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Adiantum alan-smithii (Pteridaceae), a New Maidenhair Fern from Chiapas, Mexico

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Abstract*—*Adiantum alan-smithii (Pteridaceae) is described from Chiapas, Mexico. It is similar to *A. raddianum*, and previously identified as such, however it can be distinguished by its yellow-farinose indusia, the proximal acroscopic pinnule of each pinna usually overlapping the main rachis, flabellate segments, and rachises that are weakly flexuose distally. In contrast, *A. raddianum* has non-farinose indusia, the proximal pinnule of each pinna does not overlap the main rachis, and segments are obovate to rhomboid. The new species is described, illustrated, and a key to species of the *A. raddianum* group in Mexico is provided. This contribution adds an additional endemic species of *Adiantum* to the flora of Mexico, and is part of our ongoing effort to improve the circumscription of *A. raddianum*, one of the most over-applied names in the Neotropical fern flora.

Keywords—Adiantoids, *Adiantum raddianum* group, endemic, Neotropical, taxonomy.

Mexico boasts one of the best studied fern and lycophyte floras in the world, with early accounts published by Martens and Galeotti (1842, 182 species), Liebmann (1849, 247 species), Fée (1857, 523 species), Fournier (1872, 542 species), and Conzatti (1939, 609 species). More modern accounts include Smith (1981, 609 species), Breedlove (1986, 675 species), Mickel and Beitel (1988, 690 species), and Mickel and Smith (2004, 1008 species), as well as numerous contemporary state and regional floras (further details in Mickel and Smith 2004, p. 2).

Chiapas has the highest fern and lycophyte diversity in Mexico and additional records are still being reported. Since the publications of Smith (1981) and Breedlove (1986) for the Flora of Chiapas, Riba et al. (1987) contributed 10 new records, and subsequent records have been provided by Riba and Pérez-Farrera (2000), Pérez-Farrera et al. (2003a, 2003b), Tejero-Díez et al. (2009), and Pérez-Farrera et al. (2012). Despite these previous investigations, additional diversity remains to be documented.

Adiantum L., commonly referred to as the maidenhair ferns, belongs to the Pteridaceae, a family with ca. 50 genera and 950 species (Smith et al. 2006, 2008). Phylogenetic analysis of chloroplast markers demonstrates that Pteridaceae comprise five monophyletic groups: adiantoids, ceratopteridoids, cheilanthoids, cryptogrammoids, and pteridoids (Schuettpelz et al. 2007). Adiantoids comprise *Adiantum* and their sister group, the vittarioid ferns (Prado et al. 2007; Schuettpelz et al. 2007). The sister relationship of these two groups is further supported by the shared morphological features of reddish young leaves (Sundue 2011) and silicified, epidermal, fiber-like cells, often referred to as venuloid idioblasts or silica bodies (Sundue 2009; Leroux et al. 2013).

Adiantum has a world-wide distribution, with ca. 200 species. Using characters such as lamina division, segment shape, indusial shape, and venation, Tryon and Tryon (1982) treated *Adiantum* in eight informal groups. With a focus on tropical America, they recognized the following groups and approximate number of American species, each named for their representative species: *A. capillus-veneris* L. (ca. 25 spp.), *A. patens* Willd. (ca. 10 spp.), *A. pectinatum* Kunze ex Baker (ca. 12 spp.), *A. philippense* L. (ca. 8 spp.), *A. phyllitidis* J. Sm. (ca. 10 spp.), *A. platyphyllum* Sw. (ca. 6 spp.), *A. tetraphyllum* Humb. & Bonpl. ex Willd. (ca. 20 spp.).

Huiet and Smith (2004) tested the monophyly of these groups using molecular analyses based on two chloroplast markers (*rps4* and *rps4-trnS* spacer), including over 40 species of *Adiantum.* They found that the *A. philippense, platyphyllum,* and *tetraphyllum* groups were monophyletic, while the *A. capillus-veneris*, *patens,* and *pectinatum* groups were polyphyletic. Two more recent studies by Lu et al. (2011, 2012), which focused on the *A. pedatum* L. complex and Chinese species, respectively, further corroborate the need to reconsider the higher-level classification of *Adiantum*; the current circumscription of infrageneric groups is no longer tenable.

