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A NEW FERN SPECIES *HYPODEMATIUM SHANDONGENSE* SP. NOV. (HYPODEMATIACEAE) FROM CHINA

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Abstract

Hypodematium shandongense is closely related to *Hypodematium jianxiuii* X. J. Li. Results of LM and SEM studies showed that there were significant differences between the two species. Plant height of *Hypodematium shandongense* is 22-30 cm, laminae ovate-triangular, pinnae are closely arranged, fronds, rachis, costae and the indusia are characterized by sparsely long acicular and rod-shaped glandular hairs, perispore semi-annular folds; but the plant height of *H. jianxiuii* is 60-70 cm, laminae ovate-pentagonal, pinnae are sparsely arranged, fronds sparsely covered with short acicular hair adaxially, abaxial fronds**,** rachis, costae and the indusia are densely covered with pubescence and glandular hairs, and perispore tuberculate protrusion.

Introduction

Hypodematiaceae is a single genus established by Qin Renchang in 1974 with *Hypodematium* as the stem genus. There are 12 species so far recorded and their distribution center is considered to be in China (Ching 1975). *Hypodematium* is characterized by a swollen stipe base densely covered with reddish brown scales, leaves ovate or ovate-pentagonal, with 3-4 pinnate or 5 pinnatifid, glandular hairs or non-glandular hairs, or a mixture of both types of hairs and grows on limestone habitat. Before 1980s, these morphological characteristics were used as the basis for population identification and classification in genus. A team led by (1988) Li systematically observed the spores of 15 species of *Hypodematium* using scanning electron microscopy and published relevant papers, the taxonomic significance of spore morphology and perispore ornamentation of 15 species of *Hypodematium* was reported, subsequently. This combination of classical classification and palynology created a new discipline in Pteridology. So far, more than 26 species of *Hypodematium* have been identified, including 4 species from China and Japan (Tsai and Shieh 1994, Zhang and Iwatsuki 2013, Li *et al.* 2022a, b). Scholars who studied on palynology, systematics and biogeography of the genus are Ching (1935, 1940, 1963, 1978), Shing *et al*. (1999), Zhou *et al*. (1999), Wang *et al*. (2010), Li *et al*. (2018), Fan *et al.* (2020, 2021), they laid the foundation for the establishment of new species.

Materials and Methods

The specimen of the new species (type specimen, PE), *Hypodematium shandongense*, was collected from the Martyrs' Cemetery in Yinan County, Linyi City. Dehydrated specimen were conventionally pressed, fronds and spores were taken from the type specimen. The fronds sizes were 4 × 4 mm, respectively, spores were taken from the sorus of the type specimen. The materials

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were observed under a light microscope (Table 1). Selected fronds and spores that are representative of the uncontaminated species, after spraying gold particles for 2.5 min, materials were placed under SUPRATM55 scanning electron microscope (SEM) to observe the Polynomorphs. Spores were selected from the polar view and equatorial view, magnification by 5,000 and 10,000 times. The experimental methods were carried out following Wen and Nowicke (1999).

Table 1. Information gathering.

Species	Locality	Gather time	Specimen information	Specimen deposited (Herbarium)
H. shandongense	Yinan County (Martyrs Cemetery)	2021.10.06	J. X. Li-105-8 (typus)	PE
H. jianxiuii	Linyi (Weizhuang)	2021.10.05	J. X. Li-20211005-050828-1 (typus)	PE

Hypodematium shandongense J. X. Li & X. J. Li, sp. nov.

The newly identified of *Hypodematium shandongense* is found closer to *H. jianxiuii* X. J. Li, from which it differs greatly by its plants: 22-30 cm, laminae ovate-triangular, pinnae are closely arranged, fronds, rachis, costae and the indusia are characterized by sparsely long acicular and rod-shaped glandular hairs, perispore semi-annular folds.

