



A new species of *Asplenium* section *Thamnopteris* (*Aspleniaceae*) from Indonesia

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Key words

bird-nest fern
Malesia
morphology
taxonomy

Abstract A new species, *Asplenium riswanii* (sect. *Thamnopteris*), is described from Central Java and West Papua, Indonesia. It is distinct from any known species by having thick and rigid fronds, abaxially keeled midribs, broadly lanceolate scales, and distantly spaced sori. Morphologically, *A. riswanii* is not similar to any species from Malesia but somewhat close to *A. antrophyoides* from mainland Southeast Asia. Molecular data reveal it has an isolated position in the phylogeny. The micromorphology of spores and leaf epidermis of *A. riswanii* is also documented and a key to the species of *Asplenium* sect. *Thamnopteris* from Malesia is given.

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INTRODUCTION

Asplenium sect. *Thamnopteris* C.Presl, commonly called bird-nest fern, is a morphologically distinct group with distribution in the tropics and subtropics of the Old World. The distinguishing features of this section are in fronds simple, entire, and set in a close spiral, and veins parallel, close, with their tips united and forming an intramarginal vein (Holttum 1974). Stressing the distinct morphology, some authors have preferred to accept this group as a separate genus *Neottopteris* J.Sm. (Smith 1841, Ching 1978, Wu 1999). In 1974 Holttum recognized 15 species and five infraspecific taxa within sect. *Thamnopteris* based on herbarium specimens, which is the most comprehensive summary so far available on the taxonomy of bird-nest ferns. Since Holttum's revision (1974) an additional eight taxa of *Asplenium* sect. *Thamnopteris* have been described from various regions, i.e., *N. longistipitata* R.H.Miao (1980) from southern China, *A. harmanii* D.L.Jones (1988) from northern Australia (Queensland), *N. antrophyoides* var. *crinata* Ching & S.H.Wu, *N. latipes* Ching ex S.H.Wu, *N. longistipes* Ching ex S.H.Wu and *N. subantiqua* Ching ex S.H.Wu from southwestern China (Wu 1989), *A. goudeyi* D.L.Jones (1996) from Australia (Lord Howe Island), and *A. setoi* N.Murak. & Seriz. (Murakami et al. 1999b) from Japan (Ryukyu). Recently, molecular data suggest that *Thamnopteris* is probably not monophyletic (Murakami 1995, Murakami et al. 1999a, Perrie & Brownsey 2005). Yatabe and his colleagues treated the whole section of *Thamnopteris* as a complex containing multiple cryptic species (Yatabe et al. 2001, 2002, 2009, Yatabe & Murakami 2003), but this places too much emphasis on molecular evidence and shows little attention to morphological variation, because most species within this section can be clearly recognized by morphological characters such as frond shape, midrib, stipe scale, sorus, and spore ornamentation.

When attempting to update the taxonomy of *Asplenium* sect. *Thamnopteris*, we found a cultivated plant with peculiar morphology in Bogor Botanical Garden, West Java, which was readily recognized as belonging to *Thamnopteris* but could not be identified as one of the known species. An earlier collection from Nusakambangan, Central Java was subsequently found with similar morphological features to the living plant in Bogor. Further observations on the morphology of spores and leaf epidermis confirmed that the two plants were conspecific and they represented a new species. The new species is now described as *A. riswanii* S.Y.Dong.

MATERIAL AND METHODS

Only two specimens of the new species are hitherto known. The leaf epidermis of the two specimens, as well as some related species, was anatomically examined using the method described in Wang & Lu (2010). The spore samples of both specimens and related species were observed in a scanning electron microscope (SEM) following the method in Dong & Zhang (2005). The measurements of spore size or stoma size are the average of 20 spores or 20 stomata, respectively. The recognition of seven species in Malesia and the diagnostic characteristics used in the key are based on the morphological examination of c. 2 500 specimens in the following herbaria: BM, BO, GAUA, IBK, IBSC, K, KUN, KYO, L, P, PE, PNH, PYU, SING.

For the extraction and amplification of DNA and the subsequent analysis, we refer to Wei et al. (in prep.).

