



***Adiantum* (Pteridaceae) in Brazil: Key to the species and illustrations**

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Abstract: *Adiantum* is a Pantropical genus of ferns, monophyletic, and has about 225 species. It can be recognized by the indusia with veins, bearing sporangia directly on the underside of its reflexed tissue. About 110 species occur in the Neotropical region and 65 of them are reported to Brazil. Among them, 64 are native species and occur mainly in the Amazon Rainforest, Caatinga, Central Brazilian Savanna, and in the Brazilian Atlantic Rainforest. Among the species that occur in Brazil, 16 are endemic and they represent 25% of the total. This paper presents a key to identify the 63 native species of *Adiantum* in Brazil, excluding the hybrid one. Illustrations of some morphological features, as well as of all species are also presented to help in the process of identification.

Keywords: Diversity; endemic species; ferns; flora of Brazil; identification.

***Adiantum* (Pteridaceae) no Brasil: chave para as espécies e ilustrações**

Resumo: *Adiantum* é um gênero Pantropical de samambaias, monofilético e com cerca de 225 espécies. Pode ser reconhecido pelos indúdios com nervuras e esporângios formados diretamente sobre a face inferior do seu tecido reflexo. Aproximadamente 110 espécies ocorrem na região Neotropical e 65 delas são registradas para o Brasil. Entre elas, 64 são espécies nativas e ocorrem principalmente na Floresta Amazônica, Caatinga, nas vegetações abertas do Brasil Central e na Floresta Atlântica Brasileira. Entre as espécies que ocorrem no Brasil, 16 são endêmicas e elas representam 25% do total. Este trabalho apresenta uma chave para identificação das 63 espécies nativas de *Adiantum* no Brasil, excluindo o híbrido. Também são apresentadas ilustrações de alguns caracteres morfológicos, bem como de todas as espécies para ajudar no processo de identificação.

Palavras-chave: Diversidade; espécies endêmicas; flora do Brasil; identificação; samambaias.

Introduction

Adiantum L. is monophyletic, with ca. 225 species, and is the second biggest genus of the family Pteridaceae (PPG I 2016), behind only *Pteris* L. with 250 spp. *Adiantum* has a Pantropical distribution, occurring mainly in forests as terrestrial plants. About 110 species are Neotropical.

Recently, *Adiantum* has been a target of several investigations, including also molecular data to access the evolution of the group and its relationship, and some Brazilian species were sampled for these works. For example, Hirai et al. (2016) and Hirai & Prado (2019) investigated the group of *A. raddianum* C. Presl and concluded that the group of *A. poiretii* Wikstr. is the most closely related and they can be separated morphologically by the shape of the indusium (reniform in *A. raddianum* group and oblong in the *A. poiretii* group). This important result is also strongly supported by the molecular data indicating that the species of *A. poiretii* group differ from the *A. raddianum* group by a unique deletion of 66 nucleotides, at positions 288–353 in the chlN gene alignment.

Huiet et al. (2018) addressed a global study for the genus *Adiantum*, corroborating the monophyletism of the *A. raddianum* group (sensu Hirai et al. 2016) and also showing that the reconstructions of leaf blade architecture revealed remarkable convergent evolution across multiple clades for nearly all leaf forms. Leaves once-pinnate, usually with rachises proliferous at tips define a clade (the philippense clade). Simple leaves (very rare in *Adiantum*) occur in three distinct clades (davidii, philippense, and peruvianum). Most taxa have leaves that are more than once-pinnate and only a few of these (in the formosum and pedatum clades) exhibit the distinct pseudopedate form. The data about distribution for each studied species show that most species (75%) are restricted to only one of six major biogeographical regions in the World. In this study (Huiet et al. 2018), 48 of the sampled species (ca. 30% of the total) are endemic to South America. This study showed that the previous infra-generic classification for *Adiantum* failed to compose natural group of species based only on morphological aspect because there are several homoplastic characters.

According to the Flora of Brazil online 2020 (Prado & Hirai, in preparation), there are 65 species occurring in Brazil, 64 of them are native, 16 species are endemic (25% of the total), including one that has a hybrid origin (*A. xmoranii* J. Prado). *Adiantum peruvianum* Klotzsch is largely known as cultivated.

The genus itself can be easily identified by the indusia with veins, bearing sporangia directly on the underside of its reflexed tissue (Prado et al. 2017). But the identification of its species is a challenge, especially to the non-expert on ferns.

The main objective of the current work is to present a key for the identification of the recognized species in Brazil (except for the hybrid species), accompanied by illustrations for all taxa, which can be a useful tool for experts and students of ferns.

Material and Methods

All species included in the present key have been recognized in the treatment of the genus *Adiantum* for Flora of Brazil online 2020 (Prado & Hirai, in preparation) (<http://floradobrasil.jbrj.gov.br/reflora/listaBrasil/PrincipalUC/PrincipalUC.do>).

Most of this species appeared previously cited for Brazil since the previous papers involving the genus published by Prado & Sylvestre (2010), Prado (2015), and Prado et al. (2015).

The key is based on the external morphology of the plants and there is no need to use any additional feature of the anatomical part of the organisms for their identification.

To observe the hairs and scales accurately and thus identify species of *Adiantum* with the key provided below, it is necessary to have a dissecting microscope with at least 30x and a strong light source. In some species, the hairs become modified as glands, such as in *A. dawsonii* Lellinger & J. Prado or are protected by the revolute indusia and in both cases their visualization is difficult.

Most of the morphological terms used in the key follow Lellinger (2002). And author abbreviations of scientific names follow Pichi Sermolli (1996).

The endemic species of *Adiantum* to Brazil appear marked with an asterisk in the key.

Some photos to illustrate this work were provided by the following persons: Michel Boudrie (MB, *Adiantum adiantoides* (J. Sm.) C. Chr., *A. glaucescens* Klotzsch, *A. leprieurii* Hook., *A. lucidum* (Cav.) Sw., *A. paraense* Hieron., *A. serratodentatum* Willd., *A. tetraphyllum* Willd., *A. villosum* L.), Fernando Matos (FM, *A. diphyllum* (Fée) Maxon), Gabriel Moulatlet (GM, *A. paraense*, *A. tomentosum* Klotzsch), Gabriela Zuquim (GZ, *A. cinnamomeum* Lellinger & J. Prado, *A. dolosum* Kunze, *A. glaucescens*, *A. humile* Kunze, *A. obliquum* Willd., *A. pectinatum* Kunze ex Baker, *A. terminatum* Kunze ex Miq., *A. tomentosum*), Júlio N. Carauta (JN, *A. argutum* Splitg.), Hanna Tuomisto (HT, *A. cinnamomeum*, *A. cajennense* Willd. ex Klotzsch, *A. terminatum*), Michael Sundue (MS, *A. capillus-veneris* L.), Nathan Smith (NS, *A. multisorum* A. Samp.), Paulo Labiak (PL, *A. discolor* J. Prado), Robbin Moran (RM, *A. macrophyllum* Sw., *A. villosum*), and the others were taken by the present authors. Additionally, drawings are also presented to illustrate the species.

Results

Adiantum can be recognized by terete, blackish to castaneous stipes, rachises, and costae, and sporangia borne on the false indusium (i.e., not on the laminar surface below it); also characterized by scales borne at rhizome apices and stipe bases; laminae monomorphic (sterile and fertile laminae similar in morphology), pinnate (rarely undivided) to more divided, sometimes forked or pedate; veins free or rarely anastomosing without included free veinlets; linear epidermal idioblasts (false veins) present or not between the true veins; sori formed on the recurved laminar margins (false indusia), on the veins, paraphyses (i.e., hairs among the sporangia) absent (Prado et al. 2017a).

The main characters used here to recognize the species group are the pattern of venation regular anastomosing veins (forming regular areoles without free veinlets included), irregularly anastomosing (not forming regular areoles and also lacking free veinlets included), or veins free; the veins ending into teeth or ending between teeth at sterile margins of the pinnae/pinnules; rhizome very long-creeping (i.e., cord-like), long-creeping (nodose or not nodose), and short-creeping (generally nodose); indument of the rachises, pinnae, and pinnules (glabrous or with hairs or scales, or both); pattern of the frond division (varying from pinnate to 2–5-pinnate), form of the pinnae/pinnules and indusia. Another important aspect to recognize species is the fact that the pinnae/pinnules/segments are articulate or not (i.e., continuous). In the articulate species, the dark color of the stalk stops at the base of the

Key to the *Adiantum* species in Brazil

pinnae/pinnules/segments and, when they are continuous, the color is ending into their laminar tissue. There are some species that present fronds forked one to several times and they are easy to be recognized by this feature.

To facilitate the use of the key, illustrations of some morphological features (Figure 1) and for all species (Figures 2–13) are presented after the key. Some of these illustrations are not from Brazilian specimens but show the morphology of the treated species.

