

CYRTOMIUM PRESL (DRYOPTERIDACEAE) - A NEW SPECIES FROM CHINA

XIAOJUAN LI AND JIANXIU LI^{1*}

Shandong Xiandai University, Jinan-250104, China

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Abstract

Cyrtomium semifertile J. X. Li & X. J. Li, sp. nov., a new species of *Cyrtomium* Presl from Shandong, China, is described and illustrated. It is closer to *C. fortunei* J. Smith for its morphological and palynological characters of LM and SEM studies but differs by a number of characters, such as, sterile lateral pinnae 3-4 pairs on the lower surface of the leaves, three rows of sori arranged neatly on each side of the primary vein on the back of the middle and above pinnae; shallow-dish shape of indusia, with denticle margin; spore perispore with tuberculiform-rugulate protrusion, and scaly ornamentations of its surface. The *sp. nov.* is described, comparative LM and SEM characters of spores, indusia, leaf margins and pinnae with that of *C. fortunei* J. Smith are provided with photographs.

Introduction

The genus *Cyrtomium* Presl, belonging to the fern family Dryopteridaceae, subfamily Dryopteridoideae, is represented by 35 species in Asia, Africa (including Madagascar) and the Pacific Ocean islands of Hawaii (PPG I 2016). It was reported to be represented by 40 species by Kung (2001) in the Flora Reipublicae Popularis Sinicae and 31 species in the flora of China by Zhang and Barrington (2013), mainly distributed in eastern Asia, with southwestern China as the center. Previous studies on the classification, anatomy and spore morphology of *Cyrtomium* Presl by Christensen (1930), Ching (1936), Shing (1965), Li *et al.* (1984, 2012), Zhou *et al.* (1999), Lu *et al.* (2007), Li *et al.* (2017, 2018, 2019, 2019) provided sufficient important background that warrants the recognition of this new species of the genus. During the present study the origin of the new species for resource investigation and collection of specimens in October, 2015 and August, 2020 were investigated where sufficient important background for recognition of this new species of the genus was collected.

Materials and Methods

The voucher specimens of the new species were collected from Dawenkou, China and deposited in PE (Herbaria acronyms following Thiers (2016).

Scanning Electron Microscopy (SEM) was used to study the micromorphology of spores, indusia and leaf margins. Samples were dehydrated and then placed on aluminium stubs using double-sided adhesive tape and sputter coated with gold in a Hitachi E-1010 Ion Sputter Coater, following Wen and Nowicke (1999). The materials were subsequently examined and photographed under a SUPRATM55 SEM.

***Cyrtomium semifertile* J. X. Li & X. J. Li, sp. nov.**

Plants 45 - 50 cm tall. Rhizome erect, densely scaly; scales brown, broadly ovate, scales with light brown narrow edges and fimbriate finely hairs at margin. Fronds caespitose, stipes 12 cm, base 2 - 3 mm wide, stramineous, ventral narrowly grooved, with light brown lanceolate scales,

*Author for correspondence: <jianxiu_li@163.com>. ¹Shandong University of Traditional Chinese Medicine, Jinan 250014, China.

fimbriate-tooth at margin, upward scales sparse; lamina narrow-lanceolate, 30 - 35 × 12 cm, acuminate at apex, slightly narrow at base, 1-pinnate; lateral pinnae 10 - 13 pairs, base 1 - 2 pairs, opposite, upwards alternate, obliquely ascendant, with short stalk, approximate 2 mm, slightly sickle-shaped, ovate-lanceolate, middle pinnae 6 - 7 × 1.5 - 2 cm, apices gradually acuminate, base asymmetric, slightly oblique, upside obtuse triangular auriculate, downside broadly cuneate, margin with sharp serrate, spreading forward; veins reticulate, veinlet joined into 3 rows areoles, each areole with 1 - 2 free included veinlets, obscure adaxially, slightly convex abaxially; upper pinnule rhombic, 5 - 5.5 cm long, 3 cm wide, basal 2 - 3 lobed, segment 1 - 1.5 × 0.7 cm. Lamina hard herbaceous, adaxially yellow-green, abaxially yellow-brown, pinnule smooth on both sides, only clothed with scales adaxially base and pinnule short handle. Sterile lateral pinnae 3 - 4 pairs on the lower part of the leaves, with three rows of sori arranged neatly on each side of the primary