DESCRIPTION

Asplenium riswanii S.Y. Dong, *sp. nov.* — Fig. 1, 2a, b, d, e; Map 1

Species affinis *A. antrophyoidi* H.Christ, sed lamina rigide coriacea anguste lanceolata versus basin gradatim angustata et soris remotis differt. — Typus: *H.F. Sun 7759* (holo IBSC), Indonesia, Central Java, Nusakambangan, on sloping walls, 20 m, 4 Apr. 1962.

Living fronds forming a bird-nest appearance, straight (not curving adaxially) at base. *Rhizomes* short and erect, covered

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Fig. 1 Holotype of *Asplenium riswanii* S.Y.Dong (H.F. Sun 7759, IBSC).

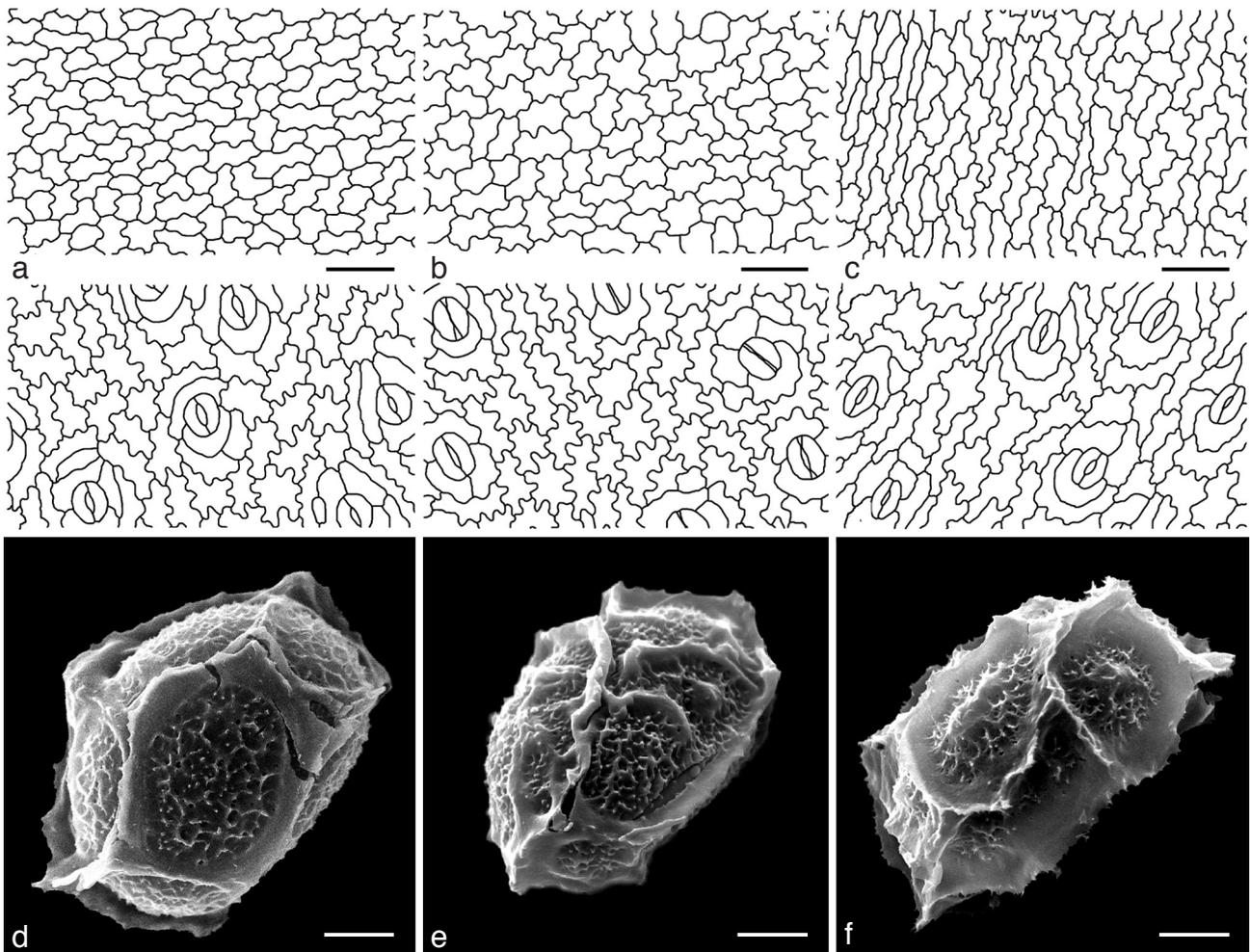


Fig. 2 Leaf epidermis and spores. a–c. Cell pattern of leaf epidermis (upper halves is adaxial surface); d–f. scanning electron microscope photographs. — a, b, d, e: *Asplenium riswanii* S.Y.Dong; c, f: *A. antrophyoides* H.Christ (a, d: S.Y. Dong 3373; b, e: H.F. Sun 7759; c: Chen 10973; f: Sino-Japan Exped. 104; all IBSC). — Scale bars: a–c = 100 µm; d–f = 10 µm.

with numerous scales; rhizome scales as well as those on basal stipes broadly lanceolate, c. 10 by 2–3 mm, dark brown, entire or with a few hair-like projections at margin and at apex. *Fronde*s: lamina lanceolate, 55–70 cm long, to 5.5–7 cm wide, widest at the middle or a bit above the middle of the lamina, hardly narrowed upwards and acute