In light of these phylogenetic studies and recent taxonomic contributions (Sundue and Prado 2005; Sundue et al. 2010), a new picture of *Adiantum* is beginning to emerge; characters diagnostic of large clades within the genus include branching pattern of the blades (pinnate or imparipinnate; with or without a conform terminal pinna), shape of the ultimate divisions (whether dimidiate or flabellate), venation (free or anastomosing), indument of blades and axes (hairs, scales, or neither), and whether the silicified, epidermal, fiber-like cells are visible or not. Earlier studies described these cells as being present or absent (Tryon and Tryon, 1982; Sundue and Prado, 2005). Sundue (2009) demonstrated that they are probably present in all *Adiantum*, but inconspicuous except in cases when they occur between veins, such as in the *A. tetraphyllum* group. Kao et al. (2008) and Sundue (2009) determined these cells were silicified using x-ray scanning electron microscopy (SEM) and wet-ashing, respectively, and referred to them as silica bodies; however, Leroux et al. (2013) demonstrated that the silica was confined to the cell wall and not the lumen, and so suggested the name 'silicified fiber-like cells', which we adopt here.

In contrast, characters useful for distinguishing among species include rhizome morphology, degree of division of blades, scale margins and color, whether veins end in leaf teeth or sinuses between teeth, whether or not ultimate segments are articulate, and the presence or absence of farinose (epicuticular flavonoid) deposits (Wollenweber 1978). Farinose deposits (or farina) are most frequently encountered in the cheilanthoids (Wollenweber 1978), but are also present in some *Pityrogramma* Link (Wollenweber and Dietz 1980) and *Onychium* Kaulf. (Wollenweber 1982) species. They also occur