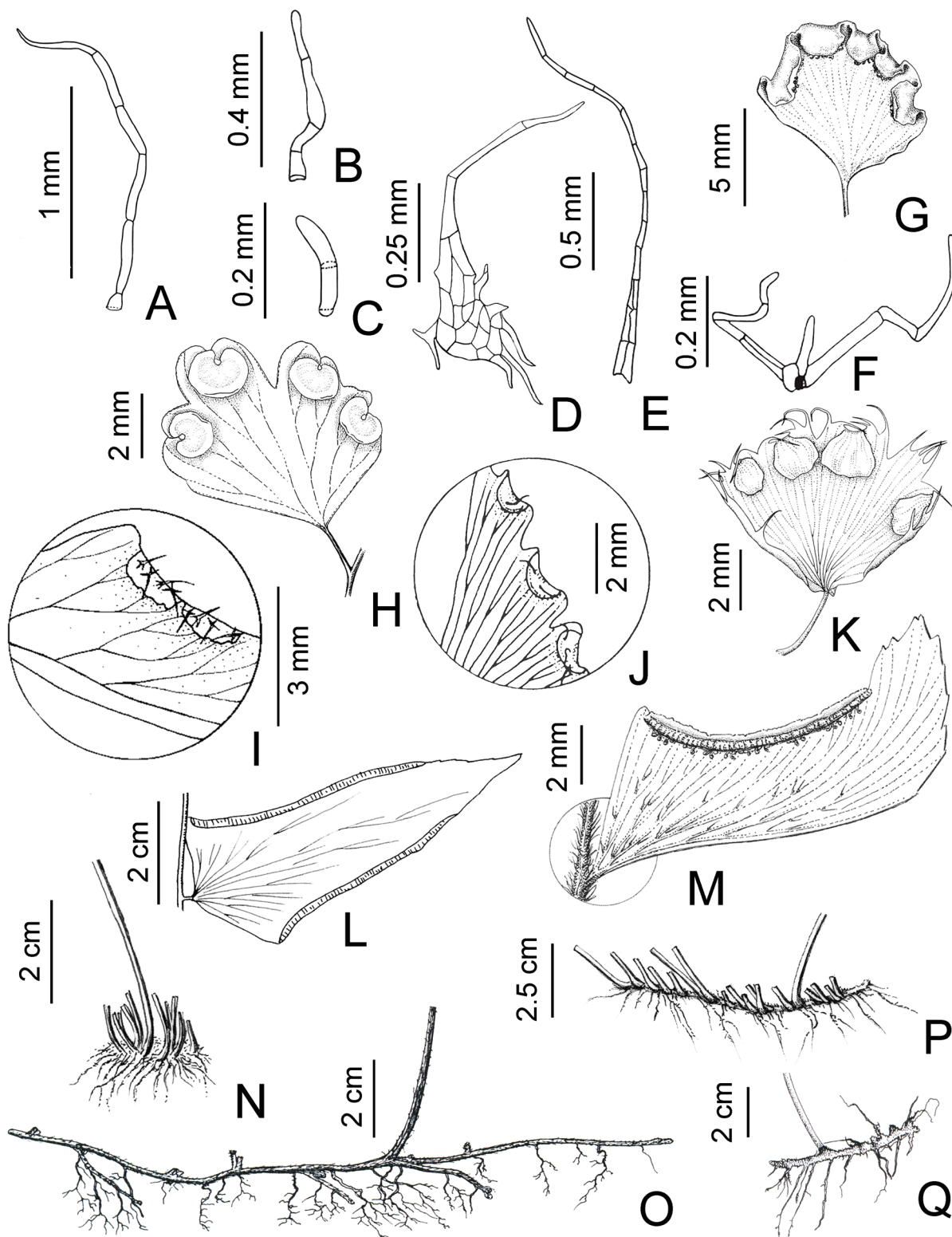


Figure 1. Morphological characters of *Adiantum*: A. Long-hair. B, C. Short-hairs. D. Lanceolate scale, with pectinate base. E. Linear scale. F. Arachnoid scale. G. Oblong and glabrous indusia. H. Reniform–rounded and glabrous indusia. I. Oblong and scaly indusia. J. Lunate and pubescent (with short-hairs) indusia. K. Lobate-rounded and glabrous indusia. L. Linear and glabrous indusia. M. Linear-arcuate and glabrous indusium. N. Short-creeping rhizome. O. Very long-creeping (cord-like) rhizome. P. Long-creeping and nodose rhizome. Q. Long-creeping rhizome.



Figure 2. *Adiantum* species: **A–B.** *A. diphyllum*, **A.** Habit. **B.** Pinna abaxially (photos: FM). **C–D.** *A. adiantoides*, **C.** Habit. **D.** Sori (photos: MB). **E.** *A. leprieurii*, habit (photo: MB). **F–G.** *A. deflectens*, **F.** Habit. **G.** Pinnules abaxially. **H–I.** *A. platyphyllum*, **H.** Habit. **I.** Young sori.

Key to the *Adiantum* species in Brazil

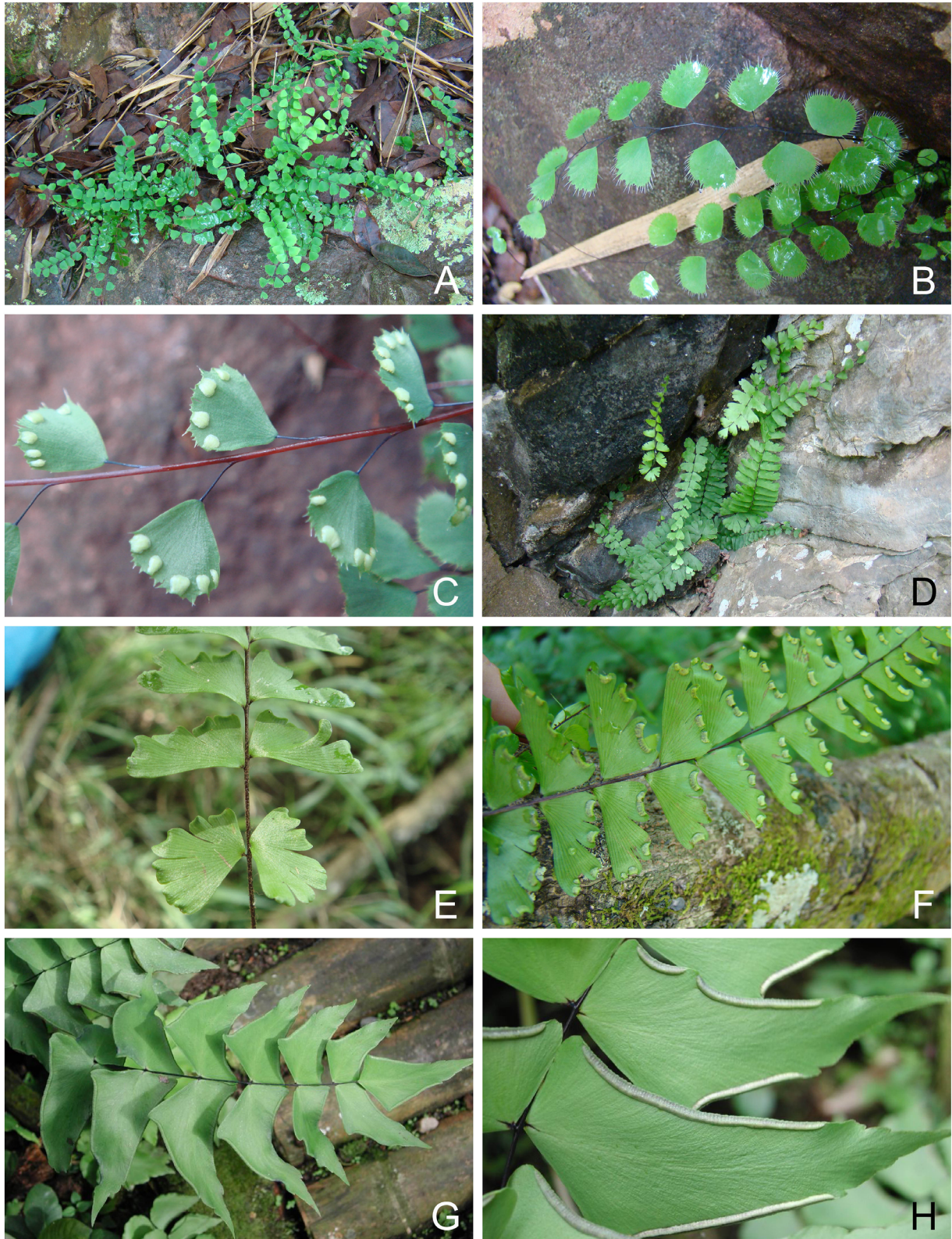


Figure 3. *Adiantum* species: **A–C.** *A. delicatulum*, **A.** Habit. **B.** Sterile fronds. **C.** Sori. **D–F.** *A. calcareum*, **D.** Habit. **E.** Proximal pinnae. **F.** Pinnae abaxially. **G–H.** *A. macrophyllum*, **G.** Fertile frond. **H.** Sori (photos: RM).

