A new species of Hemionitis (Pteridaceae) from central Brazil

Authors: Regina Y. Hirai, Rafael Cruz, and Jefferson Prado
Source: Willdenowia, 48(3) : 371-380
Published By: Botanic Garden and Botanical Museum Berlin (BGBM)
URL: https://doi.org/10.3372/wi.48.48305
A new species of Hemionitis (Pteridaceae) from central Brazil

Abstract: Hemionitis umbrosa (Pteridaceae) is described from the state of Goiás in central Brazil. It resembles H. tomentosa and was previously identified as such; however, it can be distinguished by having rhizome scales serrulate and spores cristate-reticulate. In contrast, H. tomentosa has rhizome scales entire or rarely sparsely denticulate and spores cristate. The new species is morphologically and anatomically described, illustrated, and a key is provided to the species of Hemionitis with free veins.

Key words: Brazil, cheilanthoid ferns, endemic, Goiás, hemionitids, Hemionitis, Neotropical, new species, Pteridaceae, taxonomy

Introduction

Hemionitis L. belongs to the Pteridaceae, a huge family with c. 50 genera and 950 species (Smith & al. 2006). In the most recent classification for extant lycophytes and ferns (PPG I 2016), Hemionitis remains within the same family, with 53 genera and an estimated 1211 species, belongs to the subfamily Cheilanthoideae (with 23 genera and about 426 species) and contains five accepted species. Christenhusz & al. (2018) transferred all of the nearly 500 species of subfam. Cheilanthoideae into Hemionitis. This nomenclatural act greatly affects the circumscription of the genus and it is very controversial, as already discussed by Schuettpelz & al. (2018).


Recent molecular phylogenetic studies have recovered Hemionitis as monophyletic (e.g. Schuettpelz & al. 2007; Zhang & Ranker 2013). Also, these studies have excluded the single Asian species previously included in the genus (now treated the monotypic Parahemionitis Panigrahi). Thus, Hemionitis is now entirely neotropical.

Relationships in Hemionitis were studied by Schuettpelz & al. (2007), who included four species in their analysis: H. levyi, H. palmata, H. rufa and H. tomentosa.
(Lam.) Raddi. The first two species, both of which have areolate veins, form a clade, sister to the other two species, both of which have free veins. All four species are sister to *Parahemionitis arifolia* (Burn. f.) Panigrahi. The molecular works by Zhang & al. (2009) and Eisenhardt & al. (2011) obtained these same results.

The last species described in *Hemionitis* (sensu PPG I 2016) was described by Maxon (1913, *H. otonis* Maxon) based on material from Costa Rica. However, this species was synonymized in *H. levyi* by Mickel & Beitel (1988) and followed by Lellinger (1989), Ranker (1995) and Mickel & Smith (2004).

Graçano & al. (2001) carried out an anatomical study of several *Pteridaceae* species from the Parque Estadual do Rio Doce, state of Minas Gerais, Brazil, an area dominated by the Brazilian Atlantic forest vegetation, and among the studied species was *Hemionitis tomentosa*. For this species, details of the anatomy of the petiole and leaf were presented, as well as of the indumentum from all parts of the plant. These characters were important to distinguish *Hemionitis* from the other studied genera.

The main objective of the current paper is to describe morphologically and anatomically a new species of *Hemionitis* based on specimens collected in the state of Goiás in central Brazil. It is the first new species to be described in *Hemionitis* in nearly 105 years.

**Material and methods**

This study is based on analysis of specimens from the following herbaria: HUEFS, IPA, MBM, NY, RB, SP, SPF, UB, UC, UEC, UFG and UFP, as well as recent material collected in the field by two of the present authors (R.Y.H. and J.P.).

Anatomical studies — Herbarium samples were softened in a 1:1 solution of 70% ethanol and glycerine at 60°C for various times depending on their hardness (about one day for pinnae and two weeks for stipes). Samples were dehydrated in an ethanol/tert-butanol gradient and embedded in paraffin (Johansen 1940), sectioned with a rotary microtome and stained with Safranin and Astra Blue dyes (Bukatsch 1972). Additionally, the material was freehand sectioned and stained with the same dyes. Samples of three different pinnae and stipes, with apical, middle and basal portions, were analysed with transverse, longitudinal and paradermal sections.

**Results**

**Key to the species of *Hemionitis* in Brazil with free veins**

1. Pinnae stalks abaxially with dark colour gradually passing into bases of pinnae/pinnules ................. *H. rufa*

2. Rhizome scales serrulate; spores cristate-reticulate

   - Rhizome scales entire or rarely sparsely denticulate; spores cristate ............... *H. tomentosa*

   - Pinnae stalks abaxially with dark colour gradually passing into bases of pinnae/pinnules ................. 2