China, Yinan County, Linyi City, 35°29′28.22″N, 118°11′45.43″E, 6 October 2021, J. X. Li & X. J. Li-105-8 (Holotype: PE) (Fig. 1).

Plants 22-30 cm tall. Rhizomes creeping; stipe base with scales 8–12 × 2–3 mm, margin sparsely serrated, apex acuminate. Fronds approximate; stipe stramineous, 13–15 cm × 1 mm, base covered with long acicular hair, nearly glabrous upward; laminae ovate-triangular, 10–16 × 12–21 cm, 4-pinnate-pinnatifid, base broad-cordate, apex acuminate and pinnatifid; pinnae 7–8 pairs, slightly oblique, lower 1 pairs sub-opposite, 3–3.5 cm apart, upper pairs alternate; basal pinnae largest, ovate–triangular, 6–11 × 5–7 cm, 3–pinnate pinnatifid, base cordate, pinnae tapered; pinnules 7–8 pairs, connected to each other, proximal basiscopic pair largest, long lanceolate, 4.0 – 5.5 × 1.5 – 2.0 cm, base cuneate, pinnae tapered; secondary pinnules 7–8 pairs, connected to each other, oblong, basiscopic 4-5 pairs subequal, 10–12 × 4–5 mm; lobe 3–4 pairs, ovate, apex obtuse, 4–5 denticle, margins entire. Herbaceous fronds, yellowish green when dry, fronds, rachis and costae sparsely covered with long acicular and glandular hairs. Sori orbicular; indusia reniform, the indusia are sparsely covered with long acicular hair and a few glandular hairs. Spores oval, semi-annular folds, and surface rough (Fig. 1).

Results and Discussions

A plant of the *Hypodematium* originally belonging to the Thelypteridaceae. The base of the stipe of *Hypodematium* is enlarged into a spindle shape and densely puffy reddish brown scales. This morphological feature is different from that of Thelypteridaceae (stipe base not swollen and scales not reddish brown). On the basis of morphological characteristics, Qin Renchang (Ching 1974) established Hypodematiaceae, separate from Thelypteridaceae, which has been highly recognized at home and abroad. Hypodematiaceae containing a single genus, *Hypodematium*, the leaves are ovate or ovate-pentagonal, with 3-4 pinnate or 5 pinnatifid. It is difficult to distinguish the species within the genus and interspecific classification with found morphology. The type of stable appendage hairs on leaves is very stable in the same population and varies significantly

between populations, becoming an important feature for population identification and interspecific classification in the genus. Leaf appendage hairs include rod-shaped glandular and non-glandular

Fig. 1. *Hypodematium shandongense* J. X. Li & X. J. Li, sp. nov.

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hairs. These important features of the indumentum are very stable in the species of *Hypodematium*, but with significant differences between species. Therefore, as an important basis for the classification and identification of *Hypodematium*, it is the consensus of scholars studying *Hypodematium*. There were 15 species of the *Hypodematium* according to the type of hairs (Zhang and Iwatsuki 2013, Li *et al*. 2022 a,b), which were divided into three complex groups: *H. sinense*, *H. fordii* and *H. glandulosum* with only rod-shaped glandular hairs; *H. crenatum*, *H. hirsutum* and *H. glabrum* with only pubescence; the remaining 9 species of the *Hypodematium* with having both the glandular and non-glandular hairs. According to the characteristics of plant body hairs type, *Hypodematium shandongense* have glandular hairs and non-glandular hairs types. It's

fronds, rachis, costae and indusia are sparsely covered with long acicular hair and glandular hairs, showed closely related to *Hypodematium jianxiuii* (Table 2 and Fig. 2).