at apex, gradually tapering toward base; wingless stipes very short, less than 5 mm; midribs convex adaxially and distinctly keeled on abaxial surface, deltoid in cross-section; lamina texture rigidly coriaceous. *Sori*: on upper 1/3 of fronds, extending from near midrib and covering 2/3 or more the length of the veins, distantly spaced, 4–5 sori every 2 cm distance along midribs. *Spores* 44.9–48.5 by 31.4–36.8 µm, with lophate perispores and alate folds. *Leaf epidermis* hairless on both surfaces, cells irregular in shape,

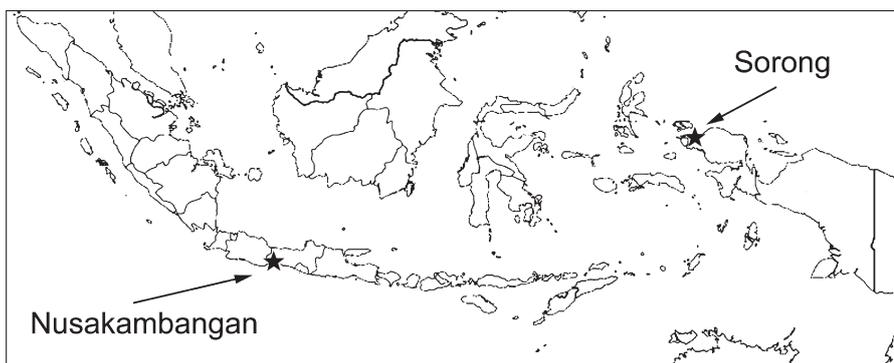
hypostomatic, with anisocytic, diacytic, or tetracytic stomata, stomata 65–66 by 52–54 µm in average.

Distribution — Indonesia: Nusakambangan, Central Java; Sorong, West Papua.

Habitat & Ecology — On rocks in rain forest; altitude 20–40 m above sea level.

Etymology — The epithet honours Soedarsono Riswan, Professor from the Indonesian Institute of Science who helped the first author accomplishing his first visit to West Java.

Note — For this new species only two specimens are currently known: One is H.F. Sun 7759 (IBSC) collected from Nusakambangan, Central Java in 1962 and the other is S.Y. Dong 3373 (IBSC) newly collected from a living plant in Bogor Botanical Garden which was transferred there from Sorong,



Map 1 Distribution of *Asplenium riswanii* S.Y.Dong.