Fig. 1. A branch of *Cyrtomium semifertile* J. X. Li & X. J. Li, sp. nov. (Holotype).

vein on the back of the middle and above pinnae; indusia shallow-dish shape, margin with denticle. Spores reniform, spore perispore with tuberculiform-rugulate protrusion, and its surface is decorated with scaly ornamentations. This species is known only from the area around the type locality in Dawenkou, Shandong. Usually it grows in limestone crevices of wet areas.

Type specimen: China, Shandong Province, Taian City, Dawenkou, limestone rocks, 300 m a. s. l., 27. 08. 2012, J. X. Li 816 (Holotype: PE, Isotype: SDCM). Fig. 1.

Results and Discussion

Spores are the core part of fern's reproductive organs, the main place where genetic material exists and the expression form of very stable character morphology. The spore morphology of ferns is of great significance in classification and phylogenetic studies, the types of spore perispore ornamentation varies greatly among different groups and can be used as an important feature to identify different groups (Lu *et al.* 2007). The spore perispore of *C. semifertile* is tuberculiform-rugulate protrusion, and its surface is decorated with scaly ornamentations (Fig. 3A-D), which was clearly different from the auricular protrusion of the spore perispore of *C. fortunei* (Fig. 3E-H). Therefore, the spore perispore protrusion feature was one of the main bases for establishing a new taxa of *C. semifertile*.

The consensus of the fern scholars is that the feature of the indusia edge is one of the important features of the interspecies classification of *Cyrtomium*. The sub-microstructural characteristics under the SEM showed that the indusia edge of *C. semifertile* was tooth-shaped, there was no regularity in the arrangement direction of the cells that make up the indusia (Fig. 2E), this was obviously different from the entire of indusia edge of the *C. fortunei*, the cells forming the indusia were regularly arranged in a radial pattern to the surroundings (Fig. 2G). This stable feature, which has not been reported by predecessors, is the first recorded of the author, and is an important and innovative feature for identifying *C. semifertile*.

The *C. semifertile* had sterile lateral pinnae 3 - 4 pairs on the lower part of the leaves (Fig. 1), this feature is not only distinctly different from *C. fortunei*, but also a very significant important feature in this genus.

Therefore, *Cyrtomium semifertile* is an independent new taxa.

Table 1. Comparison of pinnae, leaf margins, indusia and spore morphology in two closer species of *Cyrtomium*.

Organ	<i>Cyrtomium semifertile</i>	<i>C. semifertile</i> Fig.	<i>Cyrtomium fortunei</i>	<i>C. fortunei</i> Fig.
Pinnae	With sterile pinnae 3 - 4 pairs on the lower part of the leaves; with developmental pinnae on the middle and above of the leaves	Fig. 2A	With fertile pinnae	
Upper pinnule	Rhombic, basal 2 - 3 lobed	Fig. 2B	Narrowly ovate, basal 1 - 2 shallow lobed	
Sori distribution	With three rows of sori on each side of the primary vein of the fertile pinnae	Fig. 2C	Densely with sori on abaxially pinnae	
Leaves margin	Margin with sharp serrate, spreading forward	Fig. 2D	Entire margin or small tooth	Fig. 2F
Indusia	Tooth crack at margin	Fig. 2E	Entire margin	Fig. 2G
Spore perispore ornamentation	Tuberculiform-rugulate	Fig. 3A-D	Auriculate	Fig. 3E-H
Voucher	J. X. Li 816		J. X. Li 86-12	

