erythrostyle* in Pernambuco State, also in the northeast). As such, the present work updates the geographical distribution of *Dalechampia* in northeastern Brazil, reports three new occurrences for that country, and provides a key to the identification of all of its species, with illustrations and comments on the different taxa.

Materials and Methods

Northeastern Brazil comprises nine states (Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, and Sergipe), and covers an area of more than 1,500,000 Km², equivalent to approximately 20% of the area the country (IBGE 2004).

The main geological features found in the northeastern region are Great Depressions (e.g., the mid-São Francisco depression), interspersed with plateaus and other mountain ranges with elevations often above 800 m a.s.l. (e.g., Chapada do Araripe, Chapada do Apodi, and Chapada Diamantina). The phytophysiognomies there reflect the different environmental conditions in those distinct geomorphological regions – being principally Caatinga (a low, deciduous, thorny vegetation), Cerrado (neotropical savanna, characterized by low woody and herbaceous plants, and small trees having thick bark), and Atlantic Forest (characterized by tall perennial and broad-leaved plants) (Queiroz 2009).

The regional climate in northeastern Brazil is semiarid (BSh), with mean annual temperatures between 23 and 27 °C, mean annual rainfall levels of less than 800 mm,

and relative humidity of 50% (EMBRAPA 1993). The most frequently occurring soils in the region are: Argisols, Latosols, Neosols, Litholic, Quartzeneic Neosols, Planosols, and Vertisols (Cunha et al. 2010).

Periodic field excursions were undertaken since 2015 until 2018 to observe natural populations and make botanical collections, following the methodology described by Mori et al. (1989). The collected materials, after processing, were deposited in the Professor Vasconcelos Sobrinho Herbarium (PEUFR) of the Federal Rural University of Pernambuco.

The identifications of the taxa were based mainly on Webster & Armbruster (1991). Exsiccates from the following herbaria were examined to analyze intraspecific morphological variations: ASE, BHCB, CEN, CEPEC, CESJ, DAV, ESA, FURB, G, HBR, HRCB, HST, HUEFS, HVASF, IAN, IBGE, INPA, IPA, K, M, MAC, MBML, NY, P, PEUFR, R, RB, S, SJRP, SP, SPF, TEPB, UB, UCR, UEC, UPCB, W (acronyms according to Thiers 2017). The standardization of vegetative and reproductive structural terminology was based on Radford (1974) and Webster & Armbruster (1991). Comments on geographic distributions, habitats, and phenological data were based on field collections, information available in the literature, and exsiccate labels.

Maps with the geographic distributions of the species were prepared using QGIS® 2.18 software, based on the geographic coordinates provided on the herbarium labels. When geographical coordinates were not noted on the those labels, georeferencing was based on the GeoLoc tool of the speciesLink network (<http://splink.cria.org.br/tools>).

Conservation status assessments were primarily based on EOO (the extent of occurrence) and AOO (area of occupancy), using the Geocat web tool (<http://geocat.kew.org/>), following Bachman et al. (2011). Conservation statuses were subsequently determined based on criterion “B1” proposed by the IUCN red list, Version 3.1 (IUCN 2001).

Results and Discussion

Twenty-nine species of *Dalechampia* were recorded for northeastern Brazil: *D. affinis* Mull. Arg., *D. alata* Mull. Arg., *D. allemii* Webster, *D. arciana* Baill., *D. armbrusteri* Webster, *D. brasiliensis* Lam., *D. convolvuloides* Lam., *D. coriacea* Klotzsch ex Müll. Arg., *D. cujabensis* Mart. ex Baill., *D. erythrostyla* R. A. Pereira-Silva & A. L. Melo, *D. fernandesii* Webster, *D. ficifolia* Lam., *D. ilheotica* Wawra, *D. leandrii* Baill., *D. linearis* Baill., *D. olfersiana* Müll. Arg., *D. peckoltiana* Müll. Arg., *D. pentaphylla* Lam., *D. pernambucensis* Baill., *D. purpurata* Cordeiro, *D. scandens* L., *D. schenckiana* Pax & K. Hoffm., *D. stipulacea* Mull. Arg., *D. subintegra* Müll. Arg., *D. sylvatica* S. Moore, *D. tiliifolia* Lam., *D. triphylla* Lam., and *D. viridissima* Webster.

Webster & Armbruster (1991) proposed the most complete and comprehensive taxonomic revision of the Neotropical species of *Dalechampia*, with 92 clearly defined species arranged into six sections: *D. sect. Coriaceae* Pax & K. Hoffm., *D. sect. Cremophyllum* Baill., *D. sect. Dalechampia*, *D. sect. Dioscoreifoliae* Pax & K. Hoffm., *D. sect. Rhopalostylis* Pax & K. Hoffm., and *D. sect. Tiliifoliae* G.L. Webster & Armbruster; Armbruster (1994) subsequently updated this number to almost 120 species. Considering the species identified in northeastern Brazil, five (*Coriaceae*, *Dalechampia*, *Dioscoreifoliae*, *Tiliifoliae*, and *Triphyllae*) of the six sections are represented (Table 1).

Six new species occurrences were identified, five in northeastern Brazil and one in the southeast (Figure 1). *Dalechampia erythrostyla* is reported here for the first time for Sergipe State, *D. leandrii* for Paraíba State, *D. pernambucensis* for Piauí State, *D. affinis* and *D. linearis* for Bahia State, and *D. allemii* for Minas Gerais (southeast).

In terms of the distributions of the northeastern species, most were observed to occur in Bahia (25 spp.), followed by Pernambuco (16 spp.) and Sergipe (9 spp.). Most species occur in Atlantic Forest phytophysiognomies (coastal and montane vegetations), and preferably in sunny areas (such as forest fragment edges). In Bahia, the species preferentially occur in ecotone areas of seasonal, caatinga, and cerrado forests.

Dalechampia L., Sp. Pl. 2: 1054. 1753.

Type: *Dalechampia scandens* L.

Vine, liana or subshrub, monoecious, branches with tector trichomes, usually stinging hairs. Leaves alternate, simple or compound, with petiolar stipules, and stipels

at the base of leaf blade; leaves entire, 3–5-lobed or 3–5-foliolate, cordiform, linear, ovate, lanceolate, margins entire, slightly serrated, sinuate, serrulate or dentate, usually with glands, sometimes with stipitate glandular trichomes. Pseudanthium axillary, rarely terminal, bisexual, with 2 pairs of bracteal stipules, 2 involucre bracts; staminate pleiochasium and pistillate cymule centrally located; resiniferous glands formed by a set of bracteoles, located next to the staminate pleiochasium. Involucre bracts entire to lobed, usually not unguiculate, magenta, yellowish, greenish or whitish. Staminate pleiochasium with 6–16 flowers, enveloped by 1–5 bracteoles. Staminate flowers apetalous, pedicelate; sepals 4–6, free, lanceolate; stamens 4–100, filaments united in a column, anthers showing longitudinal dehiscence. Pistillate cymule with 3 flowers; bracteoles 1–4. Pistillate flowers apetalous, pedicelate; sepals 6–12, free, lanceolate or ovate, entire, pinnatifid or laciniate; globose ovary, 3-locular, 3-carpelar, 1 ovule per locule; cylindrical stylar column, stigma lobed, crateriform, clavate, discoid, cylindrical to peltate. Capsule with persistent stylar column, sepals, and involucre bracts. Seeds usually globose, smooth or rugose, ecarunculate.

Identification key to species of *Dalechampia* in northeastern Brazil

1. Subshrub; staminate bracteoles and sepals reddish.....15. *D. linearis*
1. Liana or vine; staminate bracteoles greenish, sepals pinkish or greenish.....2
2. Involucre bracts magenta.....3
3. Leaf 3-foliolate, petiolar stipule and staminate bracteole vinaceous; pistillate sepals pink.....21. *D. purpurata*
3. Leaf entire to 3-lobed, petiolar stipule and staminate bracteole greenish; pistillate sepals greenish.....9. *D. cujabensis*
2. Involucre bracts greenish, whitish or yellowish.....4
4. Involucre bracts superficially 3-lobed.....5
5. Leaves exclusively 3-lobed; apex of the stigma 3-lobed.....5. *D. armbrusteri*
5. Leaves varying between entire to 3-lobed; apex of the stigma crateriform or discoid to peltate.....6
6. Branches tomentose; apex of the stigma discoid to peltate; resiniferous gland fimbriate.....27. *D. tiliifolia*
6. Branches pubescent; apex of the stigma crateriform, resiniferous gland lacerate.....13. *D. ilheutica*

4. Involucral bracts deeply 3-5 lobed.....7
7. Leaves 5-lobed; involucral bracts exclusively 3-lobed; pistillate sepals 10–12.....8
8. Branches greenish; pistillate sepals laciniate; upper half of the stylar column greenish after pollination; stigma clavate.....2. *D. alata*
8. Branches vinaceous; pistillate sepals pinnatifid; upper half of the stylar column reddish after pollination, stigma lobate.....10. *D. erythrostyla*
7. Leaves compound, 5-foliolate; involucral bracts ranging from deeply 3–5-lobed; pistillate sepals 6.....9
9. Staminate bracteole free, fimbriate, with resin gland.....10
10. Leaf 5-foliolate.....19. *D. pentaphylla*
10. Leaf 3-foliolate.....11
11. Stigma slender.....25. *D. subintegra*
11. Stigma cylindrical or moderately lobed.....12
12. Pseudanthium 7–9 cm long; involucral bracts greenish to yellowish, stigma moderately lobed.....26. *D. sylvatica*
12. Pseudanthium 5–7 cm long; involucral bracts albido-virides or whitish, stigma cylindrical.....13
13. Involucral bracts albido-virides; bracteal stipule 1–1.3 cm; ovary pubescent; stylar column glabrescent, 1.4–1.5 cm long; pistillate bracteole glabrous, ciliate.....18. *D. peckoltiana*
13. Involucral bracts whitish; bracteal stipule ca. 8 mm long; ovary vellutinos; stylar column pubescent, 1.2–1.3 cm long; pistillate bracteole pubescent, no ciliate.....16. *D. luetzelburgii*
9. Staminate bracteole connate at the base, laminar resin gland.....12
12. Involucral bract unguiculate, 0.7–1 cm wide; pistillate sepals 3-fid.....3. *D. allemii*
12. Involucral bract not unguiculate, 1.3–1.9 cm wide, pistillate sepals laciniate or pinnatifid.....13
13. Leaves compound, 3-foliolate.....14
14. Adaxial leaf face glabrous; apex of stigma slender to moderately lobed; sepals persistent on fruit, 3–4 mm wide.....27. *D. triphylla*
14. Adaxial leaf face sparsely hispidous; apex of stigma discoid; sepals persistent on fruit, 1–2 mm wide17. *D. olfersiana*

13. Leaves simple, entire or lobed.....15
15. Leaves entire.....16
16. Leaves ovate, margin sinuate, apex rounded, slightly apiculate.....4. *D. arciana*
16. Leaves cordiform, margin entire, apex acute, not apiculate.....17
17. Leaves coriaceous.....8. *D. coriacea*
17. Leaves membranaceous.....18
18. Involucral bracts with 9 primary veins; ovary hispidous.....1. *D. affinis*
18. Involucral bracts with 3–5 primary veins; ovary pubescent.....19
19. Leaves cordiform; apex of the stylar column discoid.....7. *D. convolvuloides*
19. Leaves lanceolate to ovate, apex of stylar column discretely crateriform to moderately lobed.....20
20. Branches and veins on the adaxial face of the leaves hirsute; pistillate sepals lacinate.....14. *D. leandrii*
20. Branches densely villous, and veins on the abaxial side of the leaves pubescent; pistillate sepals pinnatifid.....23. *D. schenckiana*
15. Leaves 3-lobed.....21
21. Pistillate sepals 6–7.....28. *D. viridissima*
21. Pistillate sepals 8–12.....22
22. Parastipule present on the petiolar stipule.....4. *D. stipulacea*
22. Parastipule absent on the petiolar stipule23
23. Involucral bracts chartaceous.....24
24. Involucral bracts whitish to greenish, margins with glandular trichomes, bracteal stipule deltoid.....20. *D. pernambucensis*
24. Involucral bracts yellowish, margins without glandular trichomes, bracteal stipule linear.....11. *D. fernandesii*
23. Involucral bracts membranaceous.....25
25. Bracteal stipule oblong, ferruginous, velutinous.....12. *D. ficifolia*
25. Bracteal stipule linear or lanceolate, greenish, pubescent.....26
26. Bracteal stipule lanceolate; stigma slightly crateriform.....22. *D. scandens*
26. Bracteal stipule linear; stigma slightly lobed.....6. *D. brasiliensis*

1. *Dalechampia affinis* Müll. Arg. Linnaea 34: 223. 1865. Lectotype (designated by Webster & Armbruster 1991): French Guyana, La Mana, 1856, *P.A. Sagot s.n.* (G!, isoelectotype P! 2 sheets). Figure 2a & 8a.

Dalechampia affinis is distinguished by having pistillate cymule sessile, pistillate bracteole widely ovate, pistillate sepals, ovary hispidous, stigma peltate, and a discoid stylar column. It can be confused with *D. convolvuloides*, as they share cordate leaves and pinnatifid sepals. They can be differentiated, however, by the numbers of veins (nine in *D. affinis* vs. three to five in *D. convolvuloides*), ovary hispid (vs. pubescent)

Distribution, ecology, and conservation: *Dalechampia affinis* occurs in South America from Venezuela to Brazil in rainforest environments (Webster & Armbruster 1991). In Brazil, it is found in the northern (Amazonas, Amapá, Pará, Rondônia states), southeastern (Minas Gerais), and northeastern regions (Flora do Brasil, under construction 2020). In the northeast, it has been recorded in the states of Maranhão and Piauí in gallery forests. A new occurrence is recorded here for Bahia in an Atlantic Forest environment. The species is designated, using IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 97,000 km², and as endangered (EN) due to its AOO of 16,000 km².

Material examined: BRAZIL, BAHIA: Salvador, 12°58'S, 38°30'W, 18.VII.1951, fl., O. Travassos 206 (RB). PIAUÍ: Piripiri, Estrada para Pedro II, 4°20'S, 41°46'W, 05.IV.2002, R.S. Rodrigues 1488 (TEPB). MARANHÃO: Viana, 03°13'S, 45°00'W, I.1960, fl., fr., O. Carvalho s.n. (RB 105148).

Additional material examined: BRAZIL, PARÁ: Jacundá, Rio Tocantins, 4°26'S, 49°6'W, 16.V.1978, fl., M.G. Silva & R. Bahia 3591 (UB); Oriximiná, Cachoeira Porteira, 1°45'S, 55°51'W, V.1981, fl., fr., C. Davidson s.n. (UB 117738). AMAPÁ: Macapá, Rodovia JK 2 km, Cerrado do campus Marco Zero da UNIFAP, 0°2'N, 51°4'W, 19.VI.2015, fl., R.S.F.R. Sarquis 274 (IAN).

2. *Dalechampia alata* Müll.Arg. Linnaea 34: 220. 1865. Lectotype (designated by Webster & Armbruster 1991): Brazil, Rio de Janeiro, Tocaia, Schott 4198 (W!). Figure 2b & 8b.

Dalechampia alata was distinguished from other congeners by having a cuneate foliole base, lacinate pistillate sepals, and stigma clavate. It resembles *D. erythrostyla*, as both have parted leaves, 5-lobed, but are differentiated by the shape of the pistillate sepals (lacinate in *D. alata* vs. pinnatifid in *D. erythrostyla*) and by the shape of the stigma (clavate in *D. alata* vs. slightly lobed in *D. erythrostyla*).

Distribution, ecology, and conservation: *Dalechampia alata* is endemic to Brazil, having been recorded in the southeastern (Rio de Janeiro and São Paulo) and northeastern regions of that country (Flora do Brasil 2020, under construction). In the study area, it is recorded for Bahia and Pernambuco, occurring in the caatinga and Atlantic Forests. *Dalechampia alata* is designated as of least concern (LC) considering its EOO of ca. 99,300 km², and as endangered (EN) due to its AOO of 28,000 km² (IUCN 2001).

Material examined: BRAZIL, PERNAMBUCO: São Lourenço da Mata, Tapera, 8°0'S, 35°1'W, 06.III.1925, fl., D.B. Pickel 886 (IPA). BAHIA: Maracás, 13°26'S, 40°25'W, 05.V.1979, fr., S.A. Mori & T.S. Santos s.n. (CEPEC 16131).

3. *Dalechampia allemii* Webster, Ann. Missouri Bot. Gard. 78: 255-257. 1991.

Holotype: Brazil, Bahia, Andaraí, 50 km NW of Andaraí, A.C. Allem, G.L. Webster & W.L. Werneck 2980 (CEN, isotype DAV!). Figure 2c & 8c

Dalechampia allemii is easily differentiated from other congeners by having 3-foliolate leaves, unguiculate involucre bracts, and 3-fid pistillate sepals.

Distribution, ecology, and conservation: *D. allemii* is endemic to Brazil, and currently considered exclusive to Bahia (northeastern region), where it is found growing in Caatinga vegetation (Webster & Armbruster 1991). We have expanded the amplitude of its distribution, however, with a new record here for Minas Gerais State (southeast) in a semideciduous montane forest. According IUCN criteria (2001), the species is designated as endangered (EN) by having an EOO of ca. 4,500 km², and as endangered (EN) due to its AOO of 16,000 km² (IUCN 2001). Part of the area in which the species occurs is located within the Morro do Chapéu State Park.

Material examined: BRAZIL, BAHIA: Wagner, 12°16'S, 41°10'W, 15.XI.1984, fl., A.C. Allem et al. 2980 (CEN).

Additional material examined: BRAZIL, MINAS GERAIS: Jequeri, área de inundação da usina de providência, 20°27'S, 42°39'W, 19.XI.1997, fl., A. Salino 3752 (BHCB).

4. *Dalechampia arciana* Baill. Adansonia 5: 314. 1865. Lectotype: Brazil, Bahia, Jacobina, Pouço d'Areia, J.S. Blanchet 3884 (P!, isoelectotypes BM!, G! 3 sheets, G-DC!, UC!). Figure 2d & 8d.

Dalechampia arciana can be distinguished from other species in the group by having leaves chartaceous, ovate, with base subcordate to rounded, apex rounded, an involucre bract, and pistillate sepals entire.

Distribution, ecology, and conservation: The species is endemic to Brazil and can be found in the southeastern (Rio de Janeiro) and northeastern regions of that country (Flora do Brasil 2020, under construction). In the northeast, it is found only in Bahia State in caatinga environments. The species is designated, according IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 69,000 km², and as endangered (EN) due to its AOO of 24,000 km². The area of occurrence of *Dalechampia arciana* includes three protected areas in southern Bahia: the Descobrimento National Park, Pau Brasil National Park, and the Una Wildlife Refuge.

Material examined: BRAZIL, BAHIA: Prado, Fazenda Riacho das Ostras, 17°19'S, 39°13'W, 28.XI.2006, fl., S.G. Resende & E.G. Resende 1699 (BHCB).

5. *Dalechampia armbrusteri* Webster, Brittonia 41:3. 1989. Holotype: Brazil, Bahia, grounds of CEPLAC, *G.L. Webster & S. Armbruster 25000* (CEPEC!, isotype DAV!). Figure 2e & 8e.

Dalechampia armbrusteri can be recognized by its 3-lobed, chartaceous leaves and obtuse to rounded base of involucre bracts. It can be confused, however, with *D. ilheotica* for sharing 3-cuspidate involucre bracts, velutinous, and 7–9 primary veins. Additionally, both were described from the same locality (Ilhéus, in Bahia State). *D. armbrusteri*, however, as monomorphic leaves (vs. dimorphic in *D. ilheotica*) and a 3-lobed stigma (vs. crateriform). *D. armbrusteri* also resembles *D. viridissima* as both share 3-lobed leaves; they can be differentiated by the velutinous abaxial leaf faces and 3-fid involucre bracts of *D. armbrusteri* (vs. glabrous leaves and 3-lobed involucre bracts in *D. viridissima*).

Distribution, ecology, and conservation: *Dalechampia armbrusteri* is endemic to Brazil, with records for the southeastern (Espírito Santo State) (Flora do Brasil 2020, under construction) and northeastern (Bahia) regions of that country, growing in ombrophilous forest environments.

Material examined: BRAZIL. BAHIA: Una, Serra Boa, 15°17'S, 39°4'W, 28.IX.1979, fl., J.L. Hage & L.A.M. Silva 317 (CEPEC).

6. *Dalechampia brasiliensis* Lam., Encycl. 2: 258. 1786. Lectotype (designated by Webster & Armbruster 1991): Brazil, Rio de Janeiro, *J. Dombey s.n.* (P!, isotype NY!). Figure 3a & 8f.

Dalechampia brasiliensis can be easily recognized by its linear bracteal stipules and pale green involucral bracts. The species has morphological affinities with both *D. scandens* and *D. pernambucensis* as they share 3-lobed leaves and pinnatifid pistillate sepals. They can be easily differentiated, however, by the shapes of their bracteal stipules, being linear in *D. brasiliensis* (vs. lanceolate in *D. scandens*, and deltoid in *D. pernambucensis*) and by the slightly lobed stigma in *D. brasiliensis* (vs. slightly crateriform in *D. scandens*, and peltate to discoid in *D. pernambucensis*).

Distribution, ecology, and conservation: *Dalechampia brasiliensis* is endemic to Brazil, growing in evergreen and seasonal forests (Webster & Armbruster 1991). According to Flora do Brasil (2020, under construction), the species is widely disseminated in the central-western (Mato Grosso do Sul and Mato Grosso states), southeastern (Espírito Santo, Minas Gerais, Rio de Janeiro and São Paulo), and northeastern regions of the country. *D. brasiliensis* is found in the states of Alagoas, Bahia, Ceará, Paraíba, Pernambuco, and Sergipe, growing in Caatinga and Atlantic Forest environments. The species is designated, according to IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 661,600 km², and endangered (EN) due to its AOO of 316,000 km². *D. brasiliensis* occurs in protected areas in northeastern Brazil, such as: the Chapada Diamantina National Park, Morro do Chapéu State Park, and the Raso da Catarina Ecological Station (all in Bahia), and in part of the Serra da Capivara National Park (Piauí State).

Material examined: BRAZIL, ALAGOAS: Matriz de Camaragibe, Santuário ecológico da Serra d'água, 9°5'S, 35°34'W, 26.VII.2003, fl., fr., R.P. Lyra-Lemos et al. 7805 (MAC). BAHIA: Senhor do Bonfim, Serra da Jacobina, 10°27'S, 40°11'W, 29.VII.2005, fl., V.J. Santos et al. 448 (HUEFS); Iaçú, 12°43'S, 39°52'W, 12.III.1985, fl., fr., L.R. Noblick 3565 (HUEFS). CEARÁ: Crato, Lameiro, 7°24'S, 39°41'W, 10.I.1982, fl., fr., A.L. Peixoto & O.L. Peixoto 1657 (UEC). PARAÍBA: Coremas, Área de tensão ecológica, próximo a Serra, 07°00'S, 37°56'W, 20.I.2010, fl., J.R. Andrade et al. 240 (PEUFR). PERNAMBUCO: Quipapá, Mata da Usina Água Branca, 8°49'S, 36°0'W, 10.I.1994, fl., A.M. Miranda 1170 (PEUFR). SERGIPE: Capela, RVS Mata do Junco, 10°32'S, 37°03'W, 30.IV.2013, fl, fr., L.A. Gomes et al. 1039 (ASE).

Additional material examined: BRAZIL, MINAS GERAIS: Itacarambi,

15°3'S, 44°8'W, 30.I.2010, fl., fr., E. Tameirão Neto & C. Vidal 4756 (BHCB).

7. *Dalechampia convolvuloides* Lam., Encycl. 2: 256.1786. Holotype: Brazil, *J. Dombey s.n.* (P!). Figure 3b & 8g.

Dalechampia convolvuloides can be recognized by having petiolar stipules sparsely hispid, involucre bracts entire, ciliated, with cordate bases, bracteal stipules ovate with obtuse bases, and ovary pubescent. It resembles *D. affinis*, but can be distinguished from it by characters discussed above in the comments concerning that species.

Distribution, ecology, and conservation: *Dalechampia convolvuloides* is restricted to Brazil where it can be found in northern (Acre, Rondônia), southeastern (Minas Gerais, Rio de Janeiro and São Paulo), and northeastern regions of that country (Flora do Brasil 2020, under construction). In the study area, the states of Bahia, Pernambuco, Sergipe, and Piauí are largely covered by Caatinga and Atlantic Forest vegetations. The species is designated, according IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 587,000 km², and as endangered (EN) due to its AOO of 68,000 km². *D. convolvuloides* occurs in the Raso do Catarina Ecological Station (Bahia), Catimbau National Park (Pernambuco), Serra da Capivara National Park (Piauí), and the Araripe-Apodi National Forest (Ceará).

Material examined: BRAZIL, BAHIA: Salvador, Dunas de Itapuã, 12°56'S, 38°21'W, 12.XII.1985, fl., L.R. Noblick & I.C. Britto 4484 (HUEFS). PERNAMBUCO: Buíque, PARNA Catimbáu, 8°34'S, 37°15'W, 25.XI.2007, fl., B.S. Amorim & A. Melo 2373 (NY). PIAUÍ: Teresina, Pq. Zoobotânico, 5°5'S, 42°48'W, 03.02.1999, fl., F.S. Santos Filho 10 (PEUFR). SERGIPE: Mata do Crasto, Santa Luzia do Itanhy, 11°22'S, 37°25'W, 15.IX.1995, M.F. Landim 659 (HUEFS).

Additional material examined: BRAZIL, ESPÍRITO SANTO: Santa Teresa, Estrada para o Cruzeiro, 19°56'S, 40°35'W, 8.V.1984, fl., fr., R.M. Piziolo 52 (MBML); Santa Teresa, Estrada para o Canaã, 19°55'S, 40°37'W, 04.XII.1985, fl., J.M. Vimercat 322 (MBML). MINAS GERAIS: Santo Hipólito, 18°17'S, 44°11'W, 24.III.1997, fl., R.M. Silva et al. 1300 (BHCB).

8. *Dalechampia coriacea* Klotzsch ex Müll. Arg., Linnaea, 35: 223. 1865. Lectotype (designated by Webster & Armbruster 1991): Brazil, without locality, *F. Sellow s.n.* (G!, isoelectotype P!, W!) Figure 3c & 8h.

Dalechampia coriacea can be recognized by having coriaceous leaves with dentate margins, entire bracts, and pistillate sepals glabrous. It is morphologically similar to *D. ilheotica* in terms of the coriaceous consistency of their leaves, and *D. coriacea* can sometimes have entire leaves (similar to those of *D. ilheotica*). They can be differentiated, however, by having pubescent branches (vs. sparsely villous in *D. ilheotica*), lanceolate bracteal stipules (vs. linear), and a discoid stigma (vs. crateriform).

Distribution, ecology, and conservation: *D. coriacea* is endemic to Brazil (Webster & Armbruster 1991), with records only for the northeastern region (Bahia and Pernambuco), being found in Caatinga and Ombrophilous Forest environments. According to IUCN (2001) criteria, the species is classified as of least concern (LC) due to its EOO of ca. 737,000 km², and as endangered (EN) due to its AOO of 144,000 km². Populations of this species can be found within the Serra das Confusões and Serra da Capivara National Parks (Piauí), the Araripe-Apodi National Forest (Ceará), the Catimbau National Park (Pernambuco), the Murici Ecological Station (Alagoas), the Raso do Catarina Ecological Station, Sete Passagens State Park, Morro do Chapéu State Park, and the Chapada Diamantina National Park (Bahia).

Material examined: BRAZIL, BAHIA: Itiruçu, 13°31'S, 40°9'W, 12.XI.1984, fl., A.C. Allem & W.L. Werneck 2949 (CEN); Santa Terezinha, Serra da Jibóia, 12°46'S, 39°31'W, 08.VII.1999, F. França et al. 3201 (CEN). PERNAMBUCO: Igarassu, Usina São José, 7°46'S, 35°00'W, 1.XII.2011, fl., fr., B.S. Amorim et al. 1309 (NY).

9. *Dalechampia cujabensis* Müll. Arg. *Linnaea* 34: 222. 1865. Lectotype (designated by Webster & Armbruster 191): Brazil, Mato Grosso, Cuiabá, *Manso in Herb. Martius* 845 (G!, isoelectotypes HAL!, M!, NY!, P!, W!). Figure 3 d & 8i.

Dalechampia cujabensis differs from other species of *Dalechampia* in northeastern Brazil by having cordate leaves, pistillate sepals lacinate, fimbriate resin glands, and a clavate stigma.

Distribution, ecology, and conservation: *D. cujabensis* is endemic to Brazil and restricted to the states of Mato Grosso do Sul (central-west) and Alagoas (northeast) (Flora do Brasil 2020, under construction). In Alagoas, it has been recorded in areas of Atlantic Forest. The species can be considered as Critically Endangered (CR), according to the IUCN (2001) criteria, due to its AOO of only 4,000 km².

Material examined: BRAZIL, ALAGOAS: Barra de São Miguel, 9°50'S,

35°31'W, 04.III.1982, R.P.L. Lemos 417 (MAC).

Additional material examined: BRAZIL, MATO GROSSO: Acampamento da base da expedição, 12°49'S, 51°46'W, 12.XI.1968, fl., fr., R.M. Harley & R. Souza 11057 (UB); Nobres, Parque Estadual do Cuiabá, 14°34'S, 56°20'W, 10.I.2005, fl., M.F. Simon 560 (UB); Cáceres, 16°0'S, 57°40'W, 13.II.1978, fl., fr., A. Allem & G. Vieira 1704 (CEN).

10. *Dalechampia erythrostyla* R. A. Pereira-Silva & A. L. Melo, Syst. Bot. 41: 989–995. 2016. Holotype: Brazil, Pernambuco, Tracunhaém, engenho Trapuá, 27 May 2014, R. Pereira-Silva & A. Laurênio 16 (IPA!, isotypes K!, NY!, P!, PEUFR!, RB!, SP!). Figure 3e & 9a.

Dalechampia erythrostyla can be recognized by having branches vinaceous, pistillate pinnatifid sepals, involucre bracts cuneate, resiniferous glands fimbriate, a reddish coloration on the upper half of the stigma following pollination, and cylindrical stigma. The taxon is often confused with *D. alata*, but can be differentiated by aspects discussed above in the comments on that species.

Distribution, ecology, and conservation: *D. erythrostyla* is currently known only to Brazil, in the states of Bahia, Pernambuco, and Sergipe in the northeast region of that country (Pereira-Silva et al. 2016). The record for Sergipe is presented here for the first time. *D. erythrostyla* was found in those areas in the Atlantic Forest and at the edges of sub-deciduous forests. The species was considered critically endangered (CR) by Pereira-Silva et al. (2016) due to its extent of occurrence of less than 100 km².

Material examined: BRAZIL, PERNAMBUCO: Tracunhaém, Engenho Trapuá, 7°48'S, 35°14'W, 1.II.2014, fl., R.A. Pereira-Silva & A. Laurênio 12 (PEUFR); idem, 13.II.2014, fl., R. A.Pereira-Silva 14 (PEUFR); idem, 27.V.2014, fr., R. A.Pereira-Silva & L. Lima-Santos 16 (PEUFR); idem, 27.VI.2014, fl., fr., R.A. Pereira-Silva 18 (PEUFR). BAHIA: Jacobina, 11°10'S, 40°30'W, 25.VIII.1980, fl., Orlandi, R. 219 (HBR). SERGIPE: Divina Pastora, Fazenda Vassouras, 10°40'S, 37°9'W, 18.XI.2014, fl., J.A. Santana Júnior, et al. 41 (ESA).

11. *Dalechampia fernandesii* Webster, Brittonia 41:1. 1989. Holotype: Brazil, Ceará, Chapada da Ibiapaba, G.L. Webster, Fernandes & Matos 25598 (EAC!, isotypes DAV!, NY, R, UCR!). Figure 3f & 9b.

Dalechampia fernandesii can be distinguished from other congeners by having

3-lobed leaves, bracteal stipules linear and yellowish, involucre bracts entire, and a peltate discoid stigma.

Distribution, ecology, and conservation: *D. fernandesii* is endemic to Brazil, being encountered only in the northeastern region of that country (the states of Ceará, Maranhão, and Piauí) in Caatinga vegetation. The species is categorized, according to IUCN (2001) criteria, as vulnerable (VU) due to its EOO of ca. 6,200 km², and as endangered (EN) due to its AOO of 12,000 km². One of its known populations occurs in the vicinity of the Aiuaba Ecological Station in Ceará state.

Material examined: BRAZIL, CEARÁ: Aracati, 4°33'S, 37°46'W, 30.V.1987, A. Fernandes & A. Nunes s.n. (EAC 15262); Jaburuna-Sul, Planalto do Iapaba-Ubajara, 3°53'S, 40°58'W, 06.VI.1994, F.S. Araújo 807 (EAC); Tianguá, Chapada da Ibiapara, 03°43' S, 40°59'W 01.XI.1986, fl., G.L. Webster et al. s.n. (EAC 14892). MARANHÃO: Timon, 05°05'S, 42°50'W, 29.IV.1978, fl., A. M. Fernandes & E. Matos s.n. (EAC 3832). PIAUÍ: Between Parnaíba and Piracuruca, 2°54'S, 41°46'W, 28.VI.1984, A. M. Fernandes & E. Matos s.n. (EAC 12725).

12. *Dalechampia ficifolia* Lam., Encycl. 2: 258.1786. Holotype: Brazil, without locality, *J. Dombey* s.n. (P!). Figure 4a & 9c.

Dalechampia ficifolia is characterized by having oblong bracteal stipules, ferruginous, velutinous, and a 3-lobed to clavate stylar column. The species is similar to *D. stipulacea*, but can be differentiated from it by aspects cited above concerning the latter species.

Distribution, ecology, and conservation: *D. ficifolia* is considered endemic to Brazil, although widely disseminated in all of its regions, growing predominantly in rainforest areas (Webster & Armbruster 1991). It is encountered in the central-western (Distrito Federal, Goiás), southeastern (Espírito Santo, Minas Gerais, Rio de Janeiro, and São Paulo), and southern (Paraná and Santa Catarina) regions of the country (Flora do Brasil 2020, under construction). It is found in Bahia, Pernambuco, and Sergipe in ecotone areas between forest and Caatinga zones. The species is designated, according to IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 1,000,000 km², and as endangered (EN) due to its AOO of 228,000 km². One of its populations has been recorded in the Chapada Diamantina National Park (Bahia); the extent of occurrence of the species includes several protected areas, such as: the Araripe-Apodi National Forest

(Ceará), Catimbau National Park (Pernambuco), Raso do Catarina Ecological Station, Morro do Chapéu State Park, the Brejo Grande Ecological Reserve (Bahia), Serra das Confusões National Park, and the Serra da Capivara National Park (Piauí)

Material examined: BRAZIL, BAHIA: Santa Tereza, Serra da Jibóia, 12°51'S, 39°28'W, 01.XI.1992, L.P. Queiroz et al. 20891 (BHCB). PERNAMBUCO: São Vicente Férrer, Mata do Estado, 7°35'S, 35°30'W, 29.X.1984, E.M.N. Ferraz et al. 602 (PEUFR). SERGIPE: Mata do Crasto, Santa Luzia do Itanhý, 11°22'S, 37°25'W, 30.X.1995, fl., fr., M.F. Landim 750 (ASE).

Additional examined material: BRAZIL, SANTA CATARINA: Blumenau, 26°54'S, 49°4'W, 05.XII.2012, fl., L.A. Funez 1299 (FURB); Bairro Ristow, 21.X.2009, fl., A. Korte 669 (FURB). SÃO PAULO: Ubatuba, Acesso ao Condomínio Laranjeiras, 23°25'S, 45°5'W, 31.I.1996. fl., H.F. Leitão Filho et al. 34413 (UEC). MINAS GERAIS: Descoberto, reserva Biológica da Represa do Grama, 21°27'S, 42°58'W, 10.XI.2001, fl., J.O. Augustin et al. s.n. (CESJ 35081).

13. *Dalechampia ilheotica* Wawra, Oesterr. Bot. Z. 13: 222. 1863. Holotype: Brazil, Bahia, Ilhéus, *Wawra & Maly 365* (W!, isotype W!). Figure 4b & 9d

Dalechampia ilheotica resembles *D. coriacea* and *D. armbrusteri* by aspects already presented for those species. *D. ilheotica* is characterized by having simple leaves, ranging from entire to 3-lobed even on the same individual, and stigma apex crateriform.

Distribution, ecology, and conservation: *D. ilheotica* has been recorded for Colombia and Brazil. In Brazil, it has been collected in the southeastern (Espírito Santo) and northeastern (Bahia and Pernambuco) regions, growing in Atlantic Forest environments such as restinga (Webster & Armbruster 1991, Flora do Brasil 2020, under construction). It is found in ombrophilous forest and restinga environments in the states of Bahia and Pernambuco, and is designated, according IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 384,000 km², and as endangered (EN) due to its AOO of 200,000 km². The largest number of populations is found in Bahia, where the species is disseminated throughout the state, growing in the Cassurubá Extractive Reserve, the Una Wildlife Refuge, and Serra das Lontras National Park. Considering its extent of occurrence, however, it is probable that populations of *D. ilheotica* occur in other protected areas in Bahia, such as: the Pau Brasil National Park, Descobrimento National Park, Canavieiras Extractivist Reserve, Boa Nova National Park, Morro do

Chapéu Park State, Raso do Catarina Ecological Station, and the Chapada Diamantina National Park.

Material examined: BRAZIL, PERNAMBUCO: Maraial, 8°48'S, 35°45'W, 10.II.1994, fr., A.M. Lourenço 1317 (PEUFR); São Vicente Ferrer, 7°35'S, 35°29'W, 20.I.1999, fl. E. M. N. Ferraz et al. 602 (PEUFR). BAHIA: Uruçuca, Distrito de Serra Grande, 14° 35'S, 39° 17'W, 07.IX.1991, A.M. Carvalho et al. 3646 (SP).

14. *Dalechampia leandrii* Baill. *Adansonia* 5: 315. 1865. Lectotype (designated by Webster & Armbruster 1991): Brazil, Rio de Janeiro, *Leandro di Sacramento 110* (P!). Figure 4c & 9e.

Dalechampia leandrii can be recognized by having hirsute trichomes on its branches, the veins of the abaxial surface of leaf, and on the pistillate laciniate sepals; leaf margins undulate, and laminar resiniferous glands. It resembles *D. schenckiana* as they share entire leaves; they can be differentiated, however, by the hirsute branches of *D. leandrii* (vs. densely villous in *D. schenckiana*), laciniate sepals (vs. pinnatifid), and hirsute trichomes on the leaf veins (vs. pubescent).

Distribution, ecology, and conservation: *D. leandrii* is endemic to Brazil, being known from the southern (Paraná) and southeastern (Rio de Janeiro and São Paulo) regions of the country (Flora do Brasil 2020, under construction). It is cited here for the first time in the study area, occurring in Paraíba state. The species is designated, according IUCN (2001) criteria, as critically endangered (CR) due to its AOO of 4,000 km². A population of that species has been recorded in the Guaribas Biological Reserve (Paraíba State).

Material examined: BRAZIL, PARAÍBA: Mamanguape, Reserva ecológica Guaribas, 6°43'S, 35°8'W, 07.VII.2015, fl., R.A. Pereira-Silva, 32 (PEUFR).

Additional examined material: BRAZIL, SÃO PAULO: Pariquera-Açú, 24°42'S, 47°52'W, 16.II.1995, fl., H. F. Leitão Filho et al. 33192 (UEC); Estrada Pariquera-Açú para Cananéia, 24°42'S, 47°52'W, 07.II.1995, fl., H.F. Leitão Filho et al. 32727 (UEC). PARANÁ: Paranaguá, Morro do Meio, 25°30'S, 48°31'W, 13.XII.1986, fl., R.M. Britez 1257 (UPCB). RIO DE JANEIRO: Parque Nacional da Tijuca, 22°56'S, 43°17'W, 27.X.1984. fl., G.L. Webster et al. 25429 (UEC).

15. *Dalechampia linearis* Baill. *Adansonia* 5: 316-317. 1865. Lectotype (designated by Webster & Armbruster 1991): Brazil, Goiás, Rio Pilões, *St. Hilaire C¹ 801* (P!, isotype

P!). Figure 4d & 9f.

Dalechampia linearis can be distinguished from congeners by having a subshrub habit, simple and entire leaves, 3-lobed involucral bracts, lanceolate stipules, and a lobed stigma. This species can be confused with *D. caperonioides*, a species presently recorded for the central-western region of Brazil. *D. linearis*, however, has a 3-lobed, greenish to vinaceous bracteole (vs. entire, whitish, or pinkish in *D. caperonioides*), and 12 pistillate pinnatifid sepals (vs. 6 entire).

Distribution, ecology, and conservation: *D. linearis* has been recorded for Paraguay and Brazil. In Brazil, there are records for the northern (Pará and Tocantins), central-western (Distrito Federal, Goiás, and Mato Grosso), and northeastern regions (Flora do Brasil 2020, under construction). In the latter region, the species is found in the states of Maranhão and Piauí. It is recorded here, for the first time, for Bahia, with occurrences in both caatinga and cerrado vegetation. The species is designated, according IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 186,000 km², and as endangered (EN) due to its AOO of 40,000 km². None of the specimens analyzed came from protected areas in the two northeastern states. It is possible, however, that greater collection efforts will result in new findings in protected areas within the range of occurrence of the species, such as: the Parnaíba River National Park, the Uruçuí-Una Ecological Station, and the Serra das Confusões National Park (Piauí)

Material examined: BRAZIL, BAHIA: Cariparé, 11°30'S, 45°2'W, 17.XII.1987, fl., T.S. Figueiras 1289 (CEN). MARANHÃO: Balsas, 7°31'S, 46°2'W, 18.XI.1997, fl., R.C. Oliveira & G.P. da Silva 545 (CEN). PIAUÍ: Ribeiro Gonçalves, 7°32'S, 45°14'W, 17.X.1980, fl., A. Fernandes & A.J. Castro s.n. (EAC); Ribeiro Gonçalves, 7°32'S, 45°14'W, 10.XII.1980, fl., M.R. Del'Marco et al. s.n. (TEPB 1417).

Additional material examined: BRAZIL, GOIAS: Estrada em direção ao centro de Goiás, 15°55'S, 50°07'W, 30.XI.2011, fl., fr., R.F. Monteiro et al. 437 (CEN); Colinas do Sul, Niquelânia, 14°16'S, 48°09'W, 22.IV.2010, fl., J.E.Q. Faria et al. 835 (CEN). TOCANTINS: Almas, Estrada para Natividade, 11°37'S, 47°23'W, 22.VII.2000, V.C. Souza et al. 24514 (CEN); Itacajá, Reserva Indígena Krahó, Aldeia Pedra Branca, 08°18'S, 47°38'W, 06.V.2000, fl., A.A. Santos et al. 650 (CEN); Parana, 3° parada após a ponte sobre o Rio São Domingos, 12°55'S, 47°41'W, 28.III.2004, fl., A.C. Sevilha et al. 3906 (CEN).

16. *Dalechampia luetzelburgii* Pax & Hoffm., Pflanzenr. IV. 147. XVII (Heft 68): 188

1924. Lectotype (designated by Athiê-Souza et al. 2018). Brazil, Bahia, São Bento das Lages, 1913, *von Lützelburg 132* (M! M0233664, islectotype M! M0233665). Figure 5a & 9g.

Dalechampia luetzelburgii is characterized by having involucre bracts whitish; bracteal stipule ca. 8 mm long, ovary velutinous, stylar column pubescent, pistillate bracteole pubescent, not ciliate. *D. luetzelburgii* can be confused with *D. peckoltiana* as both have leaves 3-foliolate and involucre bracts deeply 3-lobed. They differ, however, by *D. luetzelburgii* having involucre bracts whitish (vs. albido-virides in *D. peckoltiana*), ovary velutinous (vs. pubescent), stylar column 1.2–1.3 cm long (vs. 1.4–1.5 cm long).

Distribution, ecology, and conservation: *D. luetzelburgii* has been recorded from the northern (Pará) and northeastern regions of Brazil (Flora do Brasil 2020, under construction); the species in the latter region (in the states of Bahia and Ceará) occur in Atlantic Forest environments. *D. luetzelburgii* is included in the category of least concern, as its EOO is ca. 304,600 km², and as endangered (EN) due to its AOO of 48,000 km². The species is found in protected conservation areas such as the Araripe National Forest (Ceará) and the Pau-Brasil Ecological Station (Bahia).

Material examined: BRAZIL. BAHIA: Santa Cruz Cabrália. Estação Ecológica do Pau-Brasil 7.V.1984, F.S. Santos 325 (CEPEC). CEARÁ. Crato, chapada do Araripe, 7°16'S, 39°32'W, 19.I.1983, fl., fr., T. Plowman 12736 (NY); Guaramiranga, Serra de Baturité, 09.VIII.1993. fl., M. R. L. Oliveira 59 (EAC). PARÁ. Rio Tocantins: nella foresta Capuera Roca presso Itacayuna 1.VII.1899. L. Buscalioni 3650 (NY).

17. *Dalechampia olfersiana* Müll. Arg., *Linnaea* 34: 280. 1865. Lectotype (designated by Webster & Armbruster 1991): Brazil, without locality, *F. Sellow 636 ex p.* (G!, islectotype F!). Figure 5b & 9h.

Dalechampia olfersiana is characterized by having compound leaves, 3-foliolate, pistillate sepals 7 to 8, pinnatifid, involucre bracts 1.3–1.5 × 1.3–1.8 cm, 3-lobed, green, with papilliform glands and a discoid stigma.

Distribution, ecology, and conservation: *D. olfersiana* is endemic to the southeastern (Minas Gerais, Rio de Janeiro, and São Paulo) and northeastern regions of Brazil (Flora do Brasil 2020, under construction). It occurs in the northeast in the states of Bahia and Pernambuco in caatinga, ombrophilous forest, semideciduous seasonal forest, and gallery forest environments. The species is designated, according to IUCN

(2001) criteria, as critically endangered (CR) due to its AOO of 8,000 km² (IUCN 2001).

Material examined: BRAZIL, BAHIA: Maracás, 13°31'S, 40°33'W, 22.IV.2002, fl., K.R.B Leite et al 212 (HUEFS). PERNAMBUCO: Brejo da Madre de Deus, 8°8'S, 36°22'W, 04.II.1995, M.J.N. Rodal et al. 456 (PEUFR).

Additional material examined: BRAZIL, MINAS GERAIS: Serra do Cipó, Santana do Riacho, 19°10'S, 43°42'W, 27.IV.1993, fr., J.A. Lombardi & F.R.N. Toledo 189 (BHCB).

18. *Dalechampia peckoltiana* Müll. Arg., in Martius, Fl. Bras. 11(2): 647. 1874.

Holotype: Brazil, Rio de Janeiro, Canta Gallo, *Peckolt 93* (M, isotypes BR!, G!). Figure 5c & 9i.

Dalechampia peckoltiana is distinguished by its pseudanthium with deeply 3-lobed, whitish, involucre bracts, deltoid to lanceolate bracteal stipules, and a cylindrical stigma. It demonstrates morphological similarities with *D. subintegra* by sharing 3-foliolate leaves and bracteal stipules deltoid to lanceolate; they can be differentiated by the cylindrical stigma of *D. peckoltiana* (vs. thin in *D. subintegra*). *D. peckoltiana* is also similar to *D. luetzelburgii* as both have similarly shaped leaves and involucre bracts; they can be distinguished by the characteristics noted in the comments above concerning *D. luetzelburgii*.

Distribution, ecology, and conservation: *D. peckoltiana* is endemic to Brazil, having originally been considered to be restricted to Rio de Janeiro (southeast) (Webster & Armbruster 1991). The species is currently known to the states of Espírito Santo and Minas Gerais (both in the southeastern region), and to the northeast (Flora do Brasil 2020, under construction). In the northeast, the species can be found in Alagoas, Bahia, Pernambuco, and Sergipe, in caatinga and ombrophilous forest environments. The species is designated, according to IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 305,000 km², and as endangered (EN) due to its AOO of 228,000 km² (IUCN 2001). Some populations occur in and around the Chapada Diamantina National Park (Bahia), and several populations have been recorded from the vicinity of the Sete Passagens State Park (Bahia). According to the geographic extension of the species, it is expected that some populations will be found in other protected areas in Bahia State, such as: the Canavieiras Extractivist Reserve, the Serras das Lontras National Park, and the Una Wildlife Refuge.

Material examined: BRAZIL, ALAGOAS: Coruripe, Usina Coruripe, Mata do Riachão, 10°02'S, 36°16'W, 04.XI.2002, fl., W.W. Thomas et al. s.n. (NY 13268). BAHIA: Jacobina, Itaitu, Cachoeira do Véu da Noiva, 11°10' S, 40°31'W, 24.IV.1999, fl., R.C. Forzza, A.M. Amorim & Sant'Ana 1337 (SP); Lençóis, Pai Inácio, 12°28'S, 41°27'W, 12.III.1997, P. Gasson & L. Natalino 6210 (SP). PERNAMBUCO: Tapera, 9°25'S, 40°45'W, 1936, fl., B. Pickel 4210 (IPA). SERGIPE: Nossa Senhora do Socorro, Floresta Nacional do Ibura, 10°83'S, 37°13'W, 02.X.2014, J.P. Santana 347 (ASE).

19. *Dalechampia pentaphylla* Lam. Encycl. Botanique 2: 258. 1786. Holotype: Brazil, probably near Rio de Janeiro, 1790, *Vandelli s.n.* (P). Figure 6a & 9j.

Dalechampia pentaphylla can be recognized by having compound leaves, 5-foliolate and deeply involucral bracts, 5-lobed, and six entire pistillate sepals. The species demonstrates morphological similarities with *D. alata* and *D. erythrostyla*. They can be easily differentiated, however, as *D. pentaphylla* has 5-foliolate compound leaves (vs. the pseudo-compound, deeply 5-lobed leaves of *D. alata* and *D. erythrostyla*), 5-lobed involucral bracts (vs. 3-lobed in *D. alata* and *D. erythrostyla*), and six entire pistillate sepals (vs. 12, 3–5-lobed sepals in *D. alata* and 12 pinnatifid sepals in *D. erythrostyla*).

Distribution, ecology, and conservation: *D. pentaphylla* is endemic to Brazil, occurring in the central-western (Goiás and Mato Grosso do Sul), southeastern (Espírito Santo, Minas Gerais, Rio de Janeiro, and São Paulo), southern (Paraná), and northeastern regions of that country (Flora do Brasil 2020, under construction). In the northeastern region, it only occurs in Bahia State, where it was found in transitional areas between seasonal caatinga and cerrado forests. The species is designated, according to IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 50,600 km², and as endangered (EN) due to its AOO of 28,000 km². Considering the geographic coverage of the species, individuals will probably be encountered in the Boa Nova National Park (Bahia).

Material examined: BRAZIL, BAHIA: Jaguaquara, Cascalheira, 13°31'S, 39°58'W, 13.X.2012, fl., W. Milliken et al. 5048 (HURB).

Additional examined material: BRAZIL, SÃO PAULO: São Pedro, Cachoeira da Peroba, 22°33'S, 47°55'W, 30.I.1992, fl., S. Gandolfi et al. s.n. (ESA 33223); Campinas, Santa Elisa, 22°55'S, 47°4'W, 15.IV.1992, fl., fr., J.A. Lombardi 15

(BHCB). ESPÍRITO SANTO: Alegre, Parque Nacional do Caparaó, 20°23'S, 41°44'W, 22.II.2000, fl., V.C. Souza et al. 23673 (ESA). MINAS GERAIS: Carandaí, Pedra do Sino Hotel Fazenda, 20°52'S, 43°48'W, 29.XII.2005, N.F.O. Mota & P.L. Viana 491 (ICB).

20. *Dalechampia pernambucensis* Baill., Adansonia 5: 311. 1865. Holotype: Brazil, Pernambuco, *G. Gardner 1130* (G!, isotypes BM, K! 2 sheets, P!). Figure 5d-e & 10a

Dalechampia pernambucensis is characterized by having deltoid bracteal stipules, involucre bracts that vary from whitish to greenish, with glandular trichomes on their margins, and the stylar column peltate to discoid. *D. pernambucensis* is commonly confused with *D. brasiliensis* and *D. scandens*, but can be differentiated by aspects already mentioned in the comments above concerning *D. brasiliensis*.

Distribution, ecology, and conservation: *D. pernambucensis* is endemic to Brazil, having been recorded in the northern (Amazonas, Pará, and Roraima) and northeastern regions of the country (Flora do Brasil 2020, under construction). In the northeastern region, *D. pernambucensis* can be found in Bahia, Ceará, Paraíba, and Pernambuco. In the study area, it has been identified in caatinga and Atlantic Forest vegetations. *Dalechampia pernambucensis* is considered of least concern (LC) due to its EOO of ca. 1,400,000 km², and as endangered (EN) due to its AOO of 312,000 km². Populations of this species are widely disseminated in the study region and have been recorded in the Araripe-Apodi National Forest and Aiuaba Ecological Station (Ceará). Taking into account the extent of expected occurrence of the species, populations may be encountered in other protected areas in the region (Catimbau National Park in Pernambuco, Raso do Catarina Ecological Station, Boa Nova National Park, Serras das Lontras National Park, and Una Wildlife Refuge in Bahia, and the Paraíba River National Park on the borders of the states of Piauí, Maranhão, Bahia, and Tocantins). In the study area, it was found here for the first time in Piauí state.

Material examined: BRAZIL, BAHIA: Caetitê, 14°03'S, 42°28'W, 19.II.1992, fl., A.M. Carvalho et al. 3771 (CEPEC). CEARÁ: Meruoca, Sítio Santo Antônio dos Fernandes, 3°32'S, 40°27'W, 26.V.1994, fl., fr., A.S. Fernandes s.n. (EAC 20877); Caridade, 4°5'S, 39°3'W, 06.V.1990, fl., B. Freitas s.n. (EAC 16780); 11 km de Canindé pela BR 02, 4°21'S, 39°18'W, 27.I.1990, fl., I. Cordeiro & J.R. Pirani 520 (SP). PARAÍBA: Remígio, 6°55'S 35°53'W 17.III.1975, fl., V.P. Barbosa 231 (RB). PERNAMBUCO: Goiana, Itapirema, 07°33'S, 35°00'W, 06.IV.1983, fl., fr., A.

Chiappeta & R. Barreto 497 (IPA). PIAUÍ: Cocal, Baixão, 3°28'S, 41°30'W, 29.III.2003, E.M.F. Chaves & E.M.S. Júnior s.n. (TEPB 19255).

21. *Dalechampia purpurata* Cordeiro, Kew Bulletin 53: 467. 1998. Holotype: Brazil, Bahia, Abaíra, Stannard, Ganev & Queiroz H. 51654 (SPF!, isotypes K!, SP!). Figure 6b & 10c.

Dalechampia purpurata differs from the other species of *Dalechampia* in the northeast by having 3-foliolate compound leaves, 3-lobed bracts, and a magenta and slightly lobed stigma.

Distribution, ecology, and conservation: *D. purpurata* is endemic to Brazil (Flora do Brasil 2020, in constr.), and restricted to Bahia State in caatinga environments. In terms of conservation status, *Dalechampia purpurata* is included in the category of vulnerable species because of its EOO of ca. 10,600 km², and as endangered (EN) due to its AOO of 24,000 km².

Material examined: BRAZIL, BAHIA: Abaíra, 13°16'S, 41°44'W, 31.I.1992, fl., D.J.N. Hind et al. 51399 (K); Abaíra, 13°16'S, 41°44'W, 28.II.1992, fl., B. Stannard et al. 51654 (NY).

22. *Dalechampia scandens* L. Sp. Pl. 2: 1054. 175. Holotype: West Indies, illustrated by Plumier, *Plantarum Americanarum fascículos*, 5: pl. 101 (original plate at P). Figure 6c & 10c.

