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Novelties in Adiantum (Pteridaceae) from South America

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Abstract: We describe two new species of Adiantum (Pteridaceae): A. nodosum and A. pseudocajennense. These species occur in the lowland rainforests of the Amazon Basin at 100–350 m in elevation. Both species have laminae 2-pinnate and grow on waterlogged soil in tall swamp forests, but they differ in the rhizome diameter and degree of incision of the pinnule margins. Currently available information suggests that A. pseudocajennense may be endemic to Ecuador, whereas A. nodosum has a wider distribution and is known from Brazil, Colombia and Peru. For both species we present descriptions, distribution statements, comments and illustrations.

Key words: Adiantum, Amazonia, Brazil, Colombia, Ecuador, ferns, Neotropics, new species, Peru, Pteridaceae, pteridophytes, South America

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Introduction

Adiantum L. is a large genus described by Linnaeus (1753) with a worldwide distribution (Mickel & Smith 2004). The genus is monophyletic (Rothfels & Schuettpelz 2014; Fryer & al. 2016; PPG I 2016) and has about 225 species. It is characterized by terete, blackish to castaneous petioles, rachises and costae, and sporangia borne on the false indusium (i.e. not on the abaxial laminar surface below it). The rhizomes are short- to long-creeping, usually horizontal, but sometimes compact and suberect, with scales. Laminae are monomorphic or nearly so, pinnate (rarely undivided) to 5-pinnate, sometimes pedate with free or rarely anastomosing veins without included free veinlets and with or without linear epidermal idioblasts (false veins) between the true veins. Sori are formed on the veins of the recurved laminar margins (false indusia), and paraphyses are absent.

Our recent studies and those of others have revealed several new Adiantum species for South America in the last 11 years, e.g.: Peru, one species (Prado 2006); Bolivia, one species (Prado 2006); Argentina, one species (Sundue & al. 2010); Ecuador, one species (McCarthy & Hickey 2011); Brazil, one species (Prado & Hirai 2013); French Guiana, one species (Zimmer 2007); Guyana, one species; and French Guiana, three species (Boudrie & al. 2017).

The two new species described here represent one more step in the process to understand the diversity of Adiantum in the Amazon region.

Material and methods

This study is based on specimens from the following herbaria: AMAZ, COAH, CUZ, INPA, NY, QCA, QCNE, SP, TUR, UC, US and USM. Species recognition was

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based on morphological characters such as rhizomes, scales, laminar dissection, indumentum and pseudoindusia. We have illustrated the most distinctive characters for each species.

Bracketed geographic coordinates were estimated based on the closest localities, when that information was not given on the specimen label.

The dot-distribution maps are based on all specimens studied for a given species.

**Results and Discussion**

*Adiantum nodosum* J. Prado, R. Y. Hirai & A. R. Sm., sp. nov. – Fig. 2.
Holotype: Peru, Loreto, Mariscal Ramon Castilla, Río Yaguasyacu, 2–5 km SW from the village of Puerto Izcango, primary upland rain forest on a sandy terrace of Río Amazonas, 03°18’S, 72°01’W, 100–150 m, 23 May 1997, H. Tuomisto, K. Ruokolainen, V. Vargas & J. Vormisto 11250 (UC barcode UC1788281; isotypes: AMAZ, SP, TUR 3 sheets, USM).