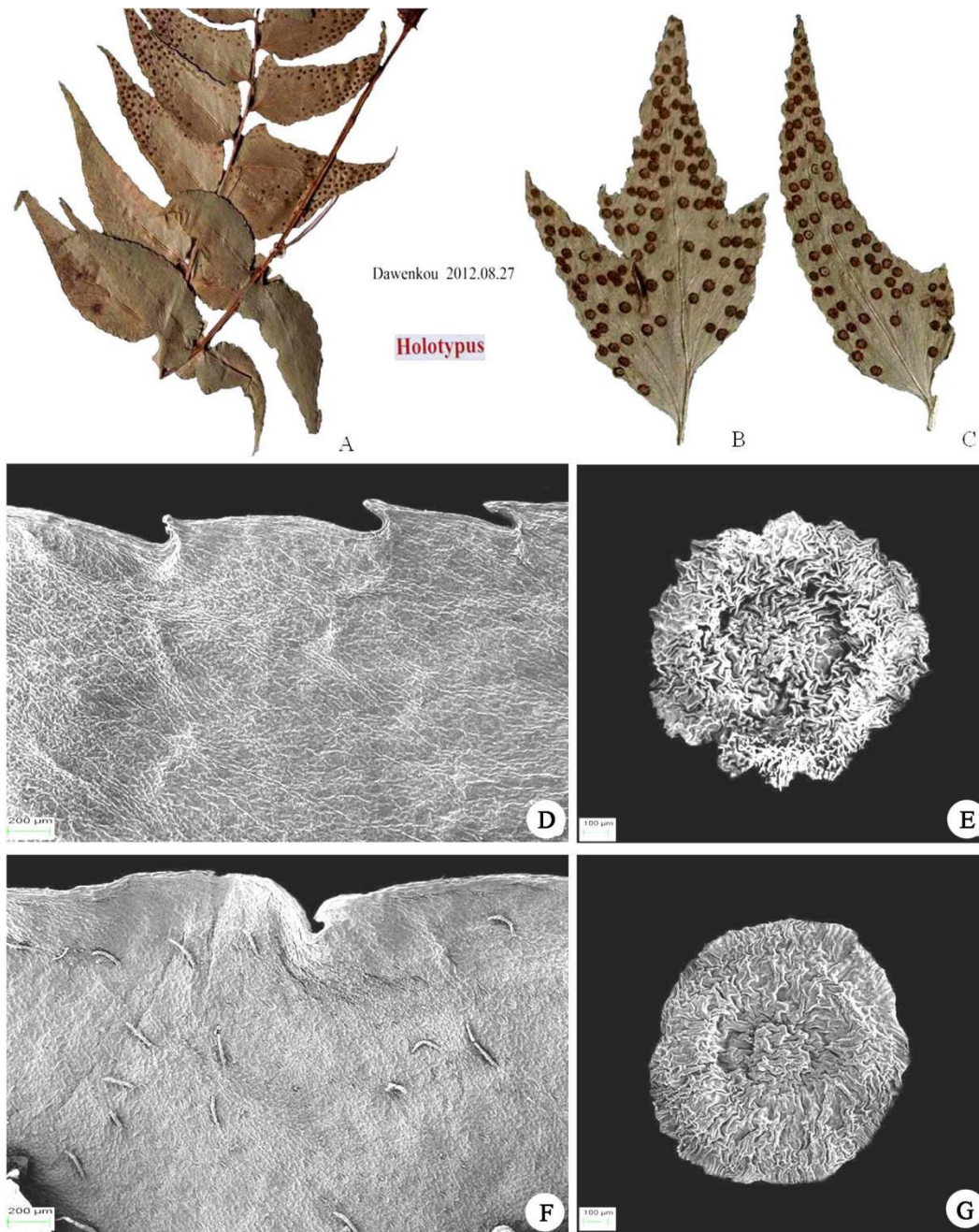


Fig. 2. The pinnae, leaves margin and indusia of *C. semifertile* sp. nov. and *C. fortunei* J. Smith (SEM). A. Lower leaves of *C. semifertile*, B. Upper pinnule of *C. semifertile*, C. Lateral pinnule of *C. semifertile*, D. Leaves margin of *C. semifertile* (35 \times), E. Indusia of *C. semifertile* (60 \times), F. Leaves margin of *C. fortunei* (35 \times) and G. Indusia of *C. fortunei* (60 \times).