Dalechampia scandens can be distinguished from its congeners mainly by having lanceolate bracteal stipules and a slightly crateriform stigma. *D. scandens* can be confused with *D. brasiliensis*, but differs from it by characteristics already mentioned above for the latter species.

Distribution, ecology, and conservation: *D. scandens* is not endemic to Brazil, occurring in Central America, the Antilles, and South America (Webster & Armbruster 1991). It is widely distributed in Brazil, occurring in the northern (Amazonas, Pará, Rondônia and Roraima), central-western (Mato Grosso do Sul and Mato Grosso), southeastern (Minas Gerais and São Paulo), and northeastern regions of the country (Flora do Brasil 2020, in constr.). In the study area, it has been recorded from Bahia, Ceará, Maranhão, Paraíba, and Pernambuco, growing in caatinga and Atlantic Forest vegetations. The species is herein designated as of least concern (LC), according to

IUCN red list (IUCN 2001) criteria, because its populations are numerous and widespread throughout the study region.

Material examined: BRAZIL, BAHIA: Barra, Ibiraba, 10°47'S, 42°50'W, 22.II.1997, fl., L.P. Queiroz 4768 (TEPB). CEARÁ: Caridade, 04°13'S, 39°11'W, 08.IV.2002, A. Fernandes s.n. (EAC 31381). PARAÍBA: São José dos Cordeiros, RPPN Fazenda Almas, 7°28'S, 36°53'W, 15.VIII.2010, fl., R.M.T. Costa & M.F.M. Brito 151 (RB). PERNAMBUCO: Ouricuri, Tamboril, 07°52'S, 40°04'W, 10.III.1982, fl., V.C. Lima et al. 206 (IPA).

Additional material examined: BRAZIL, SÃO PAULO: Parque Estadual da Ilha Anchieta, 23°32'S, 45°4'W, 08.IX.2008, fl., V.B. Zipparro 2504 (HRCB). MATO GROSSO: Poconé, Fazenda Corizal, 16°15'S, 56°37'W, 21.XII.1980, C.N. Cunha & A. Prado 12129 (UEC).

23. *Dalechampia schenckiana* Pax & Hoffm., Pflanzenr. IV. 147. XII (Heft 68): 49 1919. Neotype (designated by Webster & Armbruster 1991): Brazil, Pernambuco, Garanhuns, *G.L. Webster et al. 25648* (R!, isoneotype DAV). Figure 6d e 10d.

Dalechampia schenckiana has densely villous branches and 6–12 pistillate pinnatifid sepals. Morphologically, it is similar to *D. leandrii*, what can be differentiated by aspects already mentioned above in the comments concerning that species.

Distribution, ecology, and conservation: *D. schenckiana* is endemic to Brazil (Flora do Brasil 2020, under construction) and is known only from the northeastern region of the country. In the study area, it is known from the states of Bahia, Pernambuco, Sergipe, and Alagoas. It is recorded here for the first time in Alagoas, occurring in the caatinga (stricto sensu) and rock outcrop vegetation. The species is designated, according to IUCN (2001) criteria, as of least concern (LC) due to its EOO of ca. 165,000 km² and endangered (EN) due to its AOO of 88,000 km². Some specimens were collected in protected areas in the study region and some of the collections analyzed came from the Morro do Chapéu State Park and the Raso do Catarina Ecological Station (both in Bahia), and the Catimbau National Park (Pernambuco).

Material examined: BRAZIL, ALAGOAS: Olho d'água do Casado, Capelinha, 9°25'S, 37°49'W, 17.IX.2001. fl., fr., L.M. Cordeiro 484 (PEUFR). BAHIA: Feira de Santana, 12°13'S, 38°57'W, 22.XI.1986, fl., G.L. Webster 25846 (HUEFS). PERNAMBUCO: Buíque-Catimbau, 8°34'S, 37°15'W, 25.IV.2013, *R.A. Pereira-Silva*

37 (PEUFR). SERGIPE: Canindé do São Francisco, Fazenda Poço Verde, 9°39'S, 37°47'W, 23.III.2000, fl., R.A. Silva & D. Moura 1405 (PEUFR).

24. *Dalechampia stipulacea* Müll. Arg., *Linnaea* 34: 221. 1865. Holotype: Peru, without locality, *R. Pavon s.n.* (G!). Figure 6e & 10e.

Dalechampia stipulacea stands out for having glandular stipitate trichomes on the margins of the leaf blade, staminate bracteole, and being the only species in the Northeast with parastipules at the base of the petiolar stipule. It resembles *D. ficifolia* by having 3-lobed leaves and bracts; they can be differentiated, over, by the length of the bracteal stipules in *D. stipulacea* (1.3–1.5 cm vs. 0.4–0.2 cm in *D. ficifolia*) and by the shape of the stigma shape in *D. stipulacea* (lobed vs. discoid to crateriform in *D. ficifolia*).

Distribution, ecology, and conservation: *D. stipulacea* is found in South America growing in seasonal tropical and subtropical forest areas (Webster & Armbruster 1991). In Brazil, it occurs in the central-western (Mato Grosso do Sul), southeastern (Minas Gerais, Rio de Janeiro and São Paulo), Southern (Paraná, Rio Grande do Sul and Santa Catarina), and northeastern regions (Flora do Brasil 2020, in constr.). In the study area, there have been records of its occurrence only in the states of Maranhão and Pernambuco in Atlantic Forest vegetation.

Material examined: BRAZIL, PERNAMBUCO: Triunfo, 7.VI.1997, fl., fr., A.M. Miranda et al. 2695 (IPA). MARANHÃO: Buriti Bravo, Margem direita do Rio Itapecuru, 23.II.1983, fl., J.U. Santos et al. 684 (K).

Additional material examined: BRAZIL, PARANÁ: Tuneiras do Oeste, Reserva Biológica das Perobas, estrada interna, 23°51'S, 52°45'W, 27.X.2011, fl., M.G. Caxambu et al. 3615 (HCF); Goioerê, Parque Municipal Antônio Sestak, 24°9'S, 53°1'W, 18.VIII.2007, fl., E.M. Silva s.n (HCF 5838). SÃO PAULO: Piracicaba, Mata da Pedreira, ESALQ/USP, 22°42'S, 47°37'W, 27.IX.1985, fl., E.L.M. Catharine 432 (BHCB). MINAS GERAIS: Pedro Leopoldo, Lara Vermelha, 19°36'S, 44°2'W, 15.VI.1978, fl., J.M. Ferrari 145 (BHCB); Juiz de Fora, 21°45'S, 43°26'W, 02.IX.1981, fl., TSMG 749 (BHCB). SANTA CATARINA: Siderópolis, Barragem do Rio São Bento, 28°36'S, 49°33'W, 05.XI.2009, fl., M. Verdi, A.L. Tomazi & G. Klemz 3043 (FURB).

25. *Dalechampia subintegra* Müll. Arg., *Flora Brasiliensis* 11: 650. 1874. Holotype:

Brazil, Bahia, without locality, *Blanchet s.n.* (G!). Figure 7a & 10f.

Dalechampia subintegra shares 3-foliolate leaves, a slender stigma, and 3-lobed involucre bracts with *D. peckoltiana*, but its styler column is thinner than that of *D. peckoltiana*. The species, however, still needs to be further investigated. Other morphological comparisons can be found in the comments presented above concerning *D. peckoltiana*.

Distribution, ecology, and conservation: *D. subintegra* is endemic to Brazil (Flora do Brasil 2020, under construction), being recorded only from the northeastern region of the country in the states of Bahia and Pernambuco. It is found here for the first time in the study area for Paraíba State. *D. subintegra* is included in the category of endangered because of its EOO of 3,700 km² and as endangered (EN) due to its AOO of 12,000 km².

Material examined: BRAZIL, PARAÍBA: Areia, 6°57'S, 35°42'W, 15.VII.1976, P.C. Fevereiro 170 (RB).

26. *Dalechampia sylvatica* S. Moore, Trans. Linn. Soc. London, 2: 467–468. 1895. Holotype: Brazil Mato Grosso, between Santa Cruz and Tapirapu 376 (BM!). Figure 6f & 10g.

Apparently, *D. sylvatica* also seems morphologically with *D. peckoltiana* due the leaves 3-foliolate and involucre bracts deeply 3-lobed. However, the pseudanthium of *D. sylvatica* is 7-9 cm long (vs. 5-6 in *D. peckoltiana*), involucre bracts greenish to yellowish (vs. whitish), peduncle 5-9 (vs. 3-5 cm), stigma moderately 3-lobed (vs. cylindrical). The taxon is referred to the northeast and Central region in the states of Bahia, Mato Grosso, Minas Gerais. *Dalechampia sylvatica* is included in the category of Least Concern species because an EOO of the 2,471.704 km² and as endangered (EN) due to an AOO of the 40,000 km².

Material examined: BRAZIL, BAHIA: Macugê, 13°, 7',3" S, 41°, 29',13" W, 20.II.2002, A. M. Giuliatti, & R. M. Harley 2055 (HUEFS). CEARÁ: Parque Nacional do Araripe, Crato, 19.I.1983, T. Plowman 12736 (EAC). MINAS GERAIS: without locality, 01.I.1816, Saint-Hilaire 1062 (P).

27. *Dalechampia tiliifolia* Lam. Encycl., 2: 257.1786. Holotype: possibly Peru, without locality, *Herb. Jussieu* (P). Figure 7b & 10h.

Dalechampia tiliifolia is easily recognized by having leaves varying from entire to lobed, linear bracteal stipules, involucre bracts entire to slightly 3-lobed, chartaceous, with 7–9 primary veins, and stigma discoid to peltate.

Distribution, ecology, and conservation: *D. tiliifolia* is widely distributed in South America (Webster & Armbruster 1991), and has been recorded in the northern (Acre, Amazonas, Amapá, Pará, Rondônia and Roraima), central-western (Goiás and Mato Grosso), and northeastern regions of Brazil (Flora do Brasil 2020, under construction). In the study area, it has been collected in Bahia, Ceará, Maranhão, Pernambuco, Piauí, and Sergipe in cerrado and Atlantic Forest vegetation. The species is included in the category of least concern because of its EOO of ca. 1,135,000 km² and as endangered (EN) due to its AOO of 112,000 km². None of the collections come from protected areas, but specimens may yet be found in protected areas within the extent of occurrence of the species such as the Chapada Diamantina National Park and Morro do Chapéu State Park (Bahia), Serra das Confusões National Park and Serra da Capivara National Park (Piauí), Araripe-Apodi National Forest (Ceará), Catimbau National Park (Pernambuco), and Chapada das Mesas National Park (Maranhão).

Material examined: BRAZIL, BAHIA: Entre Rios, Areal, 12°12'S, 37°57'W, 13.IV.2012, A.V. Popovkin 1094 (HUEFS). CEARÁ: Ubajara, Parna do Ubajara, 03°51'S, 40°55'W, 13.IX.1982, fl., A. Fernandes & P. Gibbs s.n. (EAC 15081). MARANHÃO: Loreto, Ilha de Balsas, 7°28'S, 45°3'W, 17.II.1970, fl., G. Eiten & L.T. Eiten 10657 (K). PERNAMBUCO: Recife, 8°3'S, 34°52'W, 30.V.1971, fl., E.P. Heringer et al. 1005 (IPA). PIAUÍ: Tamboril, 08°24'S, 42°54'W, 22.VII.1979, fr., F. Chagas & Silva 17 (K). SERGIPE: Siriri, Mata do Cipó, 10°35'S 37°08'W, 28.VIII.2013, fl., J.P. Santana et al. 206 (ASE).

Additional material examined: BRAZIL. TOCANTINS: Itacajá, 35 km após a aldeia Pedra Branca, 8°37'S, 47°31'W, 07.V.2000, fl., A.A. Santos et al. 686 (CEN). RONDÔNIA: Pimenta Bueno, 11°39'S, 61°11'W, 25.V.1990, fl., fr., L.A. Skorupa et al. 798 (CEN). RORAIMA: Boa Vista, Fazenda Quixabeira, 2°29'N, 60°40'W, 15.VIII.1977, fl., L. Coradin & M.R. Cordeiro s.n. (INPA 683). GOIÁS: Guarani, Fazenda Forquilha, 05.III.2001, fl., fr., M.L. Fonseca et al 2418 (IBGE).

28. *Dalechampia triphylla* Lam., Encycl. 2: 258. 1786. Holotype: Brazil, without locality, *J. Dombey s.n.* (P!, isotype NY). Figure 7c & 10i.

In the vegetative stage, *Dalechampia triphylla* can be quite easily confused with other species with 33-foliolate leaves. It is characterized, however, by its hispid fruits with persistent, pistillate sepals, widely pinnatifid.

Distribution, ecology, and conservation: *D. triphylla* is known from Mexico and Brazil. It has been reported from the northern (Pará), southeastern (Espírito Santo, Minas Gerais, Rio de Janeiro and São Paulo), and northeastern region of Brazil (Flora do Brasil 2020, under construction). In the northeastern region, the species has been recorded from Pernambuco State in Atlantic Forest environments.

Material examined: BRAZIL, PERNAMBUCO: Maraiá, 8°48'S, 35°45'W, 13.III.1994, A.M. Miranda et al. 8253 (HST).

Additional examined material: BRAZIL, SÃO PAULO: Bom Sucesso de Itararé, 24°19'S, 49°08'W, 19.VIII.1995, fl., V.C. Souza et al. 8891 (ESA); Apiaí, Estrada do Pinhalzinho, 24°30'S, 48°50'W, 13.VII.1997, fl., fr., F. Chung et al. 96 (ESA).

29. *Dalechampia viridissima* Webster, Brittonia 41:6. 1989. Holotype: Brazil, Bahia, CEPLAC grounds, *G.L. Webster & S. Armbruster 25165* (CEPEC!, isotypes DAV, GH, MO, NY, R. SP, UEC). Figure 7d & 10j.

Dalechampia viridissima is characterized by reduced pubescence, linear bracteal stipules, and an intense green color of the involucre bracts. *D. viridissima* resembles *D. armbrusteri*, being differentiated by aspects already mentioned above in the comments of the latter species.

Distribution, ecology, and conservation: *D. viridissima* is endemic to Brazil (Webster & Armbruster) with records of occurrence in the southeast (Espírito Santo), and northeastern regions (Bahia) of the country, being found in ombrophilous forest environments. This species is included in the critically endangered category because of its AOO of 4,000 km²

Material examined: BRAZIL, BAHIA: Jussari, 15°7'S, 39°30'W, 13.VIII.1998, fl., A.M. Amorim et al. 2466 (NY).

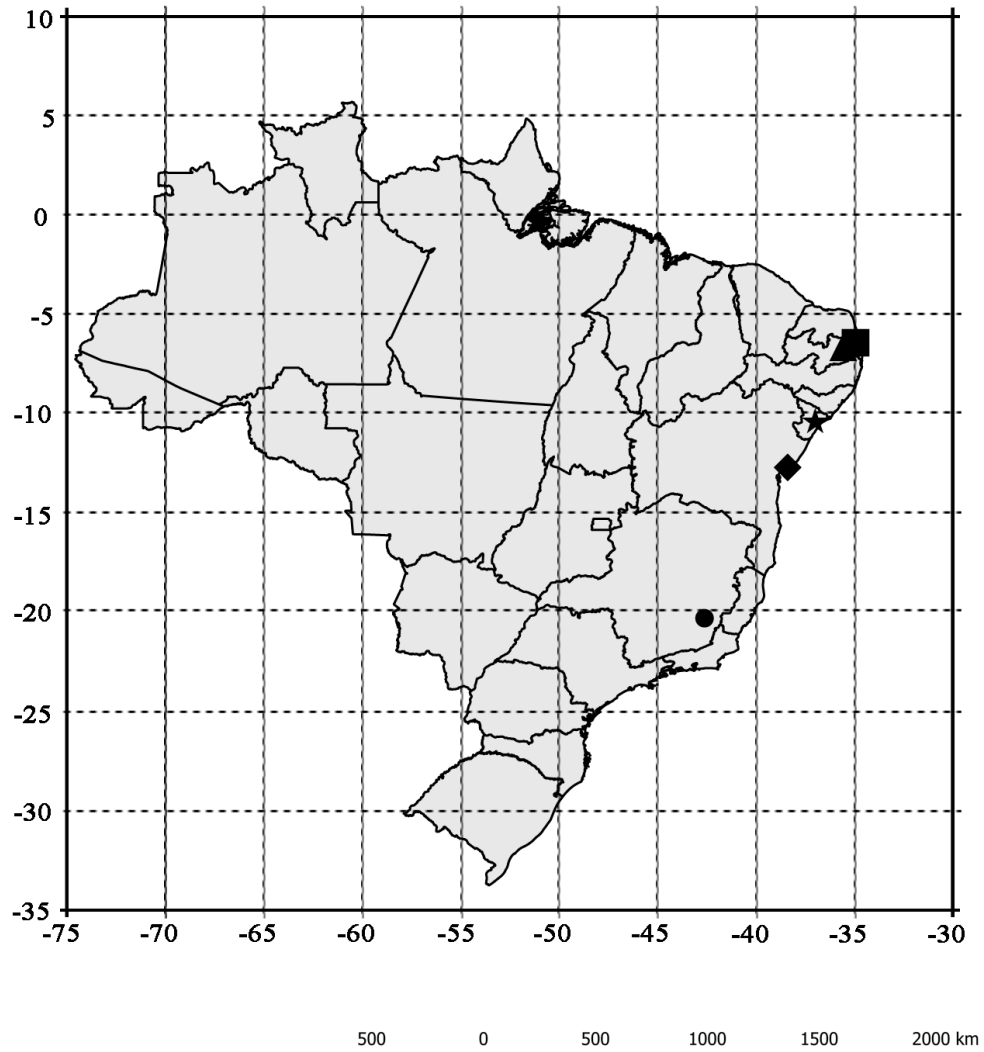


Figure 1. Distribution of *Dalechampia* in northeastern Brazil. (■) *D. leandrii*; (▲) *D. subintegra*; (★) *D. erythrostyla*; (◆) *D. affinis*; (●) *D. allemii*.

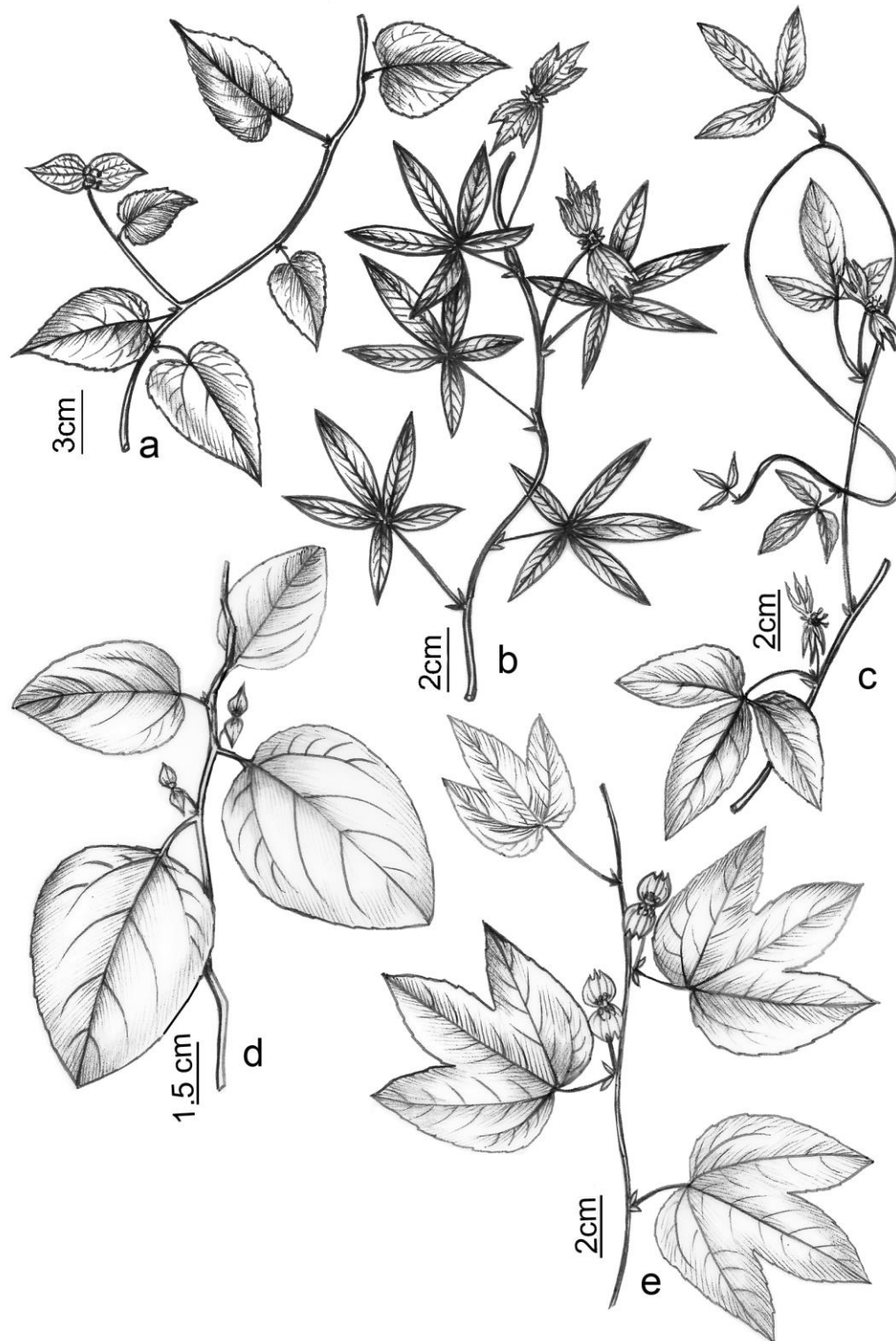


Figure 2. Habits of *Dalechampia* species. a. *D. affinis* (M.G. Silva & R. Bahia 3591). b. *D. alata* (L. Kollmann et al. 2376). c. *D. allemii* (A.C. Allem et al. 2980). d. *D. arciana* (S.G. Resende & E.G. Resende 1699). e. *D. armbrusteri* (Hage & L.A.M. Silva 317).

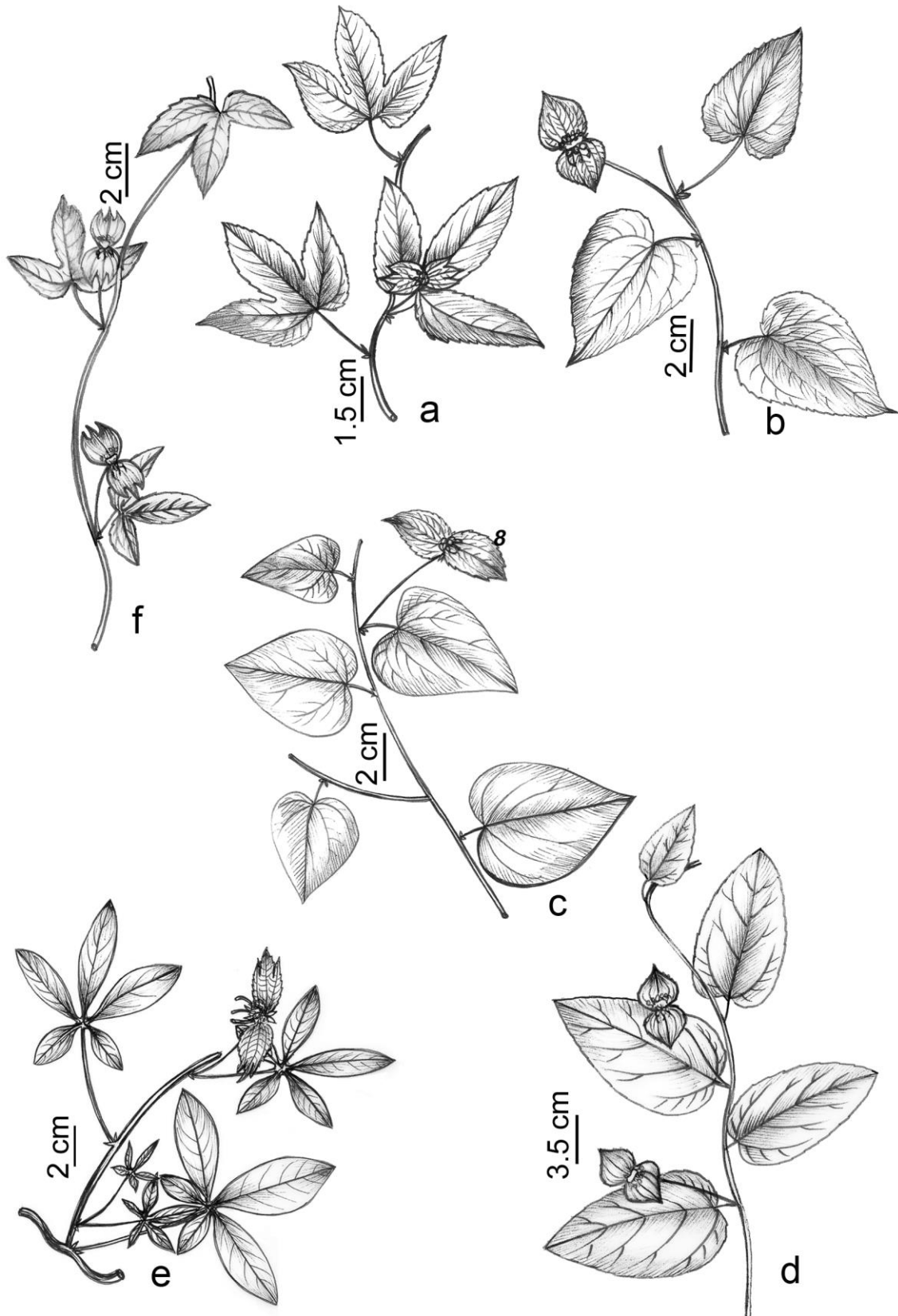


Figure 3. Habits of *Dalechampia* species. a. *D. brasiliensis* (L.R. Noblick 3565). b. *D. convolvuloides* (F.S. Santos Filho 007). c. *D. coriacea* (Allem et al. 2949). d. *D. cujabensis* (R.M. Harley & R. Souza 11057). e. *D. erythrostyla* (R. A. Pereira-Silva & A. L. Melo 16), f. *D. fernandesii* (A.M. Fernandes & E. Matos s.n. EAC 12725).

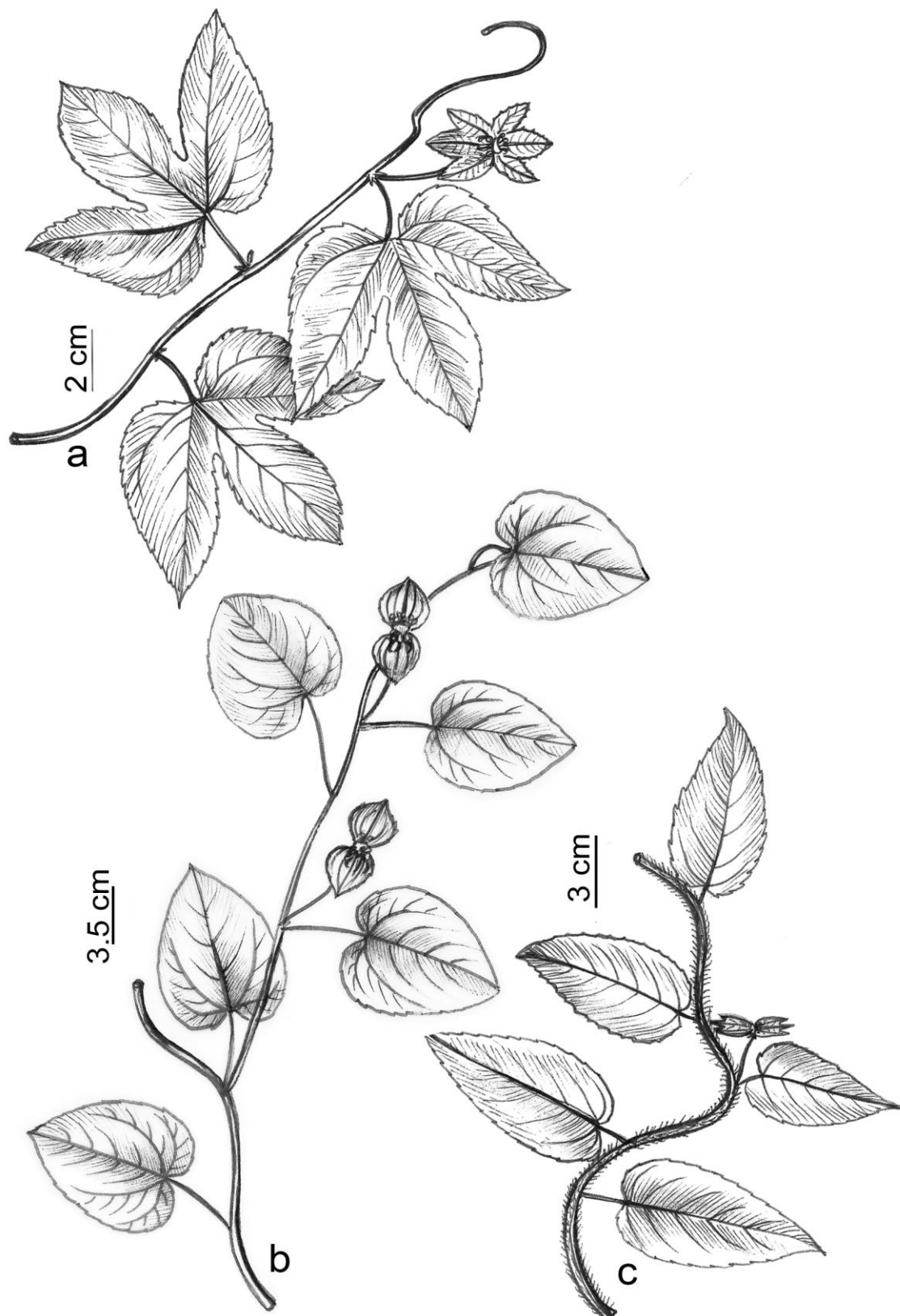


Figure 4. Habits of *Dalechampia* species. a. *D. ficifolia* (A. Korte 669). b. *D. ilheotica* (M.L. Guedes et al. 1198). c. *D. leandrii* (G.L. Webster et al. 25429).

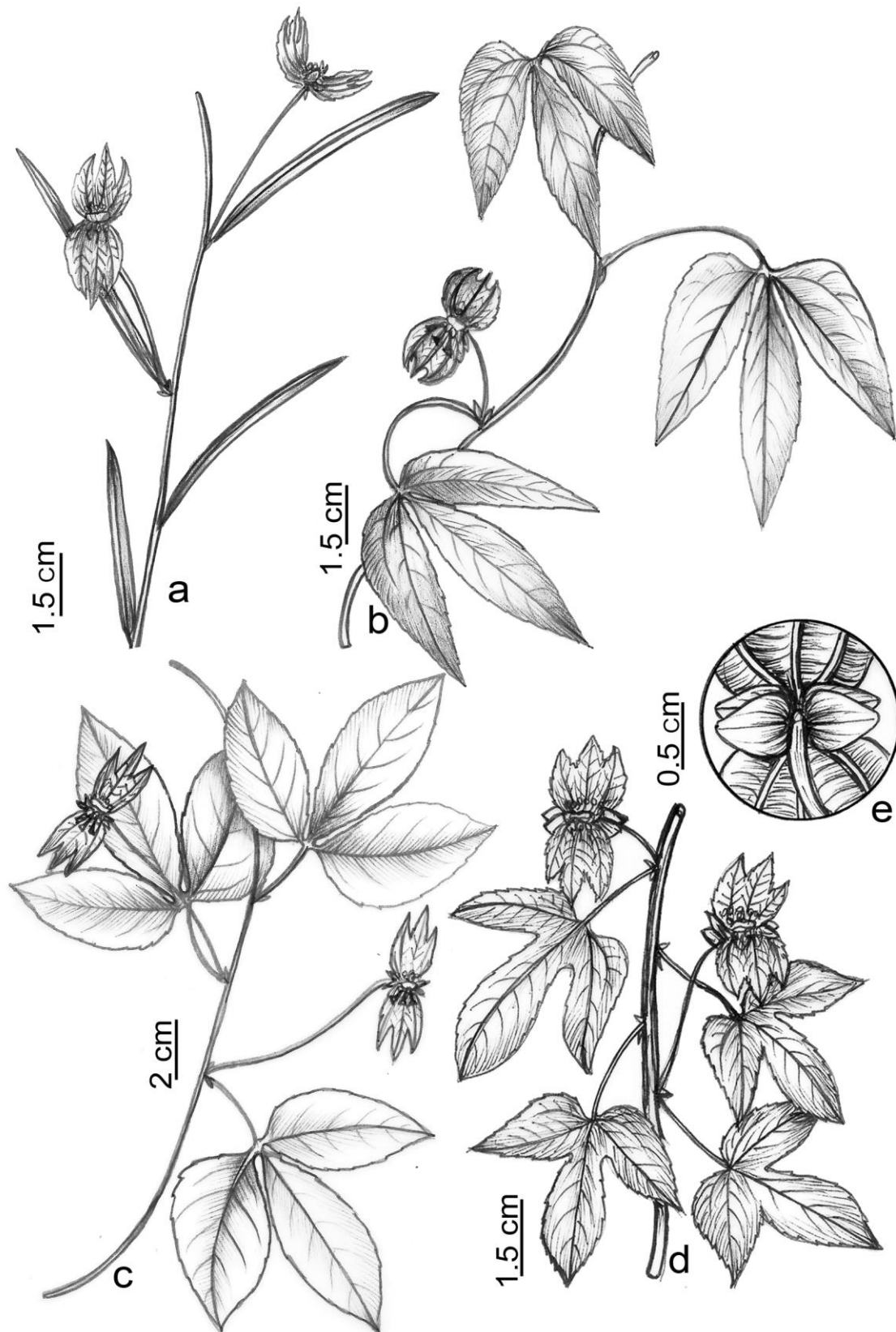


Figure 5. Habits of *Dalechampia* species. a. *D. linearis* Baill. (T.S. Figueiras 1289). b. *D. luetzelburgii* Pax & Hoffm. (M.R.L. Oliveira 59). c. *D. olfersiana* Müll. Arg. (K.R.B. Leite 212). d. *D. pernambucensis*. e. detail of bracteal stipules in *D. pernambucensis* (A.S. Fernandes s.n., EAC 20877).

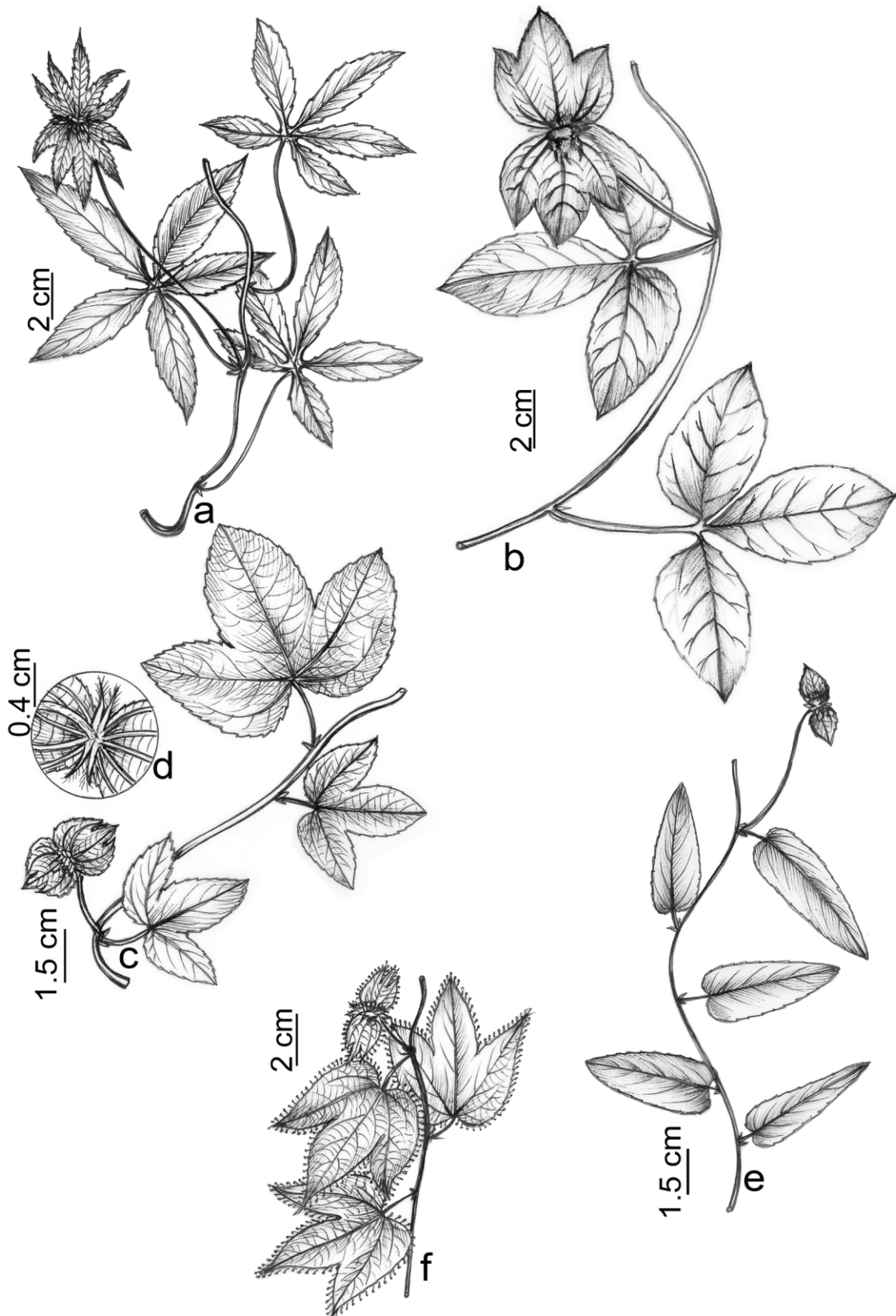


Figure 6. Habits of *Dalechampia* species. a. *D. pentaphylla* (L.P. de Queiroz et al. 9402). b. *D. purpurata* (B. Stannard et al. H51654). c. *D. scandens* L. (A.C. Allem et al. 3010). d. detail of bracteal stipules in *D. scandens*; e. *D. schenckiana* (Pereira-Silva 37). f. *D. stipulacea* (A.M. Miranda et al. 2695).

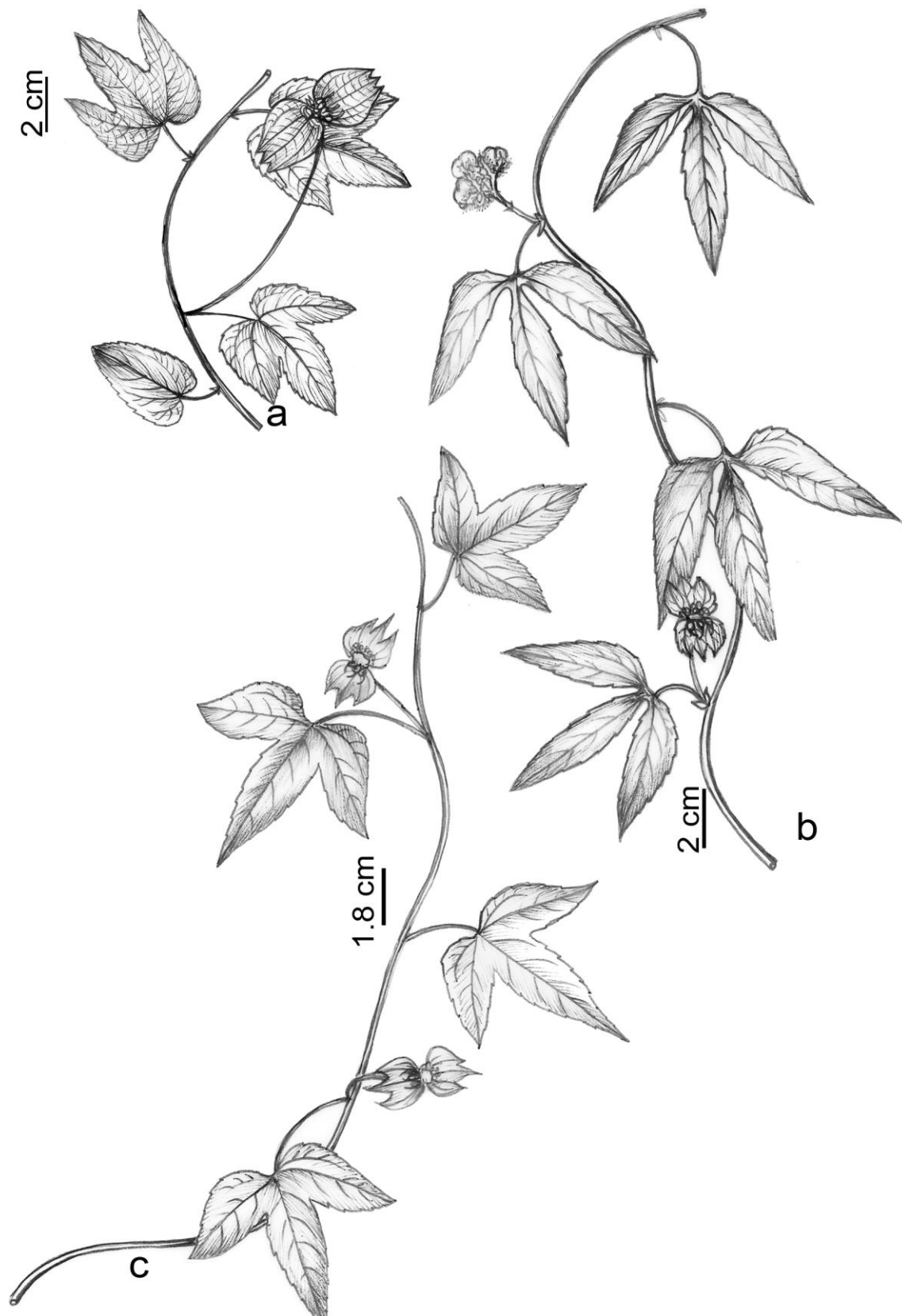


Figure 7. Habits of *Dalechampia* species. a. *D. tiliifolia* (M.J. Ballek et al. 1490). b. *D. triphylla* (K. Santos s.n., SJRP 30272). c. *D. viridissima* (A.M. Amorim et al. 2466).

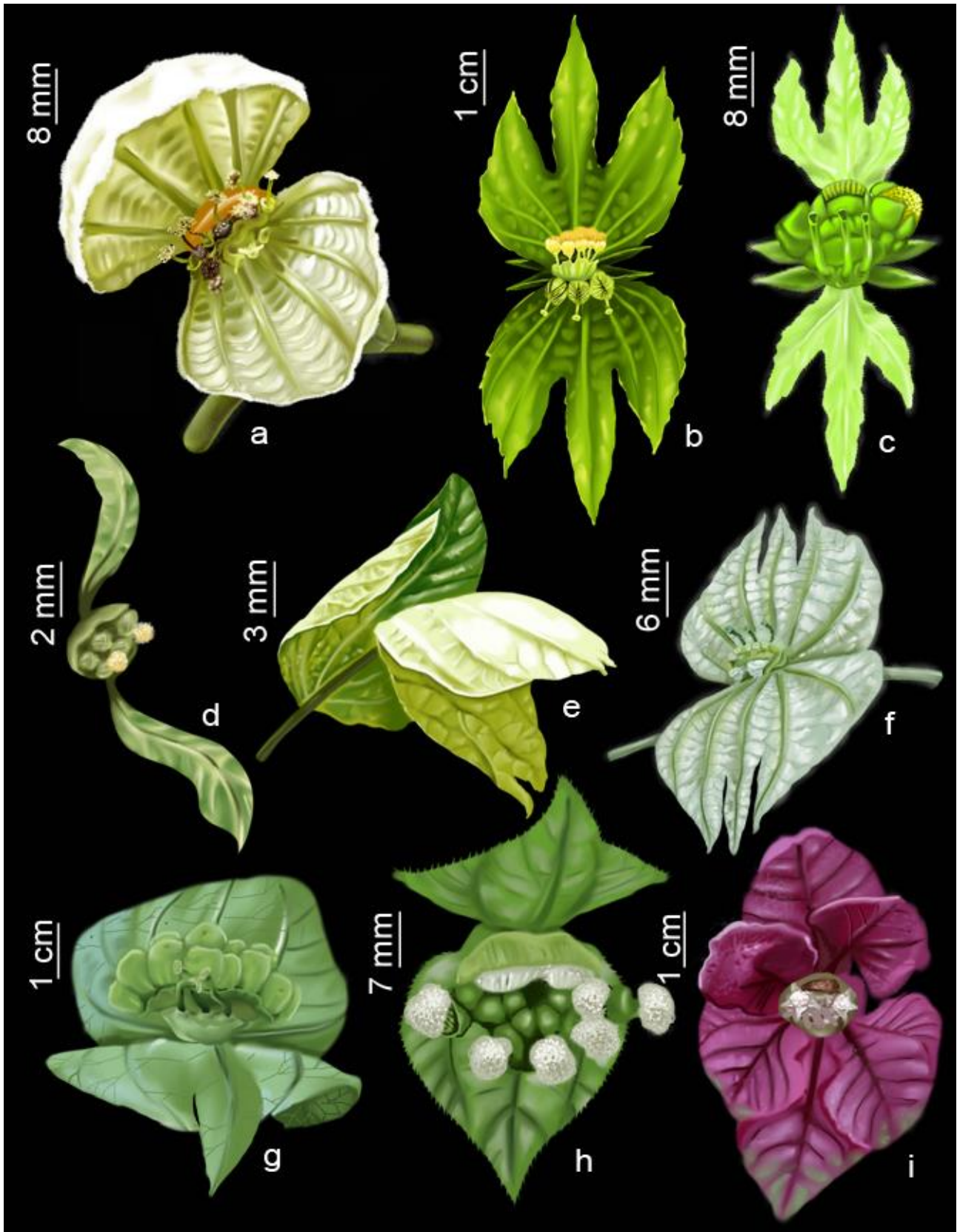


Figure 8. Pseudanthia of *Dalechampia* in northeastern Brazil. a. *Dalechampia affinis*. b. *Dalechampia alata*. c. *D. allemii* d. *D. arciana*. e. *D. armbrusteri*. f. *D. brasiliensis*. g. *D. convolvuloides*. h. *D. coriacea*. i. *D. cujabensis*.

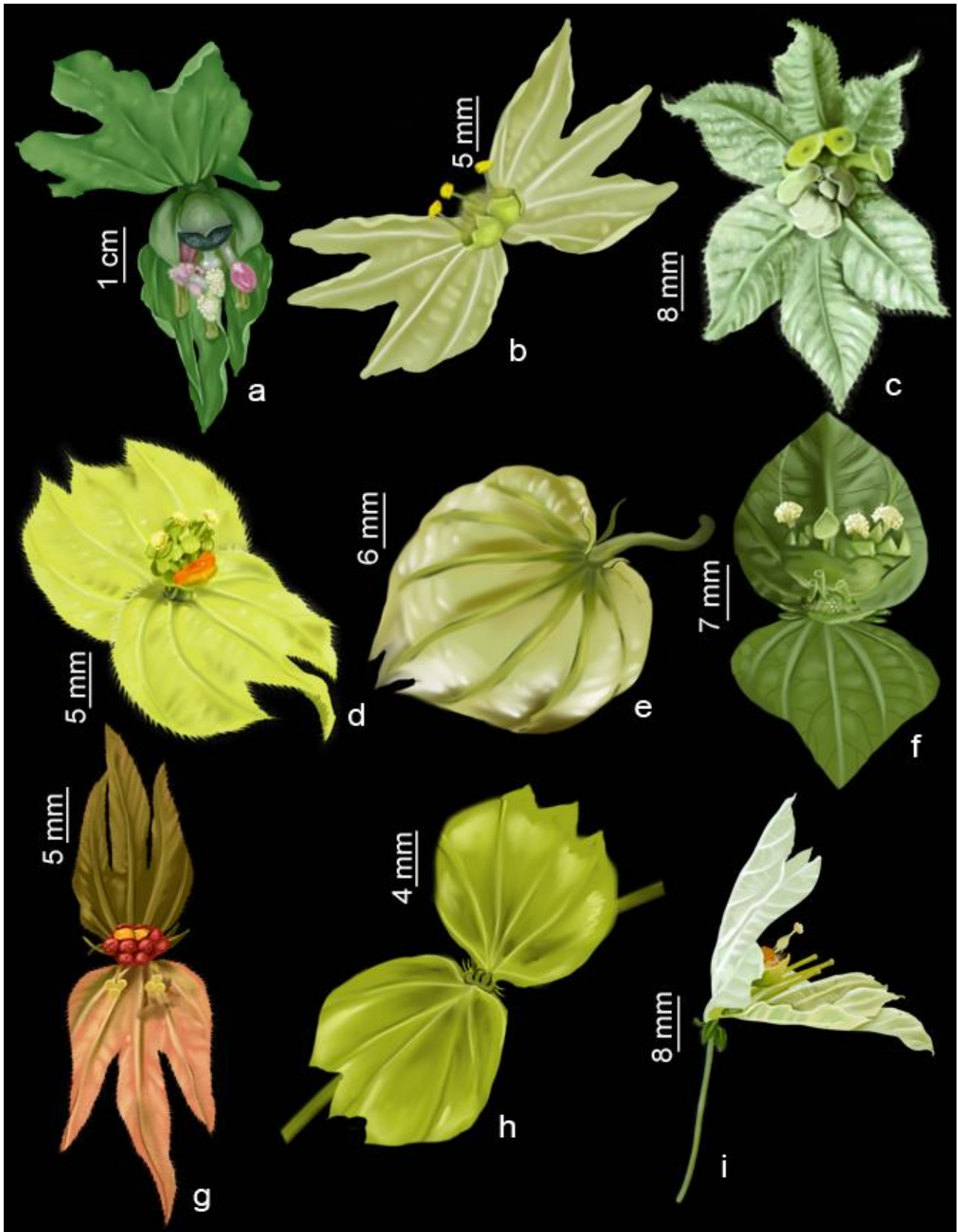


Figure 9. Pseudanthia of *Dalechampia* in northeastern Brazil. a. *D. erythrostyla*. b. *D. fernandesii*. c. *D. ficifolia*. d. *D. ilheotica*. e. *D. leandrii*. f. *D. linearis*. g. *D. luetzelburgii*. h. *D. olfersiana* Müll. Arg. i. *D. peckoltiana*.

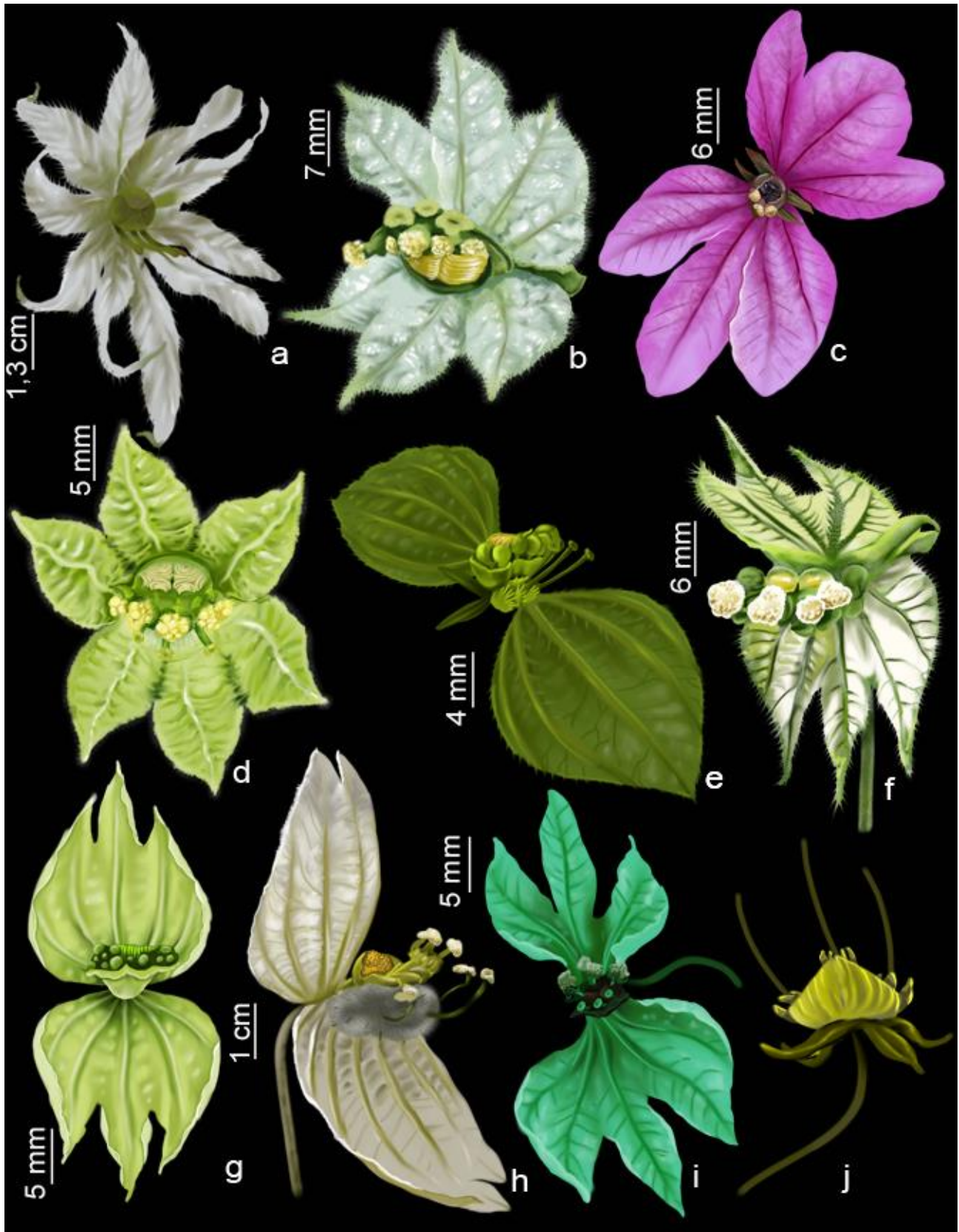
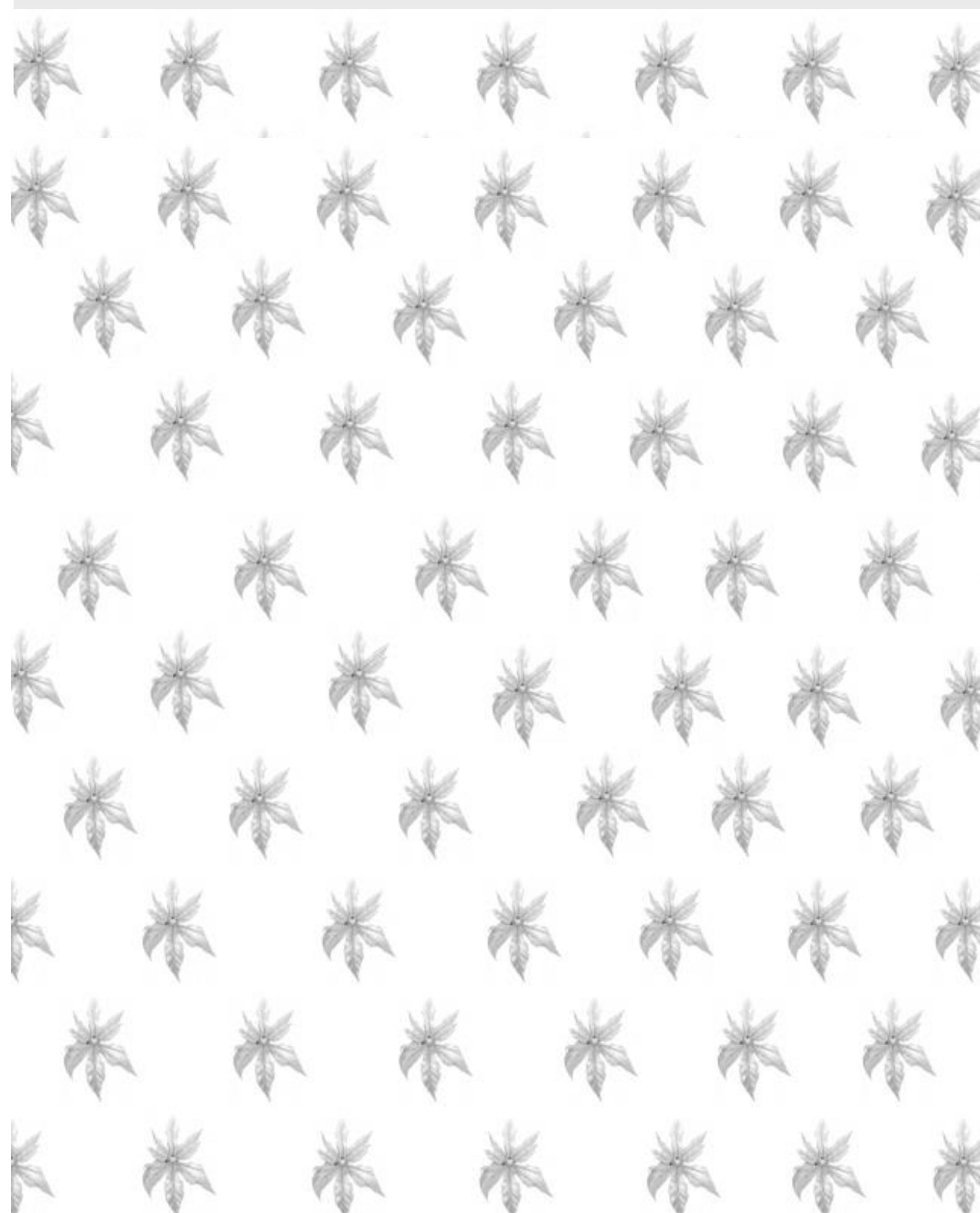


Figure 10. Pseudanthia of *Dalechampia* in northeastern Brazil. a. *D. pentaphylla*. b. *D. pernambucensis*. c. *D. purpurata*. d. *D. scandens*. e. *D. schenckiana*. f. *D. stipulacea*. g. *D. subintegra*. h. *D. tilifolia*. i. *D. triphylla*. j. *D. viridissima*.