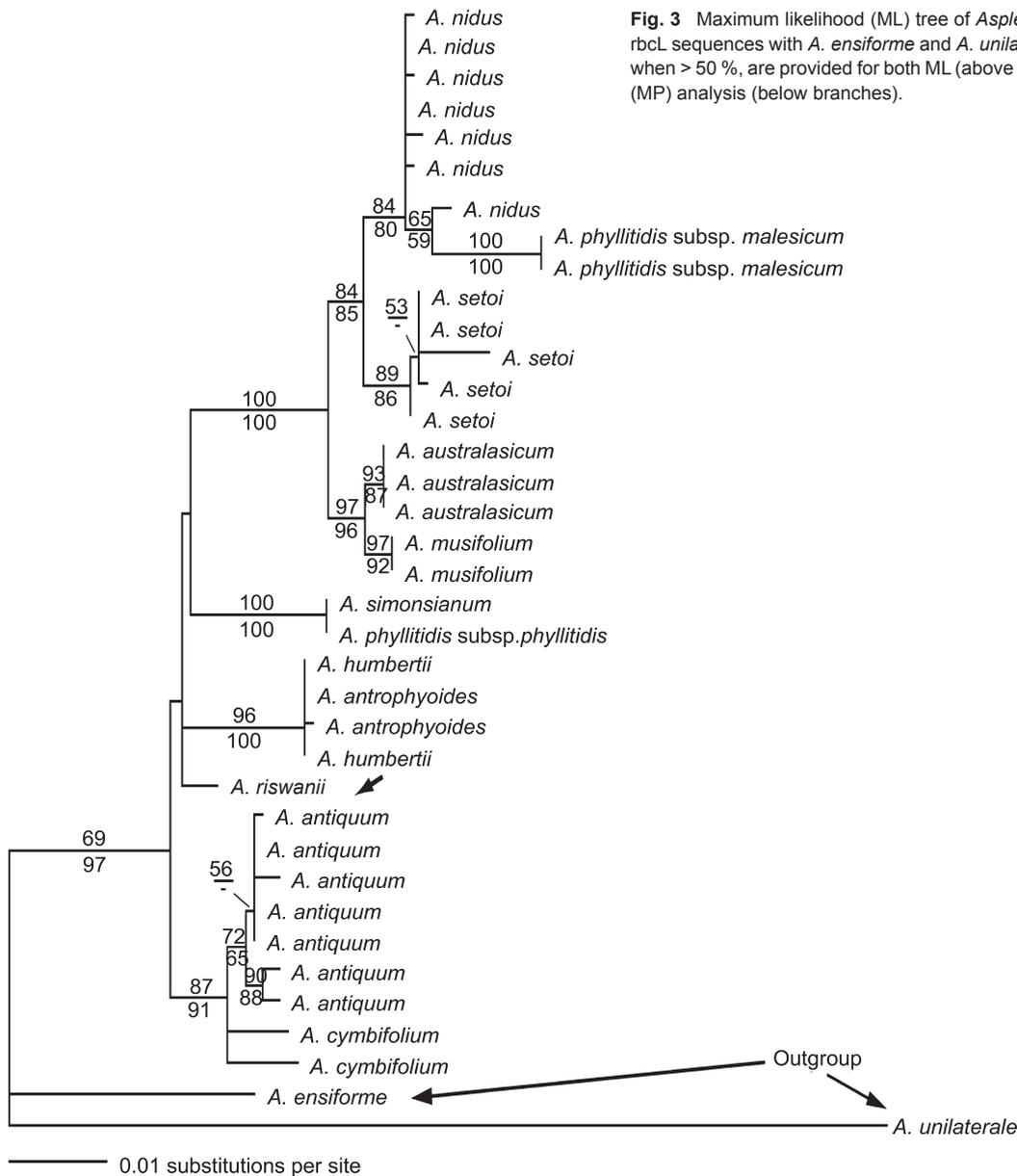


Fig. 3 Maximum likelihood (ML) tree of *Asplenium* sect. *Thamnopteris* based on *rbcL* sequences with *A. ensiforme* and *A. unilaterale* as outgroups. Support values, when > 50 %, are provided for both ML (above branches) and maximum parsimony (MP) analysis (below branches).

West Papua in 2007. The two specimens are in agreement with each other in many key characters of macromorphology: broadly lanceolate scales; the size, shape, and particular thick texture of fronds; abaxially keeled midribs; and the distribution, length, and the distantly spaced sori. Likewise they are similar in the micromorphology of leaf epidermis and spores: the shape and size of epidermal cells on either surface, the pattern and size of stomata, the lophate perispores, and the alate folds and echinulate ornamentation on perispores (Fig. 2). Clearly the two specimens represent a single species.