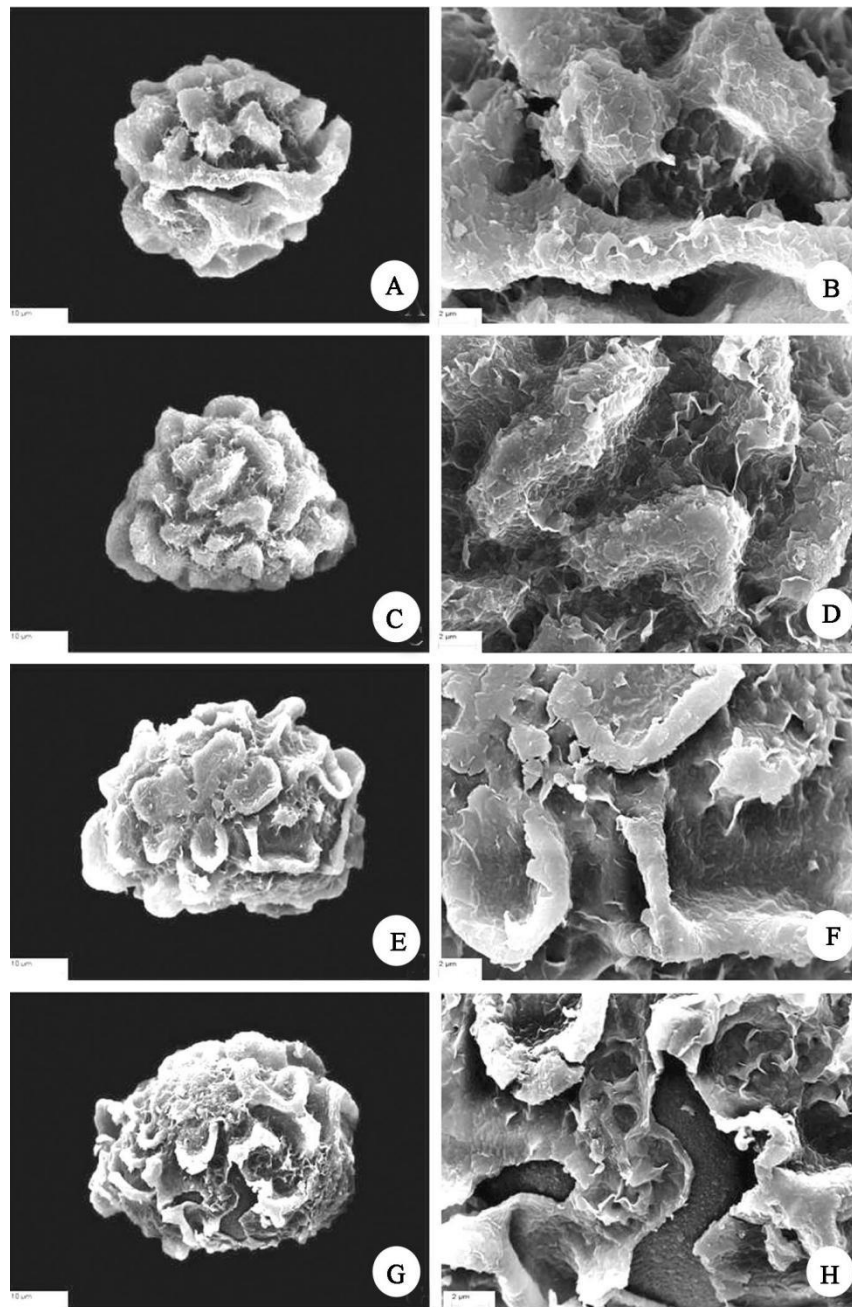


Fig. 3. Spore morphologies of two *Cyrtomium* species (SEM). A. Spore in polar view of *C. semifertile* (1500x), B. Detail of spore in polar view of *C. semifertile* (5000x), C. Spore in equatorial view of *C. semifertile* (1500x), D. Detail of spore in equatorial view of *C. semifertile* (5000x), E. Spore in polar view of *C. fortunei* (1500x), F. Detail of spore in polar view of *C. fortunei* (5000x), G. Spore in equatorial view of *C. fortunei* (1500x) and H. Detail of spore in equatorial view of *C. fortunei* (5000x).

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