Table 1. Species from northeastern Brazil in their respective sections, according to Webster & Armbruster (1991).

Sections	Species
<i>Coriaceae</i> Pax & K. Hoffm	<i>D. coriacea</i>
<i>Dalechampia</i> L.	<i>D. allemii</i> , <i>D. armbrusteri</i> , <i>D. brasiliensis</i> , <i>D. convolvuloides</i> , <i>D. ficifolia</i> , <i>D. leandrii</i> , <i>D. linearis</i> , <i>D. olfersiana</i> , <i>D. pernambucensis</i> , <i>D. scandens</i> , <i>D. schenckiana</i> , <i>D. stipulacea</i> , <i>D. triphylla</i> , <i>D. viridissima</i>
<i>Dioscoreifoliae</i> Pax & K. Hoffm.	<i>D. alata</i> , <i>D. arciana</i> , <i>D. cujabensis</i> , <i>D. erythrostyla</i> , <i>D. luetzelburgii</i> , <i>D. peckoltiana</i> , <i>D. pentaphylla</i> , <i>D. purpurata</i> , <i>D. subintegra</i>
<i>Tiliifoliae</i> G. L. Webster & Armbruster	<i>D. affinis</i> , <i>D. fernandesii</i> , <i>D. ilheotica</i> , <i>D. tiliifolia</i>

Manuscrito 7



**Taxonomic Revision of the Neotropical
species of *Dalechampia* sect. *Dalechampia*
(Euphorbiaceae)**

Rafaela Alves Pereira-Silva, Sarah Maria Athiê-Souza, André Laurênio de
Melo, Margareth F. Sales, and W. Scott Armbruster

Artigo a ser submetido

Phytokeys

PEREIRA-SILVA ET AL.: REVISION OF *D.* SECT. *DALECHAMPIA*

**Taxonomic Revision of the Neotropical species of *Dalechampia* sect. *Dalechampia*
(Euphorbiaceae)**

**Rafaela Alves Pereira-Silva,^{1,4} Sarah Maria Athiê-Souza,¹ André Laurênio de
Melo,² Margareth F. Sales,¹ and W. Scott Armbruster³**

¹Programa de Pós-Graduação em Botânica, Departamento de Biologia, Universidade
Federal Rural de Pernambuco, 52171–900, Recife, PE, Brazil.

²Unidade Acadêmica de Serra Talhada, Universidade Federal Rural de Pernambuco,
56909-535, Serra Talhada, PE, Brazil.

³School of Biological Sciences, University of Portsmouth, Portsmouth, PO1 2DY, UK;
Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska 99775, USA.

⁴Author for correspondence (rafaela.news@hotmail.com)

Abstract—*Dalechampia* sect. *Dalechampia* comprises 48 species, which are characterized by twining vines, lianas or subshrubs, with diverse kind of leaves and a involucre bracts stipuliforms or not. Twelve new synonyms, five lectotypifications and one neotype are proposed. New occurrences are recorded and new illustrations of all the species provided. Furthermore, this paper presents an identification key, comments on geographical distribution, taxonomic and nomenclatural information.

Keywords—Dalechampiinae, Morphology, Nomenclature, Plukenetieae.

Dalechampia L. (Plukenetieae, Dalechampiinae) comprises almost 130 species all of which are twining vines, erect or decumbent herbs, subshrubs or very rarely shrubs, usually with stinging trichomes (Webster 1994). The inflorescence and flowers of *Dalechampia* provide the best morphological evidence for the recognition of the genus. The inflorescence is a pseudanthium, distinguishable from the other genera of Euphorbiaceae, because it has two large involucral bracts with varying color between whitish, yellowish-greenish, pink or magenta, these bracts can be entire, 3-lobed to deeply 3-5-lobed and are inserted below a pistillate cymule of 1-3 flowers and a staminate pleiochasium that ranges from 4 to almost 50 flowers (Pax and Hoffman 1919; Webster and Armbruster 1991; Webster 1994; Pereira-Silva et al. 2016).

The center of *Dalechampia* diversity is in South and Central America, with approximately 100 species (Armbruster and Mziray 1987; Armbruster 1994). Other species can be found throughout the lowland tropics of Asia (ca. 10 species), continental Africa (ca. 12 species) and Madagascar (ca. 12 species) (Armbruster and Mziray 1987; Armbruster, 1994; Armbruster unpubl. observation).

Pax & Hoffmann (1919) revealed the complexity of the interspecific relations of *Dalechampia*, since the identification keys are inconsistent and the diagnoses for the sections are superficial and overlap morphologically one to the other. Webster & Armbruster (1991), with the synopsis for neotropical species reorganized much of the sections treated by Pax & Hoffmann (1919). In this work, the authors adopted an infrageneric classification that included 92 taxa, which were distributed in six sections (*D.* sect. *Coriaceae* Pax & K. Hoffm., *D.* sect. *Cremophyllum* Baill., *D.* sect. *Dalechampia*, *D.* sect. *Dioscoreifoliae* Pax & K. Hoffm., *D.* Sec. *Rhopalostylis* Pax & K. Hoffm., and *D.* sect. *Tiliifoliae* GL Webster & Armbruster). Later, Armbruster (1996) established the monotypic section *Brevicolumnae* to accommodate *D.*

brevicolumna Armb. *Dalechampia* sect. *Dalechampia* is the largest section of the genus, subdivided into five subsections (*Brevipedes*, *Convolvuloides*, *Dalechampia*, *Humiles*, and *Triphyllae*), comprising a total of 53 species, distributed in the Neotropical region from Mexico to Argentina and with more species in Brazil (41 spp.).

The phylogenetic analysis performed by Pereira-Silva et al. (unpublished results, chapter 1) changed the infrageneric classification established by Webster & Armbruster (1991) for *Dalechampia* and also suggested rearrangement of the subsections of *Dalechampia* sect. *Dalechampia*. In this sense, the sections *Brevicolumnae*, *Coriaceae* and *Tiliifoliae* were synonymized under *Dalechampia* sect. *Dalechampia* (with 59 spp.) and all previously established subsections were synonymized to the *Dalechampia* subsection. Additionally, the section *Dalechampia* was reduced to only two subsections (*Tamifoliae* and *Dalechampia*). The new subsection *Tamifoliae* was suggested by Pereira et al. (unpublished results, chapter 2) and aggregates species from Africa, Madagascar and Asia. While *Dalechampia* subsection now includes 53 species.

Some taxonomic decisions were made in this manuscript of phylogeny and the new circumscription for section and subsection were provided. However, the descriptions and the taxonomic and nomenclatureal decisions of all the species inserted in *Dalechampia* sect. *Dalechampia* according to this new concept suggested by Pereira et al. (unpublished results, chapter 1) were not provided. In this sense, the present work aims to bring the descriptions, geographic and taxonomic comments, key section, illustrations, nomenclatureal decisions and typifications for the 48 species of *Dalechampia* sect. *Dalechampia*.

MATERIAL AND METHODS

The morphological study was based on the observation of populations in the field, following the usual methods in plant taxonomy for the collection and processing of the material (Mori et al. 1989), and in the analysis of more than 2,000 specimens, including types and historical collection from the following 37 herbaria: ASE, BHCB, CEN, CEPEC, CESJ, DAV, ESA, FURB, G, HBR, HRCB, HST, HUEFS, HVASF, IAN, IBGE, INPA, IPA, K, M, MAC, MBML, NY, P, PEUFR, R, RB, S, SJRP, SP, SPF, TEPB, UB, UCR, UEC, UPCB and W (acronyms from Thiers 2017).

The designation of morphological terminologies was accessed the specialized literature, and classical treatment in Euphorbiaceae (Müller 1863, 1866, Pax 1912, Lawrence 1973, Radford et al. 1974, Harris & Harris 2001, Hickey 1973). The abbreviation of the names of authors and works was based on Brummitt & Powell (1992) and Stafleu & Cowan (1976). Comments on geographic distribution of species, habitat and phenology were based on the information contained in the specimens labels, literature and personal observation.

The conservation status assessments were based on the determination of the EOO (extent of occurrence) and AOO (area of occupancy) using the web tool Geocat (<http://geocat.kew.org/>), following Bachman et al. (2011). Subsequently, we established conservation status according to criterion “B1” proposed by the IUCN red list, Version 3.1 (IUCN 2001).

TAXONOMIC TREATMENT

Dalechampia* sect. *Dalechampia Webster & Armbruster, Botanical Journal of the Linnean Society 105: 137–177. 1991. TYPE: *Dalechampia scandens* L.

Dalechampia sect. *Dalechampia* subsect. *Dalechampia* Webster & Armbr.

Dalechampia sect. *Scandentes* Pax & Hoffm., in A. Engler (Ed.), Das Pflanzenreich, IV. 147. XII (Heft 68): 27. 1919. TYPE: *D. scandens* L.

= *Dalechampia* sect. *Dalechampia* subsect. *Brevipedes* (Pax & Hoffm.) Webster & Armbr. *Dalechampia* sect. *Brevipedes* Pax & Hoffm., in A. Engler (Ed.), Das Pflanzenreich, IV. 147. XII (Heft 68): 26. 1919. TYPE: *D. brevipes* Müll. Arg. **syn. nov.**

= *Dalechampia* sect. *Dalechampia* subsect. *Convolvuloides* Webster & Armbr., Botanical Journal of the Linnean Society 105: 162–163. 1991. TYPE: *D. convolvuloides* Lam. **syn. nov.**

= *Dalechampia* sect. *Dalechampia* subsect. *Humiles* (Pax & Hoffm.) Webster & Armbr., Botanical Journal of the Linnean Society 105: 164. 1991. *Dalechampia* sect. *Humiles* Pax & Hoffm., in A. Engler (Ed.), Das Pflanzenreich, IV. 147. XII (Heft 68): 53. 1919. TYPE: *D. humilis* Müll. Arg. **syn. nov.**

= *Dalechampia* sect. *Dalechampia* subsect. *Triphyllae* (Pax & Hoffm.) Webster & Armbr., Botanical Journal of the Linnean Society 105: 168. 1991. *Dalechampia* sect. *Triphyllae* Pax & Hoffm., in A. Engler (Ed.), Das Pflanzenreich, IV. 147. XII (Heft 68): 13. 1919. TYPE: *D. triphylla* Lam. **syn. nov.**

Dalechampia sect. *Dalechampia* subsect. *Tamifoliae* Pereira-Silva, R.A. TYPE: *D. tamifolia* Lam.

Twining vines, lianas or subshrubs Leaves alternate, entire, simple or compound 3–5 lobed, or 3–5-foliolate, cordiform, elliptical, ovate to deltoid, with two stipels in the base, usually associate to glands, margins entire, sinuate or serrate, with papiliforms

glands sparsely, abundant or with glandular trichomes. Petiole short or long, with a pair of petiolar stipules, rare with parastipules. Pseudhantium axillary, sometimes terminal, with two pairs of bracteal stipules on base, linear, lanceolate or deltoid. Two involucrel bracts, entire, 3-5-lobed, 3-toothed or stipuliforms, yellowish, greenish, whitish, purplish or albido-virides. Pleiochasium staminate and pistillate cymule locate in the center of inflorescence; resiniferous glands compound by a cluster of bracteoles, locate adjacent to staminate flowers. The staminate cymule is compound by 2-lipped bracts with a row of 7–15 staminate flowers. These flowers present 4–6 sepals, free, lanceolate; stamens 5–100, anthers with longitudinal dehiscence. Pistillate cymule is compound by bracts 1–4 with 3 pistillate flowers. These flowers present 6–12 sepals free, lanceolate or ovate, entire, pinnatifid or pinnatisect; ovary globoid, 3–locular, 3–carpellate, 1 ovule per locule; stylar column greenish or reddish, apex lobed, capitate, crateriform, cotyliform, peltate, slender, discoid or trigonous. Capsule 3-lobed, sparsely pubescent, densely hispidous, hispidulous, stigulose or glabrous. Seeds ecarunculate, globoid to round and usually smooth.

KEY TO THE SPECIES OF NEOTROPICAL *DALECHAMPIA* SECT. *DALECHAMPIA*

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1. *Dalechampia adscendens* Müll. Arg., Fl. Bras. 2: 640. 1874.

Dalechampia humilis var. *adscendens* Müll.Arg., Linnaea 34: 223. 1865. Type: BOLIVIA. Chiquitos, *D'Orbigny 921* (lectotype G-DC 00131989! designated by Webster & Ambruster, 1991, isoelectotypes BR 0000005101108! P).

Subshrub, 40–45 cm high. Leaves simple, unlobed; petiole 1–1.5 cm long; petiolar stipule lanceolate, entire; blade chartaceous, ovate, 6–10 × 4–5 cm, apex acute, base of leaf rounded to sub-attenuated, adaxial hispid on surface and abaxial glabrescent to velutinous on surface, margins serrate, sometimes with capitate glandular trichomes, venation actinodromous. Inflorescence axillary 4–6 cm long; bracteal stipule 6–7 × 2 mm, lanceolate, entire; involucral bracts greenish, entire to apically 3-toothed, apex acute, 2–3 × 2–2.5 cm, hispid mainly on the veins, margins serrate with sparsely stipitate glands; resiniferous gland laminar. Staminate pleiochasium 6 flowers. Staminate flowers with 11–12 stamens, bracteoles 2, ca. 3 × 7 mm, greenish, transversely oblong, glandular-dentate margins; 4 lanceolate sepals, ca. 2 × 2 mm. Pistillate cymule subtended by an involucre of 3 bracts, lanceolate to depressed ovate, 2–4 × 3–4 mm, glandular-dentate margins. Pistillate flowers with calyx of 9–12 sepals, pinnatifid, with stipitate glandular, sparsely pubescent; ovary 1–1.5 × 1–1.5 cm, pubescent, stylar column 3–5 mm long, greenish, apex crateriform. Capsule and seeds not seen.

Representative Specimens Selected—Bolivia. CHIQUITOS: Santa Cruz, 09 Feb 2017 (fl) *R. Ripley s.n* (iNaturalist 11320408). **Brazil.** GOIÁS: Chapadão do Céu, Mineiros, Parque Nacional das Emas, 17°, 49'–18°28'S, 52°, 39'–53°10'W, 08 Dec 1998 (fl), *M. A. Batalha 2308* (UEC); Niquelândia, 14°28'11"S, 48°46'08"W, 30 Nov 1999, *S. M. Verboonen et al. 116* (CEN); Serra do Caiapó, 29 Oct 1964 (fl), *H. S. Irwin & R. Soderstrom 7529* (NYBG) MATO GROSSO: Higo Araguaia, 30 km Nordeste do Higo

Araguaia, BR-36, without date (fl) *Allem & Werneck 3513* (CEN).

Distribution and Habitat—*Dalechampia adscendens* occurs in Bolivia and Brazil. In both countries, the specimens were collected in Savannah vegetation in preserved or disturbed areas.

Phenology—Flowers in February to July.

Conservation—According to the IUCN red list criteria (IUCN 2001), *Dalechampia adscendens* is designated as Least Concern (LC) due to an EOO of 728,784.022 km² and Endangered (EN) due to an AOO of 24.000 km².

Notes—*Dalechampia adscendens* and *D. rubrivenia* are similar in shape of branches, leaves ovate and number of pistillate sepals. Pax & Hoffmann not described the flowers of *D. rubrivenia*, neither we were able to analyzed it, due there is only one, for this reason, we consider it hasty to propose nomenclatural changes.

2. *Dalechampia affinis* Müll. Arg., *Linnaea* 34: 223. 1865. TYPE: FRENCH GUYANA. La Mana: without local, 1856, *Sagot s.n* (lectotype G 00209174! designated by Webster & Armbruster 1991:157).

Twining vine. Leaves simple, unlobed; petiole 1.5–3 cm long; petiolar stipule linear, entire; blade membranaceous, cordiform, 3–6.5 × 3.5–5 cm, apex acute, base cordate, adaxial surface glabrescent and abaxial surface pubescent on the veins, margins entire, with sparsely papiliforms glands, venation actinodromous. Inflorescence axillary, 3.5–7 cm long; bracteal stipule ca. 2 × 1 mm, linear, entire; involucre bracts greenish, entire to 3-toothed, apex acute, 2–3.5 × 1–2.5 cm, pubescent, margins entire to moderately serrated usually with sparsely papiliforms glands; resiniferous gland laminar. Staminate pleiochasium 10–12 flowers. Staminate flowers with ca. 18 stamens, bracteoles 4, ca. 3 × 5 mm, greenish, ovate to depressed ovate, eglandular, entire margins; 4 lanceolate

sepals, ca. 2×2 mm. Pistillate cymule subtended by an involucrel of 2 bracts, widely ovate, ca. 3×2 mm., eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with sparsely stipitate glands, hispidous; ovary ca. 2×2 mm, hispidous, styler column 8–9 mm long, greenish, apex peltate. Capsule 4–7 mm long, sparsely pubescent to densely hispidous; seeds ca. 3×3 mm, globoid, light brown with dark brown macules.

Representative Specimens Examined—**Brazil**. AMAPÁ: Rodovia JK, $0^{\circ}00'28''S$, $51^{\circ}05'16''W$, 19 Jun 2015 (fr), *R.S.F.R. Sarquis 274* (IAN). AMAZONAS: Manacapurú, Lago Calado, 23 May 1981 (fl), *B.W. Nelson & S.P. Nelson 1177* (INPA). PARÁ: Oriximiná, Cachoeira Porteira, 02 Jul 1980 (fl, fr), *C. Davidson & G. Martinelli s.n.* (INPA 117.738); Rio Tocantins, Jacunda, Rio Cajazeiras, 16 May 1978 (fl, fr), *M.G. Silva & R. Bahia 3591* (INPA); Rio Itacaiunas, $5^{\circ} 53' S'$, $50^{\circ}30'W.$, 14 June 1982 (fl), *C.R Sperling et al. 6170* (INPA). PIAUÍ: Piri-piri, estrada para Pero II, 05 Apr 2002, *R.S. Rodrigues, A. Flores & M.E. Alencar 1488* (TEPB). RORAIMA: Macajá, $02^{\circ}, 30''N$, $60^{\circ}55'W$, 06 Ago 1986 (fl, fr), *E. L. Sette Silva 720* (K, NYBG). **Colombia**: CURAZAO, Rio Meta, 25 Oct 1923, *J. Cuatrecasas 4108* (NMNH). **French Guyana**: Carrefour du Gallion, 27 Aug 2005 (fl, fr), *P.J.M. Maas et al. 9683* (K, U). **Suriname**. TOEKOEMOETOE. 22 Mar 1932 (fl), *B.W. 5888* (K); Zuid River, $3^{\circ}20'N$, $56^{\circ}49'W$, $30^{\circ}10'N$, $56^{\circ}29'W$, 220 m, 6 Jun 1968 (fl), *B. Maguire et al. 54028* (K, NYBG). Nickerie, Area of Kabalebo, 8 Sep 1980 (fr), *J. C. Lindeman et al. 286* (BBS, K, U). **Venezuela**. CAPIHUARA: Alto Casiquiare, 118–120 m, 29 May 1942, *L. Willians 15661* (NMNH).

Distribution and Habitat—The species has a wider distribution occurring in Brazil, Colombia, French Guyana, Suriname and Venezuela in antropized areas and next to lakes waterfalls.

The registration for Bolivia is a novelty presented. In this last country, the species grows in open clay Savannah and next to rivers at altitude ranging from 30–220 m.

Phenology—The species flowers from March to August; fruits from May to September.

Conservation—*Dalechampia affinis* is classified as Least Concern (LC) due to an EOO of 5.947.112.590 km² and Endangered (EN) due to an AOO of 260.000 km², according to IUCN (2001).

Notes—Considering the species with cordiform leaves and pinnatifid pistillate sepals, *D. affinis* is similar to *D. convolvuloides*. They differ by habit, twining vines in *D. affinis* (vs. liana in *D. convolvuloides*); petiole 1.5–3 cm long (vs. petiole 0.5–3 cm long) and bracteal stipule linear (vs. bracteal stipule ovate).

3. *Dalechampia arenalensis* Armbruster, Systematic Botany, 9: 275, 1984. TYPE: COSTA RICA Alajuela: Volcán Arenal, S. Armbruster & Herzig 79-215 (holotype DAV, 101967 image!; isotypes ALA, photo!, CR, MO 188208, NY 00263009).

Twining vine. Leaves simple, unlobed; petiole 2–6 cm long; petiolar stipule ovate, entire; blade chartaceous, deeply cordiform, 8–12 × 5–6 cm, apex acuminate, base of leaf cordate to rounded, adaxial and abaxial surfaces glabrescent, margins entire, with papiliform glands, venation actinodromous. Inflorescence axillary, 4–6 cm long; bracteal stipule, 3–4.5 × 2.5–3.5 cm, lanceolate, entire; involucral bracts pale green to green, 5-lobed, apex acute, 3–4.5 × 2.5–3.5 cm, glabrescent, margins dentate, with papiliform glands; resiniferous gland laminar. Staminate pleiochasium 10 flowers. Staminate flowers with ca. 18–30 stamens, bracteoles 3, 2–3 × 4–6 mm, greenish, transversely oblong, eglandular, entire margins; 5–6 ovate sepals, 2–3 × 2 mm. Pistillate cymule subtended by an involucl of 2 bracts, ovate, ca. 4 × 4–7 mm, eglandular, entire margins. Pistillate flowers with calyx of ca. 12 sepals, pinnatissect,

without stipitate glands, glabrous; ovary hispidulous; stylar column 1.3–1.6 cm, greenish, apex slightly dilated. Capsule 10–12 mm long, sparsely pubescent; seeds ca. 2 × 2 mm, globoid, mottled brown and whitish.

Representative Specimens Examined—Costa Rica. ALAJUELA: without local, 10°28'N, 84°1'W, 5 Aug 1972, 450m (fl, fr), R.W. Lent 2766 (F).

Distribution and Habitat—*Dalechampia arenalensis* is found only in Costa Rica. The species grows along stream or in edge of forest, in altitude ranging from 370–450 m.

Phenology—Flowers and fruits from February to August.

Conservation—*Dalechampia arenalensis* was classified as Endangered (EN) by the extent of occurrence EOO of 255.817 km² and by the AOO of 24.000 km² according to IUCN (2001) criteria.

Notes—The description of *Dalechampia arenalensis* was based on the information contained in the protologue because of this, some characters such as wide of stylar column and the indument of the capsule were not found. The species differs of other unlobed and cordate leaves species by the 5-lobed involucre bracts and pinnatisect sepals glandular.

4. *Dalechampia armbrusteri* Webster, Brittonia 41: 3. 1989. TYPE: BRAZIL. Bahia: Itabuna, 15 Jul 1984, G. L. Webster & W. S. Armbruster 25000 (holotype CEPEC!, isotypes DAV 174413, GH, MO, NY, SP, UEC).

Twining vine. Leaves simple, 3-lobed; petiole 4–17 cm long; petiolar stipule lanceolate, obtuse or acute; blade chartaceous, 7–22 × 7–22 cm, middle lobe oblong, 4–10 cm wide, apex acute, base cordate, adaxial surface with some stimulous hairs and abaxial surface densely hirtellous, margins subentire, with sparsely papiliform glands, venation

actinodromous. Inflorescence terminal or axillary, 2.4–3 cm long; bracteal stipule 2.5–3 × 0.5–0.8 mm, lanceolate, entire; involucrel bracts pale greenish-white or green, apically 3-toothed, apex acute, 1.2–1.5 × 1.3–1.7 cm, hirtellous, margins entire. Resiniferous gland laminar. Staminate pleiochasium 12–16 flowers. Staminate flowers with ca 9–11 stamens, bracteoles 2, 2.5–3 × 6.5–7 mm, greenish, transversely oblong, eglandular, entire margins; 4 lanceolate sepals, ca. 1.5–2 × 2 mm. Pistillate cymule bracteole subtended by an involucrel of ca. 3 bracts, reniform, 2–2.5 × 3.5–5 mm, glandular-dentate margins. Pistillate flowers with calyx of 9–12 sepals, pinnatifid, with stipitate glandular, glabrescent; ovary hirsute; stylar column 4.5–5 × 7–0.8 mm, greenish, apex slightly clavate. Capsule ca. 7 mm long, sparsely hirsute; seeds ca. 3.7–4 × 3 mm, subgloboid, grayish-mottled.

Representative Specimens Examined—**Brazil**. BAHIA: Ilhéus, 16 Oct 1980 (fl), *J. L. Hage* 326 (HUEFS); Una, Serra Boa, 28 Sept 1979 (fl), *J. L. Hage & L. A. Mattos Silva* 317 (CEPEC); Ilhéus, quadra D do CEPEC, 1989 (fl), *J. L. Hage* 326 (CEPEC).

Distribution and Habitat—The taxon is restrict to to Brazil where occurs only in Bahia states growing in area of cocoa plantation and on stone.

Phenology— Flowers from September to October.

Conservation— The species is temporarily assessed as data deficient (DD) because there is inadequate information to make an assessment of the conservation status based on its distribution in the country.

Notes—We did not have opportunity to analyze specimens of this species, for that reason, the description was based on the protologue. In this way, we have no information about papiliform glands in margin of involucrel bracts, the size of ovary, wide of capsule neither exact color of macules in the seeds. *Dalechampia armbrusteri* can be compared to *D. ficifolia* due the leaves 3-lobed with chartaceous texture.

However, *D. armbrusteri* has apex of stylar column slightly clavate and involucre bracts up to 1 cm long meanwhile in *D. ficifolia* the apex is discoid to 3-lobed and the involucre bracts present 1.5–3 cm long.

5. *Dalechampia boliviana* Pax & K. Hoffm., Pflanzenr IV. 147 XII (Heft 68): 50. 1919.

TYPE: BOLIVIA, *M. Bang 2091* (lectotype NY 00842374!, isolectotype K).

Twining vine. Leaves simple, unlobed; petiole 3.5–4 cm long; petiolar stipule lanceolate, entire; blade membranaceous to chartaceous, ovate, 6–10 × 3–6 cm, apex acute, base truncate to cordate, adaxial and abaxial glabrescent to pubescent on both surfaces, margins crenate to denticulate, with papiliform glands, venation actinodromous. Inflorescence axillary 1–3 cm long; bracteal stipule, 1.5 × 1.5 cm, lanceolate, entire; involucre bracts greenish, entire, ovate, 0.5–1.5 cm, apex acute, puberulent to glabrescent, margins denticulate with papiliform glands. Resiniferous gland probably laminar. Staminate pleiochasium without information. Pistillate cymule subtended by an involucre of ovate bracts. Pistillate flowers with calyx of 12 sepals, pinatissect, with sparsely stipitate glands, glabrescent; ovary globoid, apex of stylar column slender. Capsule 6–7 mm long; seeds ca. 1.5 × 1.5 mm, globoid, pale mottled.

Representative Specimens Examined—**Bolivia**. LA PAZ: Coripata, 15 Mar 1894 (fl) *M. Bang 2091* (GH).

Distribution and Habitat—*Dalechampia boliviana* is restrict to Bolivia and grows in dry, gravelly soil.

Phenology—Flowers in March.

Conservation—*Dalechampia boliviana* was assessed as Least Concern (LC) due to an EOO of 115, 648.188 km² and Endangered (EN) due to an AOO of 20. 000 km² according to IUCN (2001).

Notes—There are two specimens to Mato Grosso state (Brazil) identified by Grady Webster in the Gbif website, however there are not photos. Nor did we find any Brazilian specimens in the herbaria visited. Therefore, we could not confirm the real occurrence in the country. The description was based on literature, so some characters in the description are absent. *Dalechampia boliviana* can be confused with *D. convolvuloides* by the similarities in shape and size of leaves and shape of involucre bracts. They differ mainly in the shape of stigma slender in *D. boliviana* (vs. discoid in *D. convolvuloides*), 6–8 sepals pinatissect (vs 12, pinnatifid).

6. *Dalechampia brasiliensis* Lam., Méthodique, Botanique 2: 258. 1786. *Dalechampia scandens* var. *brasiliensis* (Lam.) Müll. Arg., Prodr. 2: 1244. 1866. (1834: 258). TYPE: BRAZIL. Rio de Janeiro: without date, *J. Dombey s.n* (lectotype P, isotype NY 00842376 image!).

Dalechampia papposa Endlicher, Atakta Bot. 20– 21. 1834. TYPE: BRAZIL. Bahia: without local, 1840, *J. S. Blanchet* (holotype W).

Dalechampia brasiliensis var. *viridis* Müll. Arg., Fl. Bras. 11(2): 658. 1874. TYPE: BRAZIL. Bahia: without local, without date, *Salzman 504* (lectotype G!).

Twining vine. Leaves simple, 3-lobed; petiole 2–8 cm long; petiolar stipule lanceolate, entire; blade membranaceous, 4.5–9 × 5–11 cm, middle lobe ovate, 1.5–3 cm wide, apex acute, base cordate, adaxial sparsely villous on surface and abaxial pubescent on surface, margins serrated, with sparsely papiliform glands, venation actinodromous. Inflorescence axillary, 3–4 mm long; bracteal stipule 0.8–1 × 0.5 cm, linear, entire; involucre bracts pale greenish, 3-lobed, apex acute, 0.8–2.5 × 0.5–2.5 cm, pubescent, margins entire to slightly wavy, sparsely stipitate glands trichomes. Resiniferous gland

laminar. Staminate pleiochasium 7 flowers. Staminate flowers ca. 17–40 stamens, bracteoles 3, 5–6 × 4–5 mm, greenish, depressed ovate, eglandular, entire margins; 4 ovate sepals, ca. 2 × 1 mm. Pistillate cymule subtended by an involucrel of 2–3 bracts, depressed-ovate, 4–5 × 3–4 mm, eglandular, sometimes undulate margins. Pistillate flowers with calyx of 6–8 sepals, pinnatifid, with stipitate glandular, hirsutous; ovary pubescent, stylar column 4–5 mm long, greenish, apex slightly lobed. Capsule 5–8 mm long, sparsely pubescent; seeds 2–3.2 × 2–3.2 mm, globoid, dark brown with cream macules.

Representative Specimens Examined—**Brazil.** MINAS GERAIS: Catas Altas, Serra do Caraça, 18 Dec 2002 (fl), *R.C. Mota 1953* (BHCB). PARAÍBA: Coremas, Área de Tensão Ecológica, 20 Jan 2010 (fl), *J.R. Andrade et al. 240* (PEUFR). PERNAMBUCO: Quipapá, Mata da Usina Água Branca, 10 Jan 1994 (fl), *A.M. Miranda 1170* (PEUFR); Gravatá, Subida da Serra da Russa, 18 Jun 1994 (fl), *A. M. Miranda et al. 1688* (PEUFR) RIO DE JANEIRO: Macaé, estrada da Nova Aroeira Fazenda Arizona, 19 Jun 1982, *J.R. Pirani et al. 150* (SP). SÃO PAULO: Ilha Vitória, Litoral Norte, 02 Apr 1965 (fl, fr), *J.C. Gomes 2698* (BHCB). Without local, without date, *Riedel* (P05534451, P05534455, P05534459)

Distribution and Habitat—The species is endemic to Brazil, well distributed in the country, mainly in the Northeast, it occurs preferentially inside forest and less often in roadsides.

Phenology—Flowers from January to December. Fruits were registered in April.

Conservation—According to IUCN (2001), *Dalechampia brasiliensis* is considered as Least Concern (LC) due to an EOO of 3.3335.418.545 km² and Endangered (EN) due to an AOO of 476.000 km².

Notes—*Dalechampia brasiliensis* is often erroneously identified as *D. scandens*.

However, the two species can be differentiated by bracteal stipule (linear in *D. brasiliensis* vs lanceolate in *D. scandens*), the shape of stigma (slightly lobed vs. slightly crateriform) and by the color of involucre bracts (greenish vs pale green).

7. *Dalechampia brevicolumna* Armbruster, Syst. Bot. 21: 232–234. 1996. TYPE: FRENCH GUYANA. Piste de St. Elie, *Prevost 661* (holotype CAY, isotype U, image!).

Twining vine. Leaves simple, unlobed; petiole 0.4–2 cm long; petiolar stipule lanceolate, entire; blade chartaceous, oblong, 5–11 × 2–5 mm, apex acute, mucronate, base rounded, adaxial and abaxial surfaces sparsely strigulose, margins entire, with papiliform glands, venation eucamptodromous; stipels 1.5–3 mm long. Inflorescence axillary, 0.5–1 cm long; bracteal stipule 2–3 × 0.8 mm, lanceolate, entire; involucre bracts greenish, stipuliform, apex acuminate, ca. 2.5 × 2 mm, strigose, margins entire without papiliform glands; resiniferous gland laminar. Staminate pleiochasium 7–9 flowers. Staminate flowers with 20–30 stamens, bracteoles 2–4, depressed ovate, eglandular, entire margins; obovate sepals 4, 2 × 1–1.3 mm. Pistillate cymule, subtended by an involucre of 1 bract, oblong-obovate, 3.5–4 × 0.1–0.2 mm, eglandular, entire margins. Pistillate flowers with calyx of 5–6 sepals, lanceolate, without stipitate glands, densely hirsute; ovary ca. 1 × 1 mm, densely strigulose, styler column 4–5 mm long, apex slightly dilated. Capsule ca 5–6 mm long, strigulose; seeds 2 × 2 mm, slightly globoid, light brown with dark brown macules.

Representative Specimens Examined—**French Guyana:** Piste de St. Elie, near ca. 20 km S.W. Sinnamary, 19 Apr 1979, fl. *Prevost 547* (CAY). **Suriname.** Tumuc Humac Mountains, Talouakem, 2°52'N, 54°75' W, 350 m, 13 Aug 1993, fr. *P. Acevedo-Rodriguez et al. 6026* (US).

Distribution and Habitat—This species is found only on the Atlantic coast of South

America (French Guyana) and Suriname. The specimens were registered in understory and edges of lightly areas of primary and secondary forest.

Phenology—It flowers from March to July and fruits from June to October.

Notes—The description was based in the protologue and images of the taxon, because this some information as length of the capsule and pedicels, informations about the staminate pleiochasium and pistillate cymule and, size of staminate bracteole were not obtained. This species has a peculiar morphology due the involucrel bracts reduced to stipules.

Conservation—According to IUCN (2001), *D. brevicolumna* is considered near threatened (NT) due to an EOO of 21.150.871 km² and Endangered (EN) to an AOO of 16.000 km².

8. *Dalechampia brevipes* Müll. Arg., *Linnaea* 34: 224. 1865. TYPE: BRAZIL. São Paulo, Rio Pardo, *L. Riedel* 582 (lectotype NY 00842377 designated by Webster & Armbruster, 1991).

Dalechampia regnelli Müll. Arg., *Fl. Bras.* 2: 647. 1874. *Syn. nov.* TYPE: BRAZIL. Minas Gerais, Caldas Regnell 1053 (holotype G 00434754!, isotype P 00640232!, BR 0000005105625!)

Erect subshrubs, ca. 50 cm alt. Leaves simple, deeply 5-lobed; petiole 2–3 mm long; petiolar stipule linear, entire; blade membranaceous, middle lobe linear to lanceolate, 3–4 × 0.2–0.25 cm, apex lobe acute to rounded, base leaf attenuate, adaxial surface glabrous, abaxial glabrescent, margins subentire to dentate, with capitate glands, venation eucamptodromous. Inflorescence terminal, 1.7–2 cm long, bracteal stipule, 4–5 × 0.5–2 mm linear to deltoid, entire; involucrel bracts yellowish 3–4-lobed, apex acute, 0.8–1 × 1 cm, sparsely hispid, margins dentate, with sparsely papiliforms gland;

resiniferous gland laminar; staminate pleiochasium ca. 6 flowers. Staminate flowers with ca. 10 stamens, bracteoles 2, ca. 7×2 mm, greenish, depressed oblong, eglandular, entire margins; lanceolate sepals 4, ca. 1×1 mm. Pistillate cymule subtended by an involucrel of 1 bract, widely ovate, eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, pinnatisect, stipitate glands, glabrous; ovary $1.5\text{--}2 \times 2$ mm, hirsute, stylar column 2.8–3 mm long, greenish, apex peltate. Capsule and seeds not seen.

Representative Specimens Examined—**Brazil**. MATO GROSSO: Rondonópolis, BR 163, 10 Jun 1988 (fl), *G. G. Neto et al. 1354* (CH). MATO GROSSO DO SUL: Aquidauana, 10 Feb 1993 (fl), *G. Hatschbach 58297* (MBM).

Distribution and Habitat—The species is restricted to Brazil where is known in Mato Grosso and Mato Grosso do Sul states growing in Savannah.

Phenology—Flowers in February to June.

Conservation— According to the IUCN red list criteria (IUCN 2001), this species is designated as Least Concern (LC) due to an EOO of 874,666.757 km² and Endangered (EN) due to an AOO of 48. 000 km².

Notes—*Dalechampia brevipes* is recognized by the leaves deeply 5-lobed and apex of stylar column peltate. It is similar to *D. riedeliana* due linear to lanceolate lobes of the leaves and the involucrel bracts 3–4 lobed. They can be differentiated by leaves deeply 5-lobed (vs. deeply 3-lobed in *D. riedeliana*) and by the apex of stylar column peltate (vs. lobed).

Dalechampia regnellii is identical to *D. brevipes*, it is more remarkably when compared the specimen of *D. regnellii* P00640232 to the type collection of *D. brevipes*. Both species share shape of leaves (deeply 5-lobed), involucrel bracts 3-4 lobed, 12 pistillate sepals, pinnatisect and apex of stylar column peltate.

9. *Dalechampia brownsbergensis* Webster & Armbruster, Syst. Bot. 7(4): 484–488. 1982. TYPE: SURINAME. Distr. Brokopondo: Brownsberg Nature Preserve, 28 Jul 1979, L. Webster & W.S Armbrusteri 24124 (holotype DAV 95970, isotypes BBS, GH, MO, NY 00263018).

Twining vine. Leaves simple, 3-lobed; petiole 4.5–13 cm long; petiolar stipule elliptic-lanceolate, entire; blade chartaceous, 10–22 × 10–25 cm, middle lobe 4–9.5 cm wide, apex rounded, base deeply cordate, abaxial surface glabrous and adaxial surface puberulent, margins subentire, with minutely glandular, venation actinodromous. Inflorescence axillary 5–8.4 cm long; bracteal stipule 4–6 × 1.2–1.9 mm, lanceolate, sericeous; involucre bracts greenish, broadly ovate, apex 3-toothed, 2.5–4.2 × 2.5–4.8 cm, velutinous, margins entire usually with sparsely stipitate glandular trichomes; non-secretory gland laminar. Staminate pleiochasium 12–13 flowers. Staminate flowers with 3–22 stamens, bracteoles 2, 2–3 × 6.5–8 mm, greenish, transversely oblong, eglandular, entire margins; 3–6 lanceolate sepals, ca. 2.5–3 × 1.2–1.5 mm. Pistillate cymule subtended by an involucre of 2–3 bracts, reniform to 2-lobed, 2–3.4 × 3.7–8.5 mm, eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, lacinate, with stipitate glandular, glabrescent; ovary 1.5–1.8 mm long, hispidulous, stylar column 1.4–1.7 mm, greenish, apex trigonous. Capsule 7.5–8 mm long, glabrous; seeds ca. 1.8 mm, globoid, brownish.

Representative Specimens Examined—**Brazil.** PERNAMBUCO: Bonito, Reserva Municipal de Bonito, 80°29'40"S, 35°04'45"W, 22 Dec 1995 (fl, fr) M. J. Hora & M. J. Campelo 02 (NYBG).

Distribution and Habitat—The species occur in the roadside next to dense vegetation of Brejos de Altitude in Pernambuco state, conferring a new occurrence.

Phenology—Flowers and Fruits in December.

Conservation—*D. brownsbergensis* is considered as Least Concern (LC) due to an EOO of 145.073.250 km² and Endangered (EN) due to an AOO of 12.000 km², according to IUCN (2001).

Notes— The description of *Dalechampia brownsbergensis* was based in the protologue. The taxon is similar to *D. tiliifolia* due the division of the leaf (when 3-lobed leaves) and apex of the involucre bracts (when 3-toothed). However, they can be distinguished by the resiniferous glands (abortive or absent in *D. brownsbergensis* vs secretory in *D. tiliifolia*) and by the number of staminate flowers (12–13 vs 10).

10. *Dalechampia burchellii* Müll. Arg. Fl. Bras. 2: 649. 1874. TYPE: BRAZIL, Goiás, *Burchell 6661* (holotype G 00342388!, isotype K 000600720!; K 000600721!).

Dalechampia anomala Pax & Hoffmann, Pflanzenr. IV. 147 XII (Heft 68): 24. 1919. *syn. nov.* TYPE: PARAGUAY, between Rio Apa and Rio Aquidaban, without date, *Friebrig 4673* (lectotype G, isoelectotype K).

Dalechampia bangii Pax & Hoffmann, Pflanzenr. IV. 147 XII (Heft 68): 24. 1919. *syn. nov.* *Dalechampia boliviana* Gandoger, Bulletin de la Société Botanique de France, 66:286. 1919 [1920]. TYPE: BOLIVIA, *Bang 2181* (lectotype NY, isoelectotypes K 000600710!, US 00096454!).

Dalechampia cissifolia Poeppig, Nov. Gen. Sp. Pl. 3: 20. 1841. *syn. nov.* *Dalechampia cissifolia* subspecies *cissifolia*. TYPE: PERU, Maynas, Yurimanguas, *Poeppig 2085* (holotype W, isotype G 00236456).

Dalechampia hassleriana Chodat, Bull. Herb. Boissier, sér. 5: 609. 1905. *syn. nov.* TYPE: PARAGUAY, Rio Corrientes, E. *Hassler 5852* (lectotype here designated, G 00306960! isoelectotypes G 00077386!, G 00077385!, G 00077387!, G00306959!; BM000504548!, K 000600725!, GH 00047579!, MPU015277!, NY 00263023!, P

00640220!, P00640221!, UC 935382!, S07-12846!).

Dalechampia heteromorpha Pax & Hoffmann, Pflanzenr. IV. 147 XII (Heft 68): 26. 1919. *syn. nov.* TYPE: COSTA RICA, Rio Grande, San Ramón, *Brenes 14414* (lectotype K, designated by Webster & Armbruster, 1991).

Dalechampia laevigata Standley, Publ. Field Mus. Nat. Hist., Bot. Ser. 8: 312. 1929. *syn. nov.* TYPE: HONDURAS, Lancetilla Valley, *Standley 53531* (holotype F 583076, isotypes F 0056220F!, US00096461!).

Dalechampia weberbaueri Pax & Hoffmann, Pflanzenr IV. 147 XII (Heft 68): 21. 1919. *syn. nov.* TYPE: PERU, Jaén, Cajamarca, *Weberbauer 6192* (lectotype G 00237311!, isotype F 0042462F!, designated by Armbruster & Webster 1991).

Twining vine. Leaves simple to compound, entire 3-foliolate; petiole 3–4 mm long; petiolar stipule lanceolate, entire; blade membranaceous to chartaceous, middle leaflet obovate 5–8 × 2–4 cm, base attenuate, lateral leaflets ovate, of similar size to middle leaflet, apex rounded to acute, base attenuate to asymmetric, adaxial sparsely pubescent on surface and abaxial vellutinous, margins moderately dentate, with papiliform glands, venation eucamptodromous. Inflorescence axillary, 3–4 cm long; bracteal stipule 3–4 × 1 mm, lanceolate, entire; involucral bracts 3-lobed, greenish, apex acute, 1.5–2 × 1.8–2.5 cm, glabrous, margins moderately serrate, with papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 5 flowers. Staminate flowers with stamens not seen, bracteoles ca. 1, ca. 4 × 5 mm, greenish, transversely oblong, eglandular, undulate margins. Pistillate cymule subtended by an involucre of 2 bracts, depressed ovate to transversely oblong, 3.5 × 4–5, eglandular and glandular, undulate to entire margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with stipitate glandular, glabrescent; ovary ca. 2 × 2 mm, globoid, stylar column 7–8 mm long, apex crateriform. Capsule not seen.

Distribution and Habitat—Until now the species is restricted to Paraguay. Webster has identified one specimen to Paraná (South of Brazil). However, we did not locate this specimen and neither did we find the photo to confirm the identification.

Conservation— According to the IUCN red list criteria (IUCN 2001), this species is designated as Least concern (LC) due to an EOO of 1,420.080.773 km² and Endangered (EN) due to an AOO of 28.000 km².

Notes—*Dalechampia burchelli* is characterized by leaves entire to 3-foliolate, two pistillate bracteole glandular and eglandular and apex of stylar column crateriform.

The species with 3-foliolate leaves sensu from subsection Triphyllae (sensu Webster & Armbruster, 1991) comprises one of the biggest complexes of the genus *Dalechampia*. The species with leaves 3-foliolate and entire in the same individual, such as *D. anomala*, *D. bangii*, *D. hassleriana*, *D. heteromorpha*, *D. laevigata* and *D. weberbauri* do not present morphological characteristic distinctive to be considered as different taxons. In addition, *Dalechampia laevigata* represent only a constantly shape of leaves of *D. heteromorpha* (Webster & Armbruster, 1991), but the floral characteristics are the same. For this moment, we are proposing here the synonymization of these taxons to the oldest species with variable leaves *D. burchelli*. However, investments in phylogenetic analysis are needed for the better clarification them.

Regarding to *Dalechampia hassleriana*, the species was described by Chodat (1905) based on *Hassler 5852* without mentioning the herbarium. Specimens from the original collection were found in several herbaria. Considering that G would be the herbarium where Chodat worked and that the material collected by him and *Hassler* in Paraguay were primarily deposited in this same herbarium, we chose as a lectotype G 00306960. This specimen contains a label indicating that the material belonged to Chodat's personal herbarium and is very well preserved containing pseudanthus and

fruits.

11. *Dalechampia caperonioides* Baill, Adansonia. 5: 316. 1865. TYPE: BRAZIL. Minas Gerais, Patrocínio, without date, *St. Hilaire C' 495* (lectotype P 00640206!, designated by Webster & Ambruster, 1991; isolectotype P 00640207!).

Subshrub, 40–50 cm high. Leaves simple, unlobed; petiole ca. 2 cm long; petiolar stipule linear to lanceolate, entire; blade subcoriaceous, lanceolate to ovate, 3–8.5 × 0.4–3.4 cm, apex acute, base attenuate to rounded, adaxial glabrescent on surface and abaxial glabrescent to sparsely pubescent on surface mainly on the veins, margins slightly aculeate to dentate, with papiliform glands, venation eucamptodromous. Inflorescence terminal, 2.5–5 cm long; bracteal stipule ca. 4 × 0.5–1.5 mm, linear to deltoid; involucre bracts white, entire, apex acute, 1.2–2.5 × 1–2.5 cm, sparsely villous mainly on the veins, margins dentate, usually with sparsely stipitate glandular; resiniferous gland laminar. Staminate pleiochasium 8 flowers. Staminate flowers 5–15 stamens, bracteoles 2–4, 0.4–0.5 × 0.6–0.8 mm, greenish, transversely oblong, eglandular, entire margins; 4–6 ovate sepals, 1–2 × 2 mm. Pistillate cymule subtended by an involucre of 2 bracts, depressed-ovate, ca. 4 × 4 mm, eglandular, entire margins. Pistillate flowers with calyx of 6 sepals, linear-lanceolate, sometimes with a stipitate glands in the apex, hirsute; ovary 1–1.5 × 2 mm, glabrous to strigose, styler column 4–5 mm long, greenish, apex lobed. Capsule 0.5–0.7 cm long, sparsely pubescent; seeds 3–3.5 × 3.0–3.5 mm, globoid, dark brown, with pale macules.

Representative Specimens Selected—Brazil. DISTRITO FEDERAL: Brasília, 15°52'0"S, 42°51'0"W, 2015–1150 m, 23 May 1995 (fl) *M. Boaventura 152* (HEPH). GOIÁS: Higo Paraíso. Estrada para estação de tratamento de água, 14°08'14"S, 47°32'04" E, 1150 m, 22 Jan 2005 (fl, fr) *J. Paula Souza et al.*, 4440 (ESA). MINAS GERAIS: Araxá, 26 Jan 1991

(fl) *Mitzi Brandão*, 18155 (EPAMIG). TOCANTINS: Estrada para Monte do Carmo, 10°41'42"S, 47°49'36" W, 18 Jul 2000 (fl), V. C. Souza et al. 24191 (ESA).

Distribution and Habitat—The species is endemic to Brazil and found in Central (Distrito Federal, Goiás states), Southeastern (Minas Gerais) and North (Tocantins) region. It is restricted to Cerrado and cited for the first time here to Tocantins state. *Dalechampia caperonioides* occurs in preserved areas as Parque Estadual dos Pirineus and Reserva Ecológica do IBGE, beyond disturbed environments as roads and burned areas.

Phenology—Flowers in January to July. Fruit from January to August.

Conservation— According to the IUCN red list criteria (IUCN 2001), this species is designated as Least Concern (LC) due to an EOO of 1,218,593.945 km² and Vulnerable (VU) due to an AOO of 668.000 km².

Notes— *Dalechampia caperonioides* can be recognized by the white involucre bracts. However, when we consider the other characters this species can be confused with *D. francisceana*. They can be distinguished by the staminate and pistillate cymules continue green even after pollination (vs. become reddish in *D. francisceana*), two pistillate bracteoles (vs. one), the apex of stylar column lobed (vs. slightly lobed).

12. *Dalechampia clauseniana* Baill. Adansonia, 5: 310. 1865. TYPE: BRAZIL, Rio de Janeiro, Nova Friburgo, Nov 1842, P. Clausen 115 (lectotype here designated P 00640208!; isolectotypes P 00640209!, G 00342381!).

Dalechampia triphylla var. *villosa* f. *pohliana* Müll. Arg. Prodr. 15: 1240. 1866. TYPE: BRAZIL, Villa Boa, without date, J.B.E. Pohl s.n (lectotype here designated G!; isolectotype M 0233657!).

Dalechampia triphylla var. *villosa* f. *riedeliana* Müll. Arg. Prodr. 15: 1240. 1866. TYPE:

BRAZIL, Mandioca, without date *Riedel s.n* (lectotype G! designated by Webster & Armbruster 1991:169).

Twining vine. Leaves compound, 3-foliolate; petiole 3–5 cm long; petiolar stipule lanceolate, entire; blade membranaceous to chataceous, middle leaflet elliptic, 6–8 × 2–3.5 cm, base attenuate, lateral leaflets lanceolate to ovate, of similar size to middle leaflet, apex acute, base asymmetric, adaxial pubescent and abaxial surface vellutinous, margins entire, with papiliform glands, venation eucamptodromous. Inflorescence axillary, 4–5 cm long; bracteal stipule 6–7 × 1–2 mm, lanceolate, entire; involucre bracts moderately 3-lobed, green, apex acute, 1–2.5 × 1.8–2.5 cm, glabrous, margins moderately serrate, with papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 6 flowers. Staminate flowers with stamens not seen, bracteoles 1, ca. 5 × 5–6 mm, greenish, transversely oblong, eglandular, undulate margins. Pistillate cymule subtended by an involucre of 3 bracts, oblong to widely ovate, ca. 4 × 1.5–3 mm, eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with stipitate glandular, glabrescent to densely hirsute; ovary up to 1 × 1 mm, stylar column 4–6 mm long, apex moderately peltate. Capsule 0.8–1 cm long, sparsely pubescent; seeds 2 × 2 mm, globoid, dark brown, with light brown macules.

Representative Specimens Examined—**Brazil**. MINAS GERAIS, Serra do Espinhaço, 9 Feb 1972 (fl), *W. R. Anderson et al. 35711* (K, NY); Serra do Espinhaço, 4 Feb 1972 (fl), *W. R. Anderson et al. 35369* (K, NY); Serra do Espinhaço, 15 Feb 1972 (fl.fr), *Kirkbride et al 36057* (K, NY); Base da Serra da Piedade, 13 Jan 1971 (fl), *Onishi et al 30279* (K). São Paulo, Cubatão, Paranapiacaba, 29 Mar 1968 (fl), *T. M. Pedersen 8786* (K).

Distribution and Habitat— The species occurs in Southeast from Brazil, in Minas Gerais and São Paulo states, it grows in secondary forest edge. In Minas Gerais, the species was registered to a preserved area, Serra do Espinhaço.

Phenology—Flowers in February and March. Fruits in February.

Conservation— According to the IUCN red list criteria (IUCN 2001), *Dalechampia clauseniana* is designated as Critically Endangered (CR) due to an EOO of 78.025 km² and Critically Endangered (CR) due to an AOO of 8.000 km².

Notes— *Dalechampia clauseniana* is characterized by the involucre bracts moderately 3-lobed and apex of stylar column moderately peltate. The species is commonly confused to *Dalechampia olfersiana* due the leaves membranaceous to chartaceous the shape of involucre bracts, and similarities in the apex of stylar column. They differ in bracteal stipule lanceolate (vs. linear in *D. olfersiana*); involucre bract green and glabrous (vs. greenish and vellutionous in *D. olfersiana*), size of of involucre bracts 4–5 cm long (vs. 3–3.4 cm long) and number of pistillate sepals 12 (vs. 7–10).

Dalechampia clauseniana was described by Baillon (1865) based on *Claussen 115* collected in Rio de Janeiro (Brazil) and stored in Herbarium Lessert. Webster and Armbruster (1991) indicated that the holotype would be in P. However, in this herbarium were found two specimens belonging to the type collection (P 00640208 and P 00640209). In this sense, we choose as a lectotype the specimen (P 00640208). Although it is quite fragmented we consider that this voucher was used by the author during the original description because it contains the calligraphy of the same and the label indicating that the material comes from Lessert herbarium.

Müller Argoviensis (1866) proposed *D. triphylla* var. *villosa* f. *pohlana* based on *Pohl s.n.* deposited in B which was destroyed during the war. Webster and Armbruster (1991) mistankely indicated that the holotype would be in G. We choose as lectotype the specimen suggested by Webster and Armbruster (1991) respecting the decision of the authors. The specimen (M 0233657) contains on the label the same information about the location indicated in the protologue. However, it has the number 3531 that is

not included in the original description and in the other specimens of the type collection.