**Hemionitis umbrosa** R. Y. Hirai & J. Prado, sp. nov. — Fig. 1 – 3, 4E, F, 5, 6.


Morphological description — Rhizomes erect to suberect, scaly; scales 0.1 – 0.5 x 5 – 9 mm, light castaneous, concolorous, linear to linear-lanceolate, base truncate, margin serrulate, teeth formed by 1 or 2 cells, apex attenuate, non-glandular or glandular (like a long glandular hair). *Frods* (2.5 –) 8 – 20 x (9 –) 30 – 60 cm, monomorphic; *stipe* dark reddish brown, ½ – ⅔ length of lamina, scaly near base, scales similar to rhizome scales, densely pubescent throughout, hairs non-glandular or glandular, non-glandular hairs 2 – 7-celled (0.1 – 1.7 mm long), long glandular hairs stalked, 4 – 7-celled, short glandular hairs, 2-celled; *lamina* 1-pinnae or 2-pinnae at base, pinnatifid at apex, triangular or oblong, densely pubescent on both surfaces, hairs similar to those of *stipe*; *rachis* dark reddish brown, densely pubescent, hairs similar to those of *stipe*; *pinnael/pinnules* ovate to lanceolate, (1 –) 4 or 5 pairs, 1.2 – 5.5 x (2.2 –) 6 – 11.5 cm, proximal pinnae pair long stalked, (0.25 –) 0.7 – 1.5 cm long, abaxially with dark colour of stalk gradually passing into bases of pinnae/pinnules, margin entire or lobate to crenulate, apex acute or slightly rounded; *pinnules* (when present): basiscopic ones larger than acroscopic ones; venation free, veins furcate; *sori* along all veins; *spores* trilete, cristate-reticulate, c. 30 μm in diam.

Micromorphological and anatomical description — *Lamina*. Unistratified epidermis with elevated anomocytic stomata present only on abaxial surface (Fig. 5A, B). Anticlinal walls of both epidermis surfaces sinuous in frontal view (Fig 5A). Hairs present on both surfaces. Non-glandular hairs with 2 – 7 cells (Fig. 5C). Glandular hairs either long, with 4 – 6 cells forming stalk and with unicellular globular head (Fig. 5D), or short with basal cell and unicellular head (Fig. 5E). Mesophyll formed only by spongy parenchyma, but with 2 or 3 layers of cells more compacted on adaxial side than on abaxial side, formed by long arm cells with larger intercellular spaces (Fig. 5B, F). Central vein with amphilibrival elongated bundle, with 2 or 3 layers of pericycle encircled by endodermis containing Caspary’s strips (Fig. 5G). Tracheids of xylem with helical thickening (Fig. 5H). *Stipe*. Unistratified epidermis with non-glandular and glandular
hairs as in lamina (Fig. 6A), with layers of sclerenchyma beneath. Base containing scales with 1- or 2-cellular teeth (Fig. 6B, C), apex sometimes glandular, like a long glandular hair (Fig. 6D). Cortex mostly parenchymatic, with evident endodermis with densely stained content (Fig. 6A). Meristele 1, amphi cribal, with 1–6 layers of pericycle (Fig. 6E), V-shaped, formed by 2 large portions of xylem (separated by few parenchymatic cells at base of stipe and united at apex) with external ends curved inward (*Loxoma* R. Br. ex A. Cunn. type, sensu Ogura 1972) and smaller abaxial accessory bundle formed entirely by protoxylem (Fig. 6E). Tracheids varying from helical protoxylem elements to scalariform metaxylem elements (Fig. 6F).

Fig. 1. Habitat, habit and variation in lamina dissection of *Hemionitis umbrosa*. – A, B: savanna habitat; C: 1-pinnate fronds; D–F: 2-pinnate fronds.
Distribution and ecology — Central Brazil (Goiás). Among bryophytes (mostly mosses), rupicolous on limestone outcrops, in partially shaded places protected by the forest canopy, at altitudes of 580–800 m.

Etymology — The specific epithet refers to places where the new species grows: in the shade formed by the forest canopy.

Additional specimens examined — Brazil: Goiás: Caiapônia, GO-184, estrada de terra Caiapônia-Rio Verde, a 6 km do Rio Bonito, à direita, c. 400 m na
Fig. 3. *Hemionitis umbrosa* – A: habit; B: rhizome scale; C: detail of margin of scale; D: dark colour of pinna stalk; E: pinna adaxially; F: pinna abaxially; G: detail of hairs, left to right: short glandular, short non-glandular, stalked glandular and long non-glandular. – All drawn from *Hirai & Prado 803* (SP) by Klei Sousa.
estrada secundária à esquerda em direção ao afloramento rochoso, 17°04'37"S, 51°46'07"W, c. 740 m, 5 Mar 2018, R. Y. Hirai & J. Prado 801 (NY, RB, SP, UC, US); Mineiros, Pedra Aparada, 16°50'S, 52°40'W, 580–600 m, 5 Jul 1996, P. G. Windisch 8197 (SP); Serra dos Pirineus, 50 km N of Corumbá de Goiás on road to Niquelândia, valley of Rio Maranhão, c. 800 m, 24 Jan 1968, H. S. Irwin & al. 19133a (NY, UB, US), 19133a (NY, SP); Pirenópolis, 28 Jan 2005, H. D. Ferreira 4362 (UFG).