**Morphological description — Plants terrestrial. Rhizomes short-creeping, (1.5–)3–5 mm in diam., scaly, with stipes (1–)5–10 mm apart, scales light to dark brown, shiny, lanceolate, margin entire to sparingly denticulate. Fronds (25–)60–76 cm long; stipe black, c. 0.6× as long as frond, adaxially sulcate, sparsely scaly, scales appressed throughout, dark brown, concolorous, linear, (1–)1.5–2 mm long, base with several processes, margin entire, apex filiform; also with some arachnoid scales c. 0.5 mm long; lamina 2-pinnate, not reduced at base, 15–28 cm wide; rachis with indumentum similar to that of stipe; pinnae elliptic, slightly narrowed at base, tapering at apex, (8–)11–20 × 2–4 cm, indumentum of pinna rachis like that of stipe and main rachis; lateral pinnae in (1 or)2–4(–6) pairs (3–6 pairs in fertile fronds, fewer than 4 in sterile fronds), alternate, ascending; terminal pinnule conform, almost as long as or 1–1.2 × as long as subtending pinnae; pinnules in 10–32 pairs, not articulate, conspicuously oblique to pinna rachis, 2–3 × as long as wide, chartaceous, adaxial surface glabrous, abaxial surface sparsely scaly, scales borne on veins, light brown, 0.5–1 mm long, base pectinate, apex filiform and tortuous; pinnules free-veined, without evident midrib, veins slightly prominulous, with oblique idioblasts between veins on both surfaces; proximal pairs of pinnules reduced, somewhat rounded to deltate, medial pairs diminuate, trapeziform, acroscopic base rectangular, sterile margins irregularly denticulate or serrate, sterile apices obtuse, straight or curved toward pinna apex, fertile apices angular; distal pinnules c. ½ or less length of medial pinnules; terminal pinnule on each pinna broadly rhombic, similar in size or usually longer than distal ones. Sori mostly 5–7(or 8) per pinnule, lunate, oblong; indusia

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Fig. 1. Distribution of *Adiantum nodosum* and *A. pseudocajennense*. 
light brown to dark brown, lunate, glabrous, margin entire; spores light brown, trilete.

**Distribution and ecology** — Amazonian forests in Colombia, Peru and Brazil (Fig. 1). Growing in the floodplains and banks of creeks on waterlogged and often muddy sites, at 100–350 m. Usually terrestrial, but can also grow on the bases of tree trunks.

**Etymology** — The specific epithet is based on the morphology of the rhizome, with approximate stipes, leading to a nodose appearance of the rhizomes. This feature
is more evident on small specimens where the stipes are 1–1.5 mm apart.

Additional specimens examined — **BRAZIL:** Amazonas: Presidente Figueiredo, Distrito de Balbina, margem direita da estrada de acesso à Vila de Balbina, Ramal da Morena, margem do Rio Uatumá, [02°07′06″S, 59°19′07″W], 100 m, 3 Feb 2008, J. Prado & al. 1873 (NY, SP, TUR, US). Pará: Novo Progresso, Fazenda Sr. Sérgio, 15 km Sul de NP pela BR-163, 07°15′01″S, 55°41′58″W, 8 Dec 2009, F. O. Figueiredo & al. 1372 (INPA). — **COLOMBIA:** Amazonas: Rio Caquetá, 0.5 km E of Estrecho (9 km E of confluence of Rio Metá and Caquetá), 0°57′S, 71°32′W, 150–250 m, 28 Apr 1998, H. Tuomisto & al. 12232 (COAH, TUR 4 sheets); idem, close to mouth of Rio Ságalo but on opposite shore of Caquetá, 01°03′S, 71°34′W, 150–250 m, 22 May 1998, H. Tuomisto & al. 12391 (COAH, TUR 2 sheets). — **PERU:** Loreto: Mariscal Ramón Castilla, Río Clarines, 0°18′S, 72°00′W, 100–150 m, 23 May 1997, H. Tuomisto & al. 11264 (AMAZ, BM, SP, TUR 2 sheets, USM); idem, 03°18′S, 72°00′W, 100–150 m, 23 May 1997, H. Tuomisto & al. 11251 (AMAZ, TUR, USM); idem, 03°18′S, 72°01′W, 100–150 m, 23 May 1997, H. Tuomisto & al. 12624 (TUR 2 sheets); idem, 2 km S from village of Puerto Itamo, Rio Yaguasucu, 03°18′S, 72°00′W, 100–150 m, 21 Aug 1998, H. Tuomisto & al. 12684 (AMAZ, NY, TUR 2 sheets, UC, US, USM); idem, 1 km NE from village of Nueva Esperanza, 03°20′S, 71°59′W, 100–150 m, 23 Aug 1998, H. Tuomisto & al. 12717 (AMAZ, TUR 2 sheets, USM); idem, Río Ampiyacu, 3 km SW from village of Nueva Esperanza, 03°21′S, 72°00′W, 100–150 m, 24 Aug 1998, H. Tuomisto & al. 12722 (AMAZ, SP, TUR 2 sheets, USM); idem, Río Yavari-Mirín, Bosque primario, 04°29′S, 72°20′W, 100–200 m, 13 Apr 2002, G. Cárdenas & K. Salovaara 1374 (AMAZ, TUR); idem, Río Yavari-Mirín, bosque primario, 04°24′S, 72°15′W, 100–200 m, 21 Mar 2002, G. Cárdenas & K. Salovaara 1280 (AMAZ, TUR 2 sheets, USM); idem, Río Tigre, 2.5 km SW of village 28 de Julio W of river, 03°29′S, 74°49′W, 100–200 m, 5 Feb 2005, H. Tuomisto & al. 14942 (AMAZ, TUR); idem, Tierra firme 1 km E of river, 03°41′S, 74°33′W, 100–200 m, 8 Feb 2005, H. Tuomisto & al. 14966 (AMAZ, TUR 2 sheets, USM). Madre de Dios: Manu, Río Madre de Dios, S of river and 15 km W from mouth of Río Azul, 12°26′S, 70°43′W, 250–350 m, 30 Oct 1998, H. Tuomisto & al. 13558 (CUZ, TUR).