We believe this number was added later.

13. *Dalechampia convolvuloides* Lam., Encycl. Methodique, Botanique, 2: 256, 1786.

TYPE: BRAZIL. without local, without date, *J. Dombey s.n.* (holotype P 00674012!).

Dalechampia monophylla Vellozo, Fl. Flumin. Icon. 10: 61, 1831. TYPE: BRAZIL: Rio de Janeiro, Santa Cruz, Rio Taguay, *J. M. C. Vellozo 5* (Lectotype pl. 61, designated by Webster & Armbruster 1991).

Liana. Leaves simple, unlobed; petiole 0.5–3 cm long; petiolar stipule linear, entire; blade membranaceous, cordiform, 6.5–9 × 4–5 cm, apex acute, base cordate, glabrous adaxial and abaxial surfaces, margins entire, with sparsely papiliform glands, venation actinodromous. Inflorescence axillary, 3.5–6 cm long; bracteal stipule ca. 2 × 2–2.3 mm, ovate, entire; involucre bracts greenish, entire to 3-toothed, cordiform, apex cuspidate, ca. 3 × 1–2.5 cm, sparsely pubescent, margins entire usually with sparsely stipitate glandular trichomes. Resiniferous gland laminar. Staminate pleiochasium 9 flowers. Staminate flowers with 37–50 stamens, bracteoles 2–4, 0.4–0.5 × 0.5–0.7 mm, greenish, transversely oblong, eglandular, entire margins; 4 ovate sepals, ca. 4 × 3 mm, eglandular, entire margins. Pistillate cymule subtended by an involucre of 3 bracts, transversely oblong to depressed oval, 0.5–0.7 × 3–3.5 mm. Pistillate flowers with calyx of ca. 12 sepals, pinnatifid, with stipitate glands; ovary 2–2.5 × 2 mm, hirsute, stylar column 6–8 mm long, greenish, apex discoid. Capsule 3–4 mm long, glabrous; seeds 1–2 × 1.5–2 mm, subgloboid, greenish without macules.

Representative Specimens Examined—**Brazil**. BAHIA: Dunas de Itapuã, next to lagoa do Abaeté, 23 Nov 1986 (fl), *G.L. Webster et al.* 25848 (HUEFS); PERNAMBUCO: Iati, 19 Dec 2009 (fl, fr), *M. Oliveira 3734* (HVASF). PIAUÍ: Teresina, Pq. Zoobotânico, 21

Dec 1996 (fl), *F.S. Santos Filho 007* (PEUFR). ESPÍRITO SANTO: Santa Teresa, estrada para o Cruzeiro, 08 May 1984 (fl, fr) *R. M. Piziolo 52* (MBML). RORAIMA: SEMA Ecological Reserve, Ilha de Maracá, 3°22'N, 61°24'W, 17 Jun 1987 (fl, fr), *W. Milliken 347* (K).

Distribution and Habitat—*Dalechampia convolvuloides* is herein registered to North, Northeast and Southeast from Brazil, since the specimens found in the Roraima state (North) were registered for the first time. The species was collected in preserved and in disturbed area.

Phenology— The taxon flowers from May to December; fruits from May to June.

Conservation—According to IUCN (2001), *Dalechampia convolvuloides* is considered as Least Concern (LC) due to an EOO 3.348.540,451 km² and Endangered (EN) due to an AOO of 88.000 km².

Notes— *Dalechampia convolvuloides* is a liana similar to *D. denticulata* due involucral bracts entire, but they differ in multiple aspects as wide of leaves 4–5 cm in *D. convolvuloides* (vs 2–4 cm in *D. denticulata*), apex of stylar colum discoid (vs moderately 3-lobed) and pistillate sepals pinnatifid (vs pinnatisect). *Dalechampia convolvuloides* also is similar to *D. boliviana* already differentiated in the comments of this last species.

14. *Dalechampia coriacea* Klotzsch ex Müll. Arg., *Linnaea* 35: 223. 1865. TYPE: BRAZIL. without local, without date, *F. Sellow s.n.* (Lectotype P 00640210!, isolectotype W!, designated by Webster & Ambruster, 1991).

Liana. Leaves simple, unlobed; petiole 0.3–1 cm long; petiolar stipule lanceolate, entire; blade coriaceous, ovate to lanceolate, 1.5–5 × 2.5–9 cm, apex acute, base cordate to truncate, adaxial and abaxial surfaces sparsely pubescent, margins dentate, with

papiliforms glands, venation actinodromous; stipels. Inflorescence axillary, 1.2–5 cm long; bracteal stipule $3.5\text{--}4 \times 1.5$ mm, lanceolate, entire; involucre bracts greenish, ovate, apex cuspidate, $0.7\text{--}0.8 \times 2.5$ cm, sparsely pubescent, margins serrate usually with sparsely stipitate glandular trichomes; resiniferous glands laminar. Staminate pleiochasium 12–15 flowers. Staminate flowers with 25–100 stamens, bracteoles 2, $0.4\text{--}0.5 \times 0.7\text{--}1$ mm, greenish, transversely oblong, eglandular, entire margins; 4 ovate sepals, ca. 4×3 mm. Pistillate cymule subtended by an involucre of 1–4 bracts, narrowly to transversely oblong, $2.5\text{--}5 \times 5\text{--}6$ mm, eglandular, entire margins. Pistillate flowers with calyx of 7–9 sepals, pinnatifid, with stipitate glandular, glabrescent; ovary pubescent, $6\text{--}8 \times 5\text{--}6$ mm, stylar column 6–8 mm long, greenish, apex discoid. Capsule ca. 4 mm long, sparsely pubescent; seeds not seen.

Representative Specimens Examined—BRAZIL. Bahia: Bonito, $11^{\circ}54'20''\text{S}$, $41^{\circ}18'24''\text{W}$, 957 m alt., 06 Mar 1993, (fl. fr), *E. N. Lughadha et al 6104* (ALCB, CEPEC); Itacaré, 2 May 1993, (fl), *W. Thomas & J. Jardim 9763* (CEPEC, NYBG); Itirucu, 12 Nov 1984, (fl), *A.C. Allem, W.L. Werneck 2949* (CEN); Prado, the entrance at km 18 east of Itamaraju on road to Prado, 8 km from entrance, $17^{\circ}11'\text{S}$, $39^{\circ}20'\text{W}$, 22 Oct 1993, *W. W. Thomas et al. 10133* (NY). Pernambuco: Saloá, RRPN Fazenda Brejo, $36^{\circ}47'13''\text{S}$, $9^{\circ}00'36''$, 944 m alt., 29 Dec 2008, fl., *M. Oliveira & A. P. Júnior 3650* (HVASF).

Distribution and Habitat—The species is exclusively found in Brazil where occurs in the Northeast region of the country (Bahia and Pernambuco states) in different phytogeographies of Atlantic Forest, usually in preserved or partially disturbed areas.

Phenology—*Dalechampia coriacea* flowers from March to December; Fruits were registered in March.

Conservation—The species is considered by the IUCN (2001) as Least Concern (LC)

due to an EOO 1.703,779.8863 km² and Endangered (En) due to an AOO 196.000 km².

Notes—*Dalechampia coriacea* is similar to *D. ilheotica* when this is with unlobed leaves, due the coriaceous leaves. But, *D. coriacea* present always entire leaves and lanceolate bracteal stipule (vs. varying between entire to 3-lobed and linear bracteal stipule in *D. ilheotica*), beyond apex of the column discoid (vs crateriform).

15 *Dalechampia denticulata* Wright ex Griseb., Nachr. Königl. Ges. Wiss. Georg-Augusts-Univ. 181, 1865. TYPE: CUBA: probably Pinar del Rio, without date, *C. Wright 2011* (holotype GOET 003370, isotypes CDG 316799!,GH, S000600731!).

Twining vine. Leaves simple, unlobed; petiole 2–4 cm long; petiolar stipule lanceolate; blade membranaceous, ovate, 4–9 × 2–4 cm, apex acute, base cordate, adaxial and abaxial glabrescent on both surfaces, margins crenate, with papiliform glands, venation actinodromous. Inflorescence axillary 4–4.5 cm long; bracteal stipule, 2–3 × 1 mm, lanceolate to deltoid; involuclral bracts greenish, entire, apex acute, 2–2.2 × 1.8–2.5 cm, glabrescent, margins slightly dentate, with papiliform glands. Resiniferous glands not seen. Staminate pleiochasium not seen. Pistillate cymule subtended by an involucl of 2 bracts, depressed ovate, ca. 2 × 3 mm, eglandular, entire margins. Pistillate flowers with calyx of 9–10 sepals, pinnatifid, with stipitate glandular and hispidous trichomes; ovary globoid ca. 2 × 2 mm, stylar column 2–6 × 0.5 mm long, greenish, apex moderately 3-lobed. Capsule ca. 5 cm long, sparsely pubescent; seed ca. 3 × 3 mm, globoid, light brown with dark brown macules.

Phenology—Flowers and fruits registered in January.

Distribution and Habitat—The species is endemic to Cuba.

Conservation—*Dalechampia denticulata* was assessed as Critical Endangered due the EOO of 1.724 km² and due the AOO of 8.000 km² according to IUCN (2001) criteria.

Notes— The species is recognized by the wide of leaves, pistillate sepals pinnatifid and hispidous. *Dalechampia denticulata* can be confused with *D. convolvuloides* and the comparison between them was made in the comments of *D. convolvuloides*

16. *Dalechampia fernandesii* Webster, Brittonia 41: 1. 1989. TYPE: BRAZIL: Ceará, Chapada da Ibiapaba, G. L. Webster, Fernandes & Matos 25598 (holotype EAC, isotypes DAV170435, NY, R).

Twining vine. Leaves simple, 3-lobed; petiole 2–2.5 cm long; petiolar stipule linear entire; blade chartaceous, 3–5 × 4.5–9 cm, middle lobe oblong, 1.4–2.5 cm wide, apex rounded, base cordate, adaxial surface glabrescent and abaxial surface velutinous, margins entire, with sparsely papiliforms glands, venation actinodromous. Inflorescence axillary, 2.5–5 cm long; bracteal stipule ca. 2 × 1 mm, linear, entire; involucre bracts yellow to greenish, 3-lobed, apex acute, 1.5–2.5 × 1.5–2 cm, velutinous, margins serrate usually with sparsely papiliforms glands; resiniferous glands laminar. Staminate pleiochasium ca. 9-flowers. Staminate flowers with 14–19 stamens, bracteoles 2, 3.5–4 × 2–5 mm, greenish, depressed ovate, eglandular, entire margins; 4 lanceolate sepals, ca. 2 × 1.5–2 mm. Pistillate cymule subtended by an involucre of 4 bracts, widely ovate, 4–5 × 5–6 mm, eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with sparsely stipitate glandular, sparsely hispidous; ovary, ca. 2 × 2 mm, stylar column 5–6 mm long, greenish, apex discoid to peltate. Capsule 3 mm long; seeds not seen.

Representative Specimens Examined—Brazil. CEARÁ: Tianguá, Chapada da Ibiapaba,

07 Oct 1989 (fr), A. *Fernandes et al. s.n.* (EAC 16.233). PIAUÍ: between Parnaíba and Piracuruca, 28 Jun 1984 (fl) A. *Fernandes & E. Matos s.n.* (EAC 12725); Aracati, 30 May 1987 (fl), A. *Fernandes & E. Nunes s.n.* (EAC 15262); Jabaruna-Sul, Planalto do Ibiapaba-Ubajara, 06 Jun 1994, (fl), *F.S. Araújo 807* (EAC).

Distribution and Habitat—The species is endemic to Brazil where it is known in the northeast region (Ceará and Piauí states) and occurs next to littoral trail or in high elevations of both states.

Phenology—*Dalechampia fernandesii* flowers from May to June; fruits in October.

Conservation—According to IUCN (2001), *D. fernandesii* is considered as Critically Endangered (CR) due to an EOO 16,711 km² and for the AOO of 8,000 km².

Notes— This taxon is similar to *D. tiliifolia* due to the leaves chartaceous and involucre bracts velutinous. However, they differ in multiple aspects as monomorphic leaves in *D. fernandesii* (vs. dimorphic in *D. tiliifolia*), apex of stylar column larger than the apex of *D. tiliifolia*, and involucre bracts 3-lobed (vs. entire to 3-cuspidate).

17. *Dalechampia ficifolia* Lam., Encyclopédie Méthodique, Botanique 2: 258. 1786. *Dalechampia tiliifolia* var. *ficifolia* (Lam) Kuntze, Revis. Gen. Pl., 1: 596. 1891. TYPE: BRAZIL. without locality, *J. Dombey s.n.* (holotype P 00640212!).

Liana. Leaves simple, 3-lobed; petiole 1–11.5 cm long; petiolar stipule lanceolate; blade chartaceous 8.5–16 × 11–20 cm, middle lobe oblong, 1.5–4 cm wide, apex acute, base cordate of leaf, adaxial surface sparsely hispid and abaxial surface pubescent, margins serrate, with papiliform glands, venation actinodromous; stipules linear, ca. 1 mm long, linear, not associated to glands. Inflorescence axillary or terminal, 3–6 cm long, bracteal stipule ca. 5–7 × 1.5–2 mm, oblong, entire; involucre bracts pale green, 3-

lobed, apex acute 1.5–3 × 1.5–3 cm, pubescent, margins serrate to undulate, with papiliform glands. Resiniferous glands laminar; staminate pleiochasium 8–16 flowers. Staminate flowers with 17–36 stamens, bracteoles 1–5, 3–5 × 4–5 mm, greenish, reniform, eglandular, entire margins; 4 lanceolate sepals, 2.5–3.5 × 2–4 mm. Pistillate cymule subtended by an involucre of 3 bracts, reniform, 1.3–5 × 1.5–5 mm, eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with stipitate glandular, hirsute; ovary, ca. 2 × 2 mm, glabrous, styler column 7–9 mm long, greenish, apex discoid to 3-lobed. Capsule ca. 1–1.5 cm long, pubescent; seeds ca. 3 × 4 mm, globoid, light brown without brown macules.

Representative Specimens Examined—Brazil. BAHIA: Santa Terezinha, Serra da Jiboia, 01 Nov 1992 (fl), *L.P. Queiroz 20891* (BHCB). ESPÍRITO SANTO: Santa Tereza, Rio Saltinho, 24 May 1989 (fl), *W.A. Hoffmann 2195* (SP). MATO GROSSO: Denise, Margem do Rio dos Bugres, 31 Jan 1996 (fl), *G.F. Árbocz 34413* (ESA). MINAS GERAIS: Descoberto, Reserva Biológica do Gramma, 21 Oct 2001 (fl), *F.R.G. Salimena & P.H. Nobre 936* (CESJ). PARANÁ: Cerro Azul, Morro Grande, 17 Nov 1981, fl., *G. Hatschbach 44381* (F). PERNAMBUCO: São Vicente Férrer, Mata do Estado, 29 Oct 1984 (fl, fr) *E.M.N. Ferraz et al. 602* (PEUFR). SÃO PAULO: Ubatuba, Acesso ao Condomínio Laranjeiras, 31 Jan 1996 (fl), *H.F. Leitão Filho et al. 34413* (UEC). SANTA CATARINA: Blumenau, 05 Dec 2012 (fl), *L.A. Funez 1299* (FURB).

Distribution and Habitat—This species is widely distributed in Brazil and can be found in different regions of the country (Northeast, Southeast and South) growing in ombrophilous forest and fragment of seasonal forest semideciduous montane.

Phenology—Flowers in January to December; Fruits was registered in October.

Conservation—*Dalechampia ficifolia* is considered as Least Concern (LC) due to an EOO of 10.394, 450.756 km² and Vulnerable due to an AOO of 672.000 km², according

to IUCN (2001).

Notes—*Dalechampia ficifolia* is similar to *D. armbrusteri* due the leaves 3-lobed and chartaceous. However, *D. ficifolia* is commonly identified as *D. stipulacea* and vice versa because the leaves and involucral bracts are 3-lobed. Nevertheless, they differ by the absence of stipitate glands in the margins of some organs of the plants in *D. ficifolia* (vs presence of stipitate glands in almost all organs of the plant in *D. stipulacea*) and absence of parastipule (vs. presence).

18. *Dalechampia francisceana* Baill, *Adansonia*. 5: 316. 1865. Type: BRAZIL. Minas Gerais, São Francisco, *Weddell 1879* (holotype P00640213!).

Subshrub, 20–40 cm high. Leaves simple, unlobed; petiole 2–3 cm long; petiolar stipule linear, entire; blade membranaceous, lanceolate to ovate, 2.5–7 × 1–2.4 cm, apex acute, base attenuate to rounded, adaxial and abaxial sericeous on surfaces, margins slightly aculeate to dentate, with papiliform glands, venation eucamptodromous. Inflorescence terminal, 4–4.5 cm long; bracteal stipule 4–5 × 1–1.5 mm, linear to lanceolate, involucral bracts pinkish, entire, apex acute, 1.5–2.5 × 0.9–2.0 cm, sparsely villous mainly on the veins, margins dentate, usually with sparsely stipitate glandular trichomes; resiniferous gland laminar. Staminate pleiochasium ca. 8 flowers. Staminate flowers 11–18 stamens, bracteoles 2, 3 × 5 mm, greenish to reddish, transversely oblong, eglandular, entire margins; 4 ovate sepals, ca. 2 × 2 mm. Pistillate cymule subtended by an involucl of 1 bract, widely, ovate ca. 3 × 2 mm, eglandular, entire margins. Pistillate flowers with calyx of 6 sepals, linear-lanceolate, sometimes with stipitate glands in the base, densely hirsute; ovary ca. 1 × 1 mm, sparsely hirsute, styler column ca. 3 mm long, greenish, apex slightly lobed. Capsule not seen.

Representative Specimens Selected—**Brazil**. DISTRITO FEDERAL: Brasília. Estação Ecológica do Jardim Botânico de Brasília, 08 Jan 2004 (fl) *I. N. C. Azevedo et al.* 132

(HEPH); Lago Sul, área do cristo, 25 Aug 2011 (fl) *V. F. Paiva et al. 763* (HEPH); EEJBB-Área do Cristo Redentor, 15°, 52', 0" S, 47°, 51' 0" W, Nov 2002 (fl), *M. G. Nóbrega et al. 1751* (HEPH). GOIÁS: Fazenda Sítio Novo, próx. da Divisa com o DF, 09 Nov 1971 (fl), *M. B. Ferreira 660* (HEPH).

Distribution and Habitat—*Dalechampia francisceana* is restricted to Brazil and was registered to areas preserved and to areas affected by fire, in 1025–1150 m high from Distrito Federal and Goiás.

Phenology—Flowers in January, August and November.

Conservation—This species is designated as Critically Endangered (IUCN 2001), due to an EOO of 0.000 km² and Critically Endangered due to an AOO of 8. 000 km². Due to the similarities shares with *Dalechampia caperonioides*, many specimens of *D. francisceana* were mistakenly identified, thus compromising knowledge about its actual distribution.

Notes—*Dalechampia francisceana* can be recognized by pinkish involucre bracts and reddish cymules after pollination. *Dalechampia francisceana* and *D. caperonioides* are very similar, however, they were characterized in the comments of the latter species.

19. *Dalechampia granadilla* Baill., *Adansonia* 5: 312. 1865. TYPE: BRAZIL. Minas Gerais: Uba, *St. Hilaire A' 507* (isotype P 00640216!).

Twining vine. Leaves simple, deeply 5-lobed; petiole 2–6 cm long; petiolar stipule deltoid, entire, with parastipules; blade membranaceous, 3.5–9 × 5–10 cm, middle lobe lanceolate, 1–1.2 cm wide, apex acute, base cordate, adaxial surface pubescent and abaxial velutinous, margins entire to sinuate, with sparsely papiliform glands, venation actinodromous. Inflorescence and fruits not seen.

Distribution and Habitat—There is only one collection of *Dalechampia granadilla* from

Rio de Janeiro (Brazil).

Conservation— Few specimens of *D. grandilla* are known, so it is assessed as data deficient (DD) according to IUCN (2001) criteria.

Notes— This species is known only by the type collection and for this reason we have not had opportunity to analyze all the organs such as inflorescences and fruits. Considering the 5-lobed species, *D. grandilla* can be distinguished from the others due the presence of parastipule in each petiolar stipule.

20. *Dalechampia glechomifolia* Baill. Adansonia 5: 314. 1865. TYPE: BRAZIL. São Paulo: 1816–1821, *St. Hilaire C³ 1567* (lectotype here designated P!). Syntypes: BRAZIL. São Paulo: *Gaudichaud 104* (P!).

Dalechampia microphylla Müll. Arg. Linnaea 34: 224. 1865. TYPE: BRAZIL, without locality, *Sellow s.n.* (holotype B, destroyed).

Dalechampia parvula Pax & Hoffmann, Pflanzenr. IV. 147 XII (Heft 68): 55. 1919. *syn. nov.* TYPE: ARGENTINA, Misiones, San Pedro, *Niederlein 1504b* (holotype destroyed B).

Subshrub, 30–35 cm high. Leaves simple, unlobed; petiole 5–7 mm long; petiolar stipule linear, entire; blade membranaceous, cordiform, 1–1.5 × 2.5 cm, apex rounded to acuminate, base cordate, adaxial and abaxial surfaces glabrous, margin dentate, with capitate glands, actinodromous. Inflorescence axillary 1.5–2.5 cm long; bracteal stipule ca. 2 × 1 mm, lanceolate, glabre; involucre bracts pale to yellowish-greenish, entire, apex acute, 0.7–1.3 × 0.5–1.0 cm, glabrescent, margins dentate, with papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 7 flowers. Staminate flowers ca. 25 stamens, bracteoles 3–4, 2–3 × 3–4 cm, greenish, transversely oblong, glandular-dentate margins; 6 lanceolate sepals, 3 × 1–2 mm. Pistillate cymule subtended

by an involucrel of 4 bracts, 1–4 × 4 mm, eglandular, entire margins. Pistillate flowers with calyx of 6–7, pinnatifid, with stipitate glands, glabrous; ovary up to 1 × 1 mm, sparsely pubescent, styler column 3–4 mm long, greenish, apex cylindrical. Capsule and seeds not seen.

Representative Specimens Selected—Brazil. PARANÁ: Ponta Grossa, Passo do Pupo, 14 Dec 1976 (fl), *L. Kriger 709* (BHCB); Ponta Grossa, Dec 1969 (fl), *L. Kriger 7484* (UFJF; BHCB); Passo do Pupo, 05 Dec 1995, *J. M. Silva & J. Cordeiro 1561* (BHCB). GOIÁS: Fazenda Lagoa Santa, 140 km N of Brasília, 48° 35' W, 15° 30' S, 24 Sep 1972 (fl), *J. A. Ratter et al.*, 2512 (UB).

Distribution and Habitat—The species is registered in Argentina and Brazil. However, any specimens from Argentina were selected. *Dalechampia glechomifolia* was collected in field and woods from Paraná and in areas of Savannah in Goiás.

Phenology—Flowers from September to December.

Conservation—*Dalechampia glechomifolia* is designated as Least Concern (LC) due to an EOO of 1,799,113.217 km² and Endangered (EN) due to an AOO of 76. 000 km² (IUCN 2001).

Notes—*Dalechampia glechomifolia* was described by Baillon (1865) based on two collections, *St. Hilaire C³ 1567* and *Gaudichaud 104*, both syntypes are stored in P and in good conservation status; however, the first one has three branches separated and two pseudanthia. For these reasons we elected the *St. Hilaire C³ 1567* as lectotype. In addition, we are synonymizing *Dalechampia parvula* to *D. glechomifolia* due similarities shape of leaves, cordiform with margins dentate, number and shape of pistillate sepals, 6 lanceolate. Differing of other species of subshrubs habit.

Dalechampia glechomifolia is recognized by small leaves 1–1.5 × 2.5 cm, with margins dentate and involucrel bracts entire. This species is similar to *D. humiles* and *D.*

ulmifolia, because they share beyond the habit Subshrub and the leaves cordiform. However, they differ in margins of leaves dentate in *D. glechomifolia* (vs. denticulate in *D. humilis* and crenate to dentate in *D. ulmifolia*), involucre bracts exclusively entire (vs. 3-lobed in *D. humilis*, and or apically 3-toothed to rare entire in *D. ulmifolia*) and apex of stylar column cylindrical (vs. lobed in *D. humilis* and *D. ulmifolia*). The number of sepals also differs between *D. glechomifolia* (6) and *D. humilis* (12).

21. *Dalechampia guaranitica* Chodat & Hassler Bull. Herb. Boissier, sér. 2, 608: 1905.

Type: PARAGUAY, Apepu (Tapiraguay), *Hassler 4334* (holotype G!).

Dalechampia morifolia Pax K. Hoffman, 42: 1919, *syn. nov.* Type: PARAGUAY, Apepu (Tapiraguay), *Hassler 4336* (Neotype G!, designated here).

Subshrub 40–45 cm high. Leaves simple, 3-lobed to entire; petiole 0.3–1 cm long; petiolar stipule lanceolate, entire; blade chartaceous to membranaceous, cordiform, 5–8 × 3.5–5 cm, middle lobe ovate, 0.5–1.5 cm wide, apex rounded, base truncate, adaxial glabrescent on surface and abaxial sparsely hispid mainly on veins, margins completely dentate, without capitate glandular trichomes, venation eucamptodromous. Inflorescence axillary, 5–6 cm long; bracteal stipule 5–7 × 1.8–2 mm, lanceolate, entire; involucre bracts greenish or green-pinkish, 3-lobed, apex acute, 2.5–3.0 × 2–2 cm, pubescent, margin dentate, without glandular trichomes; resiniferous gland laminar. Staminate pleiochasium 7 flowers. Staminate flowers, stamens not seen, 1 bracteole, 0.5–6 × 1 cm, greenish, transversely oblong, eglandular-entire margins; sepals not seen. Pistillate cymule subtended by an involucre of 3 bracts, oblong to lanceolate, 3–5 × 1–4 mm, glandular-dentate margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with stipitate glandular; ovary ca. 3 × 2–5 mm, densely velutinous, stylar column 5–7 ×

1 mm long, greenish, apex slightly clavate. Capsule and seeds not seen.

Representative Specimens Selected—Brazil. GOIÁS: Serranópolis, Estrada entre Jataí e Serranópolis, 17° 53' 46" S, 51° 39' 56" W, 762 m. 24 Nov 2007 (fr), *Pastore J. F. B.* et al., 2364 (CEN). MATO GROSSO DO SUL, Centro Universitário Coxim, 24 Sep 2016 (fl. fr), *Pereira-Silva & R. Sodr  54* (PEUFR). **Paraguay.** REGIÃO FLUMINIS TAPIRAGUAY, without date (fl), *E. Hassler, 43344* (KEW).

Distribution and Habitat—Species occurs in environment of Savannah from Brazil and Paraguay. Registered here for the first time to Goiás and Mato Grosso do Sul states.

Phenology— Flower in September, Fruits from September to November.

Conservation—*Dalechampia guaranitica* was assessed as Endangered (EN) due to an EOO 889.591 km² and also as Endangered (EN) due to an AOO 24.000 km² (IUCN 2001).

Notes—*Dalechampia guaranitica* is recognized by leaves deeply 3-lobed, rare entire, and glandular trichomes present on margins of pistillate sepals and pistillate bracteoles. It is similar to *D. weddelliana* due to the leaves that sometimes are entire in *D. guaranitica*.

Webster & Armbruster (1991), considered *D. morifolia* as a synonym of *D. weddelliana*. This last species was described by Baillon (1865) based on *Weddell 2974*. Although these species share one staminate bracteole and 12 pinnatifid pistillate sepals, they differ by deeply 3-lobed leaves, rare entire in *D. morifolia* (vs. entire rare 3-lobed in *D. weddelliana*), involucre bracts entire (vs. 3-lobed), the pistillate sepals and pistillate bracteole have glandular trichomes (vs. without glandular trichomes in pistillate bracteole neither in the pistillate sepals).

Dalechampia guaranitica and *D. morifolia* share involucre bracts entire (vs. 3-lobed in *D. weddelliana*); the pistillate sepals and pistillate bracteole present stipitate

glandular on their margins (vs. without stipitate glandular in pistillate bracteole margins neither in the pistillate sepals in *D. weddelliana*). So, *D. morifolia* differ from *D. weddelliana*, but is more morphologically close to *D. guaranitica*, for these reasons we are proposing the synonymy between them.

The type of *Dalechampia morifolia* Hassler 4335 was not found in G herbarium. For this reason we are proposing here Hassler 4336 as neotype, this exsiccate has the same locality of the original type and it is in good conditions of conservation. In addition, the collection Hassler 4336 of *D. morifolia* has the same type locality of *D. guaranitica* Hassler 4334 (Paraguay, Apepu, Tapiraguay) and we could not find any differences between them. For this reason, we are proposing here *D. morifolia* as synonym of *D. guaranitica*.

22. *Dalechampia hispida* Poepp. in E.F.Poeppig & S.L. Endlicher, Nov. Gen. Sp. Pl. 3: 19. 1841. TYPE: PERU, Mission Tocache, *E.F. Poeppig 2016* (holotype W; isotype F 0042460!, G 00237306!).

Twining vine. Leaves simple, unlobed; petiole 6–10 cm long; petiolar stipule widely lanceolate, entire; blade membranaceous, cordiform, 8–13 × 4–10 cm, apex acute, base of cordate, adaxial sparsely hispidous on surface and abaxial hispidous mainly on the veins, margins sinuate to dentate, with papiliforms glands, venation actinodromous. Inflorescence axillary, 4.5–5 cm long; bracteal stipule 4–5 × 1 mm, lanceolate, hispidous; involucre bracts greenish to yellowish, 3-lobed, apex acute, 2.2–2.5 × 2.8–3 cm, sparsely hispidous, margins dentate usually with estipitate glandular trichomes; resiniferous gland laminar. Staminate pleiochasium ca. 5 flowers. Staminate flowers with 12–24 stamens, bracteoles 2, ca. 4 × 5 mm, greenish, transversely oblong, eglandular, entire margins; 4–5 deltoid sepals, ca. 1.5 × 1.5 mm. Pistillate cymule

subtended by an involucrel of 4 bracts, widely ovate to lanceolate, ca. $4 \times 1.5\text{--}3$ mm, eglandular, entire margins. Pistillate flowers with calyx of ca. 12 sepals, pinnatisect, with stipitate glandular, hispid; ovary ca. 1×1 mm, styler column 5–6 mm long, apex cylindrical to 3-lobed. Capsule ca. 1 cm long, pubescent and seeds ca. 0.9×1 cm, globoid, dark brown with pale macules.

Representative Specimens Examined— PERU: Mariscal Caceres, 23 Oct 1969, fl. fr., *J. V. Schuncke* 3561 (USM; G). Mariscal Caceres, 11 Apr 1970, fl. fr., *J. V. Schuncke* 3885 (F; USM; G).

Distribution and Habitat—Species restricted to Peru in sunny environments.

Phenology—Flowers and fruits April to October.

Conservation—The species was assessed as Near Threatened (NT) due an EOO of 42, 682.815 km² and Endangered due an AOO of 16.000 km² by the criteria of IUCN (2001).

Notes— *Dalechampia hispida* is easily recognized by leaves and involucrel bracts with trichomes sparsely hispidous, the involucrel bracts always 3-lobed and the apex of styler column cylindrical to 3-lobed.

23. *Dalechampia humilis* Müll. Arg. Linnaea, 34, 233: 1865. TYPE: BRAZIL, Goias, Rio das Velhas, *Riedel s.n* (holotype G 00169586!, isotype CDG!) .

Subshrub 38–45 cm high. Leaves simple, unlobed; petiole 2–4 mm long; petiolar stipule linear entire; blade membranaceous, cordiform, $2.5\text{--}5 \times 2\text{--}3$ cm, apex rounded, adaxial and abaxial pubescent on surfaces, margins denticulate, usually with papiliform glands, venation actinodromous. Inflorescence axillary 3–4.6 cm long; bracteal stipule $4\text{--}5 \times 0.5\text{--}1$ mm, lanceolate, entire; involucrel bracts greenish to reddish, 3-lobed, apex

acute, 1.5×2.3 cm, pubescent, margins serrate with papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 9 flowers. Stamens not seen, bracteole 1, $3-4 \times 4-5$ mm, greenish, transversely oblong, eglandular, entire margins; 4 lanceolate sepals $2-2.5 \times 2-2.2$ mm. Pistillate cymule subtended by an involucrel of 3 bracts, deltoid to elliptical, $0.4-5 \times 1.5-7$ mm, glandular-ondulate margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with stipitate glands, pubescent; ovary $1 \times 1-2$ mm, glabrescent, styler column 2.5–3 mm long, reddish, apex widely lobed. Capsule not seen.

Representative Specimens Selected—Brazil. BRASÍLIA: 1865, *L. Riedel s.n.* (GH00047580). GOIÁS: Cristalina, $16^{\circ}47'08''\text{S}$, $47^{\circ}34'18''\text{W}$, 30 Sep 2011 (fl), *J.E. Q. Faria et al.* 1485 (UB). Abadiânia, 14 Sep 2003, *J. F. B. Pastore et al.*, 692 (CEN). MATO GROSSO: Campo Verde, 32 km de Nova Brasilândia, $15^{\circ} 07' \text{ S}$, $65^{\circ} 06' \text{ W}$. 08 Oct 1997, *V. C. Souza et al.*, 20409 (ESA). MINAS GERAIS: Cabeceira, região da Ponte sobre o Rio Preto. $16^{\circ} 02' 15'' \text{ S}$, $47^{\circ} 18' 34'' \text{ W}$, 14 Feb 2002 (fl), *A. C. Servilha et al.*, 2133 (CEN); Pirenópolis, 8 km em direção a Corumbá. 14 Jul 2000, *V. C. Souza et al.*, 23892 (ESA). SÃO PAULO: Itararé. Bom Sucesso de Itararé, Jun 2004 (fl), *L. C. Bernacci*, 3644 (IAC).

Distribution and Habitat—The species occurs beyond Brazil, in the Paraguay, however any material from this country was examined. In Brazil, it is well distributed in the Central region, frequently found in roadside, in 850 m high., and in disturbed area after fire. There is also registered to São Paulo state from west Central.

Phenology—Flowers in February, June and September.

Conservation—The species was assessed as Least Concern (LC) due to an EOO 1,271,727.332 km² and Endangered (EN) due to an AOO 188.000 km² according to IUCN (2001).

Notes—*Dalechampia humilis* can be recognized by leaves cordiform, 2.5–5 × 2–3 cm, with margins denticulate and involucre bracts 3-lobed greenish-reddish. The species is close to *D. ulmifolia* due the sharing one staminate bracteole with style lobed and involucre bracts 3-lobed. However, they differ in margins of leaves denticulate (vs. margins crenate to dentate in *D. ulmifolia*, margin of pistillate bracteole with glandular trichomes (vs. absent) and number of pistillate sepals 12 (vs. 6–10).

24. *Dalechampia ilheotica* Wawra, Oesterreichische Botanische Zeitschrift, 13: 222.

1863. TYPE: BRAZIL. Bahia: Ilhéus, without date, *H. Wawra & J.K. Maly 365* (holotype W 0023458 image!).

Dalechampia bahiensis Müll. Arg., Prodr.15(2): 1247. 1866. TYPE: BRAZIL. Bahia:

Blanchet 128 (Lectotype G!, designated by Webster & Ambruster, 1991).

Liana. Leaves simple, entire to 3-lobed in the same individual; petiole 3–4 cm long; petiolar stipule lanceolate, entire; blade membranaceous to coriaceous, cordiform 6–8 × 5–8 cm, middle lobe ovate, 1.5–3 cm wide, apex acute, base cordate, adaxial and abaxial glabrous or sparsely hispid on surface, margins slightly serrate, with papiliform glands, venation actinodromous. Inflorescence axillary, 6–7 cm long; bracteal stipule ca. 1 × 4 mm, linear, entire; involucre bracts greenish, entire to 3-lobed, apex acute to rounded, 2.5–3.5 × 2.5–4 cm, velutinous, margins dentate usually with sparsely stipitate glandular trichomes; resiniferous glands lacerate. Staminate pleiochasium 11 flowers. Staminate flowers ca. 28 stamens, bracteoles 2, 1–1.2 × 0.7–0.85 mm, greenish, depressed ovate, eglandular, entire margins; 4 deltoid sepals, 3–4 × 3 mm. Pistillate cymule subtended by an involucre of 2 bracts, widely depressed ovate, 4–5 × 5–6 mm, eglandular, entire margins. Pistillate flowers with calyx of ca. 12 sepals, pinnatifid, with stipitate glandular, sparsely pubescent; ovary 1–1.2 × 1–1.2 mm,

stylar column 8–12 mm long, greenish, apex crateriform. Capsule 1.3–1.5 cm long, glabrescent; seeds ca. 4.5×5 mm, globoid, dark brown with pale macules.

Representative Specimens Examined—**Brazil.** BAHIA: Buerarema, $15^{\circ}9'95''\text{S}$, $39^{\circ}18'4''\text{W}$, 17 Dec 2002 (fl), *P. Fiaschi et al. 1159* (CEPEC, NY); Camumu, 23 Jul 1881, *A.M. de Carvalho & J. Gatti 753* (CEPEC); Jacobina, $11^{\circ}09'07''$, $40^{\circ}00'41''$, 23 Aug 1980 (fl), *R. Orlandi 211* (CEPEC); Prado, 20 Oct 1993 (fl), *W. W. Thomas et al. 10019* (CEPEC); São Miguel das Matas, Fazenda Engenho da Lama, 24 Feb 2000 (fl), *J. G. C. Jardim et al 2896* (SP); Without local, 1854 (fl) *without collector* (K000903315). PERNAMBUCO: Maraial, Serra do Urubu, 10 Feb 1994 (fr), *A.M. Miranda 1317* (PEUFR).

Distribution and Habitat—*Dalechampia ilheotica* is endemic to Brazil and can be found only in the northeast region (Bahia and Pernambuco states) where grows specifically in Atlantic forest, occurring in serra, edge of forest or coastal region.

Phenology—Flowers from February to December; fruits in February.

Conservation—*D. ilheotica* is assessed as Least Concern (LC) due to an EOO of 3,942,892.511 km² and Endangered (EN) due to an AOO of 244,000 km², according to IUCN.

Notes—*Dalechampia ilheotica* resembles *D. coriacea* by aspects already mentioned in the comments of these species. It can be characterized by dimorphic leaves, beyond stigma crateriform.

25. *Dalechampia leandrii* Baill., in *Adansonia* 5: 315. 1865. TYPE: BRAZIL. Rio de Janeiro: without local, 1819, *Leandro di Sacramento 110* (lectotype P!, designated by Webster & Armbruster 1991).

Dalechampia vulpina Müll. Arg., in *Linnaea* 34: 222. 1865. TYPE: BRAZIL. “In Brasilia prope Rio de Janeiro”, without date, *C. Gaudichaud 1133* (lectotype G! designated by Webster & Armbruster 1991).

Twining vine. Leaves simple, unlobed; petiole 1–2.5 cm long; petiolar stipule linear to deltoid, entire; blade membranaceous, ovate 3–11 × 2.5–6 cm, apex acute, base of leaf rounded to cordate, adaxial and abaxial pubescent on surface, margins undulate, with papiliform glands, venation eucamptodromous. Inflorescence axillary, 4–5.8 cm long; bracteal stipule 4–6 × 1–1.5 mm, lanceolate, entire; involucre bracts greenish, vary between entire to 3-lobed, 2–2.9 × 1.5–2 cm, hirsutous, margins entire with sparsely papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 9 flowers, Staminate flowers 9–16 stamens, bracteoles 1–2, 0.3–0.4 × 0.5–1 cm, greenish, narrowly transversely oblong, eglandular, entire margins; 4 ovate sepals, 2–3 × 2 mm. Pistillate cymule subtended by an involucre of 2 bracts, widely depressed ovate, 4–5 × 5–6 mm, eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, pinnatisect, with stipitate glands, hispidous; ovary ca. 1 × 1 mm, stylar column ca. 6 mm long, greenish, apex slightly lobed. Capsule 0.8–1 cm long, sparsely pubescent; seeds ca. 3 × 2 mm, globoid, dark brown with pale macules.

Representative Specimens Examined—**Brazil**. SÃO PAULO: Pariqueira-Açú, 16 Feb 1995 (fl), *H. F. Leitão Filho et al. 33192* (UEC); Estrada Pariqueira-Açú para Cananéia, 07 Feb 1995 (fl), *H.F. Leitão Filho et al. 32727* (UEC). PARAÍBA: Mamanguape, Reserva ecológica Guaribas, 07 Sept 2015 (fl, fr), *R. A. Pereira-Silva 32* (PEUFR). RIO DE JANEIRO: Parati, Laranjeiras, 09 Dec 1993 (fr) *T. Konno et al. 371* (RB); Parque Nacional da Tijuca, 27 Dec 1984 (fl), *G. L. Webster et al. 25429* (UEC).

Distribution and Habitat—The occurrence of species is confirmed only to Paraíba, São

Paulo and Rio de Janeiro states (Brazil). The specimens found were registered to edge forest mainly in preserved areas.

Phenology—Flowers from February to December; fruits from September to December.

Conservation—According to IUCN Criteria (2001), the species was assessed as Least Concern (LC) due to an EOO of 36,776.298 km² and Endangered (EN) due to an AOO of 16,000 km².

Notes—*Dalechampia leandrii* presents petiole 1–2.5 cm long; margins of leaves undulate and 12 pistillate sepals pinnatisect. The taxon can be compared morphologically to *D. schenckiana* and *D. tenuiramea* because they share entire leaves. The species is already differentiated in *D. tenuiramea* comments. However, *D. leandrii* is differentiated from *D. schenckiana* by the number of pistillate sepals 12 pistillate sepals (vs 6 pistillate respectively). The involucral bracts vary between entire to 3-lobed in *D. leandrii* (vs always entire in *D. schenckiana*). The apex of stylar column is slightly lobed in *D. leandrii* (vs slightly crateriform in *D. schenckiana*).

26. *Dalechampia leucophylla* Müll. Arg., Linnaea 34: 219. 1865. Type: BRAZIL, Goiás, Pohl s.n. (lectotype G0034238 designated by Webster & Armbruster 1991, isolectotype FOBN005345).

Subshrub, 40–45 cm high. Leaves simple, unlobed; petiole 2–3 mm long; petiolar stipule lanceolate, pinnatifid; blade chartaceous to membranaceous, ovate, 4–7 × 2.5–3 cm, apex acute, base truncate, adaxial and abaxial densely velutinous, rare glabrous on surfaces, margins entire, without glandular trichomes, venation actinodromous. Inflorescence axillary, ca. 3.3 cm long; bracteal stipule ca. 3 × 1 mm linear, entire; involucral bracts greenish, entire, apex acute, 1.5–1.6 × 1.3 cm, velutinous, margins

entire, without papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 7 flowers. Pistillate cymule not seen. Pistillate flowers with 6, linear, without glandular trichomes, velutinous; styler column greenish, apex lobed. Capsule not seen.

Distribution and Habitat—*Dalechampia leucophylla* is endemic to Brazil, it is found only to Goiás state.

Conservation—*Dalechampia leucophylla* is designated as Critically Endangered (CR) due to an EOO of 0.000 km² and also Critically Endangered (CR) due AOO of 8. 000 km².

Notes—Part of the staminate bracteoles, ovary, part of pistillate cymule and capsule were not seen, due to the description be based only in the fragmented type. *Dalechampia leucophylla* can be recognized by vellutinous branches and 6 pistillate sepals entire. It is similar to *D. occidentalis* due the long of leaves (4–11 cm) and the indument, which can vary between glabrous to velutinous on leaves in both species. However, differ in many aspects such as venation actinodromous in *D. leucophylla* (vs. eucamptodromous in *D. occidentalis*), involucre bracts entire (vs. 3-lobed) and 6 pistillate sepals entire (vs. 12 pinnatifid).

27. *Dalechampia linearis* Baillon. Adansonia. 5: 315. 1865. TYPE: BRAZIL. Goiás, Rio Pilões, *St. Hilaire C¹ 801* (lectotype P 00712324!, designated by Webster & Armbruster, 1991).

Dalechampia brevipes var. *monophylla* Mueller Argoviensis, 2244: 1865. TYPE: BRAZIL, Piauí, *Gardner 2955* (G00342386! lectotype designated by Webster & Armbruster, 1991).

Dalechampia linearis var. *hilariana* Baillon, 316: 1865. TYPE: BRAZIL, Goiás, *St.*

Hilaire 676 (holotype P!).

Dalechampia linearis var. *subintegra* Muller Argoviensis, 644: 1874. TYPE: BRAZIL, Goias, *Pohl 3936* (lectotype G 00342383! designated by Webster & Armbruster, 1991).

Dalechampia goyazensis Mueller Argoviensis, 643 1874.—*Dalechampia linearis* var. *goyazensis* (Mull. Arg.) Pax & K. Hoffman, 442: 1919. TYPE: BRAZIL. Goias, without date, *Burchell 7491* (lectotype here designated K! BR). Remaining syntypes: Goias, without date, *Gardner 3980* (G00342384! G00342385!); Goias, without date, *Glaziou 22072a* (not located); Goias, without date, *Glaziou 22073* (not located); PARAGUAY, Sierra de Maracayu, without date, *Hassler 5296a* (not located).

Subshrub, 29–40 cm high. Leaves simple, unlobed; petiole 2–4 mm long; petiolar stipule linear, entire; blade membranaceous, linear, 4–10 × 0.3–10 cm, apex acuminate, base rounded to acuminate, adaxial and abaxial glabrous to hispid on surfaces, margins serrate, usually with capitate glandular trichomes, venation eucamptodromous. Inflorescence terminal, 3–5 cm long; bracteal stipule 4–5 × 0.3 mm, linear, entire; involucre bracts pale or yellowish, sometimes with vinaceous veins, 3-lobed, apex acute, 1.5–2.5 × 1.5–2.0 cm, hispid to glabrescent, margins serrate, rare glandular trichomes; resiniferous gland laminar. Staminate pleiochasium 9-flowers. Staminate flowers 8 to 12 stamens, bracteoles 1–3, 2.5–3 × 4–5 mm, reddish, depressed ovate, eglandular, entire margins; 4 lanceolate sepals, 2–2.2 × 2 mm. Pistillate cymule subtended by an involucre of 3 bracts, deltoid to elliptic, 3–4 × 2–5 mm, glandular-dentate margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with stipitate glandular, glabrous to densely velutinous; ovary up to 1 × 1 mm, stylar column 4–6 mm

long, greenish, apex lobed, sometimes 3-fid. Capsule 2–3 × 2–4 mm, glabrescent; seeds 2–3 × 2–3, globoid, pale with white macules.

Representative Specimens Selected— Brazil. DISTRITO FEDERAL. 26 Sep 1980 (fl), *Grandi T. M. M. 395* (BHCB). GOIÁS: Niquelândia, estrada Uruaçu, margem do Rio Maranhão. 12 Sep 1998 (fr), *V. C. Souza et al., 21573* (ESA). MARANHÃO: Balsas, next to Vila Nova de Caldas, 46° 5' S, 7° 35' W 18 Nov 1997 (fl), *R. C. Oliveira & G. P. Silva, 545* (CEN). MATO GROSSO, 30 km de Xavantim 400 m, 11 Jun 1966 (fl, fr), *H. S. Irwin et al., 16393* (UB). PIAUÍ: Ribeirão, estação ecológica de Uruaçu-una. 17 Oct 1980 (fl), *Fernandes A. & Castro A. J. s.n.* (EAC 9060). TOCANTINS: Palmas, Estrada para Natividade, 11° 37' S, 47° 23' W. 22 Jul 2000 (fl), *V. C. Souza et al., 24514* (CEN). **Paraguay**, Estancia La Manina, Distr. San Estanislao, 22 Nov 1969 (fl), *without collector 9342* (K).

Distribution and Habitat—*Dalechampia linearis* occurs in Paraguay and is well distributed in environment of Savannah, in Brazil, since Tocantins and Piauí in the Northeast until Central region in river bank, conservation unit or in road side, ca. 514 m high., and rocky soil.

Phenology—Flowers from June to November. Fruits registered from June to September.

Conservation—According to the IUCN red list criteria (IUCN 2001), the species is designated as Least Concern (LC) due to an EOO of 577.636 km² and Vulnerable (VU) due to an AOO of 336.000 km².

Notes—*Dalechampia linearis* can be characterized by mainly staminate and pistillate cymules purplish. A comparative analysis of types and specimens of *Dalechampia serrula* and *D. linearis* showed that these are very similar. The collections share 12 pinnatifid pistillate sepals with glandular trichomes and predominantly 3-lobed

involucral bracts. However, *D. linearis* has margins of leaves serrate (vs. dentate in *D. serrula*), staminate bracteoles, sepals and stylar column purplish (vs. green).

Regarding to the lectotypification, the collection of exsiccate *Burchell 7491* from K was chosen since it presents flowers and also because is one of the main institutions housing types studied by Burchell.

28. *Dalechampia magnistipulata* Webster & Armbruster., Brittonia 31: 352–357. 1979.

TYPE: MEXICO. Veracruz: without local, 2 Sept 1976, *G. L. Webster & S. Armbruster 20986* (holotype DAV 97023 image!, isotypes NY 00263010 image!, MEXU 00785203 image!).

Twining vines. Leaves simple, 3-lobed; petiole 5.5–15 cm long; petiolar stipule, lanceolate, entire; blade chartaceous, 10–20 × 8–20 cm, middle lobe obovate, 4–7 cm wide, apex acuminate, base of leaf deeply cordate, adaxial and abaxial surfaces puberulent, margins subentire or inconspicuously crenulate venation actinodromous. Inflorescence axillary or terminal, 4–7.5 cm long; bracteal stipule 1.1–1.5 cm long, elliptic to oblong; involucral bracts greenish, 3-toothed apically, 2–3.5 × 3.5–6 cm, puberulent, margins denticulate, with papiliforms glands. Resiniferous glands laminar. Staminate pleiochasium 8–10 flowers. Staminate flowers ca. 15–24 stamens, bracteoles 2, 2.5–4 × 10–11 mm, greenish, depressed ovate, eglandular, entire margins; 4–6 lanceolate, 4–4.7 × 1.7–2.5 mm. Pistillate cymule subtended by an involucl of usually 2 bracts, reniform. 2–3 × 3–5 mm, glandular-dentate margins. Pistillate flowers with calyx of 10–12, lacinate, with stipitate glands, hispidulous; ovary ca. 2 × 3 mm, stylar column 9–11.5 mm long, greenish, apex peltate. Capsule ca. 13 mm long, sparsely hispidulous; seeds ca. 5 × 5 mm long, globoid, grey or brown with white macules.

Representative Specimens Examined—Mexico. VERACRUZ: San Andres Tuxtlas, 5 Apr

1972 (fr), *J. I. Calzad a* 802 (MEXU).

Distribution and Habitat—*Dalechampia magnistipulata* is found only in Mexico occurring in open areas in mature rainforest and in open secondary woodland in 450 m alt.

Phenology—Flowers in February; Fruits in April.

Conservation—According to IUCN criteria (2001), the species is assessed as Least Concern (LC) 159. 586. 427 km² due to an AOO of 159.586.427 km² and Endangered due to an AOO of 52. 000 km².

Notes—*Dalechampia magnistipulata* is characterized by leaves monomorphic 3-lobed and involucre bracts 3-toothed. Morphologically, is close to *D. tiliifolia*. However, they differ in leaves always 3-lobed in *D. magnistipulata* (vs. varying between entire to 3-lobed in the same individual in *D. tiliifolia*) and the resiniferous glands are laminar (vs. fimbriate in *D. tiliifolia*).

29. *Dalechampia meridionalis* M ull. Arg. (M uller Argoviensis 1874: 648). TYPE:

BRAZIL, S ao Paulo, without date, *W. J. Burchell* 4299 (lectotype G 00169584!, designated by Webster & Ambruster, 1991; isoelectotypes BR 0000005902606!, K 000895660!).

Dalechampia pallida Klotzsch ex Pax & Hoffmann, A. Engler (Ed.), Das Pflanzenreich, IV. 247. VII (Hefte 68): 22 (1919). TYPE: Brazil, Sellow 636 (holotype B, destroyed; lectotype G, designated by Webster & Armbruster 1991).

Twining vine. Leaves compound, 3-foliolate; petiole 1.5–2 cm long; petiolar stipule linear, entire; blade membranaceous to chartaceous, middle leaflet elliptic, 3.8–5 × 1.2–2 cm, lateral leaflets elliptic to lanceolate, of similar size to middle leaflet, apex acute, base asymmetric, adaxial glabrous on surface and abaxial glabrous to vellutinous,

margins serrate, with papiliform glands, venation eucamptodromous. Inflorescence axillary, 2.5–3 cm long; bracteal stipule ca. 3×0.8 mm, linear, entire; involucre bracts moderately 3-lobed, greenish, apex acute, $1-1.5 \times 1.5-2$ cm, glabrous, margins serrate, with papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 7 flowers. Staminate flowers with stamens not seen, bracteoles ca. $5 \times 5-6$ mm, greenish, transversely oblong, eglandular, undulate margins. Pistillate cymule subtended by an involucre of 3 bracts, oblong to widely ovate, ca. $4 \times 1.5-3$ mm, eglandular, entire margins. Pistillate flowers with calyx of 7–12 sepals, pinnatisect, with stipitate glandular sparse, sparsely hirsute; ovary up to 1×1 mm, stylar column 4–6 mm long, apex cotyliform. Capsule ca. 8 mm long, sparsely pubescent; seeds not seen.

Representative Specimens Examined—Brazil. PARANÁ, Londrina, Salto do Apucarantina, 11 Sept 1989 (fl), *A. Laforga et al. s.n* (FUEL 8154). RIO DE JANEIRO, Petrópolis, Carangola, Sept 1943 (fl), *O.C. Góes 517* (RB). SÃO PAULO, Villa Emma (fl), *Brade 12964* (RB).

Distribution and Habitat—*Dalechampia meridionalis* is endemic to Brazil. The species is registered to South (Paraná state) and Southeast (Rio de Janeiro, São Paulo states) in environment of Cerrado and Atlantic Forest.

Phenology—Flowers in September.

Conservation The species was categorized as Data deficient according to the IUCN (2001), since the number of specimens available in the collections is quite low and, for the most part, does not contain information on the collection sites.

Notes—*Dalechampia meridionalis* is characterized mainly from other species with 3-foliolate leaves by the apex of stylar column cotyliform. This species is closer to *D. stenosepala* due the adaxial surface of leaflet glabrous and the long of pseudhantium, however can be differentiated by the apex of stylar column cotyliform (vs. moderately

delegate to slightly lobed in *D. stenosepala*).

30. *Dalechampia micromeria* Baill. (Baillon 1865: 310). TYPE: BRAZIL. Rio de Janeiro, 1833, *Gaudichaud 1130* (lectotype designated here G-DC 00317216!; isoelectotype G 00169585!, P 00640225!, P 00640226!).

Dalechampia sellowiana var. *serrata* Müll. Arg. (Müller Argoviensis 1865: 220). TYPE: BRAZIL, São Paulo, *Sellow 4177* (lectotype P!, designated by Webster & Ambruster, 1991; isoelectotype F 0056227!).

Dalechampia sellowiana var. *subintegra* Müll. Arg. (Müller Argoviensis 1865:220). Type: BRAZIL, Rio de Janeiro, *G. Casaretto 1178* (lectotype G! designated by Webster & Ambruster, 1991: 170).

Dalechampia micromeria var. *angustifolia* Pax & Hoffm. (Pax & K. Hoffmann 1919: 23). Type: PARAGUAY, Cordilheira de Altos, *Hassler 6067* (lectotype G!).