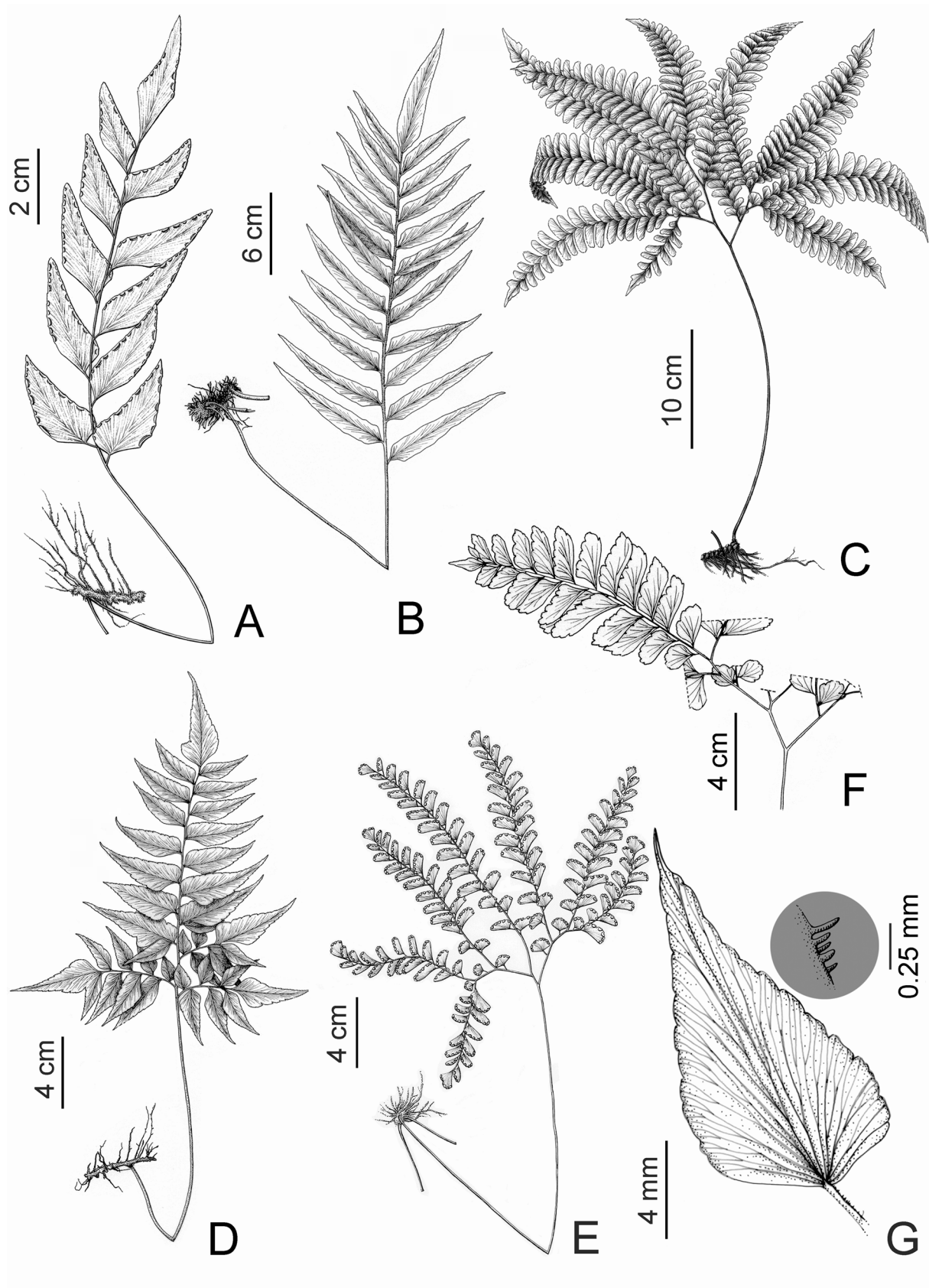


Figure 4. *Adiantum* species: **A.** *A. nudum*, habit. **B.** *A. scalare*, habit. **C.** *A. lindsaeoides*, habit. **D.** *A. poeppigianum*, habit. **E.** *A. patens*, habit. **F.** *A. ornithopodum*, part of a frond. **G.** *A. papillosum*, pinnule and detail of the rachis's hairs.

Key to the *Adiantum* species in Brazil

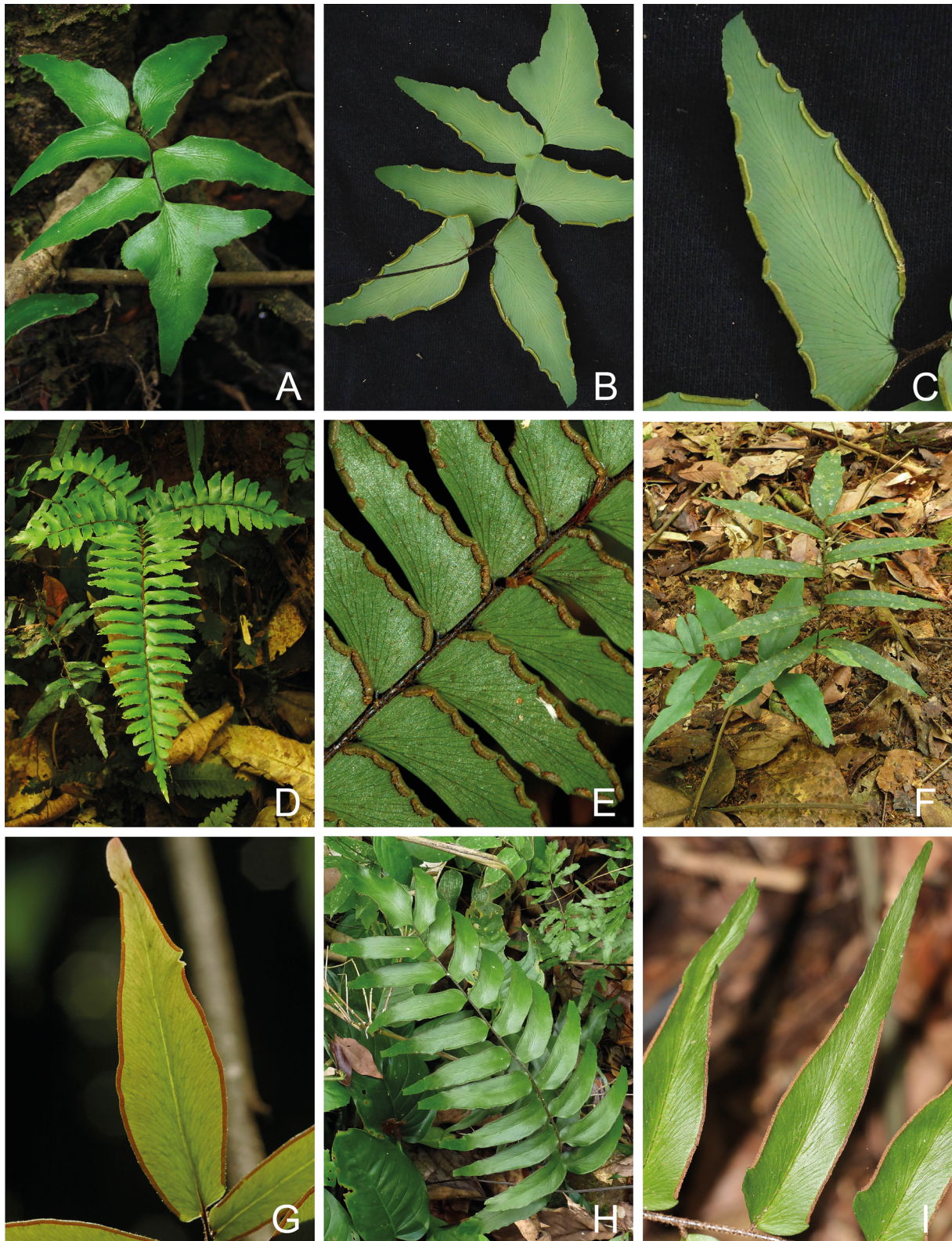


Figure 5. *Adiantum* species: A–C. *A. petiolatum*, A. Habit. B. Pinnae abaxially. C. Sori. D–E. *A. obliquum*, D. Habit. E. Sori (photos: GZ). F–G. *A. dolosum*, F. Habit. G. Sori (photos: GZ). H–I. *A. lucidum*, H. Frond. I. Sori (photos: MB).



Figure 6. *Adiantum* species: A–B. *A. pseudotinctum*, A. Frond. B. Pinnules abaxially. C. *A. pentadactylon*, Habit. D–F. *A. sinuosum*, D. Habit. E. Young plant. F. Sori. G–I. *A. glaucescens*, G. Frond. H. Pinnules abaxially. I. Sori (photos: MB).