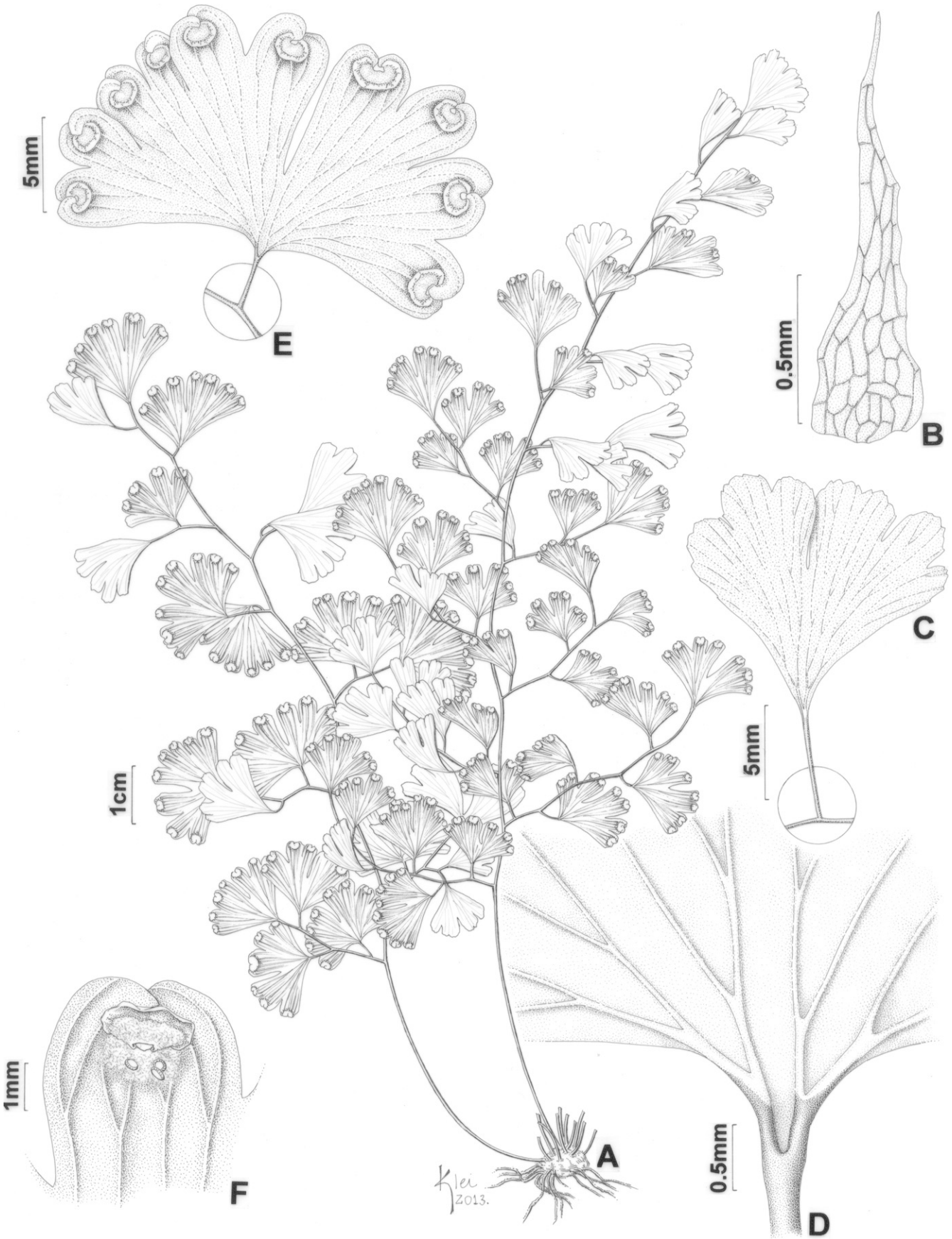

FIG. 1. *Adiantum alan-smithii*. A. Habit. B. Rhizome scale. C. Sterile pinnule. D. Detail of the segment base. E. Fertile pinnule, abaxial view with indusia. F. Detail of the indusium with fallen sporangia and yellow-farina (all from *Breedlove 27375*, MO).

sporadically in *Adiantum*, particularly the species affiliated with *A. poiretii* Wikstr. (Sundue et al. 2010).

Our recent research has been focused on the circumscription of *Adiantum raddianum* C. Presl, one of the most widespread species in the Neotropics whose range is known from central Mexico southward to Venezuela, Brazil, Argentina, and Uruguay, as well as the Greater and Lesser Antilles, and naturalized in the Old World. Our studies indicate this name has been applied too broadly, including overlooked and narrowly restricted taxa. Previously, we distinguished *A. rufopunctatum* Mett. ex Kuhn from *A. raddianum* in the central Andes using lamina architecture, segment size, and the presence of glandular indument (Sundue et al. 2010). Here we recognize a distinct Mexican taxon from *A. raddianum* sensu lato based on morphological and molecular analyses (Hirai et al. unpublished data), and describe it below.

Adiantum alan-smithii R. Y. Hirai, Sundue & J. Prado, sp. nov.—TYPE: MEXICO. Chiapas: Ocozocoautla de Espinosa, Río de la Venta at the Chorreadero near Derna, tropical deciduous forest [with] *Hauya*, *Ceiba*, *Tabebuia*, and *Capparis,* 800–1,000 m, 24 Aug 1972, *D. E. Breedlove 27375* (holotype: MO!; isotypes: DS, image!, MEXU!).

Diagnosis—This species differs from *Adiantum raddianum* by the presence of yellow-farinose indusia and the proximal, acroscopic pinnule of each pinna often overlapping the main rachis. It differs from *A. poiretii* by having orbicular to reniform indusia.

Plants terrestrial. Rhizomes ca. 5 mm diam, moderately slender, short-creeping to suberect, compact, dark brown, scaly, the scales 1.4 × 0.2 mm, lanceolate, castaneous, concolorous, shiny, basifixed, apices acuminate, margins entire. Fronds closely spaced (1–3 mm apart), arching; stipes 5–7.5 cm × 0.5–1.0 mm, 1/4–1/3 the frond length, castaneous to dark brown, lustrous, glabrous, with a few scales at the base similar in morphology to those of the rhizomes; rachis slightly flexuous, castaneous to dark brown, glabrous; laminae herbaceous, 12.5–16.0 × 6.2–10.2 cm, lanceolate to ovate-lanceolate, 2 or 3-pinnate proximally, 1 or 2-pinnate distally; pinnae 5–8 pairs, stalked, the stalks of the proximal pinna pair 2.5–4.0 mm long, apices gradually reduced, alternate; proximal acroscopic pinnule of each pinna often overlapping the main rachis; ultimate segments 0.9–2.2 × 0.7–1.6 cm, stalked, the stalk 2.5–3.5(–4.0) mm, non-articulate, with dark color passing into the pinnule bases, obovate to flabellate, cuneate to truncate at base, apices rounded, sometimes deeply incised, sterile margins lobed to slightly denticulate, abaxially and adaxially glabrous; veins free, forking, ending in the sinuses between marginal teeth; silicified fiber-like cells present, obscured by veins and inconspicuous; sori (2–)4–10 per pinnule, confined to the distal margins of the segments; indusia 1.0–2.0 mm wide, orbicular to reniform with deep sinuses, yellow-farinose, the farina deposited on the abaxial surface among the sporangia. Figure 1.