Twining vine. Leaves compound, 3-foliolate; petiole 1.5–4 cm long; petiolar stipule linear, entire; blade membranaceous, middle leaflet elliptic, 3.5–4 × 0.5–0.7 cm, base attenuate, lateral leaflets ovate, of similar size to middle leaflet, apex acute to rounded, base asymmetric, adaxial and abaxial glabrous on surfaces, margins entire to sinuate, with papiliform glands, venation eucamptodromous. Inflorescence axillary 2–4 × 0.7–2 cm long; bracteal stipule 3 × 1 mm, linear, entire; involucre bracts moderately 3-toothed apically, greenish, apex acute, 1.5 × 0.7–2 cm, glabrous, margins entire to moderately sinuate, with rare papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 6 flowers, stamens not seen, bracteoles 1, ca. 4 × 4 mm, greenish, transversely oblong, eglandular, entire margins; 4 lanceolate sepals, ca. 1 × 1 mm. Pistillate cymule subtended by an involucre of 3 bracts, oblong to widely oblong, eglandular, entire margins. Pistillate flowers with calyx of ca. 8 pinnatisect, with

stipitate glandular, sparsely hirsute; ovary up to 1×1 mm, stylar column ca. 3mm long, apex cylindrical. Capsule and seeds not seen.

Representative Specimens Examined—Brazil. BRASÍLIA, 1854 (fl), *L. Sellow* (K000600723). MINAS GERAIS, Belo Horizonte, Terceira Estação Ecológica UFMG, 08 Nov 1990 (fl), *E. Tameirão Neto & França 235* (BHCB). PARANÁ, Curitiba, Parque Barugui, s/date, *C. Koserá & V. A. O. Dittrich 300* (BHCB); Pitanga, 28 Nov 2001 (fr), *O.S. Ribas et al. 3900* (BHCB/UFMG). SÃO PAULO, Eldorado, 22 Abr 2003 (fl), *R.A.G. Viani et al. 204* (ESA). **Paraguay.** Villa Rica, 1905 (fl), *E. Hassler 8635* (P).

Distribution and Habitat—The species is distributed in the central of Brazil (Brasília) and Southeast (Minas, Paraná and São Paulo), in Paraná is registered next to Rio Corumbataí in Mata de Galeria and in forest edge of Parque Barigui. In São Paulo state was found in 790 m alt of the Parque Estadual Intervales, Access track to Estação Ecológica Xituê and in Minas Gerais to woods. In Paraguay occurs in mountainous regions.

Phenology—Flowers in April and November; fruits in November.

Conservation— According to the IUCN red list criteria (IUCN 2001), *Dalechampia olfersiana* is designated as Least Concern (LC) due to an EOO of 990,278.833 km² and Endangered (EN) due to an AOO of 224.000 km².

Notes— *Dalechampia micromeria* distinguished from the other species with 3-foliolate leaves due the long of leaves 3.4–5 cm long, being the smaller among them and apex of stylar column cylindrical.

Dalechampia micromeria was proposed by Baillon (1865) based on *Gaudichaud 1130* stored in *herb. Lessert*. Webster and Armbruster (1991) indicated that the holotype was stored in G. However, we found two specimens in this herbarium (00317216 and 00169585). In this sense, we elected the specimen G-DC 00317216 as the lectotype.

31. *Dalechampia occidentalis* Müll. Arg., in Fl. Bras., 2: 641. 1874. TYPE: BRAZIL,

Tamberlik s.n (holotype W, isotype G 00237308!).

Subshrub, 35–40 cm high. Leaves simple, unlobed; petiole 3–4 mm long; petiolar stipule linear, entire; blade membranaceous, lanceolate, 4–11 × 1.8–3 cm, apex rounded, base serrate, sub cordate, adaxial and abaxial surfaces slightly pubescent to velutinous, margins serrate, with papiliform glands, venation eucamptodromous. Inflorescence axillary, 2–5 cm long; bracteal stipule 4–6 × 0.5–3 mm, linear to deltoid, pubescent; involucral bracts greenish, 3-lobed, apex acute, 2.5–4.5 × 1.5–3 cm, pubescent, margin serrate, usually with sparsely stipitate glandular; resiniferous gland laminar. Staminate pleiochasium ca. 9-flowers. Staminate flowers 12–15 stamens, bracteoles 1, 12 mm circumference, greenish, depressed ovate, eglandular, entire margins; 4–6 lanceolate sepals, ca. 2 × 1 mm. Pistillate cymule subtended by an involucl of 1–3 bracts, widely ovate, to depressed ovate, 4–5 × 3–7 mm, eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with stipitate glandular, densely velutinous; ovary 1–2 × 1–2 mm, glabrescent, styler column 6–8 mm long, greenish, apex crateriform. Capsule 0.8–1.5 × 0.8–1.5 cm, glabrous; seeds ca. 2 × 3 mm, globoid, dark brown with white macules.

Representative Specimens Selected—Brazil. MATO GROSSO: Xavantina, estrada Cachimbo, 12° 49' S, 51° 46' W, 29 Feb 1968 (fl), *D. Philcox & A. Ferreira 4386* (UB); CHAPADA DOS GUIMARÃES, 22 Nov 1982, *J. U. Santos & C S. Rosário 451* (fl. fr) (INPA). TOCANTINS: Estrada para Arraiais/Paraná, Oct 2001 (fl), *J. B. A Bringel Jr 278* (CEN). GOIÁS: Posse, 16 Oct 2001, *R. C. Mendonça 4451* (fl) (CEN).

Distribution and Habitat—*Dalechampia occidentalis* is endemic from Brazil, distributed in Mato Grosso, Tocantins and Goias states in Savannah. The species occurs

preferentially in burned areas and road side with sandy soil.

Phenology—Flowers from June to November. Fruits registered from June to September.

Conservation— According to the IUCN red list criteria (IUCN 2001), *Dalechampia occidentalis* is designated as Least Concern (LC) due to an EOO of 798.198.179 km² and Endangered (EN) due to an AOO of 60.000 km².

Notes— The species can be recognized by leaves lanceolate, margins serrate and apex of stylar column lobed. It is similar to *D. adscendens*, they are differentiated in the comments of this species.

32. *Dalechampia olfersiana* Müll. Arg., Linnaea 34: 220. 1865. TYPE: BRAZIL. Minas

Gerais, without date, F. Sellow 636 (lectotype G!, islectotype F 0BN005348,

image! designated by Webster and Armbruster 1991).

Twining vine. Leaves compound, 3-foliolate; petiole 0.5–4 cm long; petiolar stipule linear-lanceolate, entire; blade membranaceous to chartaceous, middle leaflet elliptic, 4.5–6 × 1.2–1.8 cm, base sub-attenuate, lateral leaflets ovate, of similar size to middle leaflet, apex acute, base attenuate to asymmetric, adaxial sparsely hispidous on surface and abaxial vellutinous mainly on the veins, margins serrate, with papiliform glands, venation eucamptodromous. Inflorescence axillary, 3–3.4 cm long; bracteal stipule 4–7 × 0.8–1 mm, linear-lanceolate, entire; involucre bracts 3-toothed to moderately 3-lobed, greenish, apex acute, 1.3–1.5 × 1.3–1.8 cm, vellutinous, margins entire with papiliform glands; resiniferous gland laminar. Staminate pleiochasisium 7–8 flowers, Staminate flowers with 81–93 stamens, bracteoles 1, ca. 4 × 4–5 mm, greenish, transversely oblong, eglandular, undulate, sometimes cropped margins; 4–5 deltoid sepals, ca. 1.5 × 1.5 mm. Pistillate cymule subtended by an involucre of 4 bracts, widely

ovate to lanceolate, ca. $4 \times 1.5\text{--}3$ mm, eglandular, entire margins. Pistillate flowers with calyx of 7–10 sepals, pinnatisect, with stipitate glandular, hirsute; ovary $0.8\text{--}0.9 \times 0.8\text{--}0.9$ mm, stylar column 8–1.3 mm long, apex discoid. Capsule 3–4 mm long, sparsely pubescent; seeds $2\text{--}2 \times 2\text{--}2$ mm, light brown without macules.

Representative Specimens Selected—Brazil. BREJO DA MADRE DE DEUS, Fazenda do Bituri, 4 Feb 1995 (fl, fr), *M.J.N. Rodal & C.S. Zickel 456* (K, PEUFR); Caruaru, Brejo dos Cavalos, $08^{\circ}18'36''$, $36^{\circ}00'00''$, 02 Dec 1994 (fl), *Sales & Rodal 463* (PEUFR, K). BAHIA: Maracá, 22 Jun 2002 (fl), *K.R.B. Leite et al. 212* (HUEFS); MINAS GERAIS: Serra do Cipó, 21 Apr 1993 (fl), *J.A Lombardi & F.R.N Toledo 189* (BHCB).

Distribution and Habitat—*Dalechampia olfersiana* is endemic to Brazil, it occurs in Northeast (Pernambuco and Bahia) in areas of clayey and in Southeast (Minas Gerais and Rio de Janeiro) in areas fragmented of Atlantic Forest and Cerrado.

Phenology—February to April in flower and in April was registered fruits.

Conservation—According to the IUCN red list criteria (IUCN 2001), *Dalechampia olfersiana* is designated as Critically Endangered (CR) due to an EOO of 0.000 km² and Critically Endangered (CR) due to an AOO of 8.000 km². **Notes—***Dalechampia olfersiana* differ easily from other species with 3-foliolate leaves due its leaves membranaceous to chartaceous, together with a involucre bracts moderately 3-lobed and apex of stylar column discoid.

Notes—The species is characterized by involucre bracts 3-toothed to moderately 3-lobed, greenish, vellutinous, bracteal stipule linear and apex of stylar column discoid. It can be confused to *D. clausseniana*, they are differentiated in the comments of this last species.

33. *Dalechampia pernambucensis* Baill., *Adansonia* 5: 311. 1865. *Dalechampia scandens* var. *pernambucensis* (Baill) Pax & Hoffmann, *Pflanzenr.* IV. 147. XII

(Heft 68): 34. 1919. TYPE: BRAZIL. Pernambuco: without local, G. *Gardner* 1130 (holotype G 00434747!, isotypes BM!, K 000895664!).

Dalechampia herzogiana Pax & Hoffmann, in A. Engler (Ed.), Pflanzenr., IV. 147. XII (Heft 68): 36. 1919. syn. nov. TYPE: BOLIVIA. Santa Cruz: between Rio Pirai and Rio Cuchi, T. K. J. *Herzog* 1455 (lectotype G 00434763!).

Dalechampia scandens var. *fallax* Mueller Argoviensis, in Martius, Flora Brasiliensis, 11 (2): 658. 1874. TYPE: BRAZIL, Para, Santarem, *Spruce* 199 (lectotype, here designated G 305408/1! isolectotype M 0233679!). Remaining syntype: Brazil. Pará, prope Santarem *Sieber s.n.* (BR 0000005101511!). Brazil. Bahia, in silvis et in dumetis ad Joazeiro, *Martius* 2391 (M 0233678).

Twining vine. Leaves simple, 3-lobed; petiole 2.5–8 cm long; petiolar stipule lanceolate, entire; blade membranaceous, 4.5–7 × 4.5–9 cm, middle lobe ovate to elliptic-ovate, 1.5–4.5 cm wide, apex acute, base of leaf cordate, adaxial surface sparsely villous and abaxial surface villosous only the veins, margins serrated, with papiliform glands, venation actinodromous. Inflorescence axillary, 1.5–4 cm long; bracteal stipule 5–8 × 3–5 mm, deltoid, entire; involucral bracts white or greenish, 3-lobed, apex acute, 1–2.2 × 1–2 cm, densely pubescent, margins serrated, with sparsely stipitate glandular trichomes; Resiniferous glands laminar. Staminate pleiochasium 7 flowers. Staminate flowers ca. 4–10 stamens, bracteoles 2, 7–8 × 4 mm, greenish, reniform, eglandular, entire margins; 4 ovate to deltoid sepals, ca. 3 × 3.5 mm. Pistillate cymule subtended by an involucl of 3 bracts, reniform, 7–8 × 3–5 mm, eglandular, entire margins. Pistillate flowers with calyx of 7–12 sepals, pinnatifid, with stipitate glands, hirsute; ovary pubescent; stylar column 8–9 mm long, greenish, apex discoid. Capsule 0.4–1 cm long, sparsely pubescent; seeds ca. 3 × 3 mm, globoid, dark brown.

Representative Specimens Examined—Brazil. AMAZONAS: 16.5 km NE of Junction

with BR-174, on AM-010, 10 May 1994 (fl, fr), *W. S. Armbruster & W. J. Kress s.n* (INPA 17421). CEARÁ: Aiuaba, 29 Apr 2004 (fl) *J. R. Lemos & P. Matias 182* (K). PARÁ: Marafamim, 16 May 1994, *P. Cavalcante 474* (INPA). PARAÍBA: Caldas Novas, Distrito de Cajá, PB 54, 27 Aug 1998 (fl) *G.S Baracho et al. 21987* (HVASF). PERNAMBUCO: Tracunhaém, Engenho Trapuá, 1 Feb 2014 (fl), *Pereira & Lima 10* (PEUFR); Recife, 30 Apr 2013 (fl, fr), *R. A Pereira-Silva & L. Lima 1* (PEUFR). **Bolivia:** SANTA CRUZ, Prov. Sara, Desmontes, 450 m, 20 Jan 1925 (fl), *J. Steinbach 7342* (G, LPB)

Distribution and Habitat—The species is known to Bolivia and Brazil. In the first country, were found in regions next to rivers and in altitude at 450 m. In Brazil, is possible to found the taxon in the regions North and Northeast growing in edge of dry or rainforest.

Phenology—Flowers from January to August; fruits from April to May.

Notes—*Dalechampia pernambucensis* is easy to be identified due the apex of stylar column discoid, bracteal stipule deltoid, involucre bracts frequently white and margins with stipitate glandular trichomes. The species here synonymized to *Dalechampia pernambucensis* share these diagnostics characters mentioned.

In the protologue of *Dalechampia scandens* var. *fallax*, Muller cites three syntypes "habitat in prov. For prope Santarem: Spruce n. 199, Sieber; nec non in prov. Bahia, in silvis et in dumetis ad Joazeiro et alibi in interioribus hujus prov.: Martius n. 2391. "

In this case, there is no holotype as cited by Webster & Armbruster (1991). Then, these authors committed a mistake and it is necessary to proceed the lectotypification, since the species was described based on syntypes. We select the specimens G 305408/1 as a lectotype, because it has more number of flowers.

34. *Dalechampia riedeliana* Müll. Arg., Prodr. 2: 1236. 1866. *Dalechampia brevipes* var. *tripylla* f. *pohliana* Müll. Arg. (Linnaea 1865: 225). TYPE: BRAZIL. Mato Grosso: Serra do Diamantina, L. Riedel 1120 (Lectotype NY, isolectotype LE 00006859, image! designated by Webster & Armbruster, 1991: 167).

Erect subshrub, 30–60 cm alt. Leaves simple, deeply 3-lobed; petiole 3–4 mm long; petiolar stipule lanceolate, entire; blade membranaceous, ovate, middle lobe linear to lanceolate, 3–5 × 0.2 cm, apex lobe acute, base leaf attenuate, adaxial and abaxial glabrescent on surfaces, margins sinuate, with capitate glands, venation eucamptodromous. Inflorescence axillary or terminal, 1.2–2.5 cm long; bracteal stipule ca. 2 × 1 mm, linear, entire; involucral bracts greenish, deeply 3–4-lobed, apex acute, 0.7–1 × 0.6–0.8 cm, pubescent, margins dentate, with stipitate glandular. Resiniferous gland laminar. Staminate pleiochasium 9–10 flowers. Staminate flowers ca. 11 stamens, bracteoles ca. 2, 2 × 4–5 mm, greenish, transversely oblong, eglandular, entire margins; deltoid sepals 4, ca. 1.5 × 1.5 mm. Pistillate cymule subtended by an involucrel of 1 bract, deltoid, ca. 3 × 2 mm. Pistillate flowers with calyx of 9 sepals, pinnatifid, sparsely stipitate glands, moderately hirsute; ovary ca. 1.5 × 1.5 mm, densely hirsute; stylar column up to 4 mm long, greenish, apex lobed. Capsule 5–7 mm long, glabrescent; seeds ca. 2 × 2 mm, globoid, brown, with dark brown macules.

Representative Specimens Examined—Brazil. MATO GROSSO: Barra do Garças, Parque estadual do Serra Azul, 15°48'49,8"S, 52°13'58,5"W, 02 Aug 2004 (fl), E. S. Lima & E. F. Silva 553 (SP); Barra do Garças, Serra do Taquaral, 23 Nov 1997 (fl. fr), L.C. Bernacci & G. Arbocz 2528 (IAC); Rondonópolis, BR 364, 12 Dec 1978 (fl), A. Allem & G. Vieira 1712 (CEN). 30 km S. of Xavantina, 11 Jun 1966 (fl), H. S. Irwin et al. 16939 (NY).

Distribution and Habitat—*Dalechampia riedeliana* is endemic to Brazil and specifically found in Mato Grosso state (Central west region of the country) where occurs in open areas of Savannah and on roadside.

Phenology—Flowers from August to December.

Conservation—According the IUCN (2001), the species was classified as Least Concern (LC) due to an EOO 468.934.321 km² and Endangered (EN) due to an AOO of 24 km².

Notes—*Dalechampia riedeliana* is recognized by leaves deeply 3-lobed and lobes of leaves linear to lanceolate. It is morphologically similar to *D. brevipes*. They were differentiated in the comments of *D. brevipes*.

35. *Dalechampia riparia* Smith & Downs, Sellowia, 11: 153. 1959. TYPE: BRAZIL.

Santa Catarina: Ibirama, 100 m, 12 Dec 1956, *Reitz & Klein 3834* (holotype US 00096465, image!).

Twining vine. Leaves simple, 3-lobed; petiole 5–8 cm long; petiolar stipule lanceolate; blade membranaceous, 3–10 × 4–12 cm, apex acute, base cordate, adaxial surface sparsely pilose, margins serrate sparsely with papiliforms glands, venation actinodromous. Inflorescence axillary, 4–7 cm long; bracteal stipule 6–8 × 1.5–2 mm, lanceolate, entire; involucre bracts greenish or yellowish, 3-lobed, apex acute, 2–3.5 × 2–3.3 cm, pubescent, margins serrate. Resiniferous glands laminar. Staminate pleiochasium 8 flowers. Staminate flowers with 35–66 stamens, bracteoles 1, greenish, eglandular, entire margins; 4–5 lanceolate sepals. Pistillate cymule subtended by an involucre of 2 bracts, reniform to widely ovate, 4 × 3–5 mm, eglandular, entire margins. Pistillate flowers with calyx of 8–10 sepals, pinnatisect, with stipitate glands only in the apex, sparsely hispidous; ovary pubescent, ca. 2 × 2 mm, stylar column 6–8 mm long,

greenish, apex slightly lobed. Fruits and seeds not seen.

Representative Specimens Examined—**Brazil**. SANTA CATARINA: Ibirama, 12 Oct 1956 (fl), R. Reitz & R.M. Klein 3834 (US); BR 470, next to Rio Itajaí-Açú 27°05'18"S, 49°28'06"W, 03 Nov 2017, D.F. Silva 39 (ICN); country side 27°01'57"S, 49°32'06"W, 03 Nov 2017 (fl), D.F. Silva 42 (ICN).

Distribution and Habitat—*Dalechampia riparia* is known only in Brazil specifically in the south of the country in the state of Santa Catarina where it grows in environments close to the water courses.

Phenology—Flowers and fruit from September to November.

Conservation—*D. riparia* is assessed as Critical Endangered (CR) due to an AOO of 8.000 km².

Notes—The description was based from protologue and literature, so sizes of middle lobe, pedicel, staminate sepals were not obtained; the shape of staminate bracteole, pubescence of ovary and some others informations as well.

36. *Dalechampia rubrivenia* Pax & K. Hoffmann, Pflanzenr. IV. 147 XII (Heft 68): 43.

1919. Type: PARAGUAY. Caaguazú, Hassler 9266 (lectotype here designated G 006153/000107!).

Subshrubs. Leaves simple; petiole 2–3 mm long; petiolar stipule linear, entire; blade sub-coriaceous, entire, rare 3-lobed, 5–7 × 2.5–3.0 cm, ovate, apex rounded, base sub-attenuate to rounded, margin dentate, with papiliform glands, venation eucamptodromous; stipels linear, 1 mm long, associate with glands. Inflorescence with involucre bracts 3-lobed. Capsule and seed not seen.

Distribution and Habitat— Actually, *Dalechampia rubrivenia* is only known to Paraguay. Due to the lack of knowledge of its flowers, this compromises its current

geographical distribution.

Conservation— The species is temporarily assessed as data deficient (DD).

Notes— Pax & Hoffman (1919) described *Dalechampia rubrivenia* based on Hassler 9266 ex p. by having “*Suffrutex procumbens; rami 30-60 cm longi, adscendentes, brevissime velutino-pubescentes... Inflorescentiae terminales,... Sepala feminam ± 10...pinnatipartita*”, collected in Paraguay, Caaguazú. The holotype of this collection was destroyed in Berlin, however one isotype was found in G herbarium. The exsiccate is in good status of conservation, so we are lectotipifying Hassler 9266.

The type of *D. rubrivenia* presents only one pseudhantium, so, for keep it preserved, we did not analyzed it. Despite the difficulty of analyzing the type, it was possible to verify the similarity with *D. adscendens*. The affinities between both species were discussed in the description of this last taxon.

37. *Dalechampia scandens* L. Species Plantarum: 105: 1753. TYPE: WEST INDIES.

Plantarum Americanarum fasciculus, 5: pl. 101 (original plate at P!, illustrated by Plumier).

Dalechampia scandens var. *scandens* Webster & Armbruster, Botanical Journal of Linnean Society 105: 160. 1991. syn. nov.

Dalechampia latifolia Lamarck, Encyclopedie Methodique, Botanique, 2: 257. 1786.

Dalechampia scandens forma *latifolia* (Lamarck) Mueller Argoviensis, in De Candolle, Prodromus Systematis Universalis Regni Vegetabilis, 2: 1244. 1866.
TYPE: ANTILLES, *Surian s.n.* (holotype P!).

Dalechampia villosa Lamarck, Encyclopedie Methodique, Botanique, 2: 257. 1786.

TYPE: DOMINICAN REPUBLIC, Saint-Domingue, Royal Garden of Trianon, 1764, without collector and number (Lectotype P00072056! Isolectotype

P00674025!)

Dalechampia mollis Vahl, *Eclogae Americanae*, 3: 44. 1807. *Dalechampia scandens* var. *mollis* (Vahl) Mueller Argoviensis, in De Candolle, *Prodromus Systematis Universalis Regni Vegetabilis*, 2: 1244. 1866. TYPE: COLOMBIA, Santa Marta, von Rohr (holotype C).

Dalechampia fimbriata H.B.K., *Nova Genera et Species Plantarum*, 2: 100. 1817. *Dalechampia scandens* var. *fimbriata* (H.B.K.) Mueller Argoviensis, in De Candolle, *Prodromus Systematis Universalis Regni Vegetabilis*, 2: 1244. 1866. TYPE: MEXICO, Campeche, Humboldt & Bonpland (holotype P00669919).

Dalechampia mollis H.B.K., *Nova Genera et Species Plantarum*, 2: 101. 1817. *D. mollis* Vahl, 1807. TYPE: Colombia, Mariquita, Humboldt & Bonpland (holotype P00669920! isotypes P00136057!, P00136058!). *nom. illeg.*

Dalechampia ruboides H.B.K., *Nova Genera et Species Plantarum*, 2: 102. 1817. *Dalechampia rubiformis* Sprengel, *Systema Vegetabilium*, 3: 86. 1826. TYPE: VENEZUELA, Orinoco, Angostura, Humboldt & Bonpland *s.n* (holotype P00669921!).

Dalechampia sidaefolia H.B.K., *Nova Genera et Species Plantarum*, 2: 100. 1817. TYPE: VENEZUELA, Orinoco, Pararuma Island and Angostura, *Humboldt & Bonpland 844* (Lectotype, here designated P 00669918!). Remaining syntype: Venezuela, Orinoco, Pararuma Island and Angostura, *Humboldt & Bonpland 1050* (P 00669917!)

Dalechampia passiflora Chodat and Hassler, *Bulletin de l'Herbier Boissier*, serie 2,5: 609. 1905. TYPE: PARAGUAY, Chaco-y Island, near Concepcion, *Hassler 7231* (holotype G; isotypes S-R-10875!, P 00640235!, P 00640234!, NY 00842373!, US 00096464!, BM 000504562!, MPU 015279! MICH 1286098!, UC 941592!).

Dalechampia scandens var. *heterodonta* Mueller Argoviensis in Martius, Flora Brasiliensis, 2: 658. 1874. TYPE: WESTERN BRAZIL, *Tamberlik s.n.* (holotype G 00434749! Isotype W).

Twining vines. Leaves simple, 3-lobed; petiole 1–12 cm long; petiolar stipule lanceolate, entire; blade membranaceous to chartaceous, 3–9 × 6.5–8 cm, middle lobe ovate, 1.3–3.4 cm wide, apex acute, base cordate, adaxial and abaxial villosous on surfaces, margins serrate, with stipitate or papiliforms glands sparsely, venation actinodromous; stipels linear, up to 1 mm long, associate with glands. Inflorescence axillary, 4–5.5 cm long; bracteal stipule 4–7 mm long, lanceolate, entire; involucre bracts greenish, 3-lobed, 1.5–3 × 1.5–2.5 cm, villosous, margins serrate with stipitate glandular trichomes. Resiniferous glands laminar. Staminate pleiochasium 7–10 flowers. Staminate flowers ca. 59 stamens, bracteoles 2, 4–5 × 7–8 mm, transversely oblong, eglandular, entire margins; 4 lanceolate sepals, ca. 3 × 5 mm. Pistillate cymule subtended by an involucre of 2 bracts, widely depressed ovate, 4–5 × 5–6 mm, eglandular, entire margins. Pistillate flowers with calyx of 8–12 sepals, pinnatisect, with stipitate glands, hirsutous; ovary 2–3 × 1.5–3 mm, stylar column 5–7 × 5–7 mm long, greenish, apex slightly crateriform. Capsule 5–7 mm, sparsely pubescent. Seeds 1.5–3 × 1.5–3 mm, globoid, white brown with cream macules.

Representative Specimens Examined—Brazil. AMAZONAS: Manaus, km 3 da estrada do paredão, 21 Jul 1955 (fl), *W.A. Rodrigues s.n.* (INPA 1546A). BAHIA: Barra, Ibiraba, 22 Feb 1997 (fl), *L.P. Queiroz 4768* (TEPB). CEARÁ: Santa Quitéria, 29 Apr 2012 (fl), *J. P. Souza et al. 11123* (ESA). MATO GROSSO: Jurema, estrada entre a cidade de Jurema e o Rio Jurema, 10 Jul 1997 (fl), *V.C. Souza et al 18722* (ESA). MINAS GERAIS: Januária, Distrito de Fabião, 25 May 1997 (fl, fr), *J.A. Lombardi, A. Salino 1677*

(BHCB). Santo Hipólito, 21 Nov 2002 (fl), *V. C. Souza et al 28126* (ESA). PARÁ: Santarém, 19 Apr 1989 (fl), *T.M.S. 7* (INPA). PERNAMBUCO: Ouricuri, Tamboril, 10 Mar 1982 (fl), *V.C. Lima et al. 206* (IPA). RORAIMA: Ilha de Maracá, Sema Ecological Station, 23 Feb 1987 (fl, fr) *J.A. Ratter et al. 5392* (KEW). SÃO PAULO: Eldorado, Parque Estadual de Jacupiranga, 25 Mar 2005, fl., *A. Oriani et al. 580* (ESA). **Mexico:** Queretaro, Calle Pedro Joaquín, Codwel, Alfredo V. Bonfil, 9 Feb 2018 (fl), *T. Velasco s.n* (iNaturalist 9801313). **Nicaragua:** 1.3 km SE of El Ostional along Road to El Pochote, 20 Jan 2017 (fl, fr), *W. D. Stevens 30369* (MO).

Distribution and Habitat—*Dalechampia scandens* is one of the species that presents greater amplitude of geographic distribution being able to be found in North-Central of Mexico, Central America (Dominican Republic, Nicaragua) and South America (Brazil, Colômbia, Paraguay and Venezuela). The species is found frequently in opened areas, in sunny environments of mainly moist forest. In Brazil can be found in almost regions of the country (North, Northeast, Central-west and Southeast) always in forest edge and roadside.

Phenology— Flowers January to July; fruits January to May.

Notes—Morphologically, the species more similar to *D. scandens* is *D. brasiliensis*. However, *D. scandens* has bracteal stipule lanceolate and apex of stylar column slightly crateriform. The two species are differentiated in *D. brasiliensis* comments.

Two specimens of *Dalechampia villosa* in the Paris herbarium were found and Webster and Armbruster did not indicate which one would be the holotype (they did not cite the record). For this reason, it is necessary to proceed with the lectotyping. In addition, the exsiccate P00674025 has two records belonging the fragments of a different species, one being indicated only as *Dalechampia*. Increasing the need for lectotypification.

Webster and Armbruster cited syntypes of *Dalechampia sidaefolia* next to the acronym of the Paris Herbarium. However, in the prototype only one specimen is mentioned. The two specimens found in Paris and with the identification of *Dalechampia sidaefolia*, with the same collector and the same localities mentioned in the prototype, have different collection numbers (1050 and 844). The exsiccate with the number 844 has the registration P00669918 and the other 1050 has the registration P00669917. Perhaps, due the existence of different numbers Webster and Armbruster considered syntypes. In this case, we need to proceed the lectotypification. We choose the *Humboldt & Bonpland 844* as the best choice for lectotype due having more flowers.

The species synonymized here share with *Dalechampia scandens* the diagnostics character as shape of bracteal stipules (lanceolate) and apex of styler column (slightly crateriform) are unmistakable compared with closer species as *D. pernambucensis* and *D. brasiliensis*.

38. *Dalechampia schenckiana* Pax & K. Hoffm., Pflanzenr. IV. 147 XII (Heft 68): 49.

1919. TYPE: BRAZIL. Pernambuco: Garanhuns, *G. L. Webster et al. 25648* (neotype R designated by Webster & Armbruster, 1991, isoneotype DAV).

Twining vine. Leaves simple, unlobed; petiole 0.3–1 cm long; petiolar stipule ovate to lanceolate, entire; blade chartaceous, ovate, 2–4.5 × 1.5–2.5 cm, apex acute to rounded, base slightly cordate, adaxial and abaxial highly velutinous on surface, margins slightly serrate, with capitate glandular trichomes sparsely, venation eucamptodromous. Inflorescence axillary, 1.5–3.5 cm long; bracteal stipule 0.5–0.7 × 1.5 cm, lanceolate,

entire; involucre bracts white greenish, entire, 0.7–1 × 0.6–1 cm, pubescent, margins serrate with papiliform glands; resiniferous gland laminar. Staminate pleiochasium 6–7 flowers. Staminate flowers 13–22 stamens, bracteoles 3–4, 0.3–0.4 × 0.4–1 cm, greenish, depressed ovate to reniform, eglandular, entire margins; 4 ovate sepals, ca. 2 × 1 mm. Pistillate cymule subtended by an involucre of 2 bracts, widely depressed ovate, 4–5 × 5–6 mm, eglandular, entire margins. Pistillate flowers with calyx of 6 sepals, pinnatifid, with stipitate glandular, sparsely hirsute; ovary, 1–1.5 × 1.2–1.5 mm, stylar column 8–10 mm long, greenish, apex slightly crateriform. Capsule and seeds not seen.

Representative Specimens Examined—**Brazil.** BAHIA: Senhor do Bonfim, Sett da Maravilha, 14 Jul 2005 (fl, fr), *D. Cardoso et al. 731* (HUEFS). PERNAMBUCO: Buíque-Catimbau, 25 Apr 2013 (fl, fr), *R. A. Pereira-Silva 37* (PEUFR). SERGIPE: Canindé do São Francisco, Fazenda Poço Verde, 23 Mar 2000 (fl), *R.A. Silva & D. Moura 1405* (PEUFR). ALAGOAS: Olho do Casado, Capelinha, 17 Sept 2001 (fl, fr), *L. M. Cordeiro 484* (PEUFR).

Distribution and Habitat—*Dalechampia schenckiana* is endemic to Brazil and restrict to Northeast region (Alagoas, Bahia, Pernambuco, and Sergipe states). It can be found in Caatinga environments.

Phenology—Flowers from March to September and fruits from April to September.

Conservation—*Dalechampia schenckiana* was assessed as Least Concern (LC) due to an EOO of 165,481,183 km² and Endangered (EN) due to an AOO of 88,000 km², according to IUCN (2001).

Notes—The species can be distinguished from the other species in the section by the leaves velutinous on both surfaces and 6 pistillate sepals pinnatifid. It is similar to *Dalechampia leandrii* but was differentiated morphologically in the comments of this last species.

39. *Dalechampia schippii* Standley, *Fieldiana, Botany*, 11: 133. 1932. TYPE: BELIZE, Sarawee, *Schipp S-181* (holotype F 0056222F).

Twining vine. Leaves simple, entire; petiole 0.2–0.5 mm long; petiolar stipule lanceolate, entire; blade cartaceous to coriaceous, ovate, 3–9 × 1.3–3.5 cm, apex acuminate, base subcordate to truncate, adaxial glabrous on surface and abaxial velutinous on surface, margins serrate, sparsely with capitate glandular trichomes, venation eucamptodromous. Inflorescence axillary, 3–14 cm long; bracteal stipule 5–7 × 1–2 mm, deltoid; involucral bracts white, yellow or dark pink, entire to 3-lobed, apex acute, 5–7 × 6.5–7 cm, glabrous, margins dentate, sparsely with capitate glandular trichomes. Resiniferous gland laminar. Staminate pleiochasium 9 flowers. Staminate flowers 26 stamens, bracteoles 1, ca. 3 × 7 mm, transversely oblong eglandular, entire margins; 4 ovate sepals, 3 × 1–2 mm. Pistillate cymule subtended by an involucre of 1–3 bracts, depressed ovate, 2–4 × 3–5 mm, eglandular, entire margins. Pistillate flowers with calyx of ca. 9 sepals, pinnatifid, with stipitate glandular, glabrous; ovary glabrescent, stylar column 0.8–0.9 mm long, greenish, apex cotyliform to crateriform. Capsule 7 mm long, glabrous; seeds 2 × 2 mm, globoid, dark brown with pale macules.

Representative Specimens Examined—**Belize**. PINE RIDGE, 19 Aug 1976 (fl), *C. Whiteford* 1291 (BM); Cayo Distr. Pineland in vicinity of Privacion Creek, Mountain Pine Ridge ca. 12 mi. S. Cayo, 12 Apr 1972 (fl), *D. Burch* 5820 (USF); Cayo, 11 Jan 2019 (fl) *Ronimartinez s.n.* (INaturalist 19581566); Cayo, 22 Mar 1987 (fl. fr), *G. Davidse & A. E. Brant* 33044 (MO).

Distribution and Habitat—The species is restricted to Belize in the Central America. 526–700 m alt, occurring in road and, mountain Pine Ridge, in Pineland, understory forest.

Phenology—Flowers January, March, April and August, fruits in March.

Conservation—According to the IUCN red list criteria (IUCN 2001), *Dalechampia schippii* is designated as Vulnerable (VU) due to an EOO of 6,078.266 km² and Endangered (EN) due to an AOO of 100.000 km.

Notes— The species differ of other species in the section *Dalechampia* due the habit subshrub, leaves with adaxial surface glabrous and abaxial surface velutinous, involucre bracts entire to 3-lobed, white, yellow to dark pink 3–14 cm long and stylar column with apex cotyliform to crateriform.

40. *Dalechampia serrula* Pax & Hoffmann, in A. Engler (Ed.), *Das Pflanzenreich*, IV.

147. XII (Heft 68): 44. 1919. TYPE: PARAGUAY, Sierra de Maracayu, Ipehu, E.

Hassler 5296 (lectotype G, here designated, isolectotype BM 000504567).

Subshrub, ca 20–50 cm high. Leaves simple, unlobed; petiole up to 3–4 mm long; petiolar stipule linear, entire; blade cartaceous, ovate, 5.5–7 × 1–1.5 cm, apex acute, base of leaf rounded, adaxial sparsely hispid on surface and abaxial velutinous on surface, margins dentate to denticulate, with papiliform glands sparsely, venation actinodromous. Inflorescence terminal 4–5 cm long; involucre bracts yellowish, entire to 3-lobed, apex acute, 2–2.5 × 1.5–2 cm, sparsely pubescent, margins serrate with sparsely stipitate glands; resiniferous gland laminar. Pistillate flowers with calyx ca. of 10 sepals, pinnatifid, with stipitate glandular, glabre; ovary pubescent, stylar column 4 mm long, greenish, apex dilated. Capsule and seeds not seen.

Distribution and Habitat—The species until now is endemic to Paraguay, occurring in the Serra de Maracayu.

Conservation—According to the IUCN red list criteria (IUCN 2001), *Dalechampia serrula* is designated as Critically Endangered (CR) due to EOO 0.000 km² and the

same category due to an AOO of 4.000 km².

Notes—The holotype from Berlin herbarium was destroyed, and Webster & Armbruster (1991) did not designated formally the lectotype of *Dalechampia serrula*, for this reason we are lectotipifying here.

Although it was not possible analyze the staminate and pistillate cymules in detail, the species even can be recognized by staminate and pistillate cymules greenish and apex of stylar column dilated. The species is close to *D. linearis*, but already differentiated in the comment of this species.

41. *Dalechampia stenosepala* Müll. Arg. (Müller Argoviensis 1866: 1241). TYPE:

BRAZIL. Without date, *Sellow s.n* (lectotype G 00434834! designated by Webster & Ambruster, 1991).

Dalechampia patagonica Pax & Hoffm. (1924: 190). TYPE: BRAZIL, Paraná, Santa

Cruz, Ponta Grossa, without date, *Dusén 2497* (isotype S-R-10646!).

Twining vine. Leaves compound, 3-foliolate; petiole 1–2.5 cm long; petiolar stipule linear, entire; blade membranaceous, elliptic to ovate, middle leaflet elliptic, 4.5–7 × 1.5–2.7 cm, base attenuate, lateral leaflets ovate, of similar size to middle leaflet, apex acute, base attenuate to asymmetric, adaxial glabrous on surface and abaxial glabrous to pubescent, margins dentate, with papiliforms glands, venation eucamptodromous. Inflorescence axillary, 3–4 cm long; bracteal stipule 4–8 × 0.8–1 mm, linear, entire; involucre bracts deeply 3-lobed, greenish, apex acute, 1.7–2 × 1.7–2.3 cm, glabrous to sparsely pubescent, margins dentate, with papiliform glands; resiniferous gland laminar. Staminate pleiochasium 7–9 flowers. Staminate flowers with stamens not seen,

bracteoles 1, ca. 5×6 mm, greenish, transversely oblong, eglandular, entire margins. Pistillate cymule subtended by an involucl of 1 bract, deltoid, ca. 3.5×3.5 mm, eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, with stipitate glandular, sparsely hirsute; ovary ca. 2×2 mm, stylar column 7–8 mm long, apex moderately delgate to moderate lobed. Capsule and seeds not seen.

Representative Specimens Examined—**Argentina.** Estancia, Santa Teresa, Prov. Corrientes, Dep. Mburucuyá, 9 Oct. 1954 (fl.,fr), *T. M. Petersen s.n* (P05595723); Prov. Corrientes, Dep. Berón de Astrada, 46 km W de Itá Ibaté, Velencia, 15 Jan 1977 (fl), *A. Schinini 14048* (G); Misiones, San Javier, 06 Feb 1978 (fl), *A.G. Schulz 7031* (G). **Brazil.** PARANÁ, Londrina, Floresta dos irmãos Godoy, 18 Jun 1986 (fl), *F. Chagas & Silva 01129* (FUEL); Londrina, Sítio Casa de Pedra, 30 Aug 1992 (fl), *A. Laforga s.n* (FUEL 10238). RIO GRANDE DO SUL, Montenegro, 31 Oct 1945 (fl), *E. Henz s.n* (PACA 32586); Montenegro, 21 Dec 1935 (fl), *B. Rambo s.n* (PACA 2223); Santa Clara p. Lajedo, 18 Nov 1940 (fl), *B. Rambo s.n* (PACA 4890); São Luiz, Jan 1943 (fl), *P. Buck s.n.* (PACA 11090). **Paraguay.** Dep. Itapúa, 21 Mar 1993 (fl), *A. schinini et al. 27654* (G).

Distribution and Habitat—The species occurs in Argentina, Brazil and Paraguay always in edge forest, in successional forest.

Phenology—Flowers in January to December and fruits in October.

Conservation— According to the IUCN red list criteria (IUCN 2001), *Dalechampia stenosepala* is designated as Critically Endangered (CR) due to an EOO of 6, 336.084. 581 km² and Critically Endangered (CR) due to an AOO of 360.000 km².

Notes—*Dalechampia stenosepala* is characterized by the involuclal bracts deeply 3-lobed and apex of stylar column delgate to moderately lobed. The species is similar morphologically to *D. meridionalis*, been differentiated in the comments of this last

species.

42. *Dalechampia stipulacea* Müll. Arg., *Linnaea*, 34: 221. 1865. TYPE: PERU, without date, *J. A. Pavon s.n.* (holotype G 00236422! isotype CDG G00207896).

Dalechampia stipulacea f. *minor* Müll. Arg., *Prodr.* 15(2): 1243.1866. *Dalechampia stipulacea* var. *minor* Müll. Arg., *Fl. Bras.*, 11 (2): 656. 1874. TYPE: BRAZIL, Bahia, *Blanchet 3909* (lectotype G 00317230! designated by Webster & Armbruster 1991: 162, isolectotype P 00712332!).

Dalechampia stipulacea var. *membranacea* Müll. Arg., *Fl. Bras.*, 22(2): 656. 1874. TYPE: BRAZIL, Minas Gerais, Lagoa Santa, *Warming s.n.* (holotype C).

Dalechampia stipulacea var. *piauhyensis* Müll. Arg., *Fl. Bras.*, 11 (2): 657. 1874. TYPE: BRAZIL, Piauhy, *Martius s.n.* (holotype G! M0233680).

Dalechampia stipulacea var. *bogotensis* Pax & Hoffmann, in A. Engler (Ed.), *Das Pflanzenreich*, IV. 247. VII (Hefte 68): 28 (1919). TYPE: COLOMBIA, Bogotá, *J. Triana 3555* (lectotype G, designated by Webster & Armbruster 1991: 162, isolectotypes NY 00842378 image!, P 00712331!).

Liana. Leaves simple, 3-lobed; petiole 2–7 cm long., petiolar stipule ovate to deltoid, pinnatifid to entire, usually with parastipules; blade membranaceous, 5–10 × 5.5–10 cm, middle lobe ovate, 2.5–3.3 cm, apex acute, base of leaf cordate, adaxial and abaxial pubescent on surfaces, margins serrate, with glandular trichomes, venation actinodromous. Inflorescence axillary or terminal, 4–5 cm long; bracteal stipule 1.3–1.5 × 0.5–1.0 cm, deltoid, entire; involucral bracts greenish, 3-lobed, apex acute, 1–2 × 1.5–2 cm, pubescent, margins serrate with stipitate glandular; resiniferous gland laminar. Staminate pleiochasium 5–6 flowers, pedicel 2–3 mm long. Staminate flowers with ca.

75 stamens, bracteole 2, 0.4–0.6 × 0.3–4.5 mm, greenish, transversely oblong, eglandular, entire margins; 4 ovate sepals, ca. 3 × 5 mm. Pistillate cymule subtended by an involucrel of ca. 2 bracts, lanceolate to deltoid, 2–3, 4–5 × 3–5 mm, usually glandular-dentate margins. Pistillate flowers with calyx of 8–12 sepals, pinnatifid, with stipitate glandular, sparsely pubescent; ovary 1.5–2.0 × 1.2–1.5 cm, velutinos, stylar column 8–10 mm long, stigma lobed. Capsule 5–8 mm long, glabrous; seeds 2.0 × 3.0 mm, globoid, dark brown with pale macules.

Representative Specimens Examined— **Argentina.** Misiones, Eldorado, 24 Oct 1978 (fl), *S.A. Renvoize 3250* (K). **Brazil.** MINAS GERAIS: Gruta da Lapinha, 02 May 1982, fr., *S. Narayadine, D. Silva 3938* (BHCB) PARANÁ: Fênix, Parque estadual Vila Rica do Espírito Santo, 31 Oct 1998, fl., *J.M. Silva, E. Barbosa & L.M. Abe 2572* (BHCB). PERNAMBUCO: Triunfo, 7 Jun 1997, fl. fr., *A.M. Miranda et al. 2695* (IPA). SÃO PAULO: Matão, Fazenda Cambuhy, 14 Apr 1994, fl., *V.C. Souza et al. 5703* (ESA). **Bolivia:** 19 May 1881 (fl), Caricoli, *Triana, J. 2056* (K) **Paraguay:** Canindeyú, Jejui-mi, Sendero principal (km 5.5), 8 Oct 1996, fl. *B. Jiménez & G. Marín 1572* (PY, CTES, FMB, BM).

Distribution and Habitat—In Brazil, the species occur in Northeast (Pernambuco) and Southeast (Minas Gerais and São Paulo) and South (Paraná) mainly in preserved areas of Atlantic forest. The species also is registered to Argentina, Bolivia and Paraguay, frequently in edge of forest, in high forest.

Phenology— Flowers in June to October; fruits in February to June.

Conservation—According to the IUCN red list criteria (IUCN 2001), *Dalechampia stipulacea* is designated as Least Concern (LC) due to an EOO of 8,200,987.652 km² and Vulnerable (VU) due to an AOO of 572.000 km².

Notes— In herbaria is very common this species be identified as *D. ficifolia*.

Dalechampia stipulacea is characterized by presence of parastipule and stipitate glandular trichomes in the margins of stipules, leaves and involucral bracts. They are differentiated in the comment of *D. ficifolia*.

43. *Dalechampia tiliifolia* Lam., Encycl. 2: 257. 1786. TYPE: without local (possibly Peru), *J. Jussieu* (holotype P!).

Dalechampia peruviana Lam., Encycl. 2: 257. 1786. *Dalechampia tiliifolia* var. *peruviana* (Lam.) Kuntze, Revis. Gen. Pl. I: 596. 1891. TYPE: PERU, without local, without date, *J. Jussieu s.n.* (holotype P 00674013!).

Dalechampia heterophylla Vahl, Eclog. Amer. 3: 44. 1807. *Dalechampia tiliifolia* var. *heterophylla* (Vahl) Kuntze, Revis. Gen. Pl., 1: 596. 1891. TYPE: FRENCH GUYANA. Cayenna: without local, without date, *Von Rohr s.n.* (holotype C 10011208!).

Dalechampia pruriens Griseb., Fl. Brit. W. I. 51. 1859. TYPE: TRINIDAD AND TOBAGO. Without local, without date, *H. Crueger s.n.* (holotype GOET 003371!).

Twining vine. Leaves simple, entire to 3-lobed in the same individual; petiole 5–10 cm long; petiolar stipule linear, entire; blade chartaceous, 4–6 × 3–7 cm, middle lobe elliptical and ovate, 1.4–5 cm wide, apex acute, base of leaf cordate, adaxial surface sparsely pubescent and abaxial pubescent on the veins, margins slightly serrate, with papiliforms gland, venation eucamptodromous. Inflorescence axillary, 7–9 cm long; bracteal stipule 3.5–4 × 1.5–1.7 mm, linear, serrate; involucral bracts white greenish, entire to 3-cuspidate, apex acute 3.5–7.2 × 3–5 cm, velutinous, margins serrate with papiliforms glands. Resiniferous glands fimbriate. Staminate pleiochasium 10 flowers. Staminate flowers 16–18 stamens, bracteoles 4.6–8 × 6–8 mm, deltoid; 4–6 lanceolate sepals, 3–4 × 1.5–2 mm. Pistillate cymule subtended by an involucl of 2 bracts,

deltoid, 4–5 × 5–6 mm, eglandular, entire margins. Pistillate flowers with calyx of 10–12 sepals, pinnatifid, with stipitate glands, hirsutous; ovary, 3–4 × 3–4 mm, hispidous-hirsutous, stylar column 1.4–1.6 mm long, greenish, apex discoid. Capsule 0.9–1 cm long, hispidous-hirsutous; seeds ca. 3.5 × 3.5 mm, globoid, dark brown with pale macules.

Representative Specimens Examined—**Brazil**. ACRE: Rio Branco, estrada do Calafate, 31 Jul 1990 (fl), *M. Almeida & L. Lima s.n.* (INPA 162919). CEARÁ: Ubajara, Parna do Ubajara, 13 Sept 1982 (fl), *A. Fernandes & P. Gibbs s.n.* (EAC 15081); Baturité, Guarakiranga, *L.W. Lima-Verde s.n.* (EAC 21237). ESPÍRITO SANTO: Linhares, Reserva Natural do Vale, 17 Apr 2011 (fl), *J.C. Lopes et al. 201* (ESA). GOIÁS: Guarani, Fazenda Forquilha, 05 Mar 2001 (fl, fr), *M.L. Fonseca et al 2418* (IBGE). MARANHÃO: Entre Brejo e Chapadinha, 01 Jun 1979 (fl), *E. Nunes, A.J. Castro s.n.* (EAC 13913). MATO GROSSO: Alta Floresta, adjacências do Hotel Floresta Amazônica, 07 Jun 1997 (fl), *G.F. Árbocz et al. 3982* (ESA). PARÁ: Altamira, Serra do Cachimbo, BR 163, Between Garantã do Norte (MT) and Castelo dos Sonhos (PA), 07 Jun 2007 (fl) *J.B.A. Bringel 361* (CEN). Itaituba, Estrada Santarém-Cuiabá BR 163, 03 May 1983 (fl), *I.L. Amaral et al. 1128* (UB). PERNAMBUCO: Recife, 30 May 1971 (fl), *E.P. Heringer et al. 1005* (IPA). PIAUÍ: Tamboril, 22 Jul 1979 (fr), *F. Chagas & Silva 17* (KEW). RORAIMA: Ariquemes, Mineração Mibrasa, 16 May 1982, *L.O.A. Texeira et al. 511* (INPA). TOCANTINS: Icarajá, 35 km após a aldeia Pedra Branca, 07 May 2000 (fl), *A.A. Santos et al. 686* (CEN). **Guyana**: U. Takutu-U. Essequibo. SE Kanuku Bts, 3 km NNE of Crabwood Creek camp, ca. 11 km NE of Makawatta, 3°09'N, 59°16'W, 200–212 m 25 Oct 1991, (fl), *B. Hoffmann & D. Gopaul 390* (US). **Nicaragua**: Cardenas, Rivas, 429 m, 20 Jan 2017 (fl), *R. Joyce s.n.* (iNaturalist 4980498).

Distribution and Habitat—The can be found in Central America (Nicaragua) and South

America (Guyana and Brazil). However, considering the breadth of geographical distribution the species is well distributed in South America occurring in almost regions of Brazil growing in preserved or disturbed areas of the rainforests.

Phenology—Flowers in January to October and fruits from March to July.

Conservation—*D. tiliifolia* is considered as Least Concern (LC) due to an EOO 15.902.710.330 km² and Vulnerable (VU) due to an AOO of 1.176.000 km², according to IUCN (2001).

Notes—Although the taxon present the resiniferous glands and the lamina chartaceous similar to *D. fernandesii*. *Dalechampia tiliifolia* presents peculiar characters as leaves and involucral bracts dimorphic. This species also can be compared with *D. magnistipulata*. However, they were separated morphologically in the comments this last species.

44. *Dalechampia triphylla* Lam. (Lamarck 1786: 258). TYPE: BRAZIL, without date,

Dombey s.n. (holotype P! [Herb. Jussieu 162921]; isotype NY 00842379, image!).

Dalechampia crenulata Pax & Hoffm. (Pax & K. Hoffmann 1924: 189). syn. nov Type:

BRAZIL, São Paulo, Serra Caracol, C.W.H. Mosén 1626 (S-R-10879).

Dalechampia crenulata Gandoger (1920: 286). non *D. crenulata* Pax & Hoffm., 1924

TYPE: BRAZIL. São Paulo, Campinas, without date, *Novaes* 169 (not found).

Liana. Leaves compound, 3-foliolate; petiole 2–5 cm long; petiolar stipule linear, entire; blade membranaceous, middle leaflet obovate, elliptic rare ovate, 5–5.5 × 0.7–2 cm, base attenuate, lateral leaflets obovate, elliptic rare ovate, apex acute, of similar size to middle leaflet, apex acute, base attenuate to asymmetric, adaxial glabrous and abaxial

glabrous on surfaces, margins entire to dentate, with papiliform glands, venation eucamptodromous. Inflorescence axillary, 2–2.4 cm long; bracteal stipule 4×0.5 mm, linear, entire; involucral bracts 3-lobed, greenish, apex acute, $1-1.2 \times 1-1.3$ cm, glabrous, margins serrate, with papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 8 flowers. Staminate flowers with stamens not seen, bracteoles 2, ca. 5×5 mm, greenish, transversely oblong, eglandular, entire margins. Pistillate cymule subtended by an involucler of 1 bract, deltoid, ca. 3.5×3.5 mm, eglandular, entire margins. Pistillate flowers with calyx of 12 sepals, widely pinnatisect, with stipitate glandular, glabrescent; ovary ca. 2×2 mm, stylar column 8–9 mm long, apex moderately lobed. Capsule 4–5 mm long, glabrous; seeds not seen.

Representative Specimens Examined—**Brazil**. MINAS GERAIS, 20 Apr 1984 (fl), *P. M. Andrade & M. A. Lopes* 248 (BHCB); Camanducaia, 14 Sep 2000 (fl), *R.B. Torres et al.* 1328 (IAC). SANTA CATARINA, Vidal Ramos, 22 Nov 2009 (fr), *A. Korte & A. Kniess* 277 (FURB). SÃO PAULO, 08 Feb 2004 (fl), *J. R. Guillaumon s.n.* (SPSF 45750); Campinas, 28 Feb 2006 (fl), *K. Santos e A. A. Rezende s.n.* (SJRP 30270); Campinas 12 Dec 1996 (fl), *K. Santos s.n.* (SJRP 30271). Campinas 11 Aug 1984 (fl), *G. L. Webster & W. S. Armbruster* 25218 (UEC). **México**. Vera-Cruz 1840 (fl), *H. Galeotti* 3771 (K); Vera Cruz, 1838 (fl), *J. Linden* 790 (K).

Distribution and Habitat— The species occurs in Brazil and Mexico. In Brazil, it is associated to Atlantic Forest, mainly in edge of the forest from Southeast region. It can be found in Minas Gerais, Santa Catarina and São Paulo.

Phenology—Flowers in February, April, August and December. Fruits in November.

Conservation— According to the IUCN red list criteria (IUCN 2001), *Dalechampia triphylla* is designated as Least Concern (LC) due to an EOO of 5,192,594.625 km² and Critically Endangered (CR) due to an AOO of 188.000 km².

Notes—*Dalechampia triphylla* is easily recognized due the folioles usually lanceolate, and widely pinnatisect pistillate sepals. Its pseudanthium is one of the smaller among species with 3-foliolate leaves (2–2.4 cm long), been compared to *D. micromeria* (2–4 cm long).

45. *Dalechampia ulmifolia* Chodat & Hassler, Bulletin de l'Herbier Boissier, série 2, 5: 608. 1905. TYPE: PARAGUAY, Valenzuela, *Hassler 6949* (holotype G 00306227!; isotype G 00306226, G 00306228, G 00306229, G 00306230!, isotype BM 000504570!, isotype P 00640238!, isotype S).

Dalechampia grueningiana Pax, Reportorium Specierum Novarum Regni Vegetabilis, 8: 161. 1910. TYPE: BRAZIL, Rio Grande do Sul, *Brommüller 181* (holotype BSM).