**Diagnostic features** — *Adiantum nodosum* is characterized by having rhizomes nodose (i.e. with stipes approximate, 1–1.5(–10) mm apart); lamina 2-pinnate, not reduced at costal nodes, venation free-veined, without evident midrib, as illustrated by having rhizomes nodose (i.e. with stipes approximate, 1–1.5 mm apart).

*Adiantum nodosum* resembles *Adiantum tetraphyllum*, but the latter differs in having thicker rhizomes (> 5 mm in diam.), sterile pinnules with acute apices that are curved toward the pinna apices, and rachises with filiform scales adaxially and lanceolate scales abaxially. Additionally, in *A. tetraphyllum* the terminal pinnule of each pinna is long-linear (vs. broadly rhombic), and the indusia are shortly oblong and pubescent (vs. lunate and glabrous).

*Adiantum nodosum* grows in similar swampy sites as *A. pseudocajennense*. The two resemble each other in general appearance in the field, being relatively large but delicate in structure. They differ in that the rhizome of *A. nodosum* is more compact and the pinnule margins less deeply crenate than those of *A. pseudocajennense*.

Cárdenas & al. (2007) referred to *Adiantum nodosum* as “*Adiantum* sp. 2”.

*Adiantum pseudocajennense* J. Prado, R. Y. Hirai & A. R. Sm., sp. nov. — Fig. 3.

Holotype: Ecuador, Napo, Yasuní National Park, km 32 of oil road, mature forest in the floodplain of Río Tiputini, a swamp dominated by *Mauritia* palms, 00°36′S, 76°27′W, 200–300 m, 14 Apr 1997, H. Tuomisto, S. Markkanen, K. Ruokolainen & R. Montufar 10591 (UC barcode UC1788278; isotypes: QCA 2 sheets, QCNE 2 sheets, SP, TUR 3 sheets).