Key to the *Adiantum* species in Brazil

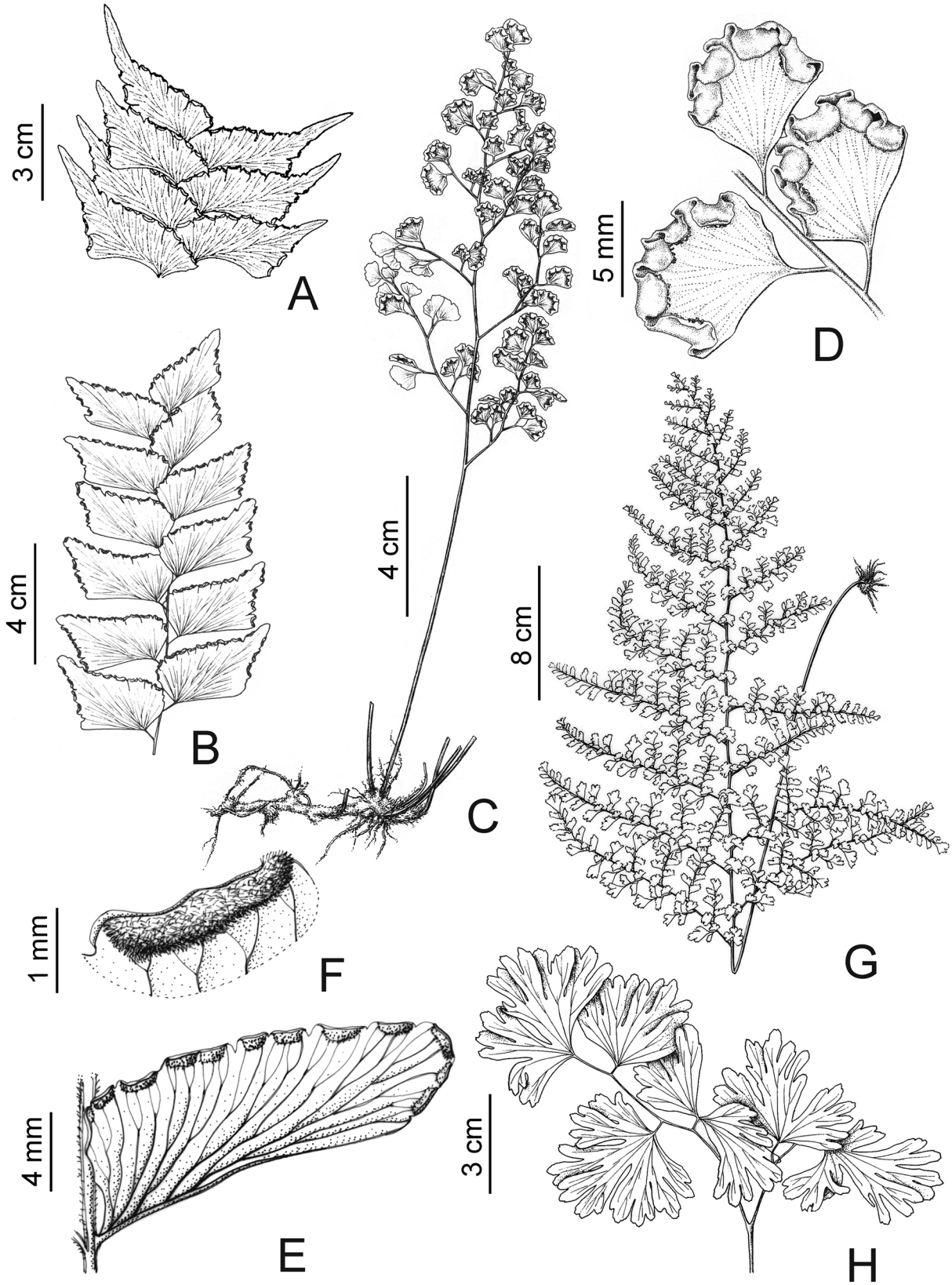


Figure 7. *Adiantum* species: A. *A. mynsseniae*, pinnules. B. *A. mathewsianum*, pinnules. C–D. *A. poiretii*. C. Habit. D. Indusia. E–F. *A. curvatum*. E. Pinnule. F. Indusium. G. *A. concinnum*, habit. H. *A. digitatum*, pinnules.

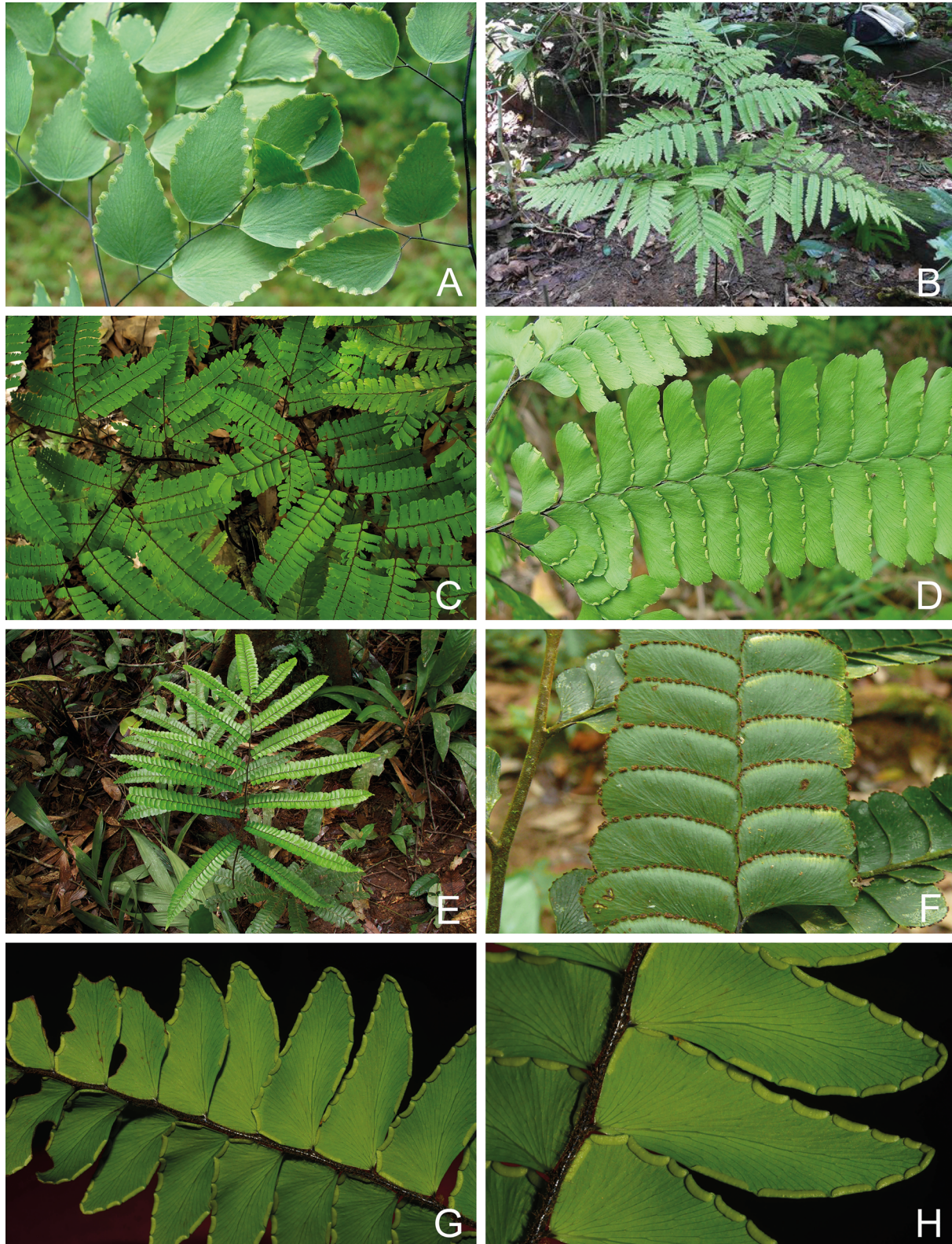


Figure 8. *Adiantum* species: **A.** *A. subcordatum*, pinnules abaxially. **B–C.** *A. pectinatum*, **B.** Habit. **C.** Pinnae (photos: GZ). **D.** *A. abscissum*, pinnules abaxially. **E–F.** *A. tomentosum*, **E.** Habit (photo: GM). **F.** Pinnules abaxially (photo: GZ). **G–H.** *A. latifolium*, **G.** Pinnules abaxially. **H.** Sori.

Key to the *Adiantum* species in Brazil



Figure 9. *Adiantum* species: **A.** *A. capillus-veneris*, sori (photo: MS). **B–C.** *A. raddianum*, **B.** Habit. **C.** Sori. **D–E.** *A. paraense*, **D.** Habit (photo: MB). **E.** Pinnules abaxially (photo: GM). **F–G.** *A. intermedium*, **F.** Habit. **G.** Sori. **H.** *A. serratodentatum*, habit (photo: MB). **I.** *A. pulverulentum*, sori.