Subshrub 30–35 cm high. Leaves simple, unlobed; petiole 3–7 mm long; petiolar stipule lanceolate; blade membranaceous, cordiform, 2.5–6.5 × 1.5–3 cm, apex rounded to acute, base cordate, adaxial glabrescent on both surfaces, margins crenate to dentate, with papiliform glands, venation actinodromous. Inflorescence axillary, 2–3.2 cm long; bracteal stipule 4–6 × 1 mm, lanceolate; involucre greenish to yellowish, 3-lobed, rare entire, apex acute 1–1.7 × 1–1.5 cm, pubescent, margins serrate, with papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 9 flowers. Staminate flowers 9–16 stamens, bracteole 1, 4–5 × 4 mm, greenish, eglandular, entire margins; 4 ovate sepals, 1–2 × 2 mm. Pistillate cymule subtended by an involucre of 4 bracts, narrowly elliptic and transversely oblong, 4 × 2–4 mm, eglandular undulate, ciliate margins. Pistillate flowers with 6–10 pistillate sepals, pinnatifid, with a stipitate glandular, pubescent; ovary ca. 2 × 2 mm, pubescent, stylar column 4–5 mm, greenish, apex lobed. Capsule and seeds not seen.

Representative Specimens Selected—Brazil. RIO GRANDE DO SUL: Espumoso, campo, Jun 1998 (fl), *M. Sobral et al. s.n* (FURB 913).

Distribution and Habitat—The species can be found in Paraguay and Rio Grande do Sul in the Brazil, next to river or in sunny areas.

Phenology—Flowers in January and June.

Conservation— *Dalechampia ulmifolia* was assessed as Least Concern (LC) due to an EOO 1,157,443.220 km² and Endangered (EN) due to an AOO 36.000 km² according to IUCN (2001).

Notes—The species is characterized by margins crenate to dentate and 6–10 pistillate flowers. The taxon is differentiated in the comments of *D. glechomifolia* and *D. humilis*.

46. *Dalechampia variifolia* Müll. Arg., *Linnaea* 34: 221. 1865. TYPE: BRAZIL. Minas

Gerais: without local, without date, *Widgren 3* (holotype UPS, isotype G!).

Twining vine. Leaves simple, entire to 3-lobed in the same individual; blade membranaceous, base cordate, adaxial surface sparsely pubescent and abaxial velutinous, margins serrate, with capitate glandular trichomes. Inflorescence probably axillary, ca. 7 cm long; bracteal stipule 1 cm long, triangular-ovate, serrate; involucre bracts pale, 3-fids, apex acute, ca. 3.5 cm long. Pistillate flowers with calyx of 10 sepals, pinnatifid, with stipitate glandular; ovary globoid, tomentose, stylar column with apex slightly dilated.

Conservation—it is assessed as data deficient (DD) according to IUCN (2001) criteria.

Notes—Part of the description of *Dalechampia variifolia* was based in the protologue, because the type is fragmented and other specimens were not found. The species is characterized by the glandular stipitate trichomes in the margin of leaf and stylar column slightly dilated. In the herbarium, can be confused with *D. tiliifolia*, being

differentiated by the absence of glandular trichomes in the margin of leaf in *D. tiliifolia*.

47. *Dalechampia viridissima* Webster, Brittonia 41: 6. 1989. TYPE: BRAZIL. Bahia, Itabuna 7 Aug 1984, Webster & Armbruster 25163 (holotype CEPEC!; isotypes DAV 169665, DAV 169680, image!, GH, MO, NY, R!, SP!, UEC!).

Twining vine. Leaves simple, 3-lobed; petiole 5–8 cm long; petiolar stipule lanceolate, entire; blade chartaceous, blade 8–10 × 9–13 cm, middle lobe 5–5.7 × 2.5–4 cm, apex acute, base cordate, adaxial and abaxial glabrous to sparsely puberulent on surfaces, margins entire to sinuate without papiliform glands, venation actinodromous; Inflorescence terminal or axillary, 1.8–2.5 cm long; bracteal stipule 4–5 × 1.8–2.5 mm, unequal, entire; involucre bracts 3-lobed, deep green, apex acute, 0.8–1.5 cm, glabrous, margins entire with papiliform glands; resiniferous gland laminar. Staminate pleiochasium ca. 7. Staminate flowers 35–65 stamens, bracteole 4, 1.5–2 × 6–10 mm, transversely oblong eglandular, entire margins; 4 lanceolate sepals. Pistillate cymule subtended by an involucre of ca. 3 bracts, ovate-reniform. Pistillate flowers with calyx of 6–7 sepals, minutely glandular at tip, glabrous; ovary glabrous; stylar column 5–7 mm long, stigma unlobed or slightly lobed. Capsule ca. 8 mm long, minutely hispidulous; seeds ca. 3.1 × 3 mm long, subgloboid, mottled.

Representative Specimens Examined— **Brazil**. Bahia, Rod. Jussari/Pamira. Entrada ca. 7.5 km de Jussari. Fazenda Teimosos. RPPN Serra do Teimoso, without date (fl), A. M. Amorim 2466 (NY).

Distribution and Habitat—*Dalechampia viridissima* is restricted to Bahia in Northeast from Brazil, occurring next to waterfall in preserved area.

Phenology— Flowers and fruit in August.

Conservation— According to the IUCN red list criteria (IUCN 2001), *Dalechampia olfersiana* is designated as Critically Endangered (CR) due to an EOO of 0.000 km² and Critically Endangered (CR) due to an AOO of 4.000 km².

Notes—*Dalechampia viridissima* detach of other species with 3-lobed leaves for the dark green color of involucre bracts during a fruiting and the extreme reduction of pubescence in all parts of the plant.

48. *Dalechampia weddelliana* Baillon, Adansonia 5: 315. 1865. Type: BRAZIL, Between Goiás and Cuiabá, *H. A. Weddel 2974* (holotype P 00640240!, isotype P 00640241!).

Dalechampia amambayensis Pax & Hoffmann, Pflanzenr. IV. 147 XII (Heft 68): 43. 1919. TYPE: PARAGUAY, Serra de Amambay, Punta Para *E. Hassler 9763* (lectotype K! designated by Webster & Armbruster, isoelectotype K!, P 00640244!).

Dalechampia trichophila Pax & Hoffmann, Pflanzenr. IV. 147 XII (Heft 68): 44. 1919. TYPE: PARAGUAY, Rio Capibary, *Hassler 4476* (lectotype G 00306222!, isoelectotypes G 00306224!, G 00306223!, G 00306225!, designated by Webster & Ambruster, 1991)

Subshrub, 32–38 cm high. Leaves simple, entire to 3-lobed; petiole 0.3–1 cm long; petiolar stipule lanceolate, entire; blade chartaceous, cordiforme 4–11 × 3–6 cm, middle lobe ovate 0.8–1.2 cm wide, apex rounded, base rounded, rare sub-attenuate, adaxial and abaxial surfaces glabrous to velutinous, margins serrate to dentate, with capitate glandular trichomes, venation eucamptodromous. Inflorescence axillary, 3.5–6.5 cm long; bracteal stipule 4–6 × 0.5 mm long, linear to lanceolate, pubescent; involucre

bracts greenish to yellowish, 3-lobed, apex acute, 1.8–2.5 × 1.5–2.5 cm, pubescent, margin dentate, with stipitate glandular; resiniferous gland laminar. Staminate pleiochasium 9-flowers. Staminate flowers 10–15 stamens, bracteole 1, 2 cm circumference, greenish, transversely oblong, eglandular, entire margins; 4 lanceolate sepals, 1.5–3 × 1.5 mm. Pistillate cymule subtended by an involucre of 3 bracts, ovate, 4–6 × 2–3 mm, eglandular, entire, ciliate margins. Pistillate flowers with calyx of 12 sepals, pinnatifid, without stipitate glands trichomes, densely velutinous; ovary up to 1 × 1 mm, styler column 5–6 mm long, greenish, apex crateriform to slightly lobed. Capsule 0.5–1 cm long, glabrescent; seeds 2–2.5 × 2.5 mm, globoid, dark brown with pale macules.

Representative Specimens Selected—Brazil. GOIÁS: Niquelândia, 15 Jul 2000 (fl. fr), V. C. Souza, J. P. Souza & G. O. Romão 23904 (ESA); Niquelândia, Estrada de Uruaçu para Barro Higo, 14° 32' 22" S, 48° 41' 52" W, 600 m. 15 Jul 2000 (fl), V. C. Souza et al., 23945 (BHCB); MATO GROSSO DO SUL: Corumbá, Morraria Urucum, 16 Feb 2006 (fl), E. Tameirão Neto 4335 (BHCB). Paraná: Jaguariaiva, 31 Dec 1997 (fl), S. M. Silva et al s.n. (BHCB).

Distribution and Habitat— The species was registered to roadside in burnt Cerrado area and in opened areas of Cerrado vegetation.

Phenology—Flowers and fruits in July.

Conservation—*Dalechampia weddelliana* was assessed as Least Concern (LC) due to an EOO 1,307,607.856 km² and Endangered (EN) due to an AOO 100.000 km² according to IUCN (2001).

Notes— This species is similar to *D. guaranitica* by shape of staminate bracteoles and number and shape of pistillate sepals. *Dalechampia weddelliana* was differentiated in the comments of that species.

References

- Armbruster WS (1996). Cladistic Analysis and Revision of *Dalechampia* Sections *Rhopalostylis* and *Brevicolumnae* (Euphorbiaceae). *Systematic Botany*, 21 (2): 209-235.
- Armbruster WS, Mziray WR (1987). Pollination and Herbivore Ecology of an African *Dalechampia* (Euphorbiaceae): Comparisons New World Species. *Biotropica*, 19(1): 64-73.
- Bachman S J, Moat AW, Hill J de la Torre, J and B Scott (2011). Supporting red list threat assessments with GeoCAT: Geospatial conservation assessment tool. *ZooKeys* 150: 117–126.
- Brummitt, RF, Powell, CE (1992). *Authors of plant names*. Royal Botanic Gardens Press, Kew.
- Harris JG, Harris MW (2001). *Plant identification terminology: an illustrated glossary*. Spring Lake, Utah.
- Hickey LJ (1973). Classification of the Architecture of Dicotyledonous Leaves
Author(s): Source: *American Journal of Botany*, 60: 1, 17-33.
- IUCN (2001) The IUCN red list of threatened species, version 2010.4. Cambridge, U. K.: IUCN Red List Unit, Available in <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.
- Mori SA, Silva LAM, Lisboa G, Corandin, L (1989). *Manual de Manejo do Herbário Fanerogâmico*. Centro de Pesquisas do Cacau, Ilhéus. Pp. 103.
- Mül Arg J (1863) *Euphorbiaceae*. *Linnaea* 32: 1-126.
- Mül Arg J (1866) *Prodromus Systematis Naturalis Regni Vegetabilis* 15(2): 1244.
- Pax F, Hoffmann K (1919) *Euphorbiaceae-Dalechampiae*. In: *Das Pflanzenreich*.

Regni vegetabilis conspectus (A. Engler, ed.), Leipzig, 147 (helf 12): 1-59.

Pereira-Silva RA, Athiê-Souza SM, Secco RS, Melo AL, Sales MF (2016). *Dalechampia erythrostyla* (Euphorbiaceae), a New Species from Northeastern Brazil. *Systematic Botany*, 41(4): 989-995

Radford AE, Dickison WC, Massey JR (1974). *Vascular plant systematic*. Harper & Row Publishers, New York, 891pp.

Stafleu FA, Cowan RS (1976) *Taxonomic Literature: a selective guide to botanical publications and collections with dates, commentaries and types*. Utrecht: Bohn, Scheltema & Holkema 991pp.

Thiers B (2014) [continuously updated] *Index Herbariorum: A global directory of public herbaria and associated staff*. *New York Botanical Garden's Virtual Herbarium*, New York Published on the internet; <http://sweetgum.nybg.org/ih/>. Acesso: 10 Jan 2019.

Webster GL (1994) Classification of the Euphorbiaceae. *Annals of the Missouri Botanical Garden*, 81, 3-32.

Webster GL, Armbruster WS (1991) A synopsis of the neotropical species of *Dalechampia* (Euphorbiaceae). *Botanical Journal of the Linnean Society*, v. 105, 137-177.

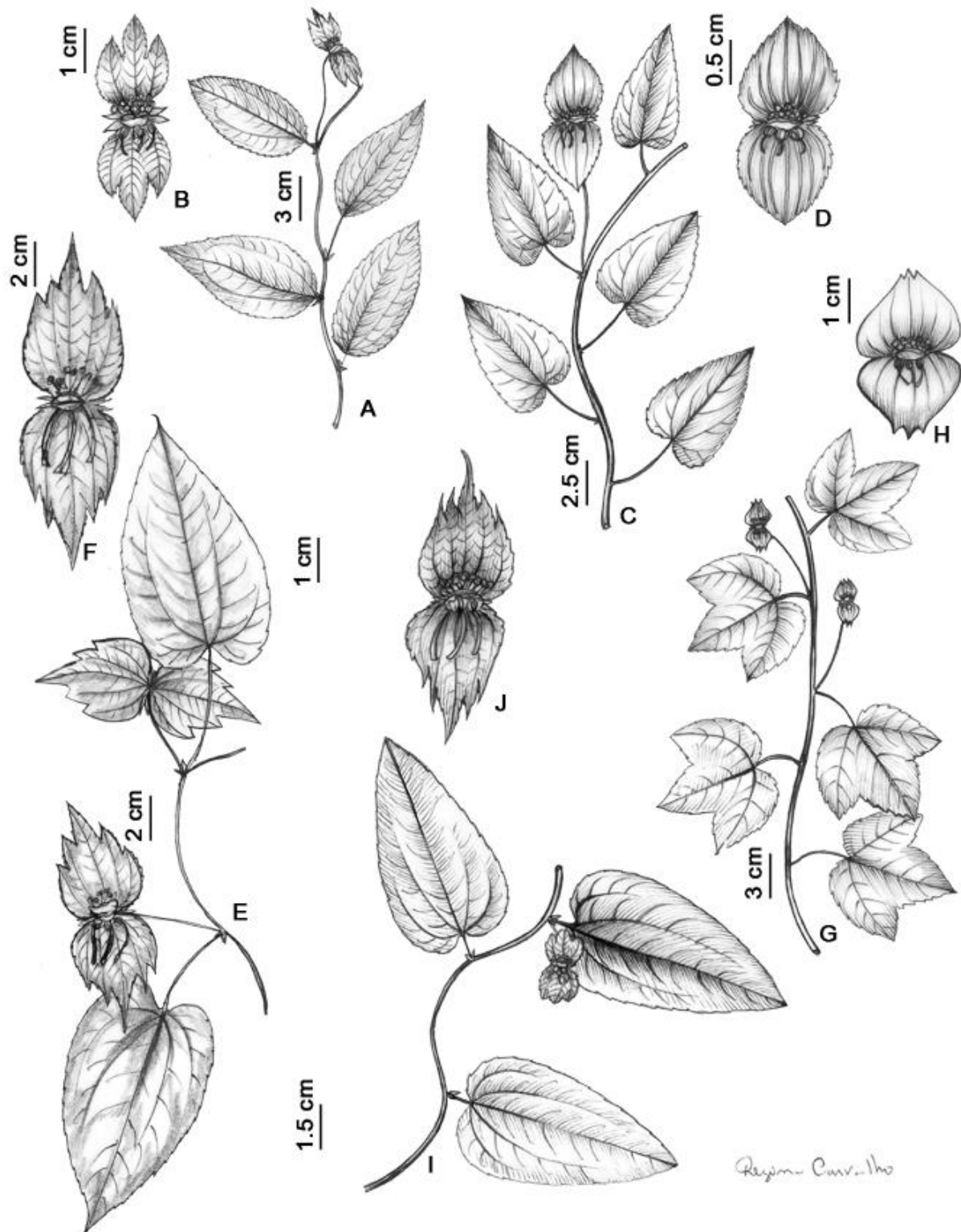


Figure 1. *Dalechampia adscendens* Müll. Arg., **A** flowering branch **B** pseudanthium, **A-B** from *H. S. Irwin & R. Soderstrom* 7529; *Dalechampia affinis* Müll. Arg., **C** flowering branch **D** pseudanthium, **C-D** from *C.R Sperling et al.* 6170; *Dalechampia arenalensis* Armbruster **E** flowering branch **F** pseudanthium, **E-F** from *R.W. Lent* 2766; *Dalechampia boliviana* Pax & K. Hoffm., **G** flowering branch **H** pseudanthium **G-H** from *M. Bang* 2091.

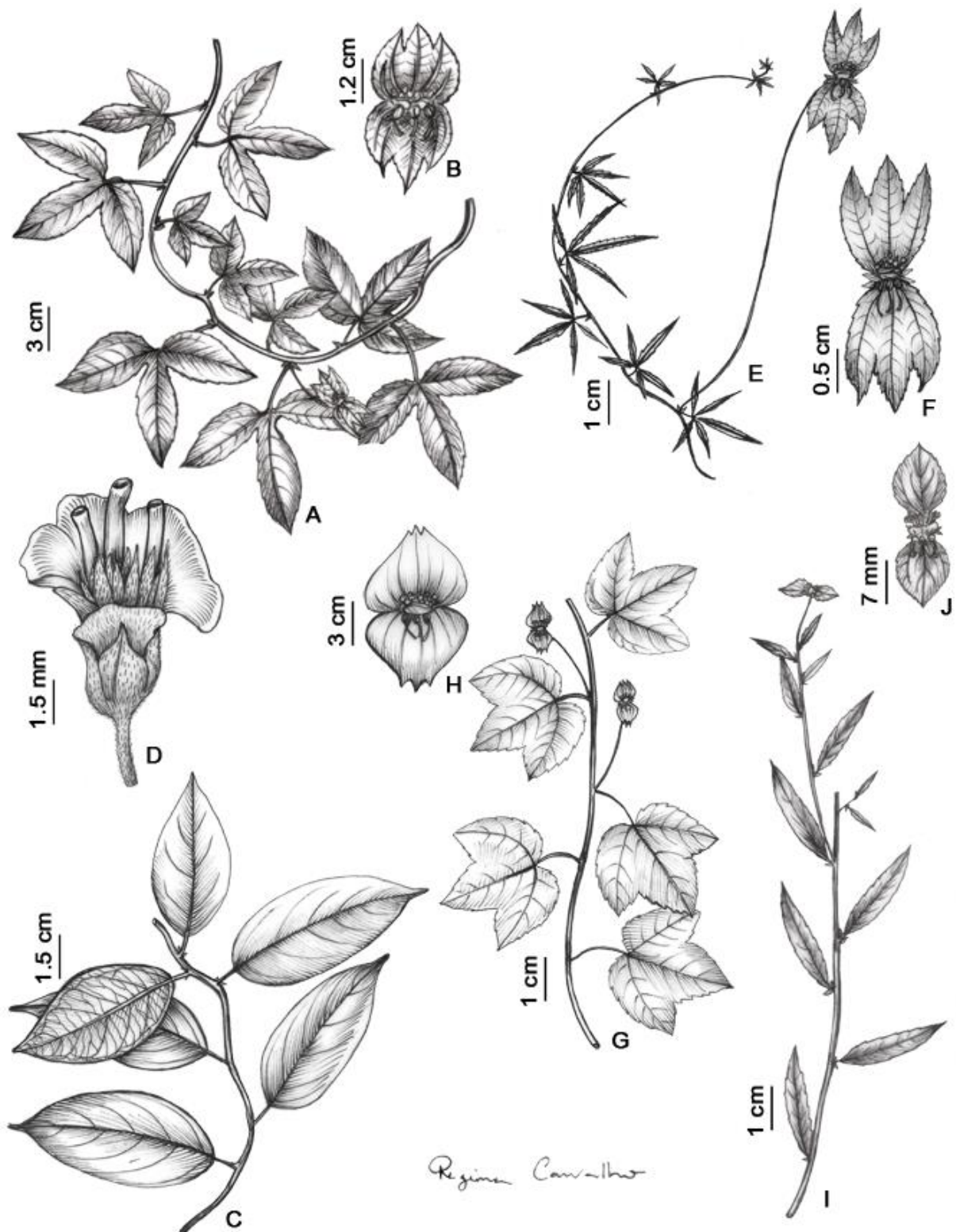


Figure 2. *Dalechampia brasiliensis* Lam. **A** flowering branch **B** pseudanthium **A-B** from A. M. Miranda et al. 1688; *Dalechampia brevicolumna* Armbruster **C** flowering branch **D** pseudanthium **C-D** from P. Acevedo-Rodriguez et al. 6026; *Dalechampia brevipes* Müll. Arg., **E** flowering branch **F** pseudanthium **E-F** from L. Riedel 582; *Dalechampia brownsbergensis* Webster & Armbruster **G** flowering branch **H** pseudanthium, **G-H** from L. Webster & W.S Armbrusteri 24124; *Dalechampia caperonioides* Baill. **I** flowering branch **J** pseudanthium, **I-J** from M. Boaventura 152.

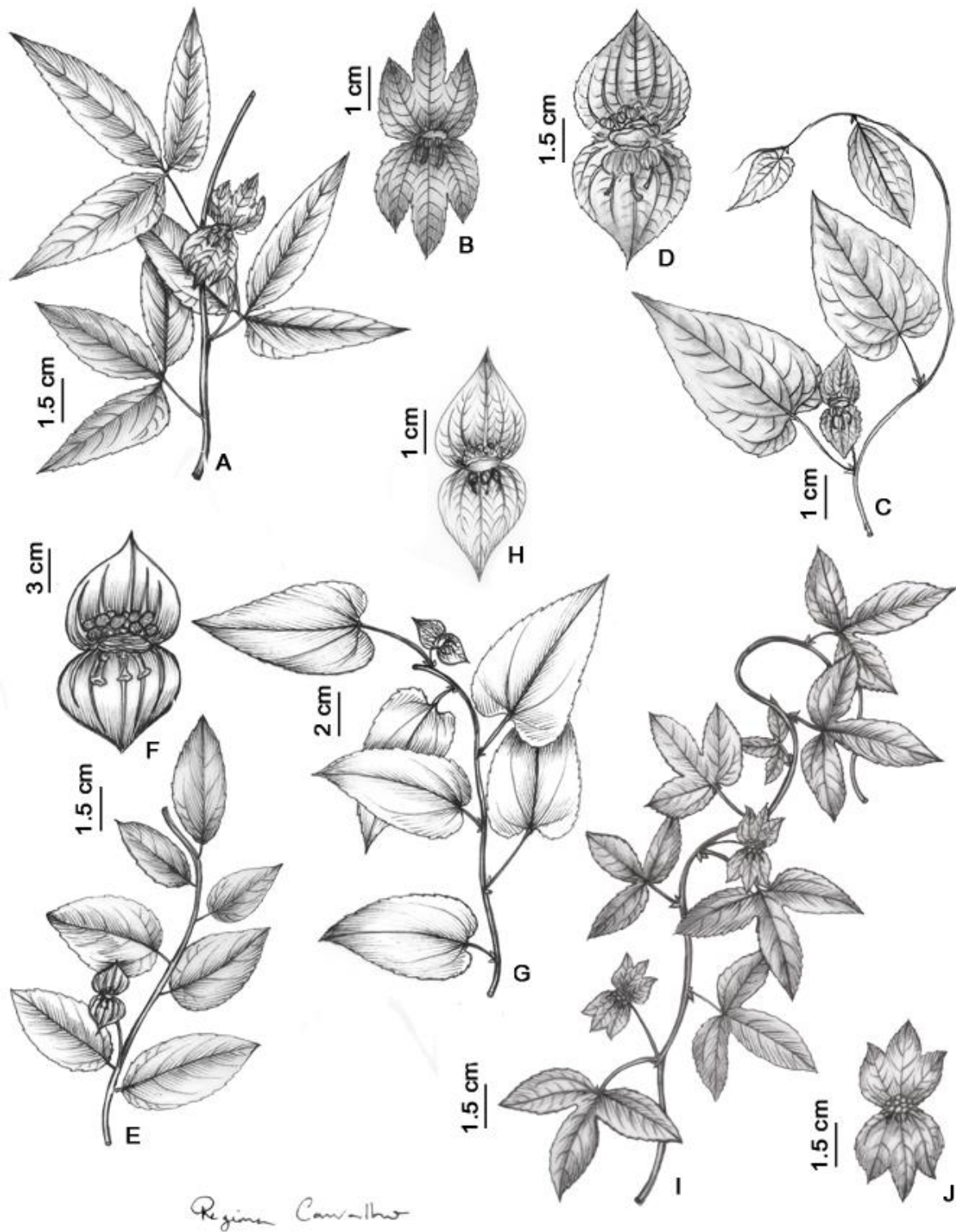


Figure 3. *Dalechampia clauseniana* Baill. **A** flowering branch **B** pseudanthium **A-B** from Kirkbride *et al* 36057; *Dalechampia convolvuloides* **C** flowering branch **D** flowering branch, **C-D** from G.L. Webster *et al.* 25848; *Dalechampia coriacea* Klotzsch ex Müll. Arg **E** flowering branch **F** pseudanthium, **E-F** from W. W. Thomas *et al.* 10133 (NY); *Dalechampia denticulata* Wright ex Griseb. **G** flowering branch **H** pseudanthium, **G-H** from C. Wright 2011; *Dalechampia fernandesii* Webster **I**. flowering branch **J** pseudanthium **I-J** A. Fernandes & E. Nunes s.n.

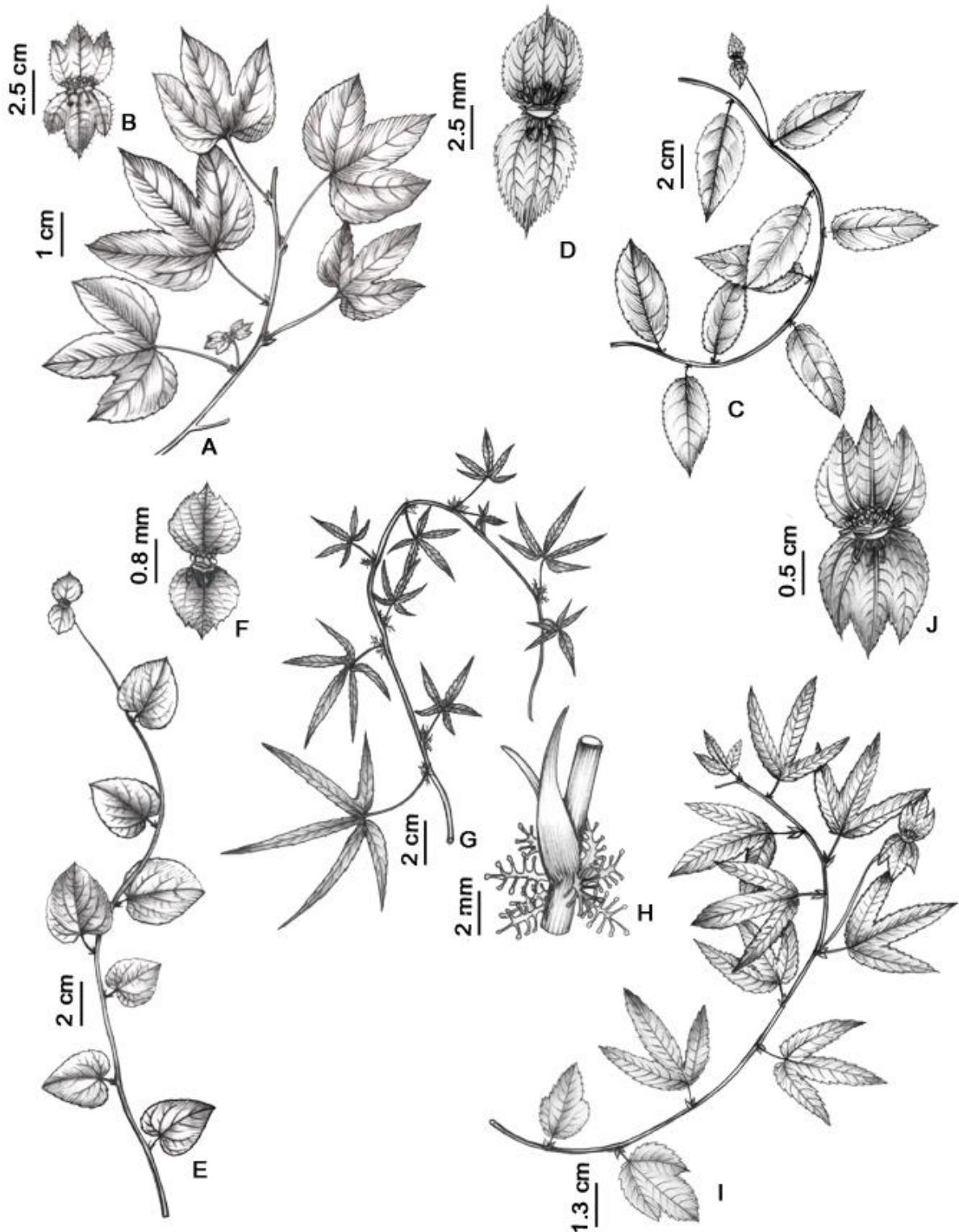


Figure 4. *Dalechampia ficifolia* Lam. **A** flowering branch **B** pseudanthium, from *H.F. Leitão Filho et al. 34413*; *Dalechampia francisceana* Baill **C** flowering branch **D** pseudanthium, **C-D** from *Weddell 1879*; *Dalechampia glechomifolia* Baill **E** flowering branch **F** pseudanthium, from *J. M. Silva & J. Cordeiro 1561*; *Dalechampia grandilla* Baill. **G** flowering branch **H** pseudanthium, from *St. Hilaire A¹ 507*; *Dalechampia guaranitica* Chodat & Hassler, **I** flowering branch **J** pseudanthium, **I-J** from *E. Hasler 9518*.

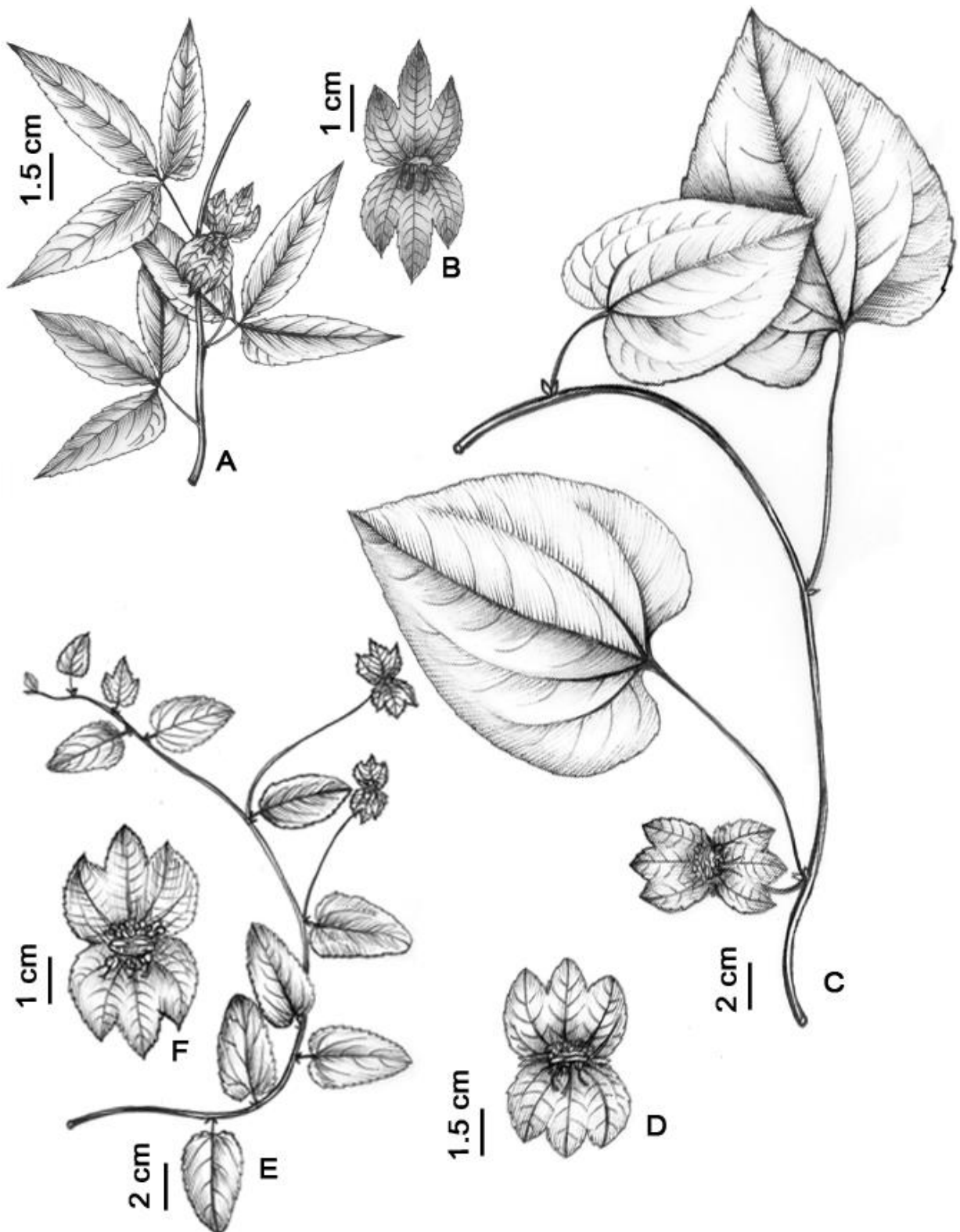


Figure 5. *Dalechampia hassleriana* Chodat, **A** flowering branch **B** pseudanthium, **A-B** from E. Hassler 5852; *Dalechampia hispida* Poepp, **C** flowering branch **D** pseudanthium, from J. V. Schuncke 3885; *Dalechampia humilis* Müll. Arg., **E** flowering branch **F** pseudanthium, **E-F** L. Riedel s.n GH00047580.

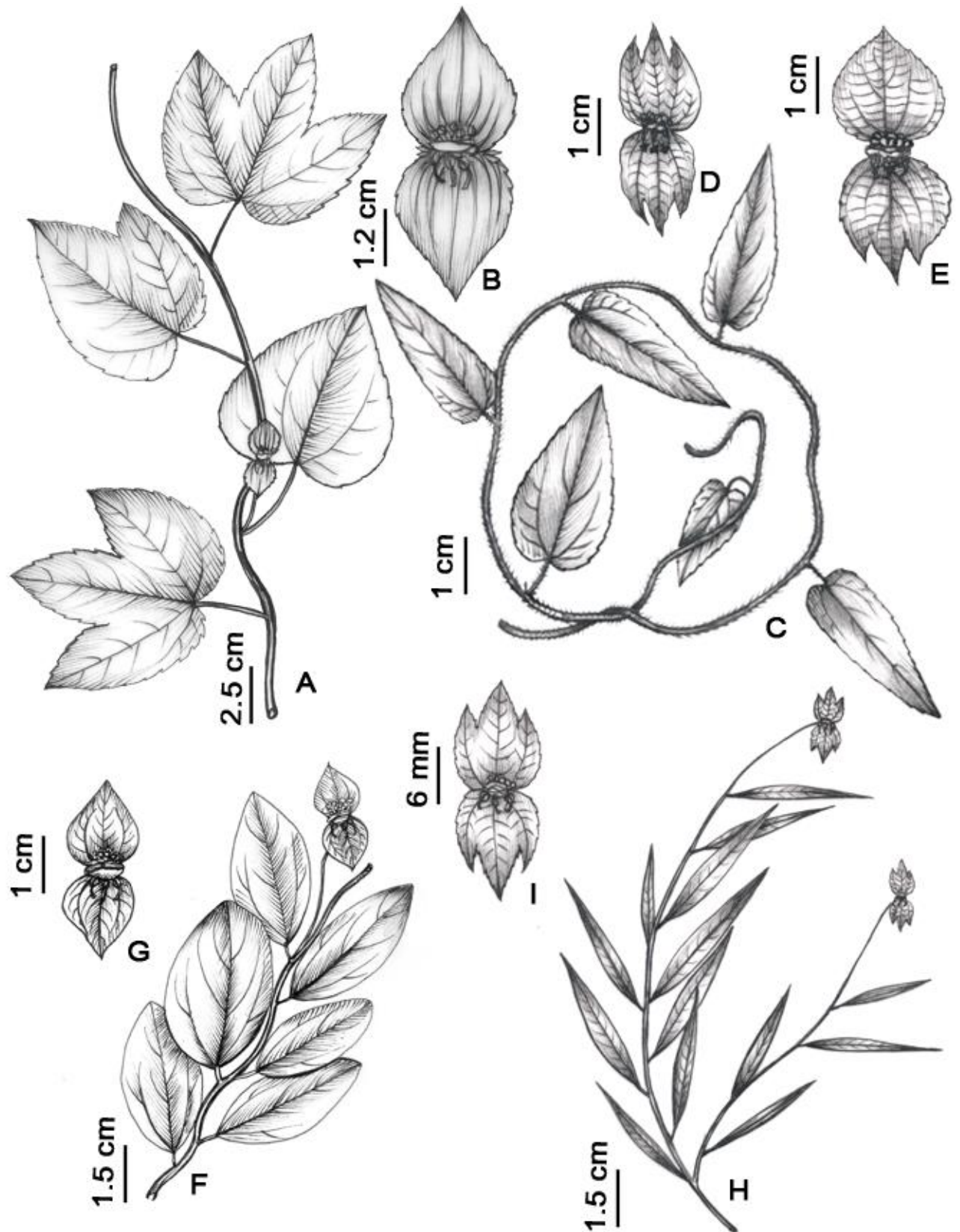


Figure 6. *Dalechampia ilheotica* Wawra **G** flowering branch **H** pseudanthium, **G-H** from W. W. Thomas et al. 10019; *Dalechampia leandrii* Baill., **A** flowering branch **B** pseudanthium, **A-B** from G. L. Webster et al. 25429; *Dalechampia leucophylla* Müll. Arg. **C** flowering branch **D** pseudanthium, **C-D** from Pohl s.n. G0034238; *Dalechampia linearis* Baill. **E** flowering branch **F** pseudanthium, **E-F** from Grandi T. M. M. 395.

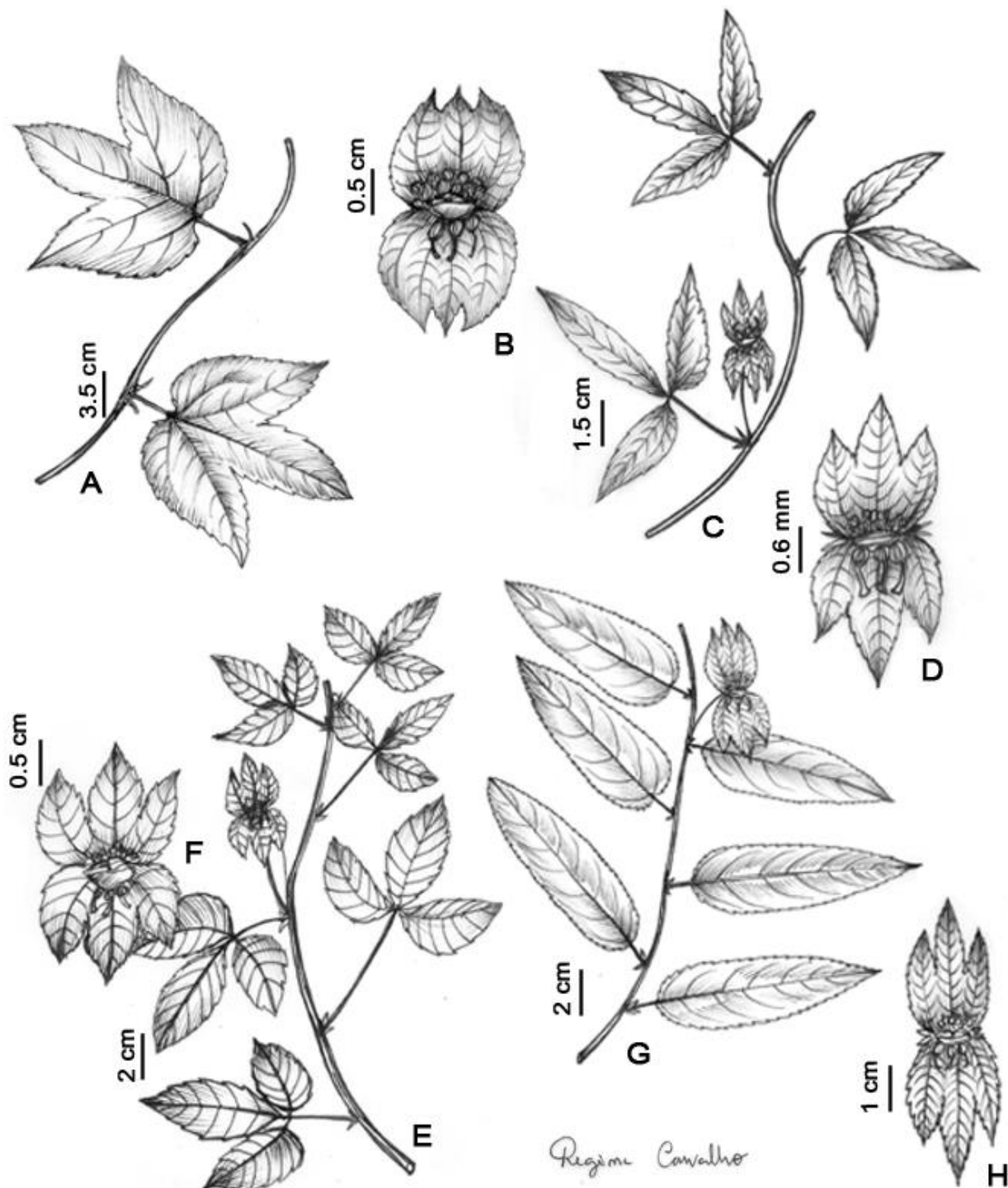


Figure 7. *Dalechampia magnistipulata* Webster & Armbruster **G** flowering branch **H** pseudanthium, G-H from G. L. Webster & S. Armbruster 20986; *Dalechampia meridionalis* Müll. Arg., **A** flowering branch **B** pseudanthium, **A-B** from W. J. Burchell 4299; *Dalechampia micromeria* Baill. **C** flowering branch **D** pseudanthium, **C-D** from L. Sellow s.n (K000600723). *Dalechampia occidentalis* Müll. Arg., **E** flowering branch **F** pseudanthium, **E-F** from Tamberlik s.n G00237308.

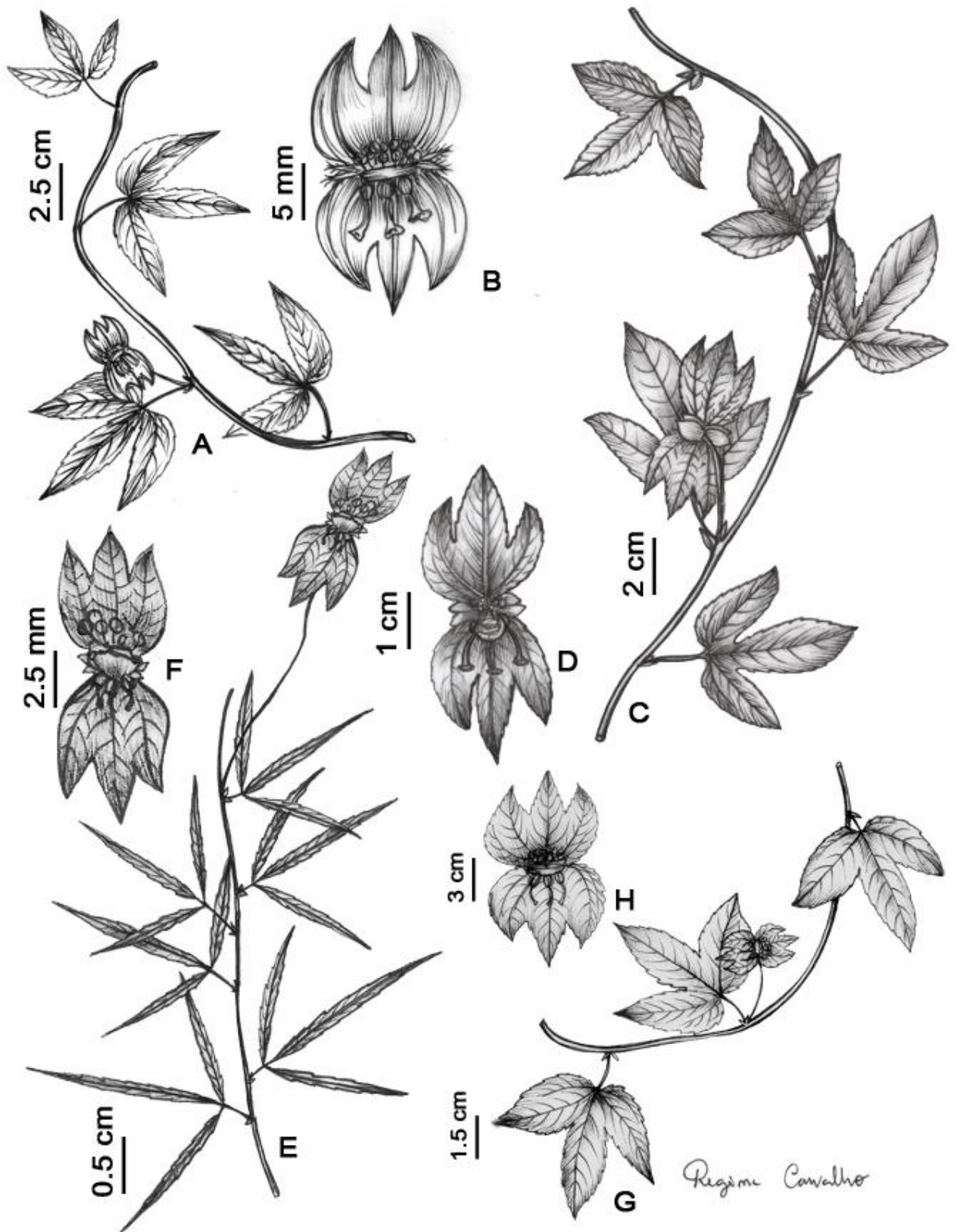


Figure 8. *Dalechampia olfersiana* Müll. Arg., A flowering branch B pseudanthium, G-H from M.J.N. Rodal & C.S. Zickel 456; *Dalechampia pernambucensis* Baill. C flowering branch D pseudanthium, C-D from J. R. Lemos & P. Matias 182; *Dalechampia riedeliana* Müll. Arg., E-F from H. S. Irwin et al. 16939; *Dalechampia riparia* Smith & Downs, E flowering branch D.F. Silva 42.

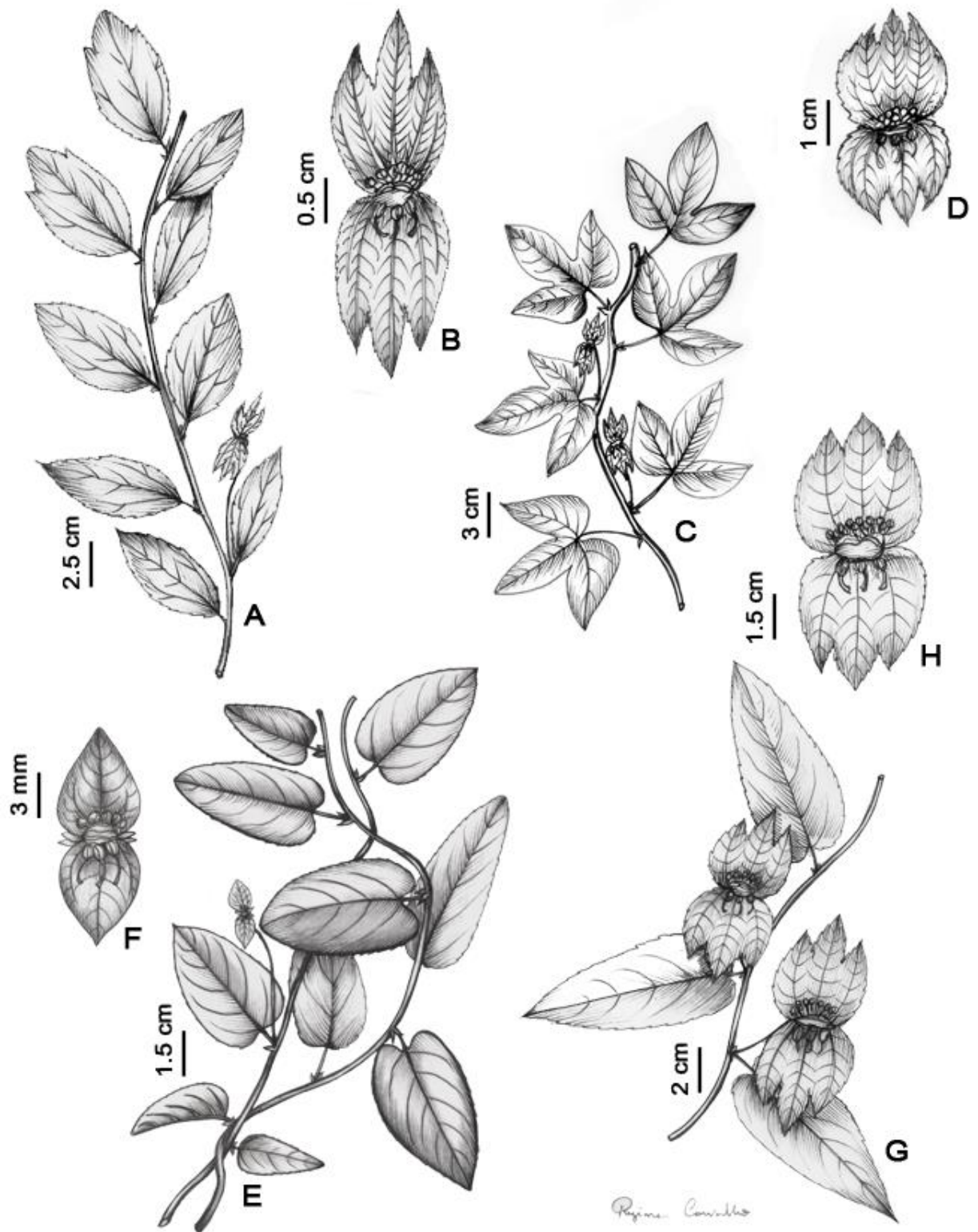


Figure 9. *Dalechampia rubrivenia* Pax & K. Hoffmann. **A** flowering branch **B** pseudanthium **A-B** from Hassler 9266; *Dalechampia scandens* L. **C** flowering branch **D** pseudanthium, **C-D** from V.C. Souza et al 29126; *Dalechampia schenckiana* Pax & K. Hoffm. **E** flowering branch **F** pseudanthium, **E-F** from R. A. Pereira-Silva 37; *Dalechampia schippi* Standl. **G** flowering branch **H** pseudanthium, **G-H** from C. Whiteford 1291.

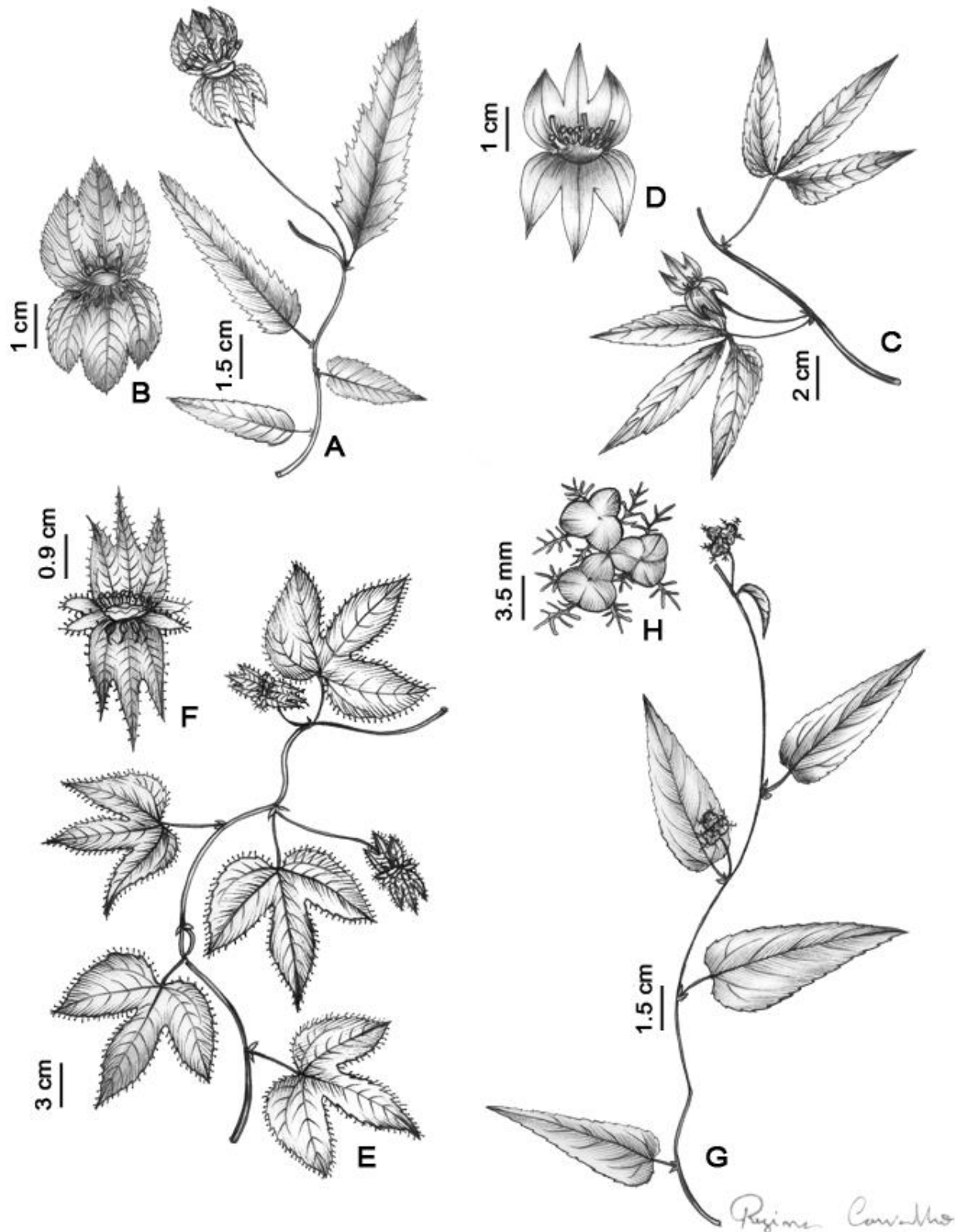


Figure 10. *Dalechampia serrula* Pax & Hoffmann. **A** flowering branch **B** pseudanthium **A-B** from Hassler 5296; *Dalechampia stenosepala* Müll. Arg. **C** flowering branch **D** pseudanthium, **C-D** from Angel et al. 28833; *Dalechampia stipulacea* Müll. Arg. **E** flowering branch **F** pseudanthium, **E. L. C. Marino 279**; *Dalechampia tenuiramea* Müll. Arg. **E** fruiting branch **F** fruits **E-F** from *M. Silva 35*.