**Morphological description** — Plants terrestrial. **Rhizomes** long-creeping, slender, 1–2 mm in diam., sparsely scaly, with stipes 2–3.3 cm apart, scales light brown, shiny, linear-lanceolate, base pectinate, margin entire. **Fronds** 23–66 cm long, maximally to 1.3 m; **stipe** black, 0.5–1 × as long as frond, adaxially sulcate, very sparsely scaly, scales appressed throughout, light brown, concolorous, filiform, c. 1 mm long, base with several processes, margin ciliate near base; also with arachnoid scales c. 0.5 mm long; **lamina** 2-pinnate, not reduced at base, 20–40 cm wide; **rachis** with indumentum similar to that of stipe, but more dense; **pinnae** elliptic, slightly narrowed at base, tapering at apex, 9–25 × 2.5–3 cm, indumentum of pinna rachis like that of main rachis; **lateral pinnae** in 1–7 pairs (5–7 pairs in fertile fronds, fewer than 5 in sterile fronds), alternate, oblique; **terminal pinna conform**, 1–1.2 × as long as subtending pinnae; **pinules** in 11–35 pairs, not articulate, oblique to pinna rachis, 2–3 × as long as wide, papyraceous, adaxial surface glabrous, abaxial surface very sparsely scaly, scales borne on veins at pinnule base, light brown, 0.5–1 mm long, base pectinate, apex filiform; pinules free-veined, without evident midrib, veins slightly prominent, with oblique idioblasts present between veins adaxially; proximal pairs of pinules reduced, somewhat deltate; medial pairs dimidiate, almost trapeziform, acroscopic base rectangular, sterile margins irregularly crenately lobed, sterile apices obtuse, straight or curved toward pinna apex, fertile apices angular; distal pinules c. ½ or
less length of medial pinnules; terminal pinnule on each pinna slightly pinnatifid, larger than distal ones. Sori mostly 1–3 per pinnule, oblong; indusia light brown, glabrous, margin entire; spores not seen.

Distribution and ecology — Endemic to Amazonian Ecuador (Fig. 1). Occurring in swamp forests dominated by Mauritia L. f. palms and in floodplain forests, usually on muddy sites, at 200–300 m.

Etymology — The specific epithet is based on the morphological similarity between the pinnules of this new species and those of Adiantum cajennense Willd. ex Klotzsch.
Additional specimens examined — Ecuador: Napo: Laguna de Yuturi, Bosque húmedo tropical, sendero hacia el moretal, 00°36'S, 76°01'W, 220 m, J. Jaramillo & E. Grijalva 11308 (QCA); idem, Yasuní National Park, 94.9 km along oil road, 00°54'S, 76°13'W, 200–300 m, 24 Feb 1998, H. Tuomisto & K. Ruokolainen 11476 (QCA 3 sheets, QCNE, SP, TUR 3 sheets); idem, Yasuní National Park, km 32 of oil road, mature forest in floodplain of Río Tiputini, 00°36'S, 76°27'W, 200–300 m, 13 Apr 1997, H. Tuomisto & al. 10589 (QCA, QCNE, SP, TUR); idem, Yasuní National Park, about 1.5 km E of bridge over Río Tiputini E of biological station, 00°40'S, 76°23'W, 200 m, 11 Apr 1996, R. C. Moran & al. 6089 (TUR 2 sheets); idem, Parque Nacional Yasuní, 3 km E of bridge over Río Tiputini E of research station, 00°45'S, 76°27'W, 200 m, 19 Apr 1996, R. C. Moran & al. 6239 (TUR).

Diagnostic features — Adiantum pseudocajennense is easily recognized by having rhizomes long-creeping, slender, 1–2 mm in diam., with fronds 2–3.3 cm apart; margins of sterile pinnules irregularly crenately lobed; pinnules almost glabrous abaxially; laminar scales concentrated near base of pinnules, petioles and rachises, with few sparse, filiform plus arachnoid scales; and indusia glabrous. Additionally, in its short-creeping and stout rhizomes (5–8 mm in diam.) pinnules in both species. However, A. cajennense is indicated by the sterile margins of the crenately lobed pinnules, petioles and rachises, which occurs widely in the Amazon Basin. The similarity that it often sparsely covers relatively large patches. Creeping rhizomes allow it to spread vegetatively such as "Adiantum sp. 2."

Tuomisto & al. (2002) referred to Adiantum pseudocajennense as ‘Adiantum sp. 2’.

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