Diagnostic Characters—*Adiantum alan-smithii* is easily recognized when fertile by its yellow-farinose indusia. It is also distinct by having laminae with 5–8 pairs of pinnae, the proximal acroscopic pinnule of each pinna often overlapping the main rachis, the segments mostly broadly flabellate, the stalk non-articulate with its dark color passing into the pinnule bases, and the rachis ± flexuous toward the tip. By comparison, *A. raddianum* has non-farinose indusia and proximal acroscopic pinnules that do not overlap the main rachis. *Adiantum poiretii* also has yellow-farinose indusia, but has oblong to lunate sori and ciliate rhizome scales.

Etymology—The epithet honors Dr. Alan R. Smith (University of California, Berkeley Herbarium). A tireless worker, Alan has made extraordinary contributions to the systematics of ferns and lycophytes. His treatment of the pteridophytes for the Flora of Chiapas (Smith 1981) was highly influential as evident from our tattered and worn copies.

Distribution—*Adiantum alan-smithii* is apparently restricted to the central depression of Chiapas, Mexico, where it occurs on cliff faces and bluffs in tropical deciduous and seasonal evergreen forest; 800–1,350 m elevation.

Specimens Examined—MEXICO. Chiapas: San Fernan, localidad 2 km al NE del ejido La Pimienta, brecha del ejido La Pimienta a la cañada El Mojón del Diablo, 17°0′25.57″N, 93°14′13.92″W, 5 Oct 2009, *A. López C. 941* (MEXU, MO); Tuxtla Gutiérrez, at El Sumidero, 22 km north of Tuxtla Gutiérrez, 1,350 m, 1 Nov 1971, *D. E. Breedlove & A. R. Smith 21589* (DS, image!).

Discussion—Thirty-five species of *Adiantum* have been recognized in Mexico, including five endemics (*A. amblyopteridium* Mickel & Beitel, *A. galeottianum* Hook., *A. mcvaughii* Mickel & Beitel, *A. oaxacanum* Mickel & Beitel, and *A. shepherdii* Hook.) (Mickel and Smith 2004). Our new species, *A. alan-smithii*, brings the number of endemic Mexican species to six, and the total number of species known from Mexico to 36.

Adiantum alan-smithii was previously treated as *A. raddianum* by Smith (1981) and Mickel and Smith (2004), who applied the name broadly. With recognition of *A. alan-smithii*, we are aware of no remaining records of *A. raddianum* from Chiapas. This conclusion is based on the previous revision of Mexican collections by Smith (1981), Mickel and Smith (2004), our revision of material on loan from B, K, MEXU, MO, NY, P, S, UC, and US.

Given that *Adiantum raddianum* is adventive in other regions, Mickel and Smith (2004) suggested that it could be a non-native element in the flora of Mexico; there are few remaining records, and the earliest dates from 1966. We agree with their suspicion; the remaining records of *A. raddianum* in Mexico may in fact be recent introductions. However, in the case of *A. alan-smithii* we believe that the recent age of the collections is because Chiapas has been, and remains, an under-collected region.

Key to the Species of the *Adiantum raddianum* Group in Mexico

1. Laminae coriaceous, 1-pinnate or (rarely) 2-pinnate proximally 2
   2. Lamina with 5–10 pairs of pinnae; ultimate segments suborbicular, slightly overlapping the main rachises . . . . . *A. galeottianum*
   2. Lamina with 27–55 pairs of pinnae; ultimate segments dimidiate, strongly overlapping the main rachises . . . . . *A. shepherdii*
1. Laminae herbaceous, (2–)3–5-pinnate proximally or laminae subdichotomously divided 3
   3. Margin of the rhizome scales ciliate; laminae subdichotomously divided; rachises pubescent . . . . . *A. patens*
   3. Margins of the rhizome scales entire; laminae (2–)3–5-pinnate proximally; rachises glabrous 4
      4. Ultimate segments subsessile or short-stalked, stalks 0.5–2 mm long; stalk of the proximal pinnule of each pinna mostly 1 or 2-furcate . . . . . *A. concinnum*

4. Ultimate segments long-stalked, stalks 2–5 mm long; stalk of the proximal pinnule of each pinna not furcate 5
   5. Pinnules of the proximal pinnae pairs often overlapping the main rachis; indusia yellow-farinose; ultimate segments ovate to flabellate ..... *A. alan-smithii*
   5. Pinnules of the proximal pinnae pairs not overlapping the rachis; indusia non-farinose; ultimate segments obovate to rhomboid ..... *A. raddianum*

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