Being characterized by broad scales, keeled midribs, distantly spaced sori, and extraordinary thick texture of fronds, *A. riswanii* is not morphologically similar to any known sympatric species but somewhat similar to *A. antrophyoides* H.Christ from mainland Southeast Asia (southwestern China, northern Vietnam, and northern Thailand). The two species are similar in frond size and features of stipe scales and midribs, but *A. riswanii* differs from *A. antrophyoides* in fronds being much thicker and more rigid in texture, gradually tapering toward the base from the middle (vs more or less abruptly narrowed at upper part of fronds in *A. antrophyoides*), and much more distantly spaced sori (4–5 vs 7–12 sori every 2 cm along midribs). In micromorphology of both leaf epidermis and spore ornamentation, there are also some differences between *A. riswanii* and *A. antrophyoides*. The ornamentation of the perispore, which

was recently demonstrated to be taxonomically significant between species in *Asplenium* sect. *Thamnopteris* (Wei & Dong 2012), shows lower folds in *A. riswanii* (c. 2 μm) than in *A. antrophyoides* (c. 5 μm). The stomata of *A. riswanii* are of the anisocytic, diacytic, or tetracytic type, and the outline of the stomata is nearly circular (with the length/width ratio being 1.2–1.3); while the stomata in *A. antrophyoides* are usually of the diacytic or polocyctic type and are elliptic in shape (length/width ratio 1.5–1.7) (Fig. 2).

Besides the morphological comparison, we also conducted phylogenetic analyses of *A. riswanii* and other species of the section *Thamnopteris* based on two datasets of plastid sequences (separate *rbcL* and a combination of *psbA-trnL*, *rbcL*, and *trnL-F*). The plastid sequences, either the *rbcL* or the combination of the three, indicate that *A. riswanii* is not clearly close to any known species. In a phylogenetic tree based on *rbcL* sequences of 37 accessions (including one each of two outgroups) (Fig. 3), *A. riswanii* is resolved as clearly separate from a number of well-supported clades. A comprehensive discussion of the phylogeny of this group will be presented in a separate paper (Wei et al, in prep.).

Paratype. S.Y. Dong 3373 (IBSC), Indonesia, West Java, Bogor Botanical Garden (in culture, originating from Sorong, West Papua), 280 m, 27 Oct. 2009.

KEY TO SPECIES OF ASPLENIUM SECT. THAMNOPTERIS IN MALESIA

1. Stipe scales narrowly lanceolate, length/width ratio more than 10 2
1. Stipe scales ovate or broadly lanceolate, length/width ratio usually 2–5 6
2. Fronds approximate on rhizomes, not nest-forming *A. spirale* Holttum
2. Fronds clustered near apex of rhizomes, nest-forming 3
3. Fronds linear, 3–4 cm wide; midribs sharply keeled abaxially *A. columbrinum* H.Christ
3. Fronds lanceolate, usually 7–30 cm wide; midribs bluntly keeled to flat abaxially 4
4. Sori spaced, 7–9 sori on every 2 cm distance along midrib; perispores echinate *A. phyllitidis* subsp. *malesicum* Holttum
4. Sori dense, 12–18 sori on every 2 cm distance along midrib; perispores lophate 5
5. Fronds less than 20 cm wide, gradually attenuate from middle toward both apex and base; midribs distinctly prominent on adaxial surface *A. nidus* L.
5. Fronds 25–30(–40) cm wide, broadly rounded at apex, abruptly narrowed at base; midribs distinctly prominent on abaxial surface *A. musifolium* Mett.
6. Fronds 20–50 by 4–5 cm, spatulate with a long stipe; midribs sharply keeled abaxially *A. grevillei* Wall. ex Hook. & Grev.
6. Fronds 55–120 by 6.7–25 cm, narrowly lanceolate without distinct stipe; midribs keeled or rounded abaxially 7
7. Midrib rounded abaxially; fronds dilated at base *A. cymbifolium* H.Christ
7. Midrib keeled abaxially; fronds gradually tapering toward base *A. riswanii* S.Y.Dong

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