Fig. 4. Spores of Hemionitis tomentosa and H. umbrosa – A–D: H. tomentosa, cristate; E, F: H. umbrosa, cristate- reticulate. – A, C, D, E: distal view; B, F: proximal view. – A, B from Botucatu, São Paulo, Prado 2147 (SP); C, D from Cantareira, São Paulo, Tamanduré s.n. (SP 7159); E, F from Goiás, Brazil, Irwin 19133a (SP). – Scale bars: A–F = 10 µm.
Hemionitis umbrosa is characterized by having rhizome scales serrulate (Fig. 3C, D, 6B, C) and fronds with non-glandular and glandular hairs (Fig. 3H, 5C, D, E). The non-glandular hairs are 2–7-celled (Fig. 5C). The stalked glandular hairs can be long, 4–7-celled (Fig. 5D) and the short glandular hairs 2-celled (Fig. 5E), present on all parts, i.e. on the stipes, rachises, costae, veins and laminar tissue on both surfaces. Hemionitis umbrosa is also typical by its cristate-reticulate spores (Fig. 4E, F).

Fig. 5. Lamina anatomy of Hemionitis umbrosa – A: paradermal section of abaxial face of epidermis with sinuous anticlinal walls and anomocytic stomata; B: elevated stoma on abaxial surface (arrowhead); C: mostly non-glandular hairs and one stalked glandular hair on abaxial surface (arrowhead); D: two stalked glandular hairs on abaxial surface; E: short glandular hair with unicellular head (left), young sporangium (middle) and fragment of non-glandular hair (right) on abaxial surface; F: transverse section of mesophyll, central vein (arrowhead) and two vascular bundles in mesophyll with more compacted cells on adaxial side; G: detail of central vein with distinct endodermis with Caspary’s strip (arrowhead); H: paradermal section of bundle presenting tracheids with helical thickening. – All from Hirai & Prado 803 (SP). – Scale bars: A, B, E, G = 50 µm; C = 400 µm; D, F = 50 µm; H = 100 µm.
Previously, specimens of this new taxon were identified as the closely related *Hemionitis tomentosa*, which differs by having rhizome scales entire to rarely sparsely denticulate (Fig. 7A, B) and spores cristate (Fig. 4A–D). The cristate spores of *H. tomentosa* were also reported by Ranker (1989) in the specimen from Paraná, Brazil; Tryon & Lugardon (1990) in the specimen from Peru; and Lorscheitter & al. (2001) in the specimen from Rio Grande do Sul, Brazil.

The micromorphological characters of *Hemionitis umbrosa* are distinct from those pointed out for *H. tomentosa* by Graçano & al. (2001). According to those authors (l.c.), only one type of short glandular hairs (Fig. 7E; Graçano & al. 2001: fig. 29) occurs in *H. tomentosa* on the laminar tissue abaxially. However, our results show two kinds of glandular hairs in *H. umbrosa*: long stalked glandular hairs (4–7-celled, Fig. 5D) and short glandular hairs (2-celled, Fig. 5E), the latter similar to those in *H. tomentosa*. The other non-glandular hairs are similar in both species (*H. umbrosa*, Fig. 5C; *H. tomentosa*, Fig. 7C, D). In all other anatomical features *H. umbrosa* and *H. tomentosa* are similar and no evident differences were found.

Unlike *Hemionitis umbrosa*, which is so far known only from the state of Goiás, *H. tomentosa* has a very wide distribution in Brazil occurring also in Goiás and elsewhere in the tropical region, from Peru to Argentina.

**Acknowledgements**

We thank The New York Botanical Garden and Dr. Robbin Moran for providing all facilities during the visit of the first author to the NY herbarium. We also thank...
Dr. Heleno D. Ferreira and Dra. Vera Lúcia G. Klein of Universidade Federal de Goiás for their help during our visit to Goiânia and explanations how to find the locality of our new species; the other curators of HUEFS, IPA, MBM, RB, SPF, UB, UEC, UFG and UFP for attention during our visits; Dra. Luciana B. Benatti (Instituto de Botânica) for preparing the SEM images of the spores (Fig. 4); and Klei Sousa for drawing the plate (Fig. 3). This study was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Proc. n.150126/2017-4). We also thank Dr. George Yastkievych and two anonymous reviewers for their comments, which improved an earlier version of this article.

References


Linnaeus C. 1753: Species plantarum, exhibentes plantas rite cognitas, ad genera relatas, […]. – Holmiae: Laurentii Salvii.

Fig. 7. *Hemionitis tomentosa* – A: rhizome scale; B: sparsely denticulate margin of rhizome scale; C, D: non-glandular hairs on abaxial lamina surface; E: short glandular hairs on abaxial lamina surface. – All from Prado & Hirai 2485 (SP). – Scale bars: A = 800 µm; B–D = 200 µm; E = 50 µm.


Ogura Y. 1972: Comparative anatomy of vegetative organs of the pteridophytes. – Berlin: Borntraeger.