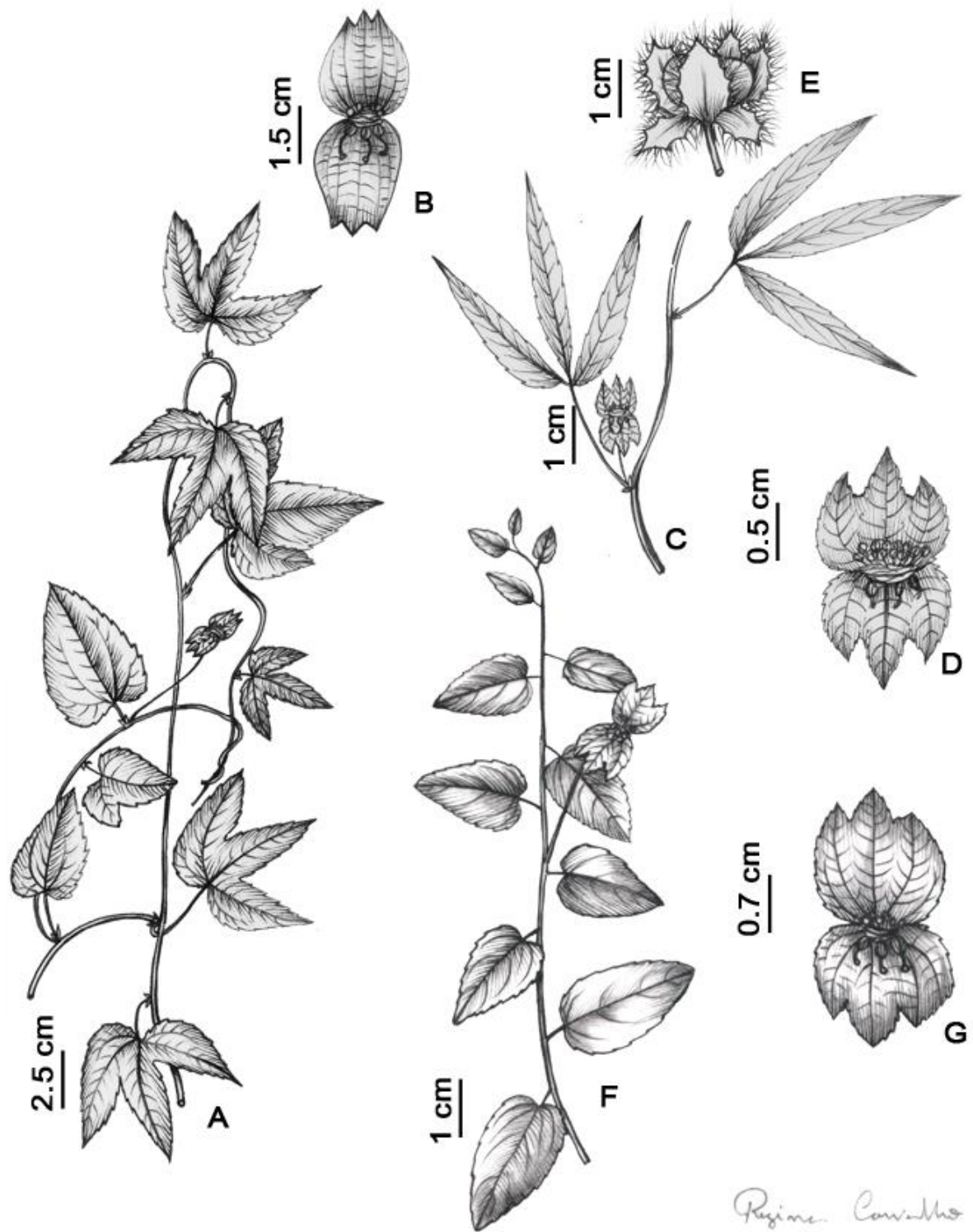


Figure 11. *Dalechampia tiliifolia* Lam. **A** flowering branch **B** pseudanthium, **A-B** from AL.W. Lima-Verde *s.n.*; *Dalechampia triphylla* Lam. **C** flowering branch **D** pseudanthium **E** fruit, **C-E** from K. Santos *s.n.*; *Dalechampia ulmifolia* Chodat & Hassler **F** flowering branch **G** pseudanthium, **F-G** from M. Sobral *et al.*, *s.n.*

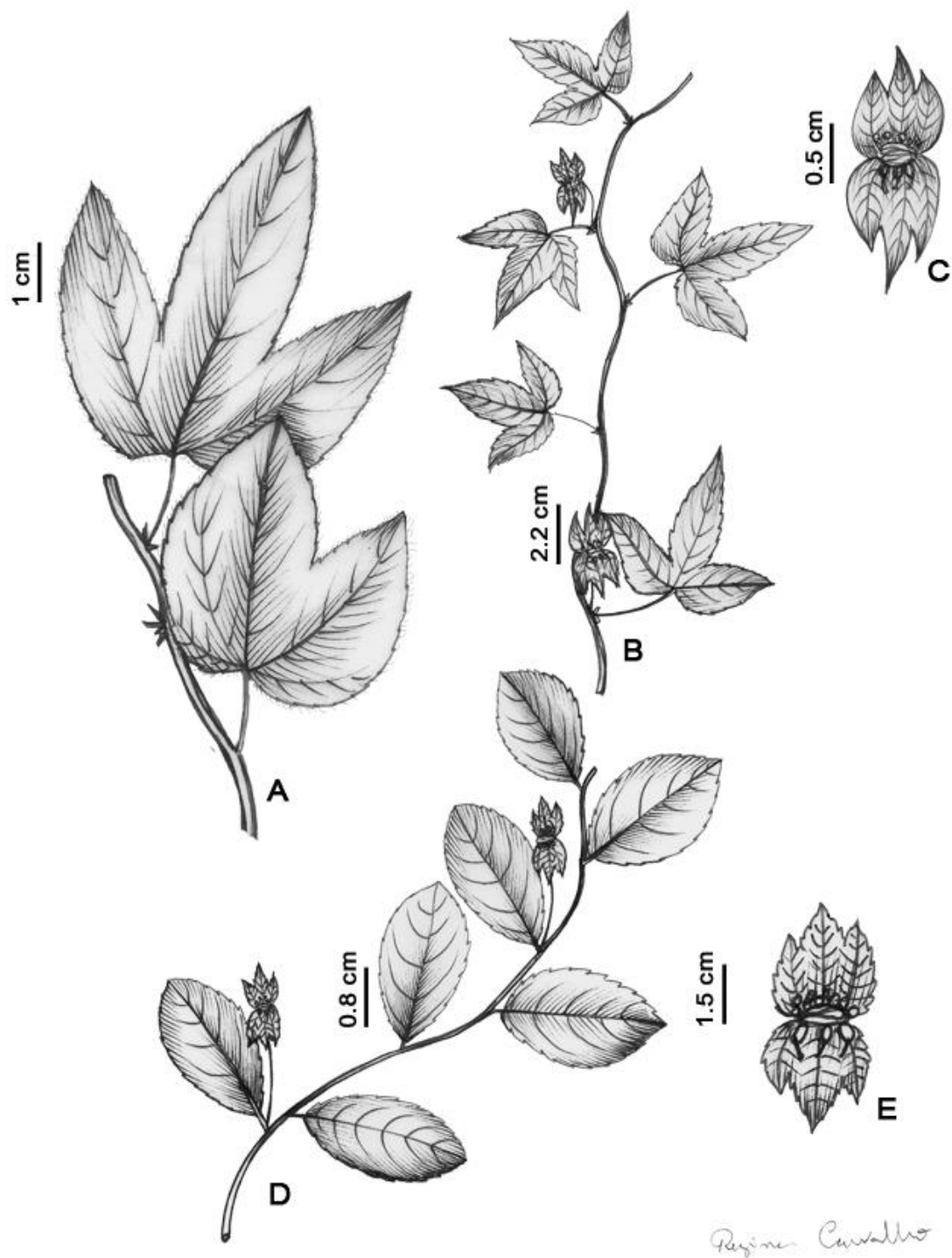


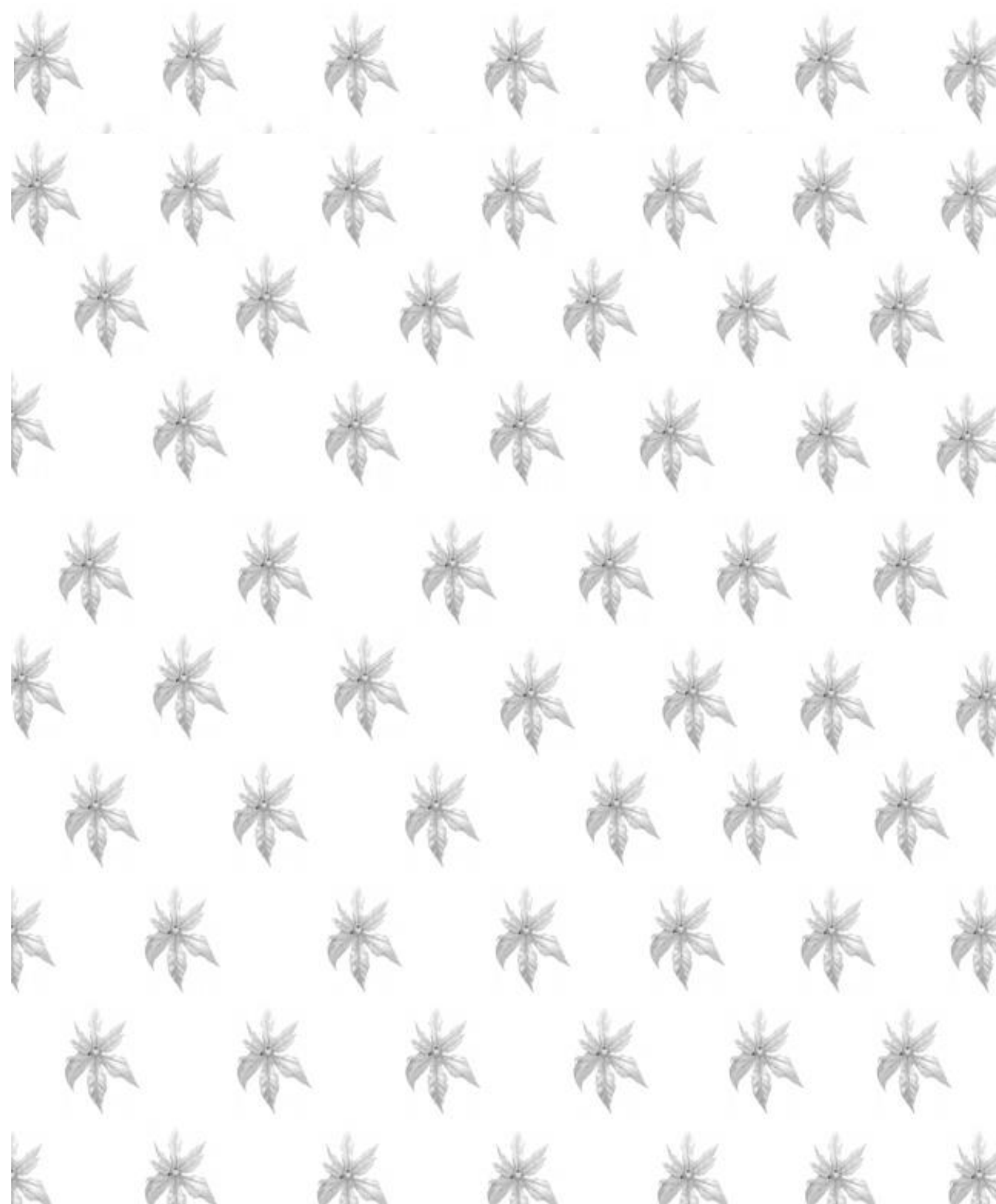
Figure 12 *Dalechampia variifolia* Müll. Arg **A** branch, **A** from *J. F. Widgren s.n.* *Dalechampia viridissima* Webster **B** flowering branch **C** pseudanthium, from *A. M. Amorim 246*; *Dalechampia weddelliana* Baill. **D** flowering branch **C** pseudanthium, **D-E** from *S. M. Silva et al s.n.*

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(IPA). **Prance, G.T.** 20103 (K). **Nester, L.** 68 (K). **Solland, G.** 7 (K). **Rodrigues, V.** s.n. (TEPB 11179). **Santos Filho, F.S.** 53 (BHCB). **Santos Filho, F.S.** 10 (TEPB). **França, R.A.** et al.s.n. (TEPB 10508). **Silva, R.M.** et al. 1300 (BHCB). **Milliken, W.** 347 (K). **Magenta, M.** et al. 3646 (SP). **Assis, M.A.** et al. 441 (SP). **Silva, S.I.** 235 (PEUFR). **Laurenio, A.** et al. 321 (PEUFR). **Cano, O.** et al. 715 (IPA). **Casas, F. & Susanna** 8594 (BM). **Rodrigues, R.S.** 1488(TEPB). **Campbell, D.G.**s.n.(INPA 46023). **Knowles, O.H.**1731(INPA). **Nelson, B.W.& Nelson, S.P.**1177 (INPA). **Davidson, C. e Martinelli, G.**s.n. (INPA 117738). **Davidson, C. e Marstinelli, G.** 10700 (UB). **Fernandes, A.M.**s.n. (EAC 12725); (EAC 15063). **Fernandes, A. e Nunes, E.**s.n. (EAC 15262); (EAC 15262). **Fernandes, A.**et al. (EAC16233). **Araújo, F. S.** 807 (EAC). **Webster, G.L.** et al. s.n. (EAC14892). **Loureiro, A.M.**1317 (PEUFR). **Ferrar, E.M.N.** et al. 602 (PEUFR). **Miranda, A.M.** 1317 (PEUFR). **Carvalho, A.M.** et al. 3646 (SP). **Silva, L.A.M. & Brito, H.S.** 637(IPA). **Prance, G.T.**s.n.(INPA 20039). **Fonseca, M.L.** et al. 2418 (SP). **Nunes, E e Martins, P.**s.n. (EAC 5799). **Lopes, J.C.** et al. 201 (EAC). **Árbocz, G.F.** et al. 3982(EAC). **Macedo, M. e Assumpção, S.** s.n. (BHCB 17745). **Almeida, M. e Lima, L.** s.n. (INPA 162919). **Texeira, L.O.A.**511(INPA). **Nunes, E. e Castro, A. J.**s.n.(EAC 6268); (EAC 13913). **Fernandes, A. e Gibbs, P.**s.n. (EAC 15081). **Fernandes, A. e Nunes, E.** s.n. (EAC 25043). **Pires, J.M. e Martin, R. T.**10032 (UB). **Amaral, I.L.** et al. 1128 (UB). **Ratter, J.** et al. 1861 (UB). **Heringer, E.P.** et al. 1005 (IPA). **Browne, S.W.** 71 (K). **CID, C.A.**et al. 4300(K). **Pourt** (K903337). **Gardner** (K903342); (K903343). **Glaziou, M.** 11536 (K). **Ratter, J.A. e Fonseca Filho, J.** 3399 (K). **Eiten, G. &Eiten, L.T.** 10657 (K). **Amaral, I. L.**11288 (K). **Sperling, C.R.** 5919 (K). **Chagas, F. E Silva** 17(K). **Stannard, B. L. & Arrais, M. G. M.** 643 (K).

Manuscrito 8



Taxonomic Revision of *Dalechampia* L. (Euphorbiaceae) in Madagascar

Rafaela Alves Pereira-Silva, Sarah Maria Athiê-Souza, Federico Fabriani,
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Systematic Botany

Taxonomic Revision of *Dalechampia* L. (Euphorbiaceae) in Madagascar

Rafaela Alves Pereira-Silva,^{1,4} Sarah Maria Athiê-Souza,¹ Federico Fabriani,²

André Laurênio de Melo,¹ Margareth Ferreira de Sales¹ and W. Scott

Armbruster³

¹Programa de Pós-Graduação em Botânica, Departamento de Biologia, Universidade Federal Rural de Pernambuco, 52171–900, Recife, PE, Brasil.

²Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK

³School of Biological Sciences, University of Portsmouth, Portsmouth, PO1 2DY, United Kingdom; Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska 99775, USA

⁴Author for correspondence (rafaela.news@hotmail.com)

Abstract— In an account of 12 species of *Dalechampia* occurring in Madagascar, ten species were lectotypified, two were synonymized and one reestablished. Information about typifications as well as the conservation status and maps of distribution for each species are provided herein. Additionally, illustrations and a key for identifying species of *Dalechampia* to Madagascar are also provided.

Keywords—Lectotype, Morphology, Nomenclature, Plukenetieae, Taxonomy

The genus *Dalechampia* L. (Euphorbiaceae) comprises almost 130 species distributed throughout tropical Asia, Africa and the New World (Webster & Armbruster 1991, Armbruster 1993; Armbruster 1994). Madagascar stands out as a center of high endemism and species of unusual blossom morphology and pollination (Armbruster & Baldwin 1998, Armbruster et al. 2013). Beyond this, the island is considered a priority area for conservation due to being a hotspot, based on richness and endemism among plants and vertebrates, where more than 90 per cent of the biodiversity of plants are endemic (Ganzhorn et al. 2001; Ganzhorn et al. 2014; Gautier et al. 2012). Twelve species of *Dalechampia* occur in Madagascar, but they are little collected and, consequently, little known, some known only from the type collection. These species are of special interest not only by its endemism but also because they have highly divergent blossom morphologies (Armbruster & Baldwin 1998, Armbruster et al. 2013). This includes the lack of resiniferous gland and variation in degree to which the sepals of staminate flowers reflex (Armbruster, 1994; Armbruster et al. 2013; Plebani et al. 2015). The loss of the resiniferous gland is associated with the dispersal from Africa to Madagascar, where the specific pollinators responsible for collecting the resin and pollinating are uncommon or absent (Armbruster and Baldwin, 1998).

Generally, *Dalechampia* species are pollinated by bees belonging to the Megachilidae family and the Apidae tribe Euglossini (Armbruster and Webster, 1982). Armbruster and Baldwin (1998) showed that most of the Malagasy species are pollinated by several functional groups of pollen-collecting insects, including beetles (Cerambycidae, Scarabidae), muscoid flies (Diptera), and bees (Halictidae and xylocopine, anthophorine and apine Apidae).

On the other hand, a few Madagascar species show a return to more specialized pollination: the staminate flowers fail to open fully and retain the mature pollen inside

the bud-like flower. This morphology restricts the pollen reward to only those bees, like *Xylocopa*, *Amegilla*, and *Nomia*, that are able to use sonication to obtain the pollen (Armbruster et al. 2013; Plebani et al. 2015; WS Armbruster unpublished observations). *Dalechampia parvifolia* Lam., a species of Africa and possibly southern Asia, has open male flowers that follow the “normal” developmental pattern seen in most species, including about half of the Madagascar species. *Dalechampia parvifolia* has emerged as potentially sister to the entire Madagascar clade, and the phylogenetic evidence indicates that all *Dalechampia* species in Madagascar form a single monophyletic clade (Armbruster et al. 1998, 2009, 2013).

Several studies have focused on the pollination biology of the Madagascar *Dalechampia* and its ecological importance (Armbruster and Baldwin 1998, 2003; Armbruster et al. 2009; Armbruster et al. 2013; Plebani et al. 2015). However, taxonomic studies for the genus in this country are rare and quite old. The most important study was conducted by Leandri (1943) in a paper entitled “Contribution a L’etude des Euphorbiaceés de Madagascar (III)”, in *Notulae Systematicae*. This treatment included nine taxa, including descriptions of four new species (*D. bathiana* Leandri, *D. humberti* Leandri, *D. decaryi* Leandri and *D. catati* Leandri) and two varieties (*D. decaryi* var. *mandrarensis* Leandri and *D. bernieri* var. *denisiana* Leandri). Madagascar species have not been reviewed since this publication. In view of this gap in the knowledge of the Madagascar species of *Dalechampia*, a taxonomic study was carried out to produce descriptions of all 12 species occurring in Madagascar, together with nomenclatural updates (one reestablished species and two synonymizations), and the typification of ten names. We also provide distribution maps and conservation status assessment for all species. A dichotomous key is provided.

MATERIALS AND METHODS

Material stored in the herbaria of the Royal Botanic Gardens, Kew (K), Museum National d' Histoire Naturelle (P) and Conservatoire et Jardin Botaniques de la Ville de Genève (G) was examined by the first author (GIVE DATES), including types and historical collections. Additional observations of herbarium specimens (K, P, MO, US) and living material in the field were conducted by the last author. Data on geographic distribution and habitat were obtained from label information and from fieldwork by the last author. The examined materials were compared to their respective types to confirm the identification, before writing the descriptions.

The conservation status assessments were primarily based on the determination of the EOO (extent of occurrence) and AOO (area of occupancy) using the web tool Geocat (<http://geocat.kew.org/>), following Bachman et al. (2011). Subsequently, we established conservation status according to criterion “B1” proposed by the IUCN red list, Version 3.1 (IUCN 2001).

TAXONOMIC TREATMENT

Dalechampia L.

Twining vines, lianas. Monoecious. Stems and leaves with simple trichomes, usually with stinging hairs. Leaves alternate, simple, 3-5 lobed or 3-5 foliate; margin entire to serrate, sometimes with capitate glandular trichomes; petiolar stipules sometimes with glands. Pseudanthium axillary or terminal, bisexual, with two involucre bracts, each associated with a pair of stipules. Staminate pleiochasium 4-50 flowers; subtended by 1-5 bracteoles, without a resiniferous gland. Staminate flowers monoclamiidous; sepals, 4-6, valvate, free, lanceolate; stamens 5-93, born on a column or dome-shaped receptacle, anthers dehiscing longitudinally. Pistillate cymule (1-) 3-flowered; pistillate

bracts 1–3. Pistillate flowers monoclamiidous; sepals 5–12, free, lanceolate or ovate, entire, pinnatifid or pinnatisect; ovary globose, 3–locular, 3–carpellate, 1 ovule per locule; stylar column cylindrical to clavate, tip lobed, capitate, crateriform, slender, or discoid. Seeds ecarunculate, ellipsoid to round and usually smooth.

KEY TO MADAGASCAR *DALECHAMPIA* SPECIES

1. Leaves simple.....2
2. Leaves exclusively 3-lobed.....3
3. Leaves 3-lobed, sinuses $< \frac{3}{4}$ deep, each lobe obovate.....*D. pseudoclematis*
- 3'. Leaves 3-lobed, sinuses $> \frac{3}{4}$ deep, each lobe lanceolate.....4
4. Leaf lobes with entire margin, apiculate apex, with glandular trichomes at the apex
..... *D. decaryi*
- 4'. Leaf lobes with deeply sinuate margin, acute apex, without glandular trichomes at
the apex *D. sinuata*
- 2'. Leaves entire or varying between entire to lobed on the same individual.....5
5. Leaves almost exclusively entire.....6
6. Petiole hirsute; involucre bracts always entire; staminate bracts widely oblong; style
tip cylindrical.....*D. bernieri var. denisiana*
- 6'. Petiole villous to pubescent; involucre bracts entire to 3-lobed; staminate bracts
lanceolate to square; stigma tip moderately dilated.....*D. humbertii*
- 5'. Leaves varying between entire to 3–7 lobed.....7
7. Leaves entire to 3-lobed.....8
8. Peduncle of staminate cymule elongate, > 2 cm long after anthesis of most staminate
flowers, pistillate bracts broadly ovate.....*D. chlorocephala*
- 8'. Peduncle of staminate cymule not elongate, < 2 cm long after anthesis of most
staminate flowers, pistillate bracts lanceolate, deltoid, reniform to transversely

- oblong.....9
9. Petiole 4–9 cm long; leaves 5–12 × 9–13 cm.....*D. tamifolia*
- 9' Petiole 1–2 cm long; leaves 4–5 × 4–4.5 cm.....*D. bernieri*
- 7'. Leaves 3–7 lobed.....10
10. Leaves exclusively 5-lobed; involucre bracts velutinous.....*D. catati*
- 10'. Leaves 3–7-lobed; involucre bracts glabrous to pubescent.....11
11. Leaves 3-lobed to deeply 3–5–7-lobed; staminate bracteole 1, completely connate; 6 pistillate sepals.....*D. bathiana*
- 11'. Leaves deeply 3–5-lobed; staminate bracteoles 5, free; ca. 8 pistillate sepals.....*D. perrieri*
- 1'. Leaves compound12
12. Involucre bracts chartaceous; ca. 2 staminate bracts; staminate column elongate, staminate sepals reflexed at anthesis; 2 pistillate involucellar bracts, transversely oblong; stigma tip cylindrical to lobed, tip moderately dilated.....*D. subternata*
- 12'. Involucre bracts membranous; 4–8 staminate bracts; staminate column not elongate, staminate sepals not reflexed at anthesis; 4 pistillate involucellar bracts, deltoid to lanceolate; stigma tip slender, not dilated.....*D. clematidifolia*

1. DALECHAMPIA BATHIANA Leandri, Notul. Syst. (Paris). 11: 35. 1943.—TYPE:

MADAGASCAR. Majunga, Jan. 1921, *J. M. H. A. Perrier de la Bâthie 13461*

(P04780231!) (lectotype, here designated: P!, isoelectotype P!); SYNTYPES:

MADAGASCAR. Ambongo, Namoroka, 11–19 Jan. 1904, *J. M. H. A. Perrier de la Bâthie 1686* (P0402219!, P04022120!); Belobaka, Jan. 1921, *H. Poisson 56*

(P04022118!); Majunga, Jan. 1908, *J. M. H. A. Perrier de la Bâthie 9914*

(P04022117!).

Twining vines, branches pubescent. Leaves alternate, simple, 3-lobed to deeply 3–5–7 lobed, membranous; petiole 1.5–7 cm long, pubescent; petiolar stipule 1.5–3 mm long, lanceolate, glabrescent, sometimes associated with glands. Lobes 3–7 × 0.6–4 cm, lanceolate to ovate, base cordate, cuneate or asymmetric, apex acute, margin sinuate to dentate, with sparse glandular trichomes, adaxial surface glabrescent, abaxial surface glabrescent, sometimes hispid on the veins, primary veins 5–7; stipels 1–2 mm long, linear, associate with glands at base and apex. Pseudanthium axillary 1–2 mm long, peduncle 4–7 mm long, pubescent; involucral bracts 0.7–1 × 0.7–1 cm, 3-lobed, membranous, greenish, base subcordate, apex acute, margin sinuate, glabrescent, with glandular trichomes, primary veins 5–7; bracteal stipule ca. 4 × 1 mm, lanceolate, base truncate, apex acute, margin entire, both surfaces glabrescent. Staminate pleiochasium 16-flowers, peduncle ca. 2 mm long, staminate bracteole 1, completely connate, transversely oblong, 10 mm circumference. Staminate flowers 5–6 mm long, pedicel 3–4 mm long; sepals 4, lanceolate, ca. 2 × 2 mm; stamens not seen; Pistillate cymule 3-flowered, sessile, pistillate involucellar bracts 2, transversely oblong, ca. 4 × 2 mm, margin cropped and sparsely ciliate, without stipitate trichomes. Pistillate flowers 4–7 mm long; sepals 6, ca. 2 × 1 mm, pinnatifid, glabrous, with stipitate glandular trichomes, ovary ca. 1 × 1 mm, velutinous; stylar column 4–7 mm long, stigma tip slender, not dilated. Capsule ca. 4 × 4 mm, brown, glabrous, sepal in fruit ca. 2 mm long. Seeds not seen. Figure 2 A–E.

Distribution and Habitat—*Dalechampia bathiana* is endemic to Madagascar and has been recorded from only Ambongo, Belobaka and Majunga, in degraded environments near riparian forest, on limestone outcrops, next to rivers. Figure 1.

Phenology—Based on specimen data, this species flowers from January to December and fruits in January.

Conservation—According to the IUCN red list criteria (IUCN 2001), *D. bathiana* belongs in the category Data Deficient (DD).

Taxonomic Considerations—This species displays wide morphological variation in the shape of leaves; these can vary between entire, 3-fid to deeply 3–5–7 lobed. The syntype “*Perrier de la Bâthie 1686*” is similar to the type of *D. perrieri* Denis.

However, the two species differ mainly by the shape of their leaves (lobed to compound in *D. bathiana* and never compound in *D. perrieri*), number of pistillate sepals (six vs eight) and number of staminate bracteoles (one fused bracteole subtending the pleiochasium vs five bracteoles).

Because Leandri (1943) published this species as “nov. sp. ad interim”, Govaerts and Radcliffe-Smith (2000) did not accept *Dalechampia bathiana* as a legitimate name, labelling it instead as “unplaced”. However, because Leandri (1943) provided Latin description and cited four syntypes, we accept Leandri’s name as legitimate (see Turland et al. 2018, article 46). We have augmented the description here and selected a lectotype. Of the four syntypes, Leandri (1943) cited (*Poisson 56, Perrier de la Bâthie 1686, Perrier de la Bâthie 13461* and *Perrier de la Bâthie 9914*), we nominate *Perrier de la Bâthie 13461* as the lectotype because it exhibits the morphological variation in the leaves and has one duplicate.

Representative Specimens Examined—MADAGASCAR. Antarika: Maroliogo, Jan 1949, *unknown collector 176* (P). Majunga: Ambongo, Jan 1904, *unknown collector 1688* (P).

2. DALECHAMPIA BERNIERI Baill., *Adansonia* 1: 277. 1860.—TYPE: MADAGASCAR.

Loukei, without date, *A. C. J. Bernier 276* (lectotype, here designated: K!),

isolectotypes P04022131!, G00434767!); SYNTYPES: MADAGASCAR. without local, without date, *L. H. Boivin s.n.* (herbarium not located); MADAGASCAR.

Porthleven, 1850, *Vesco s.n* (H).

Twining vines, branches sparsely villous. Leaves alternate, simple, entire to 3-lobed, membranous; petiole 1–2 cm long, hispid; petiolar stipule 6 mm long, entire, pubescent not associated with glands at base. Lobes 4–5 × 4–4.5 cm, ovate, base cordate, apex cuspidate, margin sinuate, with glandular trichomes, adaxial surface sparsely pubescent, abaxial surface pubescent on the veins, primary veins 5–7; stipels up to 1 mm long, linear, associate with glands at base. Pseudanthium axillary 6–7 cm long, peduncle 6–8 mm long, hispid; involucral bracts 3–3.5 × 2.5–3.5 cm, 3-lobed to entire, membranous, whitish, base cordate, apex acute, margin sinuate, glabrescent, with glandular trichomes, primary veins 6–7; bracteal stipule ca. 4 × 1 mm, lanceolate, base truncate, apex acute, margin entire, both surface pubescent. Staminate pleiochasium 14-flowers, peduncle 4–5 mm, staminate bracteole 4, free, widely oblong, 2–4 × 3 mm. Staminate flowers open slightly, ca. 8 mm long, pedicel 4–5 mm long; sepals 4, lanceolate, 2–3 × 1 mm; stamens 8; Pistillate cymule 3-flowered, peduncle ca. 1 mm long, pistillate involucelar bracts 5, lanceolate, deltoid or reniform, 1–4 × 3–4 mm, margin entire, ciliate, without stipitate trichomes. Pistillate flowers 1–1.1 cm long; sepals 12, ca. 1 × 1–2 mm, pinnatifid, glabrous, with stipitate glandular trichomes, ovary ca. 2 × 2 mm, glabrous; stylar column ca. 8 mm long, stigma tip cylindrical, not dilated. Capsule ca. 1 × 0.55 cm, brown, glabrous, sepals in fruit 5–6 mm long. Seeds ca. 3 × 2 mm, ellipsoid, pale with brown macules. Figure 2 F–G.

Distribution and Habitat—The species is widely distributed in western lowlands of Madagascar (Figure 1). It grows in degraded scrub, sandy hills and edges of roadsides.

Phenology— Flowers from January to November and fruits from January to July.

Conservation—*Dalechampia bernieri* is restricted to Madagascar (Govaerts et al. 2018) and has a discontinuous distribution in the country. The species is designated according IUCN (2001) as least concern (LC) due to an EOO of 104,857.388 km², but endangered (EN) due to an AOO of 12,000 km².

Taxonomic Considerations—*Dalechampia bernieri* is characterized mainly by have staminate flowers that remain bud-like in anthesis, and in leaves and involucre bracts that vary from entire to 2-3-lobed. *D. bernieri* is similar to *D. bernieri* var. *denisiana*, but they are easy to tell apart in the field, though obviously closely related. *D. bernieri* var. *denisiana* always has entire bracts and leaves, usually with more pubescence. *D. bernieri* nearly always has lobed leaves intermixed with unlobed when mature (flowering) and also has 2-3 lobed bracts intermixed with entire bracts. These both belong to a difficult species complex.

Representative Specimens Examined—MADAGASCAR. Ankorika, 3 Dec 1919, R. Decary 80 (P); Province d'Analalava, Ile de Nosy Lava, E.G. Waterlot 234 (P); Province d'Analalava, Île de Nosy Lava, (fl) E.G. Waterlot 235 (P); Majunga, 2 Jan 1921 (fl), H. Poisson 89 (P). Toliara: Route de Morondava a Belo sur Tsiribihina, 12 Oct 1999 (fl), L. Allorge 2393 (P).

3. DALECHAMPIA BERNIER VAR. DENISIANA Leandri., Notul. Syst. (Paris), 11: 39.

1943.—TYPE: MADAGASCAR. Environs de Majunga, 28–30 Dec. 1924, (fl.) H. Humbert 4066 (lectotype, here designated: K!, isotype P 04022129!);

SYNTYPES: MADAGASCAR, Bois sablonneux des environs d'Ampasimentera, Jan. 1902, J. M. H. A. Perrier de la Bâthie 9570 (P04022127!, P04022128!);

MADAGASCAR. Bois sablonneux des environs d'Ampasimentera, Jan. 1902, (fl) J. M. H. A. Perrier de la Bâthie 9603 (P04022130!); MADAGASCAR. Bosquets sur les rives du Jabohazo, cause d'Ankara, Jan. 1901, J. M. H. A. Perrier de la Bâthie

9943 (P04022124!, P4022123!); MADAGASCAR. Majunga, 10 Oct. *Catat 3214* (not found); MADAGASCAR. Majunga, 6 Mar. 1924, *R. Decary 2385* (not found); MADAGASCAR. Majunga, Nov. 1924, *J. M. H. A. Perrier de la Bâthie 16763* (P04022126!); MADAGASCAR. Ankarafantsika, Marovoay, Mar. 1910, *J. M. H. A. Perrier de la Bâthie 9791*; MADAGASCAR. without local, without date *Poisson 59* (2°) (P04022125!); MADAGASCAR. Without local, without date, *J. M. H. A. Perrier de la Bâthie 157* (P!).

Twining vines, branches hispid. Leaves alternate, simple, entire, membranous; petiole 1–5 cm long, hirsute; petiolar stipule 6 mm long, entire, pubescent not associated with glands at base. Lobes 4–7 × 4–4.5 cm, ovate, base cordate, apex cuspidate, margin completely dentate, with glandular trichomes, adaxial surface sparsely pubescent, abaxial surface pubescent on the veins, primary veins 5; stipels up to 1 mm long, linear, associate with glands at base. Pseudanthium axillary 6–7 cm long, peduncle 1.5–8 mm long, hispid; involucre bracts 3–4.0 × 2.5–3.0 cm, 3-lobed to entire, membranous, whitish, base cordate, apex acute, margin sinuate, glabrescent, with glandular trichomes, primary veins 6–7; bracteal stipule ca. 4–6 × 1–1.3 mm, lanceolate, base truncate, apex acute, margin entire, both surface pubescent.

Taxonomic Considerations—*Dalechampia bernieri* var. *denisiana* was proposed by Leandri (1737) based on: “a typo differt petiolis pedunculisque luteo-hirtis, foliis magis dense pilosis, bracteis albis; flores o lutei, styli virides; rhizoma perenne.” *D. bernieri* var. *denisiana* is characterized by entire bracts and leaves and being more pubescent, but otherwise similar to *D. bernieri*.

Representative Specimens Examined—MADAGASCAR. Antsiranana: Foret de Sahafany, entre Diego et Anurrano, Mar 1962 (fl, fr), *M. Keraudren, 1683* (P); 18.7 km S of Ambalanjanakoby, 16°48'S, 47°00'E, 100 m, 20 Dec 1990 (fl), *W.S. Armbruster et*

al. 90-149 (P); Ca. 2km NW of Amborovy, 15°39'S 46°20'E, 15 m, 24 Dec 1990 (fl),
W.S. Armbruster et al. 90-155 (P); Betsitindry, 12 Nov 1942 (fl), *A. Seyrig* 352 (P).
 Majunga: Environs de Majunga, 2-15 m, 28-30 Dec 1924, *H. Humbert*, 4066 (P);
 Maevatanana, 31 Dec 1941 (fl) *R. Decary* 17078 (P); Province de Diego-Suarez,
 Sakaramy, Montagne de Francais, 8 Nov 1944 (fl), *A.M. Homolle* 368 (P); Province de
 Diego-Suarez, Collines et plateaux calcaires de l'Analamera, 30-400 m, Jan 1938 (fl),
H. Humbert 19097 (P); Environs de Diego-Suarez, Forest d'Orangea, 1-100 m, 22 Jan
 1960 (fl), *H. Humbert & G. Cours* 32293 (P95/144).
 Uncertain locality: Ampajony, 1 Jan 1965 (fl), *M. Peltier*, 5383 (P); 1847-1852, *M.*
Boivin s.n. (P).

4. DALECHAMPIA CATATI Leandri, Notul., Syst. (Paris), 11: 43. 1943.—TYPE:

MADAGASCAR. Boina, environs d'Ampasimentera, *J. M. H. A. Perrier de la*
Bâthie 9601 (lectotype, here designated: P044780065!, isolectotype: P04780225!);
 SYNTYPE: MADAGASCAR, without date, Majunga, *Catat* 3215 (P04780066!).

Twining vines, branches densely pubescent to velutinous. Leaves alternate, simple,
 deeply 5-lobed, membranous; petiole 3-8 cm long, velutinous; petiolar stipule 5 mm
 long, lanceolate, pubescent, not associate with glands at base. Lobes 5-5.6 × 0.5-0.7
 cm, linear, base cordate, apex acute, margin entire to sinuate, glandular trichomes
 sparsely, adaxial surface pubescent and abaxial surface densely pubescent, primary
 veins 5-7; stipels up to 1 mm long, linear, pubescent, associate with glands at base.
 Pseudanthium axillary 3.5-4 cm long, peduncle 3-9 cm long, velutinous, involucre
 bracts 3-lobed, 1.5-2 × 1.5-2 cm, chartaceous, greenish, base sub-attenuate, apex acute,
 margin sinuate, velutinous, with glandular trichomes sparsely, primary veins 6-7;
 bracteal stipule 6-7 × 1 mm, lanceolate, base truncate, apex acute, margin truncate,
 adaxial surfaces pubescent to velutinous and abaxial surfaces pubescent. Staminate

pleiochasium flowers not seen, staminate bracteole 3–4, free, deltoid, $1-2 \times 2$ mm.

Staminate flowers 2–3 mm long, pedicel 1–2 mm; sepals 4, lanceolate ca. 1 mm long; stamens 12–16; Pistillate cymule 3-flowered, sessile, pistillate involucellar bracts ca. 3, deltoid to transversely oblong, $2 \times 2-3$ mm, margin cropped, without stipitate glandular trichomes. Pistillate flowers 3–7 mm long; sepals 6, ca. 1×1 mm, pinnatifid, glabrous, stipitate glandular trichomes sparsely; ovary ca. 1×1 mm, pubescent; stylar column 4–8 mm, stigma tip cylindrical, not dilated. Capsule not seen. Seeds not seen. Figure 2 I–L.

Distribution and Habitat—*Dalechampia catati* is apparently restricted to the Majunga region, where it is reported to grow on sandy hills (Figure 1).

Phenology—This species flowers from February to March.

Conservation—*Dalechampia catati* is assessed as Data Deficient (DD) according to the IUCN (2001).

Taxonomic Considerations—*Dalechampia catati* is recognized mainly by the leaves, which are, exclusively 5-lobed, with linear lobes, and also by bracteal stipules being 6–7 mm long. *Dalechampia catati* and *D. perrieri* are very similar, because both have leaves that are deeply 5-lobed. However, they can be separated by a set of morphological characters. *Dalechampia catati* has 3-lobed involucral bracts, densely pubescent on the adaxial surface; peduncles 3–9 cm long, velutinous; 6–7 primary veins on the involucral bracts, and glandularity sparse in bracteal stipule. In contrast, *D. perrieri* has 3-5-lobed leaves, involucral bracts entire to 3-lobed, face adaxial villous, peduncle 2 cm long, pubescent to villous, 5 primary veins on the involucral bracts, and without glandular trichomes in bracteal stipules. The lectotype of *Perrier de la Bâthie* 9601 was chosen because it has a duplicate in P and the specimen is in better condition.

5. DALECHAMPIA CLEMATIDIFOLIA Bojer ex Baill., *Adansonia* 1: 277. 1860.—TYPE:

MADAGASCAR. Emirna, 1833, *W. Bojer s.n.* (holotype P04022147!; isotypes G-DC 00317173!, H).

Dalechampia clematidifolia Bojer ex Leandri, *Cat. Pl. Madag. Euphorb.*: 47. 1935. nom. illeg.

Twining vines, branches sparsely pubescent. Leaves alternate, compound, 3-foliolate, sometimes 5-foliolate, membranous; petiole 0.5–5 cm long, pubescent; petiolar stipules 3–5 mm long, deltoid, glabrous to glabrescent, with glandular trichomes. Foliioles 3–5 × 1–1.7 cm, ovate to elliptical, base acute to asymmetric, apex acute, margin denticulate, with glandular trichomes, adaxial surface glabrous to glabrescent and abaxial surface glabrous to pubescent, primary veins 3–5; stipels ca. 1 × up to 5 mm, linear, pubescent, associate with glands at base. Pseudanthium axillary 2.5–5 cm long, peduncle 3–5 cm long, sparsely pubescent, involucre bracts 2.5–3 × 2–3 cm, 3-lobed, membranous, white-greenish or yellow-greenish, base subcordate to cordate, margin serrate, glabrous to glabrescent, with glandular trichomes, primary veins 5; bracteal stipule ca. 6 × 1.5 mm, lanceolate to deltoid, base truncate, apex acute, margin entire, adaxial and abaxial glabrescent surfaces. Staminate pleiochasium 12-flowers, peduncle ca. 2 mm long, staminate bracteole 4–8, free, lanceolate, widely lanceolate to deltoid or reniform, ca. 5 × 1–2 mm. Staminate flowers open slightly, ca. 4 mm long, pedicel ca. 3 mm long; sepals 4, lanceolate, ca. 2 mm long; stamens not seen; Pistillate cymule 3-flowered, peduncle ca. 1 mm or sessile, pistillate involucelar bracts 4, deltoid to lanceolate, margin cropped, ciliate, without glandular trichomes. Pistillate flowers 0.8–1 mm long; sepals 6–8, 1 mm, pinnatisect, densely pubescent, with stipitate glandular trichomes; ovary ca. 1 × 1 mm, pubescent; stylar column 8–1 cm long, stigma tip cylindrical, not dilated. Capsule ca. 1 × 1 cm, brown, glabrescent, sepal in fruit 8–1 cm long. Seeds ca.

2 × 3, ellipsoid, brown with white macules. Figure 3 A–B.

Distribution and Habitat— This species has been recorded from open margins of moist forests and near rivers over a wide region of central Madagascar (Figure 1). Based on the last author’s field observations, we conclude that *Dalechampia clematidifolia* is largely restricted to upland forests >1200m elevation in the Central Highlands.

Phenology—This species flowers of Jan-Dec year-round and insufficient information on fruiting.

Conservation— *Dalechampia clematidifolia* occurs only in Madagascar (Govaerts et al. 2018) covering different regions of the country, but is represented by discontinuous and isolated populations. According the criteria of IUCN (2001) the species is considered is Least Concern (LC) due to an EOO of 176,992.004 km², but Endangered (EN) due to an AOO of 16.000 km². Part of the area covered by the species is located in the Tsaratanana Nature Reserve. The species is restricted to the upland forests, it is actually very rare, as the uplands are mostly deforested or unforested. The last author has seen several populations disappear completely with clearing of small remaining forest patches north of Antananarivo.

Taxonomic Considerations—*Dalechampia clematidifolia* is easily recognized by its staminate flowers being bud-like at anthesis (i.e. sepals do not reflex, and the staminal column does not elongate; see Armbruster et al. 2013), its leaves being compound, with the margins of leaflets being denticulate with glandular trichomes. Herbarium material is commonly misidentified as *D. subternata* (or vice versa), but these two species can be readily differentiated by the latter having staminate flowers with reflexed sepals at anthesis, rather than budlike. In addition, *D. clematifolia* has membranous involucre bracts (vs. chartaceous in *D. subternata*) and 4–8 free lanceolate staminate involucellar

bracts with margins that lack glandular trichomes (vs. ca. 2 staminate involucellar bracteoles with margins that bear glandular trichomes).

Note that *Dalechampia clematidifolia* var. *dumetorum* Leandri was treated as a synonym of *Dalechampia clematidifolia* Bojer ex Baill. by Govaerts et al. (2018).

However, based on morphology and distribution, this taxon is treated here as a synonym of *D. decaryi* Leandri (see below).

Representative Specimens Examined—MADAGASCAR. Antsiranana: Foret D'Analandraisoa (Ambohijatovo), SW de Tsiroanomandidy, 1200–1300 m, 17-20 Nov 1932 (fl), *J. Leandri et al. 1834* (P04780220); Antananarivo: 156.7 km N of Antananarivo, ca 63 km N of Ankazobe on highway to Majunga, 17°58'S, 47°08'E, 1450 m, 20 Dec 1990, *Armbruster, W.S. et al. 90-148* (P). Antananarivo Foretd'Ambohiby, 1500-1600 m, 31 Jan 1933, *J. Leandri 760* (P). Fianarantsoa: Fianarantsoa, Andringitra mountains S of Fianarantsoa, northern part of the National Park Rainforest along the stream of river Zomandao, 22°08'07"S, 46°53'27"E, 1630 m, 12 Jan 2006 (fl), *A. Anderberg et al. 19* (K, S); Ihorombe, 22°34'55"S 046°42'16"E, 960 m, 04 Dec 2016 (fl), *C. Rakotovao 7151* (MO, TAN); Ambalavao, Soaramo, Androtra, 25 Nov 1954 (fl), *unknown collector* (P); Mamovoka, Aug 1906, *C. Alleizette 9843* (P). Toliara: Mont Vohipolaka au N de Betroka, 1200-1400 m, Nov 1933 (fl), *Humbert 11692* (K, P). Uncertain locality: Central Madagascar (fl), *R. Baron 4222* (K); Central Madagascar (fl), *R. Baron 3177* (K); Ambohimanga, 5 Jan 1938 (fl), *unknown collector 3248* (P).

6. DALECHAMPIA CHLOROCEPHALA Denis, Bull. Mus. His. Nat. 28: 256. 1922.—TYPE: MADAGASCAR. Majunga, 1913, *J. M. H. A. Perrier de la Bâthie 9885* (lectotype, here designated: P04022122!). SYNTYPE: Madagascar. Manongarivo, 1903, *J. M.*

H. A. Perrier de la Bâthie 9942 (P04022121!).

Twining vines, branches glabrescent to sparsely villous. Leaves alternate, simple, 3-lobed to entire, membranous; petiole 3.5–5 cm long, glabrescent to sparsely villous; petiolar stipule 1–4 mm long, linear to lanceolate, glabrescent, associate with glands at base. Leaf blade 5–7 × 2–5 cm, ovate to obovate, base cordate, apex acute to cuspidate, margin sinuate to serrate, with glandular trichomes, both surfaces glabrous, primary veins 5; stipels ca. 1 mm long, linear, associate with glands at base. Pseudanthium axillary 6–7.5 cm long, peduncle 6.5–10 cm long, glabrescent to glabrous; involucre bracts 3–3.5 × 3 cm, membranous, entire to 3-lobed, greenish, base attenuate to sub-attenuate, apex acute, margin serrate to dentate, surface glabrous, with glandular trichomes, primary veins 5–7; bracteal stipule ca. 4 × 1–2 mm, lanceolate to deltoid, base truncate, apex acute, margin entire, without glandular trichomes, both surfaces glabrous. Staminate pleiochasium ca. 19 flowers, peduncle 2.5 cm long, staminate bracteoles 3–4, free, reniform, ca. 4 × 3 mm. Staminate flowers open widely, 5–6 mm long, pedicel 3–4 mm long; sepals 4, lanceolate, ca. 2 × 1 mm; stamens 6–10; Pistillate cymule 3-fowered, sessile, pistillate involucellar bracts 2, widely ovate, 5–6 × 4–5 mm, margin entire, without stipitate glandular trichomes. Pistillate flowers ca. 9 mm long; sepals 6, ca. 2 mm long, pinnatifid, glabrous, sometimes with stipitate glandular trichomes; ovary not seen; stylar column slender, ca. 9 mm long, stigma tip slender, not dilated. Capsule ca. 1 × 0.6 cm long, brown, glabrous, sepal in fruit 8–9 mm long. Seeds ca. 3 × 3 mm, globoid, brown with pale macules. Figure 3 C–F.

Distribution and Habitat— Occurs in dry vegetation on dunes and in sea border, 200–350 m. Figure 1.

Phenology—This species flowers from January to October; fruits in May.

Conservation— *Dalechampia chlorocephala* is endemic to Madagascar (Govaerts et al.

2018) and known from few collections restricted to the northwestern region of the country. This species would be designated as endangered (EN) following IUCN (2001) by the extent of occurrence (EOO of 172,723 km²) and the area of occupancy (AOO of 12,000 km²). Some of populations occur inside the National Park of Ankarafantsika, but here they introgress with *D. subternata* (WS Armbruster, unpublished data). Typical material is largely restricted to stabilized dunes many of which have disappeared (along with the flora) in recent year due to sand extraction.

Taxonomic Considerations—Among the *Dalechampia* species from Madagascar, only *D. chlorocephala* has the staminate cymule with such an elongated peduncle (2.5 cm long vs 1–3 mm long in the other species). This species is thus one of the most easily identified.

Denis (1922) described *D. chlorocephala* based on the syntypes, *Perrier de la Bâthie* 9885 and *Perrier de la Bâthie* 9942, as having unlobed leaves (“limbus indivisus, traingulari-ovatus...”), but subsequent collections show 3-lobed leaves are also produced. The first collection was chosen as lectotype because it contains branches with many leaves and inflorescence, which are in better conditions of conservation since the other collection (*Perrier de la Bâthie* 9942) is fragmentary.

Representative Specimens Examined—MADAGASCAR. Majunga, Pointe du Caiman, 1-10 m, 12 Jan 1929 (fl), *H. Humbert* 7156 (K); Station forestiered’ Ampijoroa, ca 3 km N d’Andranofasika, 16°20’S, 46°51’E, 9 Apr 1984 (fl), *L.J. Dorr & L. Koenders* 2987A (K); Station forestiered’ Ampijoroa, ca 3 km N d’Andranofasika, 16°20’S, 46°51’E, 12 Apr 1984 (fl, fr), *L.J. Dorr & L. Koenders* 3024 (K, P); Majunga, 8 Apr 1912, *K. Afzelius*, *s.n.* (P); Majunga, 7 Mar 1924 (fl, fr), *R. Decary* 2479 (P); Majuga, Feb 1912, *J.M.H. Perrier de la Bâthie* *s.n.* (P); Majunga, Jan 1919 (fl), *J.M.H. Perrier de la Bâthie*, 12349 (P); Forestiere Ampijoroa, ca 115 km SE Majunga, 16°18’S,

46°50'E, 70 m, 22 Dec 1990 (fl), *W.S. Armbruster et al. 90-151* (P); ca. 0.5 km N

Nahamotel, ca 4 km N Majunga along coast, 1.5 km SW of Amborvy, 15°40'S,

46°20'E, 10 m, 23 Dec 1990 (fl), *W.S. Armbruster et al. 90-154* (P).

Uncertain locality: *L. J. Dorr & L. Koenders 2987* (P).

7. *DALECHAMPIA DECARYI* Leandri, *Notul. Syst. (Paris)*, 11: 36–38. 1943.—TYPE:

MADAGASCAR. Toliara: Vallee de l'Ikonda, 20 Apr. 1931, *M. R. Decary 8911*

(lectotype, here designated: P04022144!, isoelectotypes: S!, S07–17112 [image

seen]). SYNTYPES: MADAGASCAR. Toliara: Antanimora, 4 Oct. 1924, *M. R.*

Decary 3330 (P!, G00018134!); Toliara: District d'Ambovombe, 18 Apr. 1924, *M. R.*

Decary 2568 (P04022143!); Toliara: Antanimora, without date, *M. R. Decary 3273*

(P!); Vallee de l'Ikonda, 1 May 1931, *M. R. Decary 8917* (P04022145!)

Dalechampia decaryi var. *mandrarensis* Leandri, *Notul. Syst. (Paris)*, 11: 38. 1943.—

TYPE: MADAGASCAR. Vallee Moyenne du Mandrare, près d'Anadabolava, mont Vohibaria, Dec. 1933, *H. Humbert 12629* (holotype P04022142!)

Dalechampia clematifolia var. *dumatorum* Leandri, *Notul. Syst. (Paris)*, 11: 44.

1943.—TYPE: MADAGASCAR. Toliara: Antanimora, 13 Jan. 1932, *M. R. Decary*

9544 (holotype P04022146!; isotype K!). *syn. nov.*

Twining vines, branches glabrescent to pubescent. Leaves alternate, simple, deeply 3-lobed, sometimes 3-lobed, membranous; petiole 1–2.5 cm long, pubescent; petiolar stipule ca. 2 mm long, lanceolate, glabrous, not associate with glands at base. Lobe 3–5.5 × 0.5–1.5 cm, lanceolate, base cordate, apex apiculate, margin entire, with one glandular trichome only in the apex, adaxial surface glabrous, abaxial surface pubescent, primary veins 3; stipels 1–1.5 mm long, linear, associate with glands at base. Pseudanthium axillary 3–4 cm long, peduncle 2–3 cm long, pubescent to velutinous; involucre bracts 1.5–2 × 1.5–2 cm, 3-lobed, membranous, white, yellow or greenish,

base truncate, apex acute, margin serrate, glabrescent, with glandular trichomes, primary veins 4–5; bracteal stipule 4–5 × 2 mm, lanceolate, base truncate, apex acute, margin entire, adaxial and abaxial surfaces pubescent. Staminate pleiochasium 7–12 flowers, peduncle ca. 4 mm long, staminate bracteole 7, free, square to widely oblong 1–1.5 × 1–2 mm. Staminate flowers, 4–6 mm long, pedicel 1.5–4 mm; sepals 4–5, spreading widely in anthesis, lanceolate, ca. 1.5 × 1.5 mm; stamens 10–14; Pistillate cymule 3-flowered, sessile, pistillate involucellar bracts 4, lanceolate to reniform, 1.5–3 × 1–4 mm, margin entire, ciliate, with stipitate hyaline glandular trichomes. Pistillate flowers 9–1 cm long; sepals 9–10, ca. 2 × 1 mm, pinnatifid, glabrescent, with glandular trichomes; ovary ca. 1 × 1 mm, glabrescent; stylar column 7–9 mm long, stigma tip cylindrical, not dilated. Capsule ca. 1 × 1 cm, brown, glabrescent, sepal in fruit ca. 6 mm long. Seeds ca. 2 × 1.5 mm, widely ellipsoid, pale with white and brown macules.

Figure 3 G–J.

Distribution and Habitat— This species is, to date, recorded only in the province of Toliara in southwestern Madagascar where it grows in thicket vegetation on sandy soil and quartz outcrops. It has been found at altitudes close to 375 m (Figure 1).

Phenology— Flowers from January to April, and fruits are present in April.

Conservation—*Dalechampia decaryi* is restricted to Madagascar (Govaerts et al. 2018) where is found only in the southwestern of the country and by fragmented populations. According the IUCN (2001) is classified as Endangered (EN) due to an EOO of 3,005.896 km² and as Endangered (EN) due to an AOO of 12.000 km².

Taxonomic Considerations—*Dalechampia decaryi* can be highlighted among other species of Madagascar because is the unique in that the lobes of the leaves have apiculate tips.

Dalechampia decaryi was based in five syntypes and the collection *Decary 8911* was

elected as lectotype after considering the condition of preservation, the number of leaves and pseudanthia present and compliance with the protologue. In addition, it has a duplicates in herbaria P and S. Regarding *Dalechampia clematifolia* var. *dumatorum*, this taxon was recognized *in schedule* by Armbruster in 2007 as synonymous with *D. decaryi*. Indeed, these taxa do not present any morphological differences, they share leaves deeply 3-lobed, apex apiculate with glandular trichome at apex, 9–10 pistillate sepals and stigma cylindrical. Due to the absence of substantial differences justifying the maintenance of these two entities, we agree with Armbruster's opinion and proceeded to formal synonymization in the present study.