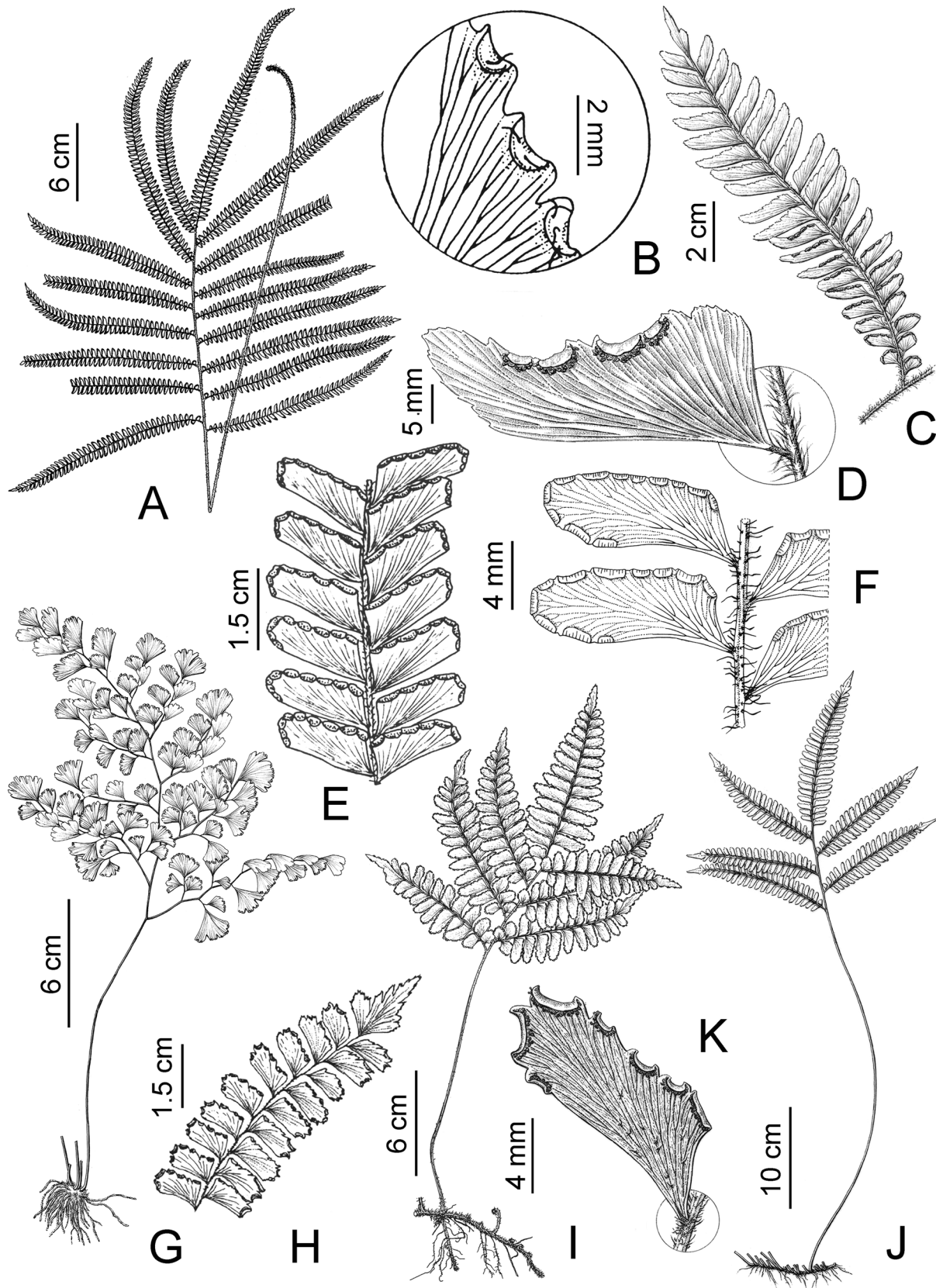


Figure 10. *Adiantum* species: A–B. *A. dawsonii*, A. Habit. B. Indusia. C–D. *A. decoratum*. C. Pinna. D. Indusia. E. *A. diogoanum*, pinnules. F. *A. incertum*, pinnules. G. *A. lorentzii*, habit. H. *A. giganteum*, pinnules. I. *A. windischii*, habit. J–K. *A. nodosum*, J. Habit. K. Indusia.

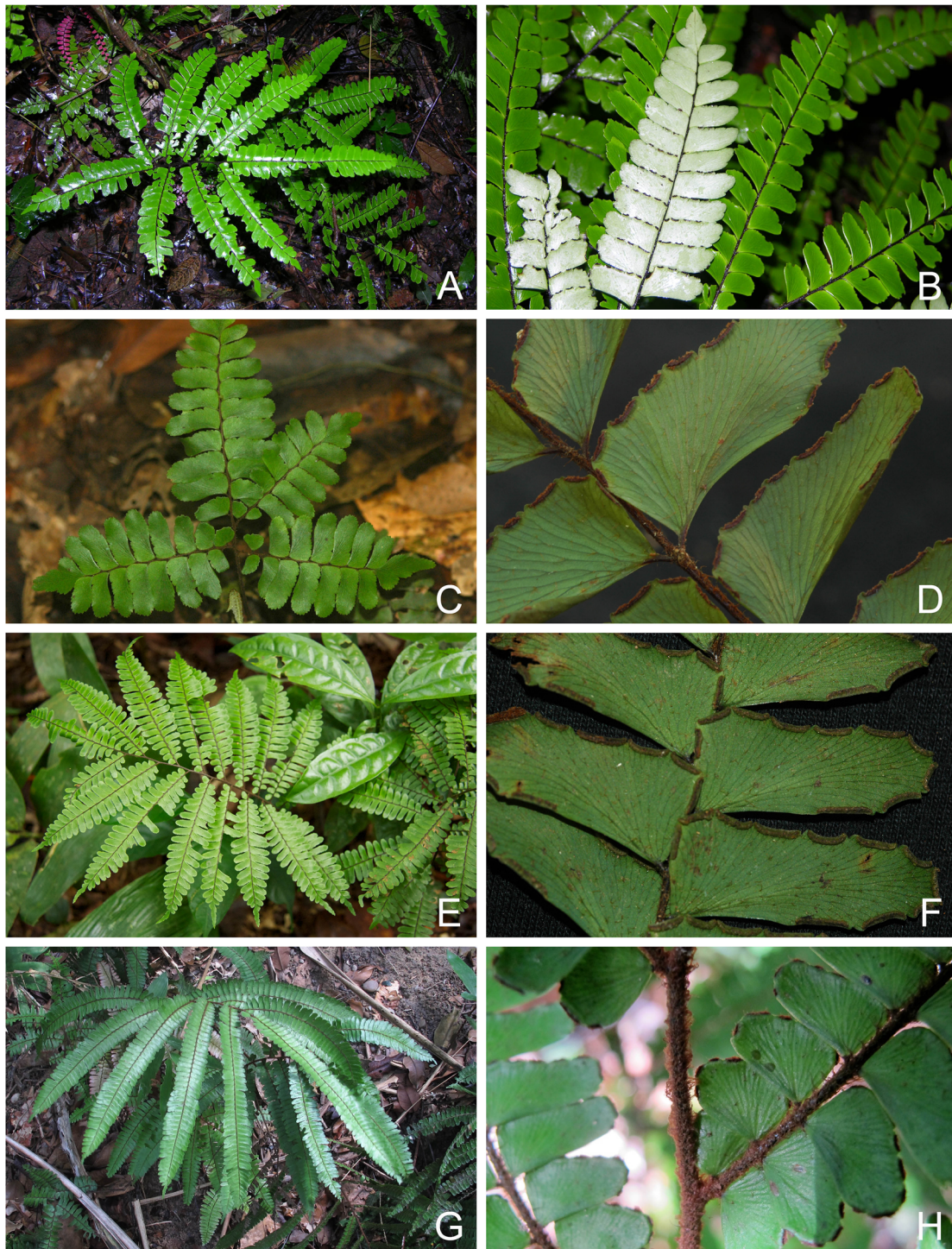
Key to the *Adiantum* species in Brazil

Figure 11. *Adiantum* species: A–B. *A. discolor*, A. Habit. B. Pinnae abaxially glaucous, adaxially green (photos: PL). C–D. *A. humile*, C. Habit. D. Sori (photos: GZ). E–F. *A. terminatum*, E. Habit (photo: HT). F. Sori (photo: GZ). G–H. *A. multisorum*, G. Habit. H. Rachis (photos: NS).