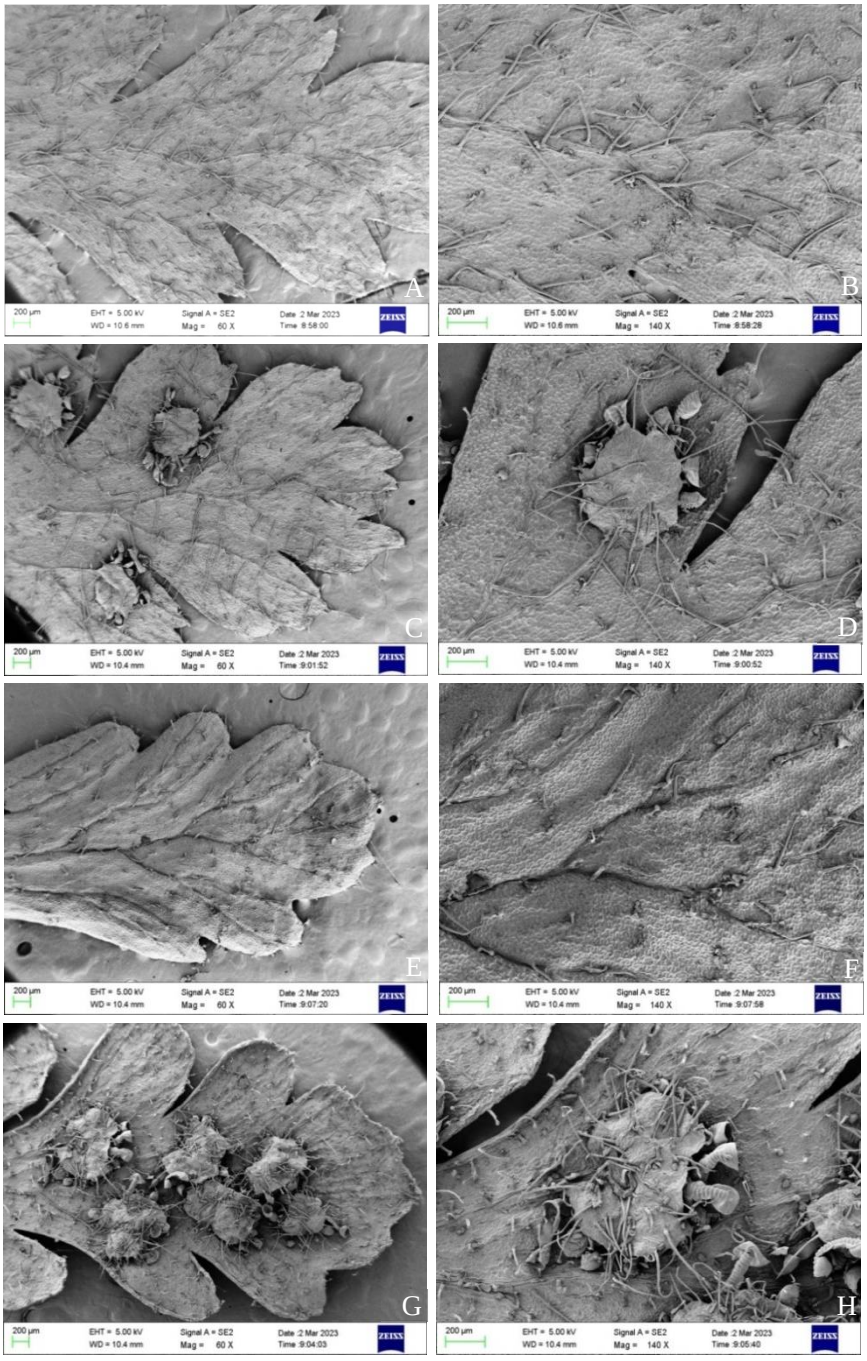

Fig. 2. A-D. Morphological features of *Hypodematium shandongense*; A-B. Adaxial laminae; C-D. Abaxial laminae; and E-H. *H. jianxiuii*; E-F. Adaxial laminae; G-H. Abaxial laminae.