Representative Specimens Examined—MADAGASCAR. Toliara: 15.6 Km S of Baraketaen Route Nationale 13, 24°19'00"S, 45°37'45"E, 500 m, 19 Mar 1992 (fl), *P.B. Phillipson et al.* 3944 (K, P); Between Antanimora and Ambovombe, 24 km N of Route National 13, near Sakave, 24°52'S, 45°53'E, 200m, 21 Feb 1990, (fl) *Phillipson, P.B. & Milijaona, J.R.* 3580 (BM).Mts. of Androy, 25 Oct 1912 (fl), *S. Roussel 21* (K); W of RN10, NW of Ampanihy, on small track to Reakaly, 24°40'S, 44°40'E, 375 m, 1 Feb 1989, *B. Du Puy, et al.* MB56A (K). Androy, 24°23'38"S, 45°38'14"E, 494 m, 17 Jan 2007 (fl), *A. Sieder et al.* 4122 (WU).

8. DALECHAMPIA HUMBERTII Leandri, Notul. Syst. (Paris), 11: 36. 1943.—TYPE:

MADAGASCAR. Vallee moyenne du Mandrare, pres d'Anadabolava, mont

Vohitrotsy, Dec. 1933, *H. Humbert 12654* (holotype P04022141!).

Twining vines, branches villous to pubescent. Leaves alternate, simple, entire, membranous; petiole 2–4 cm long, villous to pubescent; petiolar stipule ca. 4 mm long, lanceolate, densely pubescent, associate with glands at base. Leaf blade 2.5–4 × 2 cm, ovate, base cordate, apex moderately acuminate, margin entire to sinuate, rare glandular

trichomes, both surfaces pubescent, primary veins 5; stipels 1–1.5 mm long, linear, not associate with glands at base. Pseudanthium axillary 2–2.8 cm long, peduncle 1.5–2 cm long, pubescent to villous; involucre bracts 1.5–1.7 × 1–1.2 cm, entire to 3-lobed, chartaceous, greenish, base ovate, apex acute, margin serrate, pubescent, with glandular trichomes, primary veins 5; bracteal stipule ca. 4 × 1–2 mm, lanceolate to deltoid, base truncate, apex acute, margin entire, without glandular trichomes, adaxial and abaxial surface velutinous. Staminate pleiochasium ca. 18 flowers, peduncle ca. 3 mm long, staminate bracteoles ca. 5, free, lanceolate to square, ca. 2 × 2–1 mm. Staminate flowers, ca. 4 mm long, pedicel 1–2 mm long; sepals 4, opening widely at anthesis, lanceolates, ca. 1 × 1 mm; stamens 14–15; pistillate cymule 3-flowered, sessile, pistillate involucral bracts 4, lanceolate, transversely oblong, 2–4 × 2 mm, margin pinnatifid to entire, with stipitate glandular trichomes. Pistillate flowers ca. 6 mm long; sepals ca. 9, pinnatifid, 2–3 × 1 mm, glabrous, with glandular trichomes; ovary ca. 1 × 1 mm, pubescent; stylar column 6–7 mm long, stigma tip moderately clavate, dilated. Capsule not seen. Seeds not seen. Figure 4 A–E.

Distribution and Habitat— Up to now, *Dalechampia humbertii* is known only by the type collected in 1933. No specimen collected recently in the original region was found. Armbruster and Hines collected material at the type locality in 1991, with the specimens deposited at TAN, MO, and probably P, but these specimens could not be found. The absence of recent records or in other localities may be a reflection of the low collection effort or, therefore, of a possible extinction of the species. The type was collected on top of a mountain in the Mandrare basin, in the Anosy region in southern of the country. The plant was collected at altitude between 700–800 m. Figure 1.

Phenology— Flowers in December.

Conservation—According to the IUCN red list criteria (IUCN 2001), *D. humbertii*

belongs in the category Data Deficient (DD). However, the last author collected throughout the Mandarare basin and found it only on top of Vohitrosy. So maybe the occurrence be very local, not DD.

Taxonomic Considerations—This species was considered synonymous of *Dalechampia subternata* by Govaerts (2018) in the World Checklist Website. However, *D. humbertii* differs in several morphological aspects, such as shape of leaves (entire in *D. humbertii* vs 3–5-foliolate in *D. subternata*), length of leaf (2.5–4 cm long vs 4.5–15 cm, size and texture of involucral bracts (1.5–1.7 × 1–1.2 cm, membranous, vs 2.5–3.5 × 2.5–4.5, fleshy), and shape of stigma being moderately clavate (vs cylindrical to lobed). For these reasons, we are reestablishing the species status of *D. humbertii*. It has greater morphological and distributional similarity with *D. decaryi*, and future investigations are warranted to assess whether they might be conspecific.

9. DALECHAMPIA PERRIERI Denis, Bull. Mus. His. Nat., 28: 255. 1922.—TYPE:

MADAGASCAR. Region de l'Ouest, bords du Besofotra, Mar.-Dec. 1899, *J. M. H. A. Perrier de la Bathie 1007* (holotype P04022140!).

Twining vines, branches pubescent to villous. Leaves alternate, simple, 3–5-lobed, membranous; petiole 3.5–4.5 cm long, villous; petiolar stipule ca. 3 mm long, lanceolate, pubescent, not associate to gland at base. Lobes of limb 5.5–7.5 × 1–2 cm, lanceolate, base cordate, apex acute to dentate, margin dentate, with glandular trichomes, adaxial surface villous, abaxial surface pubescent, primary veins 5; stipels ca. 1.5 mm long, linear, not associate with glands at base. Pseudantium axillary 1.9–3.4 cm long, peduncle ca. 2 cm long, pubescent to villous; involucral bracts 0.8–1.7 × 0.6–1.5 cm, entire to 3-lobed, membranous, greenish, base subcordate to truncate, margin serrate, sparsely pubescent, with glandular trichomes, primary veins 5; bracteal stipule

4–5 × 1 mm, lanceolate, base truncate, apex acute, margin entire, both surfaces pubescent. Staminate pleiochasium 13 flowers, peduncle ca. 2 mm long, staminate bracteoles 5, free, ca. 2 × 2 mm. Staminate flowers maybe open widely, 3–4 mm long, pedicel 1–2 mm long, not accrescent; sepals 4–6, deltoid, ca. 1 × 1 mm; stamens 8–15; Pistillate cymule 3-flowered, sessile, pistillate involucellar bracts 4, lanceolate, 2–3 × 2 mm, margin cropped, without glandular trichomes. Pistillate flowers ca. 7 mm long, sessile; sepals ca. 8, pinnatifid, ca. 2 × 1 mm, glabrous, with stipitate glandular trichomes; ovary ca. 1 × 1 mm, pubescent; styler column ca. 7 mm long; styler column ca. 7 mm long, stigma tip cylindrical, not dilated. Capsule not seen. Seed not seen.

Figure 4 E–H.

Distribution and Habitat—No other specimen of this taxon has found. However, in 2014, W. S. Armbruster and M. E. Edwards revisited the locality of the type collection (17.08581 S, 45.67316 E, where both a village and a river by this name are located), but could not find material fitting the original description. .

Phenology—This species flowers in December.

Conservation—*Dalechampia perrieri* is classified as Data Deficient (DD) according to the IUCN (2001).

Taxonomic Considerations—Morphologically *Dalechampia perrieri* is closer to *D. catati*, sometimes it is similar with *D. bathiana*. The species is differentiated in *D. catati* and *D. bathiana* notes. Material WSA examined growing in the type locality had mostly entire leaves, much like *D. bernieri*, but more deeply dentate.

10. DALECHAMPIA PSEUDOCLEMATIS Baill., Adansonia 1: 278. 1860.—TYPE:

MADAGASCAR. Porthleven, 1849, *L. H. Boivin* 2653 (lectotype, here designated

P04780205!); SYNTYPE: MADAGASCAR. Porthleven, 1850, *Vesco s.n.* (H). stat.

nov.

Dalechampia scandens var. *pseudoclematis* (Baill.) Pax & K. Hoffm. sin. nov.

Twining vines, branches sparsely villous. Leaves alternate, simple, 3-lobed, membranous; petiole 3–7 cm long, sparsely villous; petiolar stipule ca. 1 × 2 mm long, lanceolate, villous, not associate with glands at base. Lobe, 3–5 × 1.5–2.3 cm, obovate, base cordate, apex acute, margin entire, with glandular trichomes sparsely, adaxial surface villous, abaxial villous on the veins, primary veins 5; stipels 1 × 1 mm, linear, sparsely glabrous, rare associate with glands at base. Pseudanthium axillary ca. 5 cm long, peduncle not seen, involucre bracts 2.5 × 3–3.5 cm, 3-lobed, base probably cordate, apex acute, margin denticulate, with glandular trichomes, primary veins 5; bracteal stipule not seen; pistillate cymule not seen; sepals pinnatifid, ciliate, with glandular trichomes; Ovary puberulent; stigma tip cylindrical, not dilated. Capsule puberulent. Seeds not seen. Figure 4 I.

Distribution and Habitat— This plant was collected in Porthleven, in the far north of Madagascar.

Conservation—According to the IUCN (2001), *D. pseudoclematis* belongs in the category Data Deficient (DD).

Taxonomic Considerations— This species was treated by Pax & K. Hoffmann (1919) as a variety of *Dalechampia scandens* L. Indeed the morphology of leaves is similar to *D. scandens*. However, in addition to *D. scandens* being absent from the Paleotropics (see discussion Armbruster and Steiner 1992), as supported by the ITS tree (Armbruster et al. 2009), *D. scandens* has resiniferous glands, whereas no Madagascar species does. For these reasons we are reestablishing *Dalechampia pseudoclematis*.

The description of pseudanthium, fruit and seed, was drawn from the description provided by Pax & K. Hoffmann (1919), because the unique exsiccate lacks fertile

material.

11. DALECHAMPIA SINUATA Baill., *Adansonia* 1: 278. 1860.—TYPE: MADAGASCAR.

Antsiranana: LingVatou, without date, *A. C. J. Bernier 145* (lectotype, here designated P04022139!); SYNTYPES: MADAGASCAR. Antsiranana: Baia de Diego-Suarès, 1848, *L. H. Boivin 2781* (P04022137!); Antsiranana. LingVatou, 1846, *L. H. Boivin 2652* (P04022138!).

Twining vines, branches pubescent. Leaves alternate, simple, 3-lobed, rare entire, membranous; petiole 3–5 cm long, sparsely pubescent; petiolar stipule ca. 2 × 1 mm long, lanceolate, glabrous, not associate with glands at base. Lobe 4.5–5 × 5–6 cm, deeply sinuate, base cordate, apex acute, margin sinuate, without glandular trichomes, adaxial surface glabrescent and abaxial surface pubescent on the veins, primary veins 5; stipels 1.5–1.8 mm, linear, glabrous, not associate with glands at base. Pseudhantium axillary ca. 4 cm long, peduncle ca. 4.5 cm long, pubescent, involucre bracts ca. 2 × 1.5 cm, entire to moderately 3-lobed, membranous, greenish, base cordate, apex acute, margin sinuate, glabrous, with glandular trichomes sparsely, primary veins 5–6; bracteal stipule 1–2 × 1 mm, lanceolate, base truncate, apex acute, margin entire, adaxial and abaxial surfaces glabrescent. Staminate pleiochasium not seen, peduncle ca. 1 mm long, staminate bracteole ca. 4, free, lanceolate to square. Staminate flowers open widely, not seen; Pistillate cymule 3-flowered, peduncle 1 mm long, pistillate involucellar bracts 3-flowers, sessile, pistillate bracteoles ca. 3, lanceolate to deltoid, ca. 2 × 1–2 mm, margin entire to ciliate, without glandular trichomes. Pistillate flowers ca. 7 mm long; sepals 6, ca. 2 × 1 mm, pinnatifid, glabrous, with stipitate glandular trichomes; ovary 1–1.5 × 1 mm, velutinous; stylar column ca. 1.1 mm long, stigma tip slender, not dilated. Capsule ca. 2 mm long, brown, pubescent, sepal in fruit ca. 6 mm long. Seeds not seen. Figure 5

A–E.

Distribution and Habitat—This species occurs only in the Antsiranana region of Madagascar (Figure 1).

Conservation—*Dalechampia sinuata* is endemic to Madagascar (Govaerts et al. 2018) and is classified as Critically Endangered according the criteria of IUCN (2001) because it is known, so far, to have an area of occupancy (AOO) of 4,000 km². Considering the area of occurrence (EOO) the species is categorized as also in Critically Endangered because is known from a single locality.

Taxonomic Considerations—Undoubtedly, *Dalechampia sinuata* is one of the most unusual species from Madagascar, at least vegetatively, because of the fenestrated 3-lobed leaves.

Dalechampia sinuata was described by Baillon (1860) based on several syntypes. The collection *Bernier 145* stored in P was selected as a lectotype because it is more complete than the other syntypes, presenting several branches and pseudanthium.

12. DALECHAMPIA SUBTERNATA Müll. Arg., Abh. Naturwiss. Vereins Bremen 7: 28.

1880—TYPE: MADAGASCAR. Ambohimara, 9 Oct. 1877, *Rutenberg s.n* (holotype, G!).

Dalechampia madagascariensis Voigt., Hort. Subur. Calcutt., 161. 1845.—TYPE: MADAGASCAR. Without local, Sept., *W. Bojer 5* (not located).

Dalechampia madagascariensis (Müll. Arg.) Pax & K. Hoffm., IV. 147 XII (Heft 68): 20. 1919 nom. illeg.—TYPE: MADAGASCAR. Mazangay, *W. Bojer s.n* (not located)

Dalechampia heterophylla Vahl., Eclogae Americanae 3: 44. 1807. nom. illeg.—TYPE: Without country, Cajenna, without date, *von Rohr s.n* (not located).

Dalechampia ternata var. *madagascariensis* Müll. Arg., Prodr. 15(2):1241. 1866.—

TYPE: MADAGASCAR, Mazangay, insulae Madagascariae, without date, W.

Bojer s.n. (B). MADAGASCAR, Mazangay, without date, *C. P. Thunberg s.n.*

(Holm).

Dalechampia didierei Baill., Hist. Phys. Madagascar, 198. 1891.

Twining vines, branches hispid to pubescent. Leaves alternate, compound, 3-foliolate, membranous; petiole 2.5–6.5 cm long, pubescent to hispid; petiolar stipule 4–5 cm long, lanceolate, pubescent, not associate with glands at base. Foliioles 4.5–15 × 1.5–11 cm, ovate to elliptical, base acute to asymmetric, apex acute, margin dentate, glandular trichomes sparsely, both surface glabrescent to pubescent, primary veins 3–5; stipels 1–1.5, linear, pubescent, not associate with glands at base. Pseudanthium axillary 4–7 mm long, peduncle 3–10 cm long, pubescent to hispid, involucre bracts 2.5–3.5 × 2.5–4.5 cm, 3-lobed, fleshy, greenish, base truncate, apex acute, margin serrate, glabrous, glandular trichomes absent, primary veins 5; bracteal stipule 4–5 × 1.5 mm, lanceolate, base truncate, apex acute, margin entire, both surfaces glabrescent. Staminate pleiochasium 17–25 flowers, peduncle ca. 2 mm long, staminate bracteole 2, connate at base, transversely oblong, ca. 7 × 4 mm. Staminate flowers open widely, 5–7 mm long, pedicel ca. 3 mm long, accrescent 3–4 mm long; sepals 4, lanceolate, ca. 2 × 2 mm; stamens 8–18; pistillate cymule 3-flowered, peduncle up to 0.5 mm, pistillate involucelar bracts 2, transversely oblong, 4–5 × 3 mm, margin cropped, ciliate, without glandular trichomes. Pistillate flowers 0.9–1.1 mm long; sepals 9–10, 1 × 1 mm, pinnatisect, densely pubescent, with stipitate glandular trichomes; ovary ca. 2 × 1 mm, pubescent; stylar column 7–8 cm long, stigma tip cylindrical to lobed, moderately dilated. Capsule ca. 1 cm long, brown, pubescent, sepal in fruit 6–8 mm long. Seeds ca. 2 × 2 mm, globoid, brown with white macules. Figure 5 F–H.

Distribution and Habitat—This species has been recorded in Antsiranana, Fianarantsoa, Majunga, Marovoay, Befandriana and Toliara (Figure 1). *Dalechampia subternata* usually occurs in low semideciduous dry forest and thickets growing on sand.

Phenology—Flowers from February to December and fruits in December to February.

Conservation—*Dalechampia subternata* occurs only in Madagascar (Govaerts et al. 2018) where it has a wide distribution, extending irregularly and discontinuously through large areas of the country. This species is classified (IUCN 2001) as least concern (LC) considering an EOO of 364,733.613 km² and endangered (EN) due to an AOO of 152,000 km². Some populations can be found in legally designated conservation areas throughout its range such as Kirindy Mitea National Park in the southwest and Tsaratanana Nature Reserve in the north of Madagascar.

Taxonomic Considerations— *Dalechampia subternata* is easily recognized by involucre bracts chartaceous, however it is commonly confused with *D. clematidifolia*. They are differentiated in the notes for this species.

Representative Specimens Examined—MADAGASCAR. Antsiranana: Ambilobe, Marivorahona, a 500 m a l'Ouest du mont Andavakoera, 13°05'14"S, 49°10'29"E, 100 m, 4 Feb 2005 (fr), *F. Ratovoson* 896 (K); Reserve speciale d'Ankarana, a environ 88 km au S d'Antsiranana par route RN6, a 2 km N du village d'Ambondromifehy, 12°52'36"S, 49°13'13"E, 276 m, 11 Jan 1996, *D. Andrianatoanina et al.* 924 (K). Mahamasina, Reserve Speciale d'Ankarana, 12°57'4"S, 49°7'38"E, 130 m, 16 Jan 2003 (fl, fr), *M. Bardot-Vaucoulon et al.* 1219 (P). Fianarantsoa: near Ambalavao, 67 km S of Fianarantsoa, 100 m, 29 Dec 1968 (fl), *T. Haine* 201 (K); In Betsileo land, *Baron*, *R.* 90 (K); In Betsileo land, *R. Baron* 87 (K); Route 7, AmbalavaoversIhosy, Km 113, 8 Feb 1998, *L. Allorge* 2075 (P). Majunga: Majunga province, 15°29'S, 47°35'E, 60 m, 12 Feb 1988 (fl, fr), *E. M. Bisset* 65 (K); Majunga, Dec 1902 (fl), *J.M.H Perrier de la*

Bâthie, 9535 (P); Station forestiered'Ampijoroa, ca. 3 km N d'Andranofasika, 16°20'S, 46°51'E, 15 Apr 1984, *L.J. Dorr 3050* (K); RN9 Tsingy de Bamaraha, route Antsalova-TsiandroBerano, 100-200 m, 18°39'S, 44°44'E, 24 Nov 1992, *J.-N. Labat et al. 2168* (K); Marovoay, 19 Aug 1940, *R. Decary 15870* (P); Befandriana Nord, Ankobakobaka, Ampombilava, 10 Sep 1942, *A. Seyrg 202* (P); Toliara: Haute vallé de l'Onilahy (Mangoky), 700-800 m, 20 Dec 1928 (fl), *Humbert, H. 7080* (BM, K); Toliara: Belalanda, Ranobe, 22°59'38"S, 43°43'26"E, 157 m, 6 Sep 2006 (fl), *Andrianjafy, M. et al. 1849* (K, P); Zombitsy National Park between Toliara and Ihosy, 22°53'10"S, 44°41'32"E, 800 m, 16 Jan 2006, *Anderberg, A. et al. 96* (K); Prov. De Toliara, BezaMahafaly Reserve, near Betioky parcelled, 23°39'S, 44°38'E, 140 m, 30 Oct 1987, *P.B. Phillipson 2494* (K); Route Nationale no. 7 at 15 km NE of Sakaraha, 800m, 8 Nov 1978 (fl), *D. Lorence 2097* (K); Entre le Mangoky et l'Onilahy, 1931, *Basse., E.M. s.n.* (K); N of Tulear, Lac Ihotry, W bank of small part of lake, 21°56'S, 43°36'E, 50 m, 31 Dec 1988 (fl, fr), *P.B. Phillipson 3050* (K); Morondava, in private reserve of Analabe, 1 km S of Beroboka, on Belo Tsiribihina road, 19°59'S, 44°36'E, 30 m, 15 Nov 1986 (fl), *M. Nicol 151* (K); 24.6 km S of Ankotrofotsy, on Route National 34, 19°57'S, 45°32'E, ca. 100 m, 10 Dec 1990 (fl), *L. Gillespie 4131* (K); On RN10, ca. 52 Km N of Ejeda, N of Santa, 24°04'S, 44°24'E, 390 m, 29 Jan 1989 (fl), *B. Du Puy et al. MB 39* (K); Foret de Zenrlitsy (Sakaraha), Mar 1960 (fl), *Keraudre, M. 494* (P); Environs d'Ampandrandava, entre Bekily et Tsivory, 700-1000 m (fl), *A. Seyrg 155* (P); Lambomakandro, 3 Mar 1943, *R. Decary 18.930* (K); Foret de Zenrlitsy (Sakaraha), Mar 1960 (fl), *Keraudre, M. 434* (P); Route 7, Isalo-Sakaraha, 10 Feb 1998 (fl), *L. Allorge 2087* (P); Basin de Malo (affluent de Mangoky), présAmbalabe, 400-450 m, 23-27 Nov 1946, *H. Humbert 19381* (P); Vallée de l'Ianapaly, affluent du Fiherenana, Anapaly (prés Manera), 300 m, 13 Dec 1946 (fl), *H. Humbert 6* (P); 18 km E of

Sakaraha on the road to Ihosy, 44°52'S, 44°41'E, 700 m, 12 Nov 1989 (fl), *J.S. Miller et al.* 4527 (P). Uncertain locality: (fl), *Perrier de la Bâthie, J.M.H* 9594 (BM); Central Madagascar, *Baron, R.* 4632 (BM); Central Madagascar (fl), *R. Baron* 2924 (K); *unknown collector s.n.* (K); Marou-voai insula, *unknown collector s.n.* (K); NW Madagascar (fl), *R. Baron* 5779 (K); Central Madagascar (fl, fr), *R. Baron.* 4549 (K); NW Madagascar, *R. Baron* 5407 (K); (fl), *Montagnac, P.* 116 (P); *M. Greve s.n.* (P); 1932-33 (fl), *J. Leandri* 153 (P); Ferme de Mahabo (fl), *Dequaire, J.-M.* 27057 (P).

13. DALECHAMPIA TAMIFOLIA Lam., *Encycl.* 2: 256. 1786.—TYPE: MADAGASCAR,

Without local, without date, *M. poivre* 16926 (holotype P!).

Dalechampia boiviniana Baill., *Adansonia* 1: 277. 1865. —TYPE: MADAGASCAR,

without date, *Du Petit-Thouars s.n.* (lectotype, here designated P04780068!;

isolectotype P04780069!). SYNTYPES: MADAGASCAR: without date, *Chapelier*

s. n. (not found); without local, 1826, *F. W. Sieber* 256 (G-DC, photo G00316794!);

1837, *Richard* 325 (P04780432!); Nossi Be, 29 Jul. 1840-1841, *Pervillé* 296

(P04780067!); Sainte Marie, 1847-1852, *Boivin* 1883 (P04780073!, P04780074!,

P04780075!).

Dalechampia trilobata Sieber ex Baker, *Fl. Mauritius*, 137. 1877, nom. illeg.

Dalechampia anisophylla Müll. Arg., *Bremen Abh.* 7: 29. 1880.—TYPE:

MADAGASCAR. Manambato, 8 Oct. 1877, *Rutenberg s.n.* (not located).

Dalechampia longipes Müll. Arg., *Bremen Abh.* 7: 29. 1880.—TYPE:

MADAGASCAR. Baye d'Antongil, 1899, *Mocquerys* 372 (lectotype, here

designated: G00018132!); SYNTYPE: MADAGASCAR. Nossibé, Apr. 1879,

Hildebrandt 2892 (G00018133!).

Dalechampia semitriloba Tausch ex Pax & K.Hoffm., in H.G.A.Engler, Pflanzenr., IV, 147, XII: 39. 1919, pro syn.

Dalechampia sieberi Klotzch ex Pax & K.Hoffm., in H.G.A.Engler, Pflanzenr., IV, 147, XII: 39. 1919, pro syn.

Twining vines, branches sparsely villous to hispid. Leaves alternate, simple, 3-lobed to entire, membranous; petiole 4–9 cm long, sparsely villous; petiolar stipule 0.5–1.2 cm, widely deltoid, glabrescent, not associate with glands at base. Leaf blade 5–12 × 9–13 cm, ovate to elliptic, base elliptic to asymmetric, margin moderately dentate, with glandular trichomes, adaxial surface hispid, abaxial glabrescent, primary veins 5–7; stipels 0.7–1.3 cm long, linear to lanceolate, associate with glands at base.

Pseudanthium axillary 4–9.5 cm long, peduncle 4–11 cm long, sparsely pubescent to villous; involucral bracts 2–5.5 × 1.5–4 cm, entire to 3-lobed, membranous, greenish, base cordate, apex acute, margin dentate, velutinous to glabrescent, with glandular trichomes sparsely, primary veins 6–7; bracteal stipule 0.7–1.3 × 0.3–0.4 cm, widely lanceolate, base truncate, apex acute, margin entire, adaxial and abaxial surfaces glabrescent. Staminate pleiochasium 8–14 flowers, peduncle ca. 2 mm long, staminate bracteole 4–5, free, lanceolate to oblong 2–3 × 1–2 mm. Staminate flowers open widely, 6–7 mm long, pedicel ca. 5 mm long, not accrescent; sepals 6, lanceolate, ca. 2 × 1 mm; stamens ca. 8; Pistillate cymule 3-flowered, peduncle ca. 5 mm long, pistillate involucelar bracts 4, deltoids, oblongs or widely oblongs, 0.4–1 × 6–1.5 cm, margin entire, cropped or ciliate, without stipitate glandular trichomes. Pistillate flowers 8–9 mm long, sessile; sepals 12, pinnatisect ca. 4 × 9 mm, dense hyaline trichomes, sometimes with stipitate glandular trichomes; ovary 1–1.5 × 2 mm, pubescent; stylar column 4–9 mm long, stigma tip slender, not dilated. Capsule ca. 1.5 cm long, brown, glabrescent, sepal in fruit 1–1.5 cm long. Seeds ca. 3 × 2 mm, widely ellipsoid, light

brown, with dark brown macules. Figure 5 I–O.

Distribution and Habitat— Occurs mostly in the east and northwest coastal regions, including on coastal sandplains and in dune forests; also occurs along roadsides, edges of moist forest, and along rivers, between 80-100m alt. Figure 1.

Phenology— Flowers from January to July; fruits from January to July.

Conservation— *Dalechampia tamifolia* is found in Mauritius, Comoros, Madagascar and has been reported in southwest India (Govaerts et al. 2018). In Madagascar, the species is classified according IUCN (2001) as Vulnerable due to an EOO of 6,462.433 km² and Endangered (EN) due to an AOO of 16,000 km².

Taxonomic Considerations— This species is easily recognized and distinctive by leaves simple, 3-lobed to entire, petiolar stipule widely deltoid, bracteal stipule widely lanceolate, 12 pistillate sepals and stigma slender.

Representative Specimens Examined— MADAGASCAR. Antsiranana: Nossi-bé, Apr 1879, *J. Hildebrandt* 2892 (BM, K); Bassin-versant de rano Bemahalegny, Moyen Ambahatra, 13°57'87"S, 48°26'91"E, 430 m, 20 Mar 1999, *S. Wohlhauser* SW60064 (K). Tomasina: Ambila, S de Tamatave, 8 May 1928 (fl), *R. Decary*, 6482 (K). Antananarivo: Prope Tannanarivao, *unknown collector s.n.* (BM). Uncertain locality: North Madagascar (fl. fr), *R. Baron* 6533 (BM); (fl), *M. Humblot* 169 (K); Central Madagascar (fl), *R. Baron* 2414 (K); *unknown collector s.n.* (K); Anivorano, 650 m, 19 Nov 1959 (fl), *H. J. Schlieben* 8036 (K); *R. Lyall* 131 (K); (fl), *R. Baron* 5977 (K); (fl), *unknown collector* 5988 (K); Madagascar (fl), *R. Baron* 5881 (K); 1837, *M. Richard* 329 (K); NO de Madagascar, 1841 (fl), *M. Perville* 296 (K); 1847-1852, *M. Boivin* 1883 (K); *W.T. Gerrard* 128 (K); Murunhanga, 21 Jun 1879 (fl. fr), *J. Hildebrandt* 2892a (K); *Road to capital*, *G.F. Scott Elliot* 1783 (K).

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LITERATURE CITED

- Armbruster, W. S., and Webster, G. L. 1982. Divergent pollination systems in sympatric species of South American *Dalechampia* (Euphorbiaceae). *American Midland Naturalist*, 108: 225-337.
- Armbruster, W. S., and Steiner, K. E. 1992. Pollination ecology of four *Dalechampia* species (Euphorbiaceae) in northern Natal, South Africa. *American J. Botany*, 79: 306-313.
- Armbruster, W. S. 1993. Evolution of plant pollination systems: hypotheses and tests with the neotropical vine *Dalechampia*. *Evolution*, 47: 1480-1505.
- Armbruster, W. S. 1994. Early evolution of *Dalechampia* (Euphorbiaceae): Insights from phylogeny, biogeography, and comparative ecology. *Annals of Missouri Botanical Garden*, v: 302-316.
- Armbruster, W. S., and Baldwin, B. G. 1998. Switch from specialized to generalized pollination. *Nature*, 394: 632.
- Armbruster, W. S., and Baldwin, B. G. 2003. Pollination and evolution of Euphorb

- vines in Madagascar. Pp. 391-393 in, S. Goodman and J. Benstead (eds.), *The Natural History of Madagascar*. University of Chicago Press, Chicago, USA.
- Armbruster, W. S., Lee, J., and Baldwin, B. G. 2009. Macroevolutionary patterns of defense and pollination in *Dalechampia* vines: Adaptation, exaptation, and evolutionary novelty. PNAS, 106: 18085–18090.
- Armbruster, W. S., Lee, J., Edwards, M. E., and Baldwin, B. G. 2013. Floral paedomorphy leads to secondary specialization in pollination of Madagascar *Dalechampia* (Euphorbiaceae). *Evolution*, 67: 1196–1203.
- Bachman, S. J., Moat, A. W., Hill, J., de la Torre, J., and B. Scott. 2011. Supporting red list threat assessments with GeoCAT: Geospatial conservation assessment tool. *ZooKeys* 150: 117–126.
- Baillon, H. 1860. Recueil d'observations botaniques/redige par le Dr. H. Baillon. *Adansonia*, 1: 277-278.
- Denis, M. M. 1922. *Dalechampia* Nouveaux. *Bulletin du Museum d'Historire Naturelle*, 28: 255-256.
- Ganzhorn, J. U., Lowry II, P. P., Schatz, G. E., and Sommer, S. 2001. The biodiversity of Madagascar: one of the world's hottest hotspots on its way out. *Oryx*, 35: 346-348.
- Ganzhorn, J. U., Wilmé, L., and Mercier, J. 2014. Explaining Madagascar's Biodiversity in: *Conservation and Environmental Management in Madagascar*.
- Gautier, L., Chatelain, C., Callmander, M.W., and Phillipson, P.B. 2012. Richness, similarity and specificity of Madagascar flora compared with Sub-Saharan Africa. *Plant Ecology and Evolution* 145: 55-64.
- Govaerts, R., Frodin, D. G., and Radcliffe-Smith, A. 2000. World Checklist and Bibliography of Euphorbiaceae (and Pandaceae) 1-4:1-1622. The Board of Trustees

of the Royal Botanic Gardens, Kew.

Govaerts, R., 2018. World Checklist of Euphorbiaceae. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet; <http://wcsp.science.kew.org/> Retrieved.

IUCN (2001) The IUCN red list of threatened species, version 2010.4. Cambridge, U. K.: IUCN Red List Unit, Available in <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.

Leandri J. D. 1943. Contribution a L'étude des Euphorbiacées de Madagascar (III). Notulae Systematicae. Herbarium du Museum de Paris, 11: 35-46.

Müller Argoviensis, J. 1880. Tribe Dalechampiae. Abhandlungen herausgegeben vom Naturwissenschaftlichen Vereins zu Bremen 7: 28.

Pax, F.; Hoffmann, K. Euphorbiaceae-Dalechampiae. 1919. In: Das Pflanzenreich. Regni vegetabilis conspectus (A. Engler, ed.), Leipzig, 147 (helf 12): 1-59.

Plebani, M.; Imanizabayo, O.; Hansen, D.; Armbruster, M. 2015. Pollination ecology and circadian patterns of inflorescence opening of the Madagascan climber *Dalechampia* aff. *bernieri* (Euphorbiaceae). Journal of Tropical Ecology, 31: 99-101.

Turland, N. J., Wiersema, J. H., Barrie, F. R., Greuter, W., Hawksworth, D. L., Herendeen, P. S., Knapp, S., Kusber, W.-H., Li, D.-Z., Marhold, K., May, T. W., McNeill, J., Monro, A. M., Prado, J., Price, M. J. & Smith, G. F. (eds.) 2018: *International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017*. Regnum Vegetabile 159. Glashütten: Koeltz Botanical Books. DOI <https://doi.org/10.12705/Code.2018>

Webster, G. L., and Armbruster, W. S. 1991. A synopsis of the neotropical species of *Dalechampia* (Euphorbiaceae). Botanical Journal of the Linnean Society, 105: 137-177.

TABLE 1. Comparison of species of *Dalechampia* from Madagascar.

Species	Morphological characters						
	Leaves shape	Lobe or leaflet shape	Lobe or leaflet margin	Consistence of involucral bracts	Peduncle of staminate cymule	Number and shape of pistillate sepals	Shape of stigma tip
<i>D. bathiana</i>	3-lobed to deeply 3–5–7 lobed	Lanceolate to ovate	Sinuate to dentate	Membranous	Not elongate	6 pinnatifid	Slender
<i>D. bernieri</i>	Entire to 2–3-lobed	Ovate	Sinuate	Membranous	Not elongate	12 pinnatifid	Cylindrical
<i>D. bernieri</i> var. <i>denisiana</i>	Entire to 3-lobed	Ovate	Sinuate	Membranous	Not elongate	12 pinnatifid	Cylindrical
<i>D. catati</i>	Deeply 5-lobed	Linear	Entire to sinuate	Membranous	Not elongate	6 pinnatifid	Cylindrical
<i>D. clematidifolia</i>	3–5-foliolate	Ovate to	denticulate	Membranous	Not elongate	6–8 pinnatisect	slender

		elliptical					
<i>D. chlorocephala</i>	Entire to 3-lobed	Ovate to obovate	Sinuate to serrate	Membranous	Elongate	6 pinnatifid	Slender
<i>D. decaryi</i>	3-lobed to deeply 3-lobed	Lanceolate	Entire	Membranous	Not elongate	9–10 pinnatifid	Cylindrical
<i>D. humbertii</i>	Entire	Ovate	Entire to sinuate	Membranous	Not elongate	ca.9 pinnatifid	Moderately clavate
<i>D. perrieri</i>	3–5-lobed	Lanceolate	Dentate	Membranous	Not elongate	ca. 8 pinnatifid	Cylindrical
<i>D. pseudoclematis</i>	3-lobed	Ovate	Entire	Not seen	Not seen	Not seen	Cylindrical
<i>D. sinuata</i>	3-lobed	Fenestrated	Sinuate	Membranous	Not elongate	6 pinnatifid	Slender
<i>D. subternata</i>	3-foliolate	Ovate to elliptical	Dentate	Chartaceous	Not elongate	9–10 pinnatisect	Cylindrical to lobed
<i>D. tamifolia</i>	Entire to 3-lobed	Ovate to elliptic	Moderately dentate	Membranous	Not elongate	12 pinnatisect	Slender

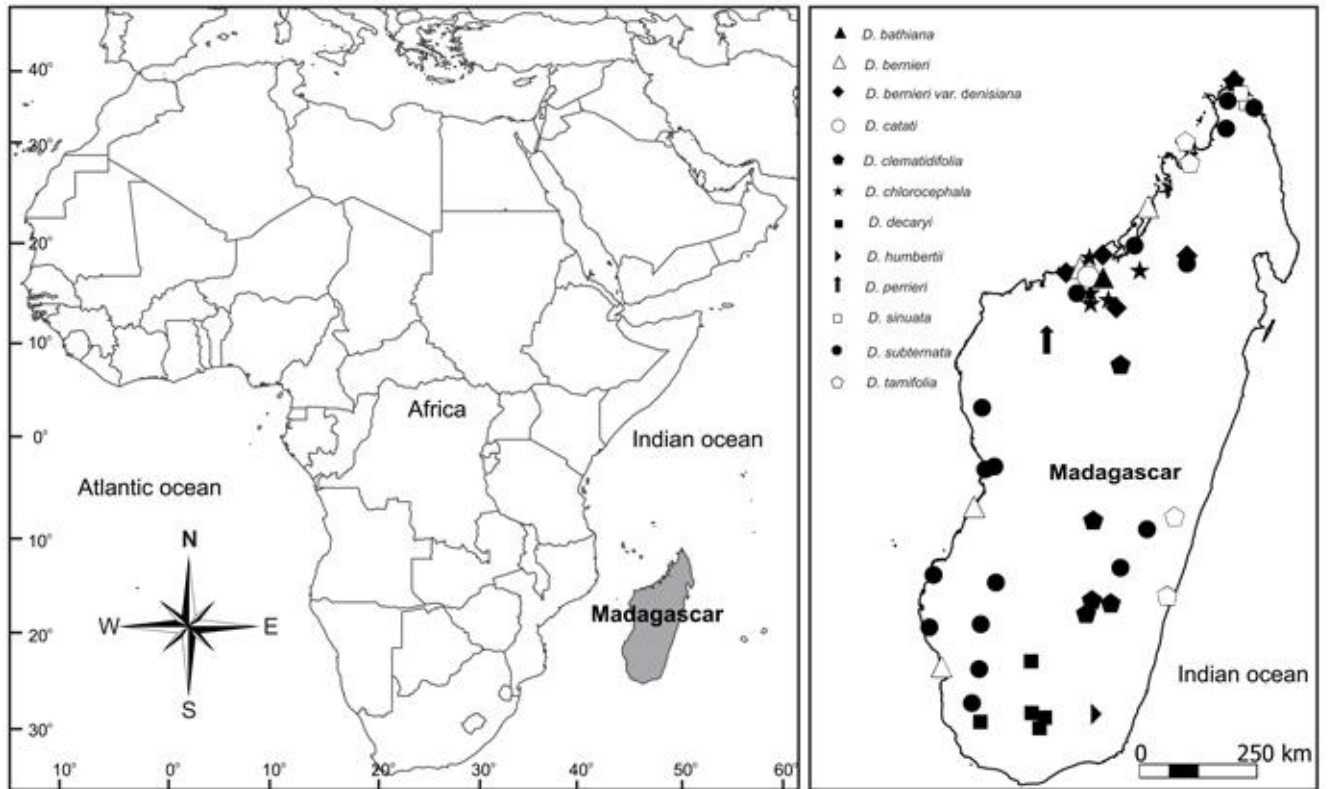


FIG. 1. Distribution of *Dalechampia* in Madagascar.

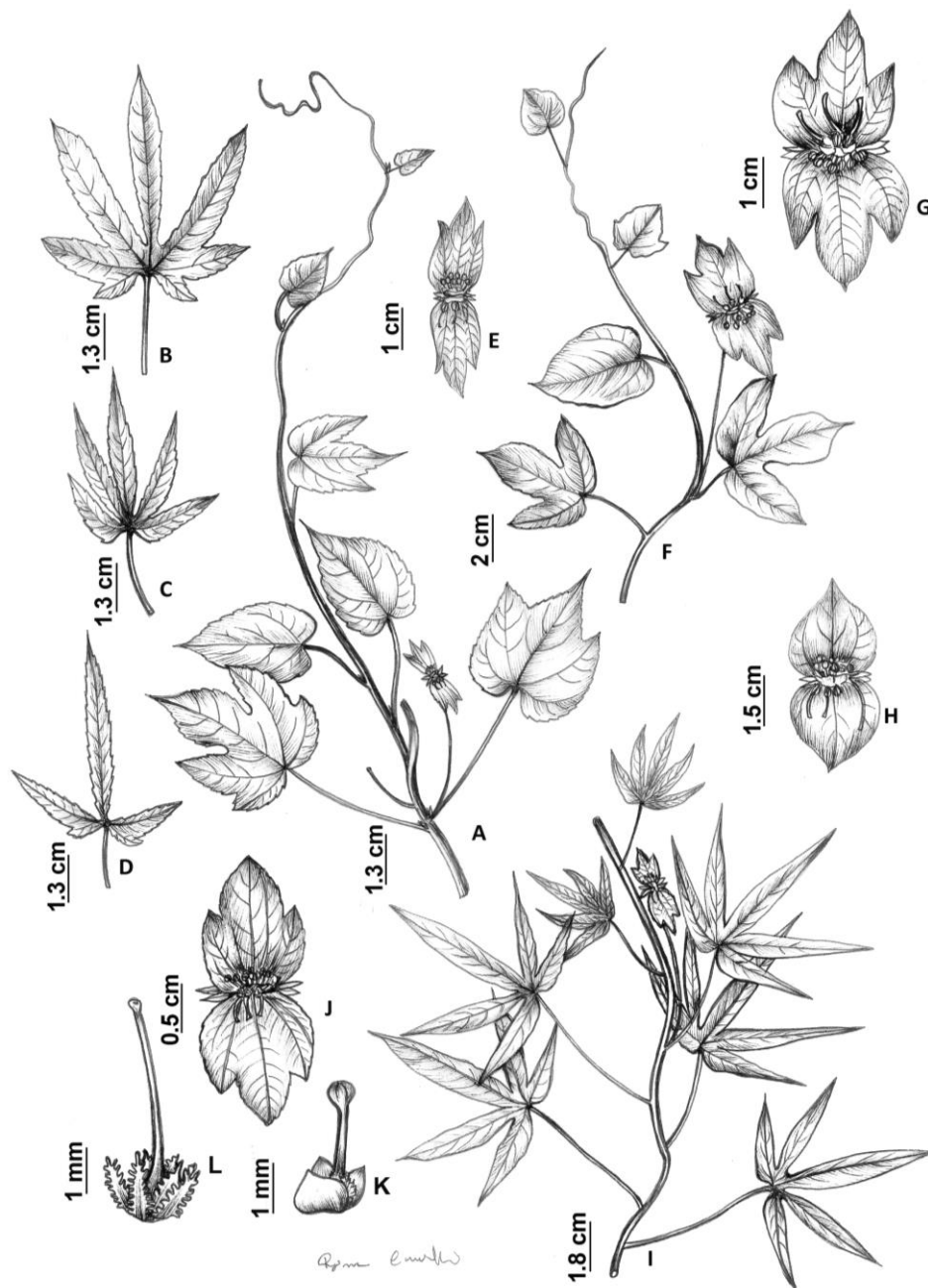


FIG. 2. *Dalechampia bathiana* Leandri. A. Flowering branch. B. Leaf deeply 7-lobed. C. Leaf 5-lobed. D. Leaf deeply 3-lobed. E. Pseudanthium. *Dalechampia bernieri* Baill. F. Flowering branch. G. Pseudanthium with 3-lobed involucral bracts. H. Pseudanthium with entire involucral bracts. *Dalechampia catati* Leandri. I. Flowering branch. J. Pseudanthium. K. Pistillate flower showing involucral bracts. L. Pistillate flower showing sepals (Fig. 2 A–E: H. Poisson 56 P; Fig. 2 F–G: A. C. J. Bernier 276 P; Fig. 2 I–L: J. M. H. A. Perrier de la Bâthie 9601 P).

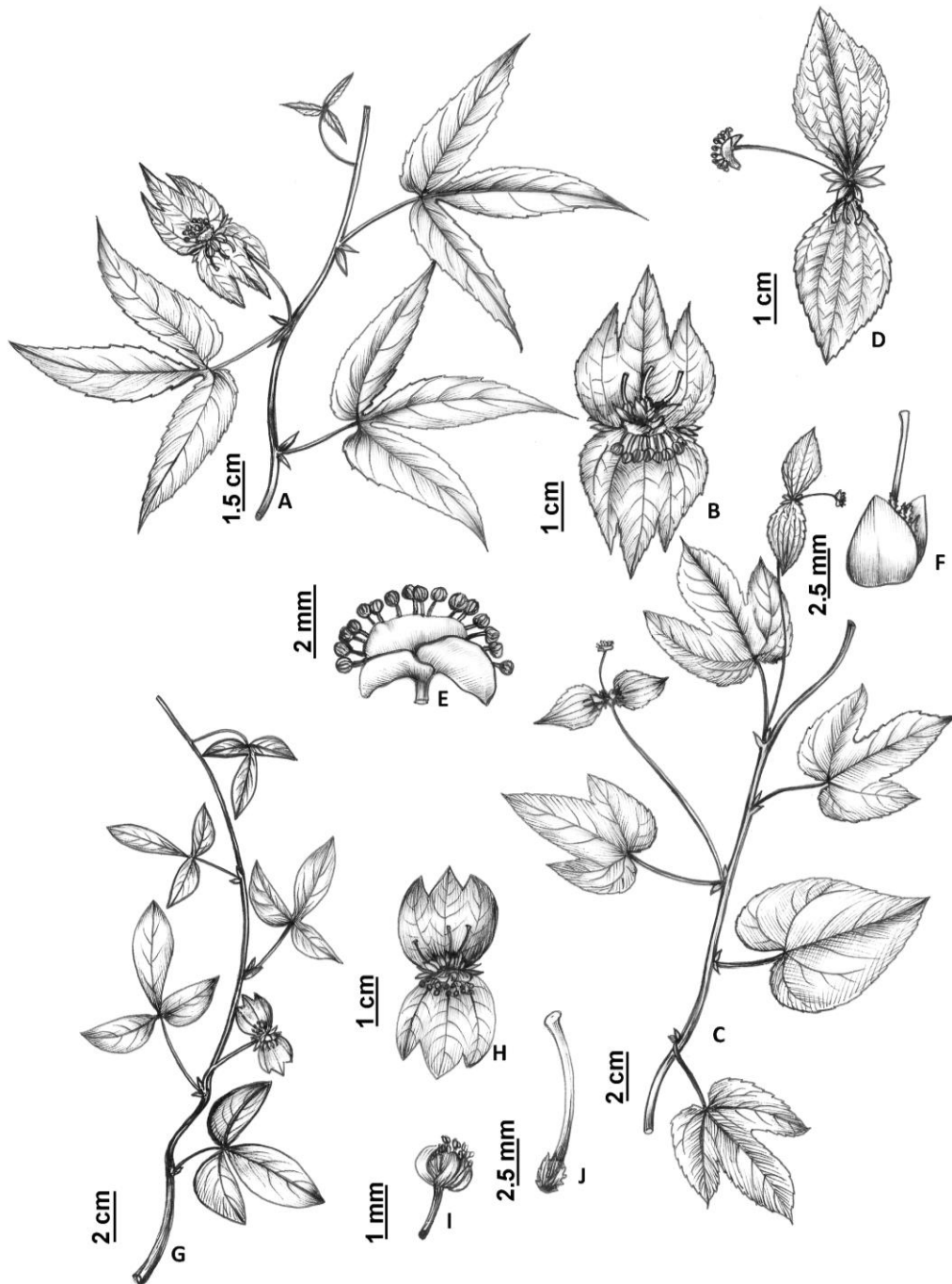


FIG. 3. *Dalechampia clematidifolia* Bojer ex Baill. A. Flowering branch. B. Pseudanthium. *Dalechampia chlorocephala* Denis. C. Flowering branch. D. Pseudanthium. E. Staminate pleiochasium F. Pistillate flower. *Dalechampia decaryi* Leandri. G. Flowering branch. H. Pseudanthium. I. Staminate flower. J. Pistillate flower (Fig. 3 A–B: Anderberg *et al.* 19 K–S; Fig 3 C–F: H. Humbert 7156 K; Fig. 3 G–J: P.B. Phillipson *et al.* 3944. K, P).

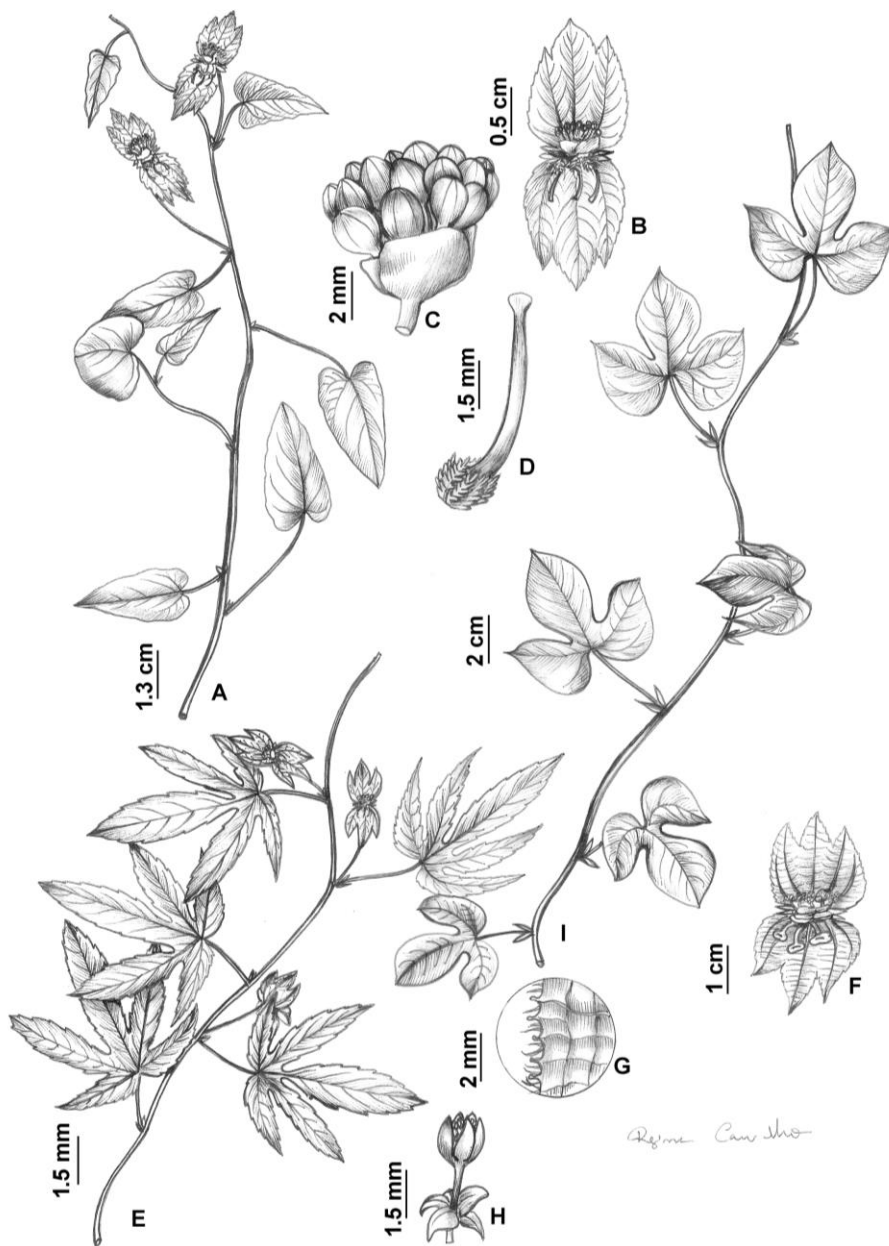


Fig 4. *Dalechampia humbertii* Leandri. A. Flowering branch. B. Pseudanthium. C. Staminate pleiochasium. D. Pistillate flower. E. *Dalechampia perrieri* Denis E. Flowering branch. F. Pseudanthium. G. Margin of involucre bract. H. Staminate flower. *Dalechampia pseudoclematis* Baill. I. Branch. (Fig. 4. A–E: H. Humbert 12654 P; Fig. 4 E–H: J. M. H. A. Perrier de la Bathie 1007 P; Fig. 4 I: L. H. Boivin 2653 P).

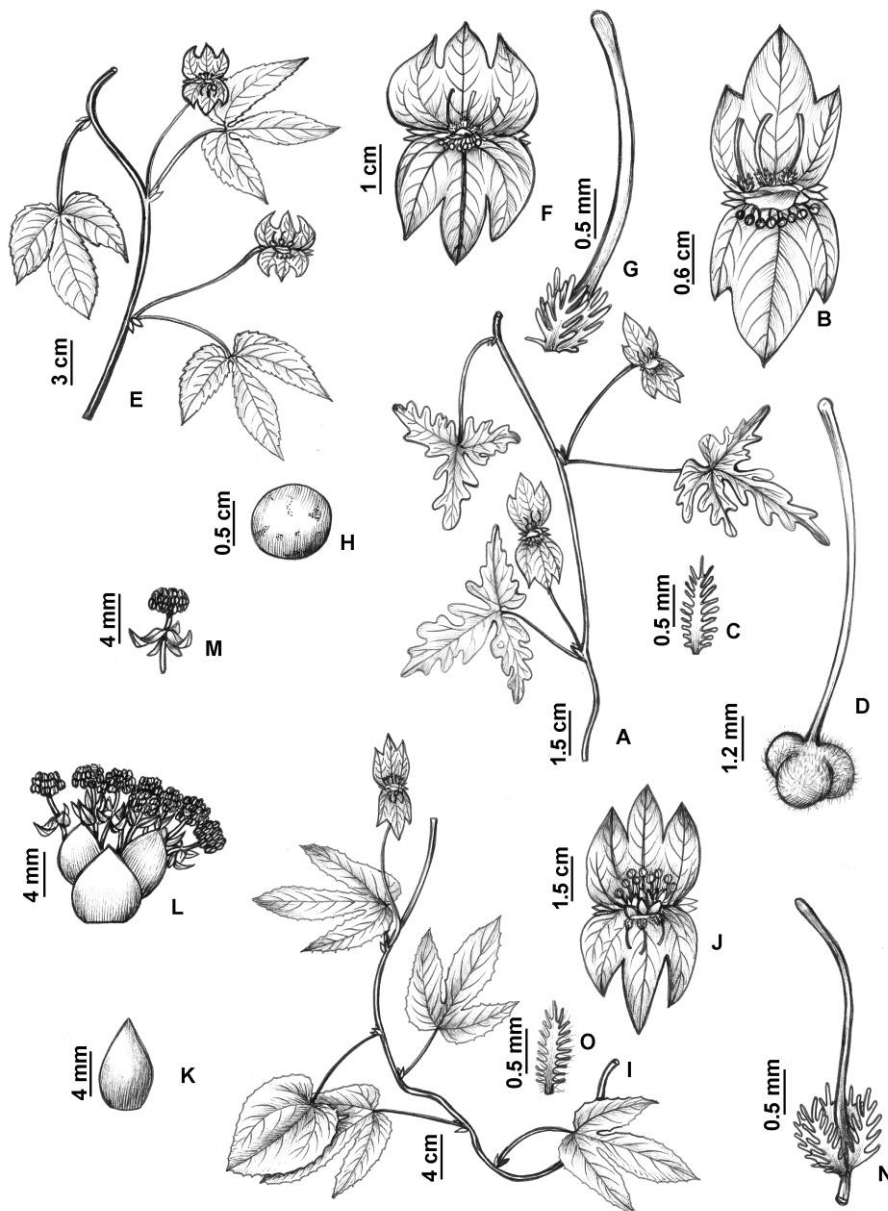


Fig 5. *Dalechampia sinuata* Baill. A. Flowering branch. B. Pseudanthium. C. Pistillate sepal. D. Styler column. *Dalechampia subternata* Müll. Arg.. E. Flowering branch F. Pseudanthium. G. Pistillate flower. H. Seed. *Dalechampia tamifolia* Lam. I. Flowering branch. J. Pseudanthium. K. Staminate bracteole L. Staminate pleiochasium. M. Staminate flower. N. Pistillate flower. O. Pistillate sepal. (Fig. 5 A–E: A. C. J. Bernier 145 P; Fig. 5 F–H: Baron, R. 4632 BM; Fig. 5 I–O: H. J. Schlieben 8036 K).