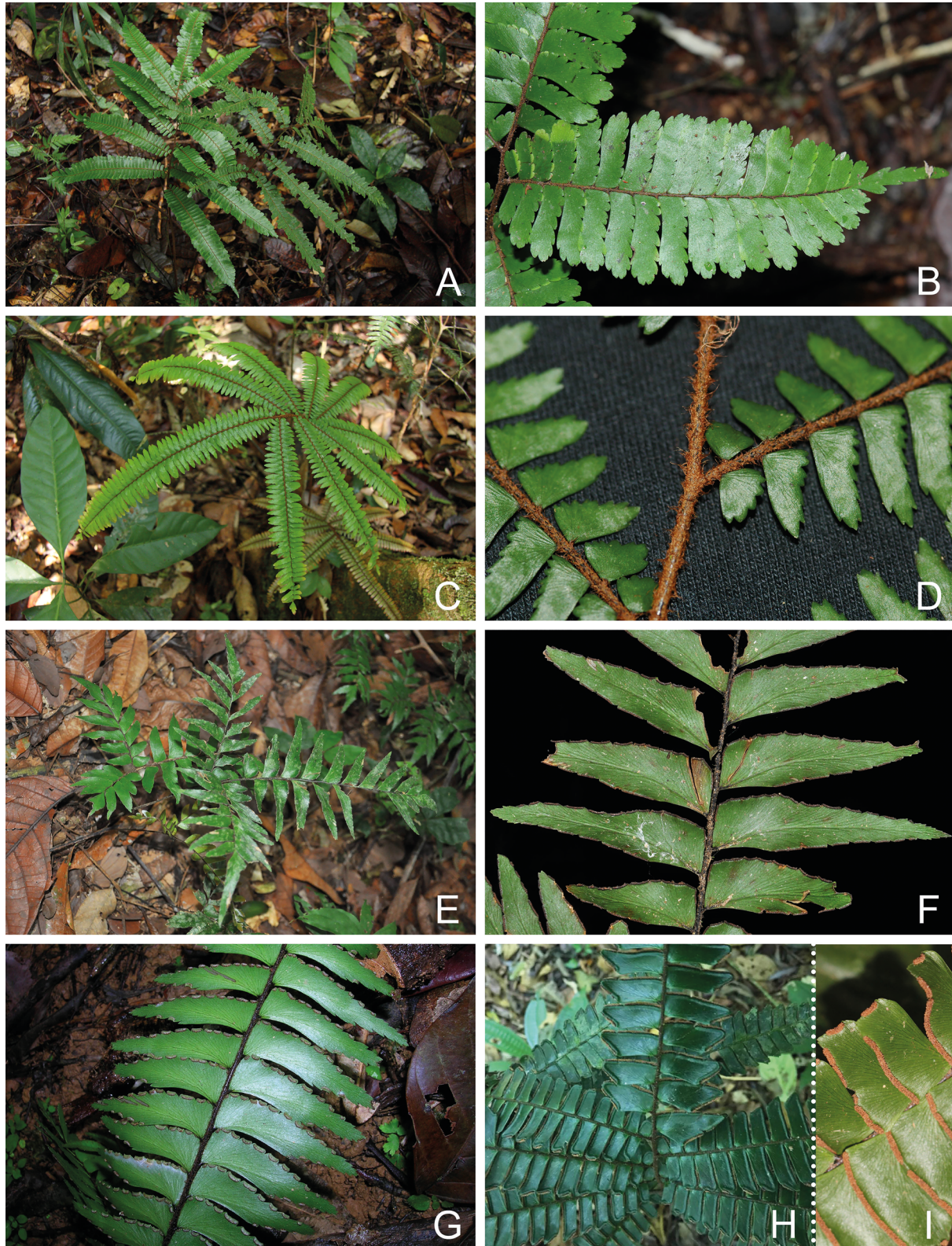


Figure 12. *Adiantum* species: **A–B.** *A. cajennense*, **A.** Habit. **B.** Sterile pinnules (photos: HT). **C–D.** *A. cinnamomeum*, **C.** Habit (photo: HT). **D.** Rachis and sterile pinnules (photo: GZ). **E–F.** *A. argutum*, **E.** Habit. **F.** Pinnae abaxially (photos: JN). **G.** *A. tetraphyllum*, habit (photo: MB). **H–I.** *A. villosum*, **H.** frond (photo: RM). **I.** sori (photo: MB).

Key to the *Adiantum* species in Brazil

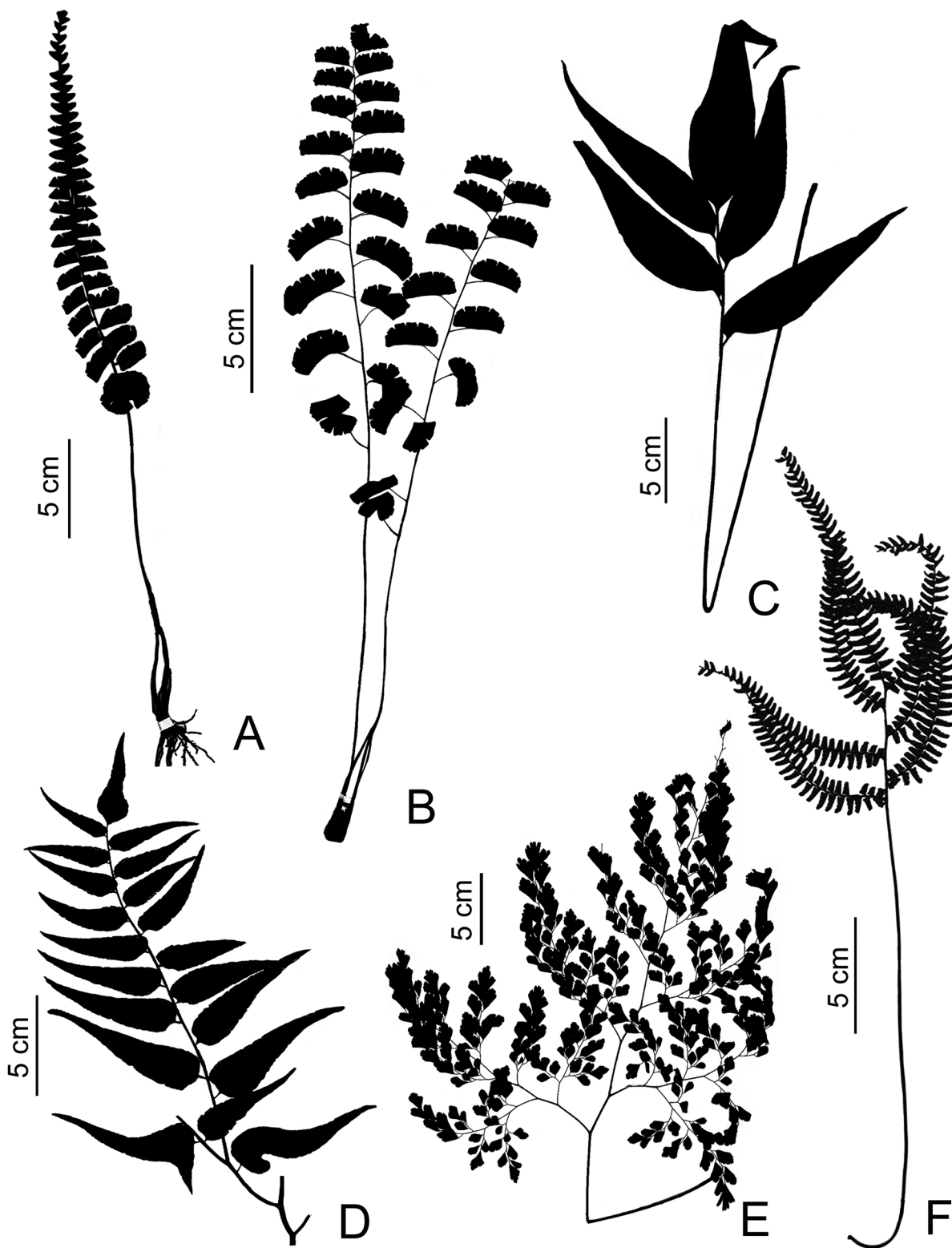


Figure 13. *Adiantum* species: **A.** *Adiantum rhizophytum*, habit (Glaziou 2287, K). **B.** *A. philippense*, habit (Bartlett & Lasser 16842, US). **C.** *A. phyllitidis*, habit (Schomburgk 300, K). **D.** *A. tetragonum*, part of a frond (Wied s.n., BR). **E.** *A. tenerum*, frond (Liogier 28690, NY). **F.** *A. gracile*, frond (Claussen s.n., P).

The treatment of *Adiantum* for Flora of Brazil (Prado & Hirai, in preparation) resulted in the recognition of 65 species, 64 of them are native, and among them, one has a hybrid origin (*A. xmoranii*). This hybrid species does not appear in the key because

of its unusual morphology, see more details about it in Prado (2005). And *Adiantum peruvianum*, a cultivated species, also does not appear in the key. Thus the following key distinguishes 63 native species.

Key to the Brazilian species of *Adiantum*

1. Veins regularly anastomosing (forming regular areoles) 2
1. Veins free or irregularly anastomosing (not forming regular areoles) 4
2. Rhizomes long-creeping; terminal pinna absent *A. diphyllum* (Fée) Maxon* (Fig. 2A,B)
2. Rhizomes short-creeping; terminal pinna conform 3
3. Rachises with few scales and densely hairy; pinnules abaxially glabrous and adaxially sparsely setose along the basal and medial costae
..... *A. adiantoides* (J.Sm.) C.Chr. (Fig. 2C,D)
3. Rachises only with hairs; pinnules glabrous on both surfaces *A. leprieurii* Hook. (Fig. 2E)
4. Fronds 1-pinnate (rarely 2-pinnate at bases) 5
4. Fronds 2-pinnate or more divided 19
5. Pinnae or pinnules articulate 6
5. Pinnae or pinnules not articulate 8
6. Pinnae dimidiately lunate or semi-rounded reniform, long-stalked, stalks 1–2 cm long *A. philippense* L. (Fig. 13B)
6. Pinnae deltate, flabellate to rhombic, stalked, stalks up to 1 cm long 7
7. Sterile margins ciliate, the cilia ca. 2 mm long; indusia lobate-rounded *A. delicatulum* Mart.* (Fig. 3A,B,C)
7. Sterile margins finely denticulate; indusia oblong to lunate *A. deflectens* Mart. (Fig. 2F,G)
8. Rachises proliferous at apex 9
8. Rachises not proliferous at apex 10
9. Median pinnae incised to digitate; indusia lobate *A. calcareum* Gardner* (Fig. 3D,E,F)
9. Median pinnae entire to bi-tripartite flabellate; indusia oblong to lunate *A. rhizophyllum* Schrad.* (Fig. 13A)
10. Rachises glabrous 11
10. Rachises only with scales, or with scales and hairs, or only with hairs 13
11. Pinnae ovate-deltate, opposite, sessile or short-stalked; sori 2 per pinna; indusia linear *A. macrophyllum* Sw. (Fig. 3G,H)
11. Pinnae or pinnules oblong, ovate-lanceolate or suborbicular, alternate, short to long-stalked; sori more than 2 per pinna; indusia oblong or linear-arcuate 12
12. Fronds 1-pinnate; pinnae dimidiate, oblong, short-stalked (stalk 1-2 mm long) *A. nudum* A.R.Sm. (Fig. 4A)
12. Fronds 1-pinnate (rarely 2-pinnate at base); pinnae or pinnules not dimidiate, ovate-lanceolate or suborbicular, long-stalked (stalk 0.5–2.5 cm long)
..... *A. platyphyllum* Sw. (Fig. 2H,I)
13. Rachises with scales and hairs 14
13. Rachises only with scales or only with hairs 15
14. Pinnae or pinnules glabrous on both surfaces; idioblasts easily visible on adaxial blade surfaces, mostly parallel between veins, not visible abaxially; indusia linear-arcuate *A. petiolatum* Desv. (Fig. 5A,B,C)
14. Pinnae or pinnules with filiform scales with pectinate bases on both surfaces; idioblasts conspicuous and oblique between veins adaxially and also visible abaxially; indusia oblong *A. obliquum* Willd. (Fig. 5D,E)
15. Laminae with hairs on both surfaces, hairs 1–2 mm long *A. scalare* R.M.Tryon (Fig. 4B)
15. Laminae with scales on both surfaces, scales with filiform apices and pectinate bases or laminae glabrous on both surfaces 16
16. Laminae glabrous on both surfaces *A. phyllitidis* J.Sm. (Fig. 13C)
16. Laminae with scales on both surfaces 17
17. Veins free; rhizomes long-creeping, non-nodose *A. poeppigianum* (Kuhn) Hieron. (Fig. 4D)
17. Veins anastomosing or irregularly anastomosing; rhizomes short-creeping and nodose 18
18. Pinnae or pinnules 6–9 times longer than wide, 4–5(–6) pairs, bases ± equal-sided, rounded to slightly cuneate; veins anastomosing
..... *A. dolosum* Kunze (Fig. 5F,G)
18. Pinnae or pinnules 2–4 times longer than wide, 10–13 pairs, bases unequal-sided, rounded on acroscopic sides and cuneate on basisopic sides; veins irregularly anastomosing but mostly free *A. lucidum* (Cav.) Sw. (Fig. 5H,I)
19. Fronds 2- or 3-pinnate or 3–5-pinnate at bases 20
19. Fronds 2-pinnate throughout 41
20. Fronds 3- to 5-pinnate at bases 21
20. Fronds 2- or 3-pinnate at bases 34
21. Fronds forked and pedate at bases 22