Fern spore morphology is of great significance in taxonomic and phylogenetic studies, which can be used as an important feature to identify different groups, or one of the important basis for establishing a high-level taxon unit (Lu *et al*. 2007). The spore perispore of *H. shandongense* showed semi-annular folds (Fig. 3 A-D), which was clearly different from the *H. jianxiuii* (tuberculate protrusion) (Fig. 3 E-H). Therefore, perispore is of great importance in species identification in this case.

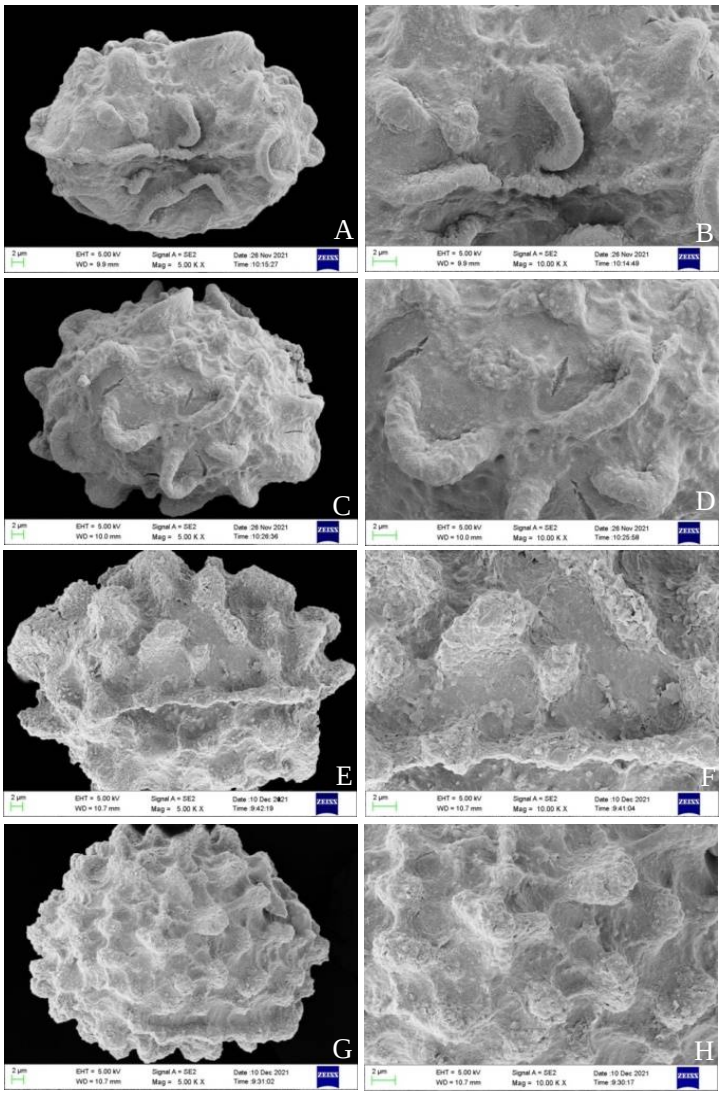

Fig. 3. Palynology *Hypodematium* spore (SEM) A-B. *H. shandongense* polar view (5000×) (10000×) and C-D. *H. shandongense* equatorial view (5000×) (10000×); E-F. *H. jianxiuii* polar view (5000×) (10000×) and G-H. *H. jianxiuii* equatorial view (5000×) (10000×).

Table 2. Characteristics comparison of *H. shandongense* and *H. jianxiuii.*

Species name	Lamina	Adaxial fronds	Indusia	Perispore ornamentation	Figure
H. shandongense	Ovate-triangular	Sparsely covered with long acicular hairs	Sparsely covered with acicular hairs, few rod-shaped glandular hairs	Semi-annular folds	2: A-D 3: A-D
H. jianxiuii	Ovate-pentagonal	Sparsely covered with short acicular hairs	Densely covered with pubescence, few rod-shaped glandular hairs	Tuberculate protrusion	2: E-H 3: E-H

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