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 indúsios com nervuras e esporangíos 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 a 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 Klotzstr. 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 chN 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 pervianum). 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 pervianum 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. paraenaes Hieron., A. serratodentatum Willd., A. tetraphyllum Willd., A. villosum L.), Fernando Matos (FM, A. diphyllum (Féc) Maxon), Gabriel Moulatet (GM, A. paraenaes, 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
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.
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. ornithopodium*, part of a frond. G. *A. papillosum*, pinnule and detail of the rachis’s hairs.
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).
Figure 7. *Adiantum* species: A. *A. mynsseniae*, pinnules. B. *A. mathewsiannum*, 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. Pinnas (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.
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.
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).
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 conform ........................................................................................................................................................................... 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 costa ......... 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 dimidiate 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 denticate; indusia oblong to lunate ................................................................................................................................. A. defectens 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. rhizophytum 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, subsessile 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-arcurate ........................................................................................................................................................................................................................................ 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-arcurate ................................................................................................................................. A. petiolarum 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. scabrum 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 basiscopic 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 ................................................................................................................................................................. 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 abaxially .......................... 23
23. Pinnules glabrous on both surfaces ................................................................. A. patens Willd. (Fig. 4E) 24
23. Pinnules dimidiate; sori reniform or rounded ........................................ 25
24. Pinnules deltate to lanceolate; sori linear, slightly arcuate ..................... A. tetragonum Schrad.* (Fig. 13D) 26
24. Pinnules obovate to flabellate or pinnules dimidiate .................................. 27
25. Rachises glabrous....................................................... A. psuedodinckum Hieron. (Fig. 6A, B) 28
25. Pinnules obovate to flabellate; Rachises glabrous ........................................ 29
26. Rhizomes short-creeping; pinnules abaxially with scales and glabrous adaxially; indusia bearing short-hairs ................................. A. ornithopodium C.Presl ex Kuhn (Fig. 4F) 30
26. Stipes pubescent along median and distal portions ........................................ 31
27. Rachises pubescent on both sides; apex of the segments rounded .............. A. lindsaeoides J.Prado & R.Y.Hirai* (Fig. 4C) 32
27. Rachises glabrous abaxially and pubescent adaxially; apex of the segment long-acuminate to acute ....................................................... A. mynsseniae J.Prado* (Fig. 7A) 33
28. Rachises with hairs adaxially, the hairs reddish ........................................... A. papillosum Handro* (Fig. 4G) 34
28. Rachises glabrous ............................................................................ 35
29. Pinnules not articulate; deltate or irregularly rhombic ................................ A. pentalactylon Langsd. & Fisch.* (Fig. 6C) 36
29. Pinnules articulate, rhombic to subcordate .............................................. A. subcordatum Sw.* (Fig. 8A) 37
30. Pinnules articulate or tardily articulate, oblong to trapeziform or flabellate; Rachises glabrous ........................................................... 38
30. Pinnules not articulate, dimidiate, orbicular, or flabellate, rhombic-cuneate; Rachises pubescent or glabrous ................................................. 39
31. Rachises only with scales ......................................................................... 40
31. Rachises with hairs adaxially, the hairs reddish ........................................... A. mathewssianum Hook. (Fig. 7B) 41
32. Rachises with and some scales; pinnules dimidiate, abaxially with hairs, glabrous adaxially ......................................................... A. pectinatum Desv. (Fig. 8B,C) 42
32. Rachises glabrous; pinnules orbicular to flabellate or rhombic-cuneate, glabrous on both surfaces ........................................................ 43
33. Rhizomes long-creeping; pinnule bases usually symmetric; sori usually with yellow farina among sporangia; indusia membranaceous ............................... A. poirettii Wikstr. (Fig. 7C,D) 44
33. Rhizomes short-creeping; pinnule bases usually asymmetric; sori without farina among sporangia; indusia rigid ......................................................... A. sinuosum Gardner (Fig. 6D,E,F) 45
34. Rachises puberulent ................................................................. 46
34. Pinnules articulate  ............................................................................. A. glaucescens Klotzsch (Fig. 6G,H) 47
35. Rachises puberulent or with scales and hairs; pinnules digitate-flabellate or dimidiate ................................................................................. 48
35. Rachises glabrous; pinnules entire to incised, orbicular, orbicular-cuneate, rhombic-cuneate or ovate to rhombic ........................................ 49
36. Rachises puberulent; pinnules digitate-flabellate, puberulent on both surfaces ....................................................................... A. digitatum Hook. (Fig. 7H) 50
36. Rachises with scales and hairs; pinnules dimidiate, glabrous on both surfaces ......................................................... A. abscissum Schrad.* (Fig. 8D) 51
37. Rachises with scales and hairs .............................................................. A. curvatum Kaulf.* (Fig. 7E,F) 52
37. Indusia glabrous .................................................................................. 53
38. Indusia with hairs .................................................................................. 54
38. Veins ending into teeth at sterile margins of the pinnules ................................ A. capillius-veneris L. (Fig. 9A) 55
38. Veins ending between teeth at sterile margins of the pinnules ........................ 56
39. Proximal pinnules overlying rachises ........................................................ A. concinnum Willd. (Fig. 7G) 57
39. Proximal pinnules not overlying rachises .................................................. 58
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. lorentzi Hieron. (Fig. 10G) 59
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) 60
41. Rachises glabrous abaxially and with only short-hairs adaxially .................. A. tomentosum Klotzsch (Fig. 8E,F) 61
41. Rachises only with scales or with scales and hairs ........................................ 62
42. Rachises with scales and hairs ................................................................ A. concinnum Willd. (Fig. 7G) 63
42. Rachises only with scales ................................................................. 64
43. Rhizomes long-creeping; pinnules glabrous on both surfaces; Indusia glabrous ................................................................. A. latifolium Lam. (Fig. 8G,H) 65
43. Rhizomes short-creeping, nodose; pinnules abaxially with scales and glabrous adaxially; Indusia bearing short-hairs ................................. A. paraense Hieron. (Fig. 9D,E) 66
44. Rachises with one kind of scales (lanceolate to narrowly lanceolate with pectinate base or filiform-subulate) ................................................ 67
44. Rachises with two kinds of scales (hairlike and lanceolate with pectinate base or arachnoid and lanceolate with pectinate base) .................................... 68
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) 69
45. Pinnules not discolorous or slightly discolorous; veins easily visible ........... 70
46. Pinnules glabrous on both surfaces or rarely with sparse scales abaxially .................................
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. 10I,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 sepaloid 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 margins serrulate or entire (not incised) on the acroscopic and distal sides of the pinnules; indusia bearing hairs ......................................................... A. serratodentatum Willd. (Fig. 9I)
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 Splittg. (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 Espirito 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. mynsseniae, Figure 7A, Prado (2003, 2004), and A. xmorani (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.

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Key to the Adiantum species in Brazil

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.

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