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21. Fronds not forked at bases 30
22. Pinnules with glandular hairs on both surfaces or glabrous abaxially and puberulent along the costae adaxially 23
22. Pinnules glabrous on both surfaces 24
23. Pinnules dimidiate; sori reniform or rounded *A. patens* Willd. (Fig. 4E)
23. Pinnules deltate to lanceolate; sori linear, slightly arcuate *A. tetragonum* Schrad.* (Fig. 13D)
24. Pinnules obovate to flabellate or pinnules dimidiate 25
24. Pinnules deltate, rhombic or subcordate to cordiform 28
25. Pinnules obovate to flabellate; rachises glabrous *A. pseudotinctum* Hieron. (Fig. 6A, B)
25. Pinnules dimidiate; rachises with hairs 26
26. Stipes glabrous along median and distal portions *A. ornithopodum* C.Presl ex Kuhn (Fig. 4F)
26. Stipes pubescent along median and distal portions, indument of scales and/or hairs 27
27. Rachises pubescent on both sides; apex of the segments rounded *A. lindsaeoides* J.Prado & R.Y.Hirai* (Fig. 4C)
27. Rachises glabrous abaxially and pubescent adaxially; apex of the segment long-acuminate to acute *A. mynseniae* J.Prado* (Fig. 7A)
28. Rachises with hairs adaxially, the hairs reddish *A. papillosum* Handro* (Fig. 4G)
28. Rachises glabrous 29
29. Pinnules not articulate; deltate or irregularly rhombic *A. pentadactylon* Langsd. & Fisch.* (Fig. 6C)
29. Pinnules articulate, rhombic to subcordate *A. subcordatum* Sw.* (Fig. 8A)
30. Pinnules articulate or tardily articulate, oblong to trapeziform or flabellate; rachises glabrous 31
30. Pinnules not articulate, dimidiate, orbicular, or flabellate, rhombic-cuneate; rachises pubescent or glabrous 32
31. Pinnules tardily articulate, oblong to trapeziform; sori orbicular to lunate *A. mathewsianum* Hook. (Fig. 7B)
31. Pinnules articulate, flabellate; sori oblong *A. tenerum* Sw. (Fig. 13E)
32. Rachises with hairs and some scales; pinnules dimidiate, abaxially with hairs, glabrous adaxially *A. pectinatum* Desv. (Fig. 8B,C)
32. Rachises glabrous; pinnules orbicular to flabellate or rhombic-cuneate, glabrous on both surfaces 33
33. Rhizomes long-creeping; pinnule bases usually symmetric; sori usually with yellow farina among sporangia; indusia membranaceous *A. poiretii* Wikstr. (Fig. 7C,D)
33. Rhizomes short-creeping; pinnule bases usually asymmetric; sori without farina among sporangia; indusia rigid *A. sinuosum* Gardner (Fig. 6D,E,F)
34. Pinnules articulate *A. glaucescens* Klotzsch (Fig. 6G,H,I)
34. Pinnules not articulate 35
35. Rachises puberulent or with scales and hairs; pinnules digitate-flabellate or dimidiate 36
35. Rachises glabrous; pinnules entire to incised, orbicular, orbicular-cuneate, rhombic-cuneate or ovate to rhombic 38
36. Rachises puberulent; pinnules digitate-flabellate, puberulent on both surfaces *A. digitatum* Hook. (Fig. 7H)
36. Rachises with scales and hairs; pinnules dimidiate, glabrous on both surfaces 37
37. Indusia glabrous *A. abscissum* Schrad.* (Fig. 8D)
37. Indusia with hairs *A. curvatum* Kaulf.* (Fig. 7E,F)
38. Veins ending into teeth at sterile margins of the pinnules *A. capillus-veneris* L. (Fig. 9A)
38. Veins ending between teeth at sterile margins of the pinnules 39
39. Proximal pinnules overlying rachises *A. concinnum* Willd. (Fig. 7G)
39. Proximal pinnules not overlying rachises 40
40. Pinnules copiously incised on distal margins to 2/3 or more of pinnule length, pinnule bases cuneate and usually symmetric on proximal pinnules and asymmetric on distal pinnules *A. lorentzii* Hieron. (Fig. 10G)
40. Pinnules entire or sometimes incised on distal margins to 1/2 of the pinnule length, pinnule bases broadly cuneate and usually asymmetric *A. raddianum* C.Presl (Fig. 9B,C)
41. Rachises glabrous abaxially and with only short-hairs adaxially *A. tomentosum* Klotzsch (Fig. 8E,F)
41. Rachises only with scales or with scales and hairs 42
42. Rachises with scales and hairs 43
42. Rachises only with scales 44
43. Rhizomes long-creeping; pinnules glabrous on both surfaces; indusia glabrous *A. latifolium* Lam. (Fig. 8G,H)
43. Rhizomes short-creeping, nodose; pinnules abaxially with scales and glabrous adaxially; indusia bearing short-hairs *A. paraense* Hieron. (Fig. 9D,E)
44. Rachises with one kind of scales (lanceolate to narrowly lanceolate with pectinate base or filiform-subulate) 45
44. Rachises with two kinds of scales (hairlike and lanceolate with pectinate base or arachnoid and lanceolate with pectinate base) 56
45. Pinnules conspicuously discolorous, light green on the abaxial surface and dark green above and veins not easily visible *A. discolor* J.Prado* (Fig. 11A,B)
45. Pinnules not discolorous or slightly discolorous; veins easily visible 46
46. Pinnules glabrous on both surfaces or rarely with sparse scales abaxially 47

46. Pinnules with conspicuous hairs or scales at least on one surface 48
47. 3 or 4 pairs of pinnae per frond; median pinnules trapeziform *A. decoratum* Maxon & Weath. (Fig. 10C,D)
47. 6–8 pairs of pinnae per frond; median pinnules falcate *A. intermedium* Sw.* (Fig. 9F,G)
48. Pinnae 2–4 pairs per frond; pinnules abaxially with hairs 49
48. Pinnae 3–10 pairs per frond; pinnules abaxially with scales 50
49. Distal pinnules approximately half the size of largest pinnules; indusia glabrous *A. humile* Kunze (Fig. 11C,D)
49. Distal pinnules less than half the size of largest pinnules; indusia bearing hairs *A. terminatum* Kunze ex Miq. (Fig. 11E,F)
50. Yellow, rounded glands present on abaxial surfaces of pinnules *A. dawsonii* Lellinger & J.Prado (Fig. 10A,B)
50. Glands lacking on abaxial surfaces of pinnules 51
51. Pinnules 2(–3) times longer than wide 52
51. Pinnules 3–5 times longer than wide 54
52. Pinnules with scales on both surfaces; indusia with scales *A. multisorum* Samp. (Fig. 11G,H)
52. Pinnules glabrous adaxially or with scales only near the sori; indusia glabrous 53
53. 2–4(–6) pairs of pinnae per frond; 10–32 pairs of pinnules per pinna *A. nodosum* J.Prado et al. (Fig. 10J,K)
53. (3–)7–10 pairs of pinnae per frond; 27–43 pairs of pinnules per pinna *A. gracile* Fée* (Fig. 13F)
54. Pinnules 16–25 pairs per pinna; indusia bearing hairs *A. diogoanum* Glaz. ex Baker (Fig. 10E)
54. Pinnules 30–45 pairs per pinna; indusia scaly 55
55. Sterile margins of the pinnules conspicuously incised and denticulate-serrate *A. cajennense* Willd. ex Klotzsch (Fig. 12A,B)
55. Sterile margins of the pinnules serrate to biserrate *A. cinnamomeum* Lellinger & J.Prado (Fig. 12C,D)
56. Rhizomes very long-creeping (cord-like) 57
56. Rhizomes moderately long-creeping (not cord-like) or short-creeping 61
57. Pinnules abaxially with septate hairs, adaxially glabrous; indusia glabrous *A. windischii* J.Prado (Fig. 10I)
57. Pinnules abaxially with scales, adaxially glabrous; indusia with hairs or glabrous 58
58. Scales of abaxial pinnule surfaces lanceolate with pectinate bases and filiform, uniseriate apices 59
58. Scales of abaxial pinnule surfaces setiform; indusia glabrous 60
59. Sterile margin serrulate or entire (not incised) on the acroscopic and distal sides of the pinnules; indusia bearing hairs
..... *A. serratodentatum* Willd. (Fig. 9H)
59. Sterile margin incised, irregularly and distantly biserrate on the acroscopic and distal sides of the pinnules; indusia glabrous
..... *A. giganteum* J.Prado (Fig. 10H)
60. Pinnules 3–8 pairs per pinna, terminal pinnules larger than distal ones, broadly subrhombic, sterile margins biserrate
..... *A. argutum* Splitg. (Fig. 12E,F)
60. Pinnules 4–15 pairs per pinna, terminal pinnules reduced, narrowly subrhombic, sterile margins finely serrate *A. incertum* Lindm. (Fig. 10F)
61. Rachises adaxially mostly with filiform scales (hairlike) and abaxially with lanceolate scales with pectinate bases; indusia oblong, with hairs,
hairs reddish brown *A. tetraphyllum* Willd. (Fig. 12G)
61. Rachises on both sides mostly with arachnoid scales and some lanceolate scales with pectinate bases; indusia linear, lunate, glabrous or with
brown hairs 62
62. One indusia per pinnule *A. pulverulentum* L. (Fig. 9I)
62. Two or three indusia per pinnule *A. villosum* L. (Fig. 12H)

Discussion

As already commented here, 16 species of *Adiantum* in Brazil are endemic and have restricted area of occurrence compared to the species widely distributed. Among those with very narrow distribution are: *Adiantum diphyllum*, Figure 2A, B and *A. discolor*, 11A, B (Brazilian Atlantic Rainforest: Bahia State; Sundue & Prado 2006; Prado 2000, respectively), *A. lindsaeoides*, Figure 4C (Brazilian Atlantic Rainforest: Bahia and Espírito Santo States; Prado & Hirai 2013), *A. tetragonum* Figure 13D (Brazilian Atlantic Rainforest: Bahia and Minas Gerais States; Prado & Sundue 2005).

Adiantum adiantoides, Figure 2C, D, is not restricted to Brazil, but has its occurrence only in the Brazilian Amazon Forest of the states of Pará, Amazonas, and Amapá (Sundue & Prado 2006).

Among those endemic species to Brazil, some have been recently described as *Adiantum lindsaeoides*, Figure 4C, Prado & Hirai (2013)

or were described in the last 20 years: *A. discolor*, Figure 11A, B, Prado (2000), *A. mynseniae*, Figure 7A, Prado (2003, 2004), and *A. xmoranii* (Prado 2005).

Among the other species recently described and that are not restricted to Brazil are: *Adiantum dawsonii*, Figure 10A, B and *A. cinnamomeum*, Figure 12C, D, Lellinger & Prado (2001), *A. giganteum*, Figure 10H, Prado (2001), *A. windischii*, Figure 10I, Prado (2005), and *A. nodosum*, Figure 10J, K, Prado et al. (2017b).

The key and data here presented are only the first steps to approach the diversity of *Adiantum* in Brazil. Based on our experience with this interesting and difficult group of plants, certainly, there are more species to be described. During our investigations, we observed some specimens that could be hybrids between known species, but describing these gatherings as distinct taxa is too premature. More fieldwork is necessary to locate more individuals and better study their biology.

We hope that the present key can be a good first step in recognizing undescribed species for our rich flora.

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Author Contributions

Jefferson Prado: Substantial contribution to the concept and design of the study, contribution to data analysis and interpretation, contribution to manuscript preparation, and contribution to critical revision, adding intellectual content.

Regina Y. Hirai: Substantial contribution to the concept and design of the study, contribution to data collection, contribution to data analysis and interpretation, and contribution to manuscript preparation (text + illustrations).

Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

References

- HIRAI, R.Y. & PRADO, J. 2019. Neotropical species of the *Adiantum raddianum* group (Pteridaceae). *Willdenowia* 49(3): 295–317.
- HIRAI, R.Y., SCHUETTPELZ, E., HUIET, L., PRYER, K.M., SMITH, A.R. & PRADO, J. 2016. Phylogeny and relationships of the neotropical *Adiantum raddianum* group (Pteridaceae). *Taxon* 65(6): 1225–1235.
- HUIET, L., LI, F.-W., KAO, T.-T., PRADO, J., SMITH, A.R., SCHUETTPELZ, E. & PRYER, K.M. 2018. A worldwide phylogeny of *Adiantum* (Pteridaceae) reveals remarkable convergent evolution in leaf blade architecture. *Taxon* 67(3): 488–502.
- LELLINGER, D.B. 2002. A Modern Multilingual Glossary for Taxonomic Pteridology. *Pteridologia* 3A. Washington, American Fern Society.
- LELLINGER, D.B. & PRADO, J. 2001. The group of *Adiantum gracile* in Brazil and environs. *Amer. Fern J.* 91(1): 1–8.
- PICHI SERMOLLI, R.E.G. 1996. Authors of scientific names in Pteridophyta. Royal Botanic Gardens, Kew.
- PPG I. 2016. A community-derived classification for extant lycophytes and ferns. *J. Syst. Evol.* 54(6): 563–603.
- PRADO, J. 2000. A new species of *Adiantum* (Pteridaceae) from Bahia, Brazil. *Brittonia* 52(2): 210–212.
- PRADO, J. 2001. *Adiantum giganteum* (Pteridaceae: Pteridophyta), a new maidenhair fern from Amazonia, Brazil. *Fern Gaz.* 16(5): 209–212.
- PRADO, J. 2003. New species in *Adiantum* from Brazil. *Amer. Fern J.* 93(2): 76–80.
- PRADO, J. 2004. Nomenclatural corrections in *Adiantum*. *Amer. Fern J.* 94(2): 112.
- PRADO, J. 2005. A new species and hybrid in *Adiantum* (Pteridaceae) from South America. *Kew Bull.* 60(1): 117–121.
- PRADO, J. 2015. Pteridaceae in Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB91951> (last access in 08/01/2018).
- PRADO, J. & HIRAI, R.Y. 2013. *Adiantum lindsaeoides* (Pteridaceae), a New Fern Species from the Atlantic Rain Forest, Brazil. *Syst. Bot.* 38(1): 28–31.
- PRADO, J. & SUNDUE, M.A. 2005. Typification and identity of *Adiantum tetragonum* (Pteridaceae). *Amer. Fern J.* 95(3): 89–93.
- PRADO, J. & SYLVESTRE, L.S. 2010. As samambaias e licófitas do Brasil. In *Catálogo de plantas e fungos do Brasil* (R.C. Forzza, J.F.A. Baumgratz, C.E.M. Bicudo, D. Canhos, A.A. Carvalho Jr., A. Costa, D.P. Costa, M. Hopkins, P.M. Leitman, L.G. Lohmann, E.M. Lughadha, L.C. Maia, G. Martinelli, M. Menezes, M.P. Morim, M. Nadruz, A.L. Peixoto, J.R. Pirani, J. Prado, L.P. Queiroz, V.C. Souza, J.R. Stehmann, L.S. Sylvestre, B.M.T. Walter & D.C. Zappi, orgs.). Jardim Botânico do Rio de Janeiro, Rio de Janeiro, v. 1, p. 69–74.
- PRADO, J., HIRAI, R.Y. & MORAN, R.C. 2017a. Fern and lycophyte flora of Acre state, Brazil. *Biota Neotropica* 17(4): e20170369. <https://doi.org/10.1590/1676-0611-bn-2017-0369> (last access in 22/10/2020).
- PRADO, J., HIRAI, R.Y., SMITH, A.R. & TUOMISTO, H. 2017b. Novelty in *Adiantum* (Pteridaceae) from South America. *Willdenowia* 47(3): 237–242.
- PRADO, J., SYLVESTRE, L.S., LABIAK, P.H., WINDISCH, P.G., SALINO, A., BARROS, I.C.L., HIRAI, R.Y., ALMEIDA, T.E., SANTIAGO, A.C.P., KIELING-RUBIO, M.A., PEREIRA, A.F.N., ØLLGAARD, B., RAMOS, C.G.V., MICKEL, J.T., DITTRICH, V.A.O., MYNSEN, C.M., SCHWARTSBURD, P.B., CONDACK, J.P.S., PEREIRA, J.B.S. & MATOS, F.B. 2015. Diversity of ferns and lycophytes in Brazil. *Rodriguésia* 66(4): 1073–1083.
- SUNDUE, M.A. & PRADO, J. 2006. *Adiantum diphyllum*, a rare and endemic species of Bahia State, Brazil and its close relatives. *Brittonia* 57(2): 123–128.

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