

A NEW SPECIES OF *HYPODEMATIUM KUNZE* (HYPODEMATIACEAE) FROM CHINA

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Abstract

Hypodematium mengshanense J. X. Li & X. J. Li, sp. nov., a new species of *Hypodematium* Kunze from Shandong, China, is described and illustrated. It is closer to *H. gracile* Ching by its morphological and palynological characters of LM and SEM study but differs by a number of characters, such as, sparsely covered villose of abaxial fronds, densely covered villose of rachis and costae; sparsely covered with rod-shaped glandular hairs on the edges; spore perispore with curved ridge folds and irregular mesh ornamentation. The sp. nov. is described, comparative LM and SEM characters of spore, fronds and indusia with that of *H. gracile* Ching are provided with photographs.

Introduction

Hypodematium Kunze is the only genus of Hypodematiaceae Ching (Ching 1975). Iwatsuki (1964) reviewed the genus and recognised four species including one subspecies. Recently, more than 16 species of the genus, mainly distributed in subtropical and temperate areas of Asia and Africa, have been established (Shing *et al.* 1999). China, with 13 species of *Hypodematium* Kunze, is regarded as the centre of distribution for this genus (Zhang and Iwatsuki 2013). The genus is characterised by a distinctive swollen scaly stipe base and grows only on limestone habitat (Zhang and Iwatsuki 2013). Previous research on systematics and palynology of *Hypodematium* (Ching 1935, 1940, 1963, 1975, 1978a,b, Instituto Botanico Academiae Sinicae *et al.* 1974, Li *et al.* 1988, Shing *et al.* 1999, Zhou *et al.* 1999, Wang *et al.* 2010, Zhang and Iwatsuki 2013, Li *et al.* 2018) provided an important background that warrants the recognition of a new species of the genus.

Materials and Methods

The voucher specimens of the new species were collected from Tashan Mountain, China and deposited in PE (Herbaria acronyms according to Thiers 2016).

Scanning electron microscopy (SEM) was used to study the micromorphology of spore and fronds. Samples were dehydrated and were 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 observed and photographed under a SUPRATM55 SEM.

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Type specimen: China, Shandong Province, Linyi City, Fei County, Tashan Mountain, limestone rocks, 35°33'59.76"N, 117°51'29.51"E, 500 - 700 m a. s. l., 11 October 1982, J. X. Li 026-1 (Holotype: PE, Isotype: SDCM). Fig. 1.



Fig. 1. *Hypodematium mengshanense* J. X. Li & X. J. Li, sp. nov.. A. Habit. B. Sori on the abaxial surface of pinnules. C. Rhizome and stipe base scales. D. Indusium with rod-shaped glandular hairs on its edges. E. Acicular hairs from the adaxial surface of fronds. F. Rod-shaped glandular hairs from the both sides of fronds and indusium on its edges and G Long hairs from the abaxial surface of fronds and indusium.

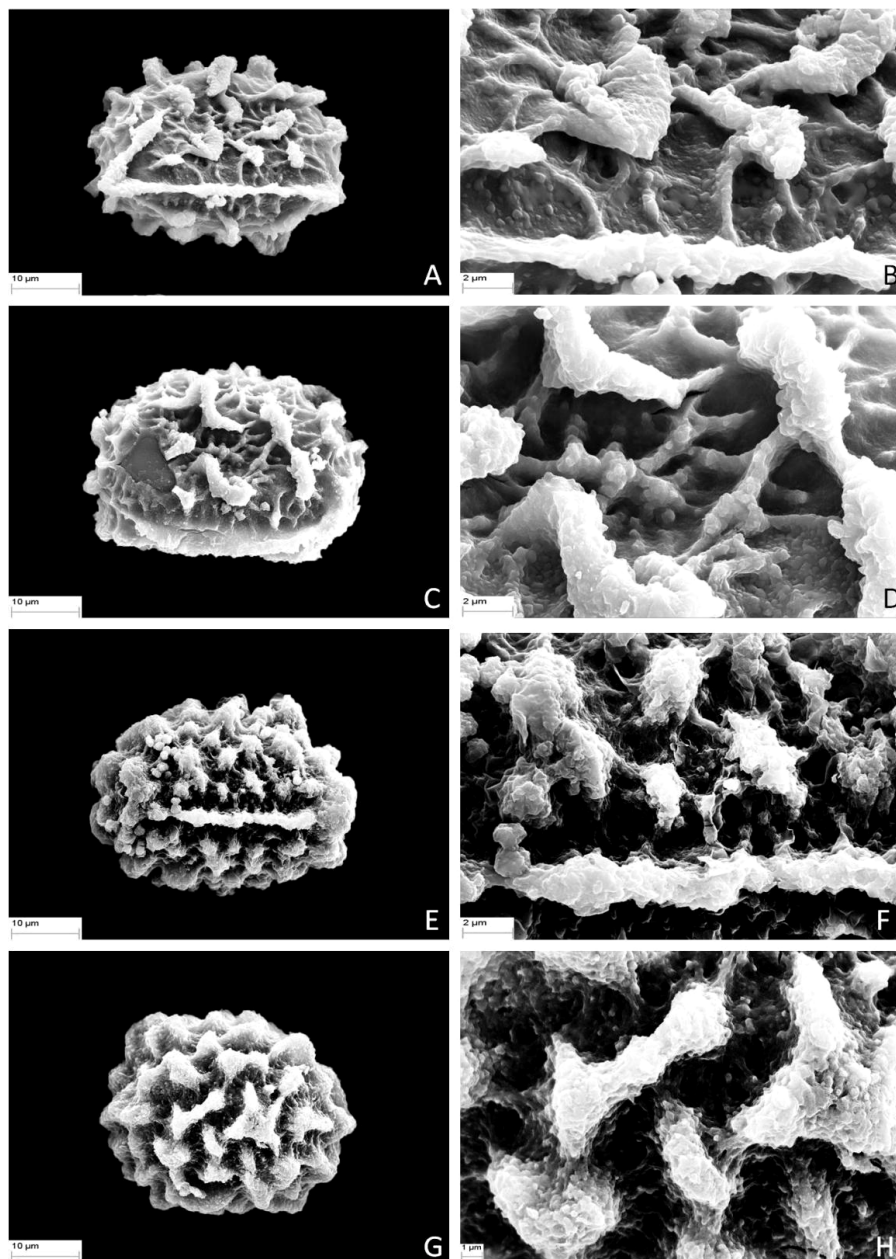


Fig. 2. Spore morphologies of two *Hypodematium* species (SEM). A. Spore in polar view of *H. mengshanense* (1500 \times). B. Detail of spore in polar view of *H. mengshanense* (5000 \times). C. Spore in equatorial view of *H. mengshanense* (1500 \times). D. Detail of spore in equatorial view of *H. mengshanense* (5000 \times). E. Spore in polar view of *H. gracile* (1500 \times). F. Detail of spore in polar view of *H. gracile* (5000 \times). G. Spore in equatorial view of *H. gracile* (1500 \times) and H. Detail of spore in equatorial view of *H. gracile* (5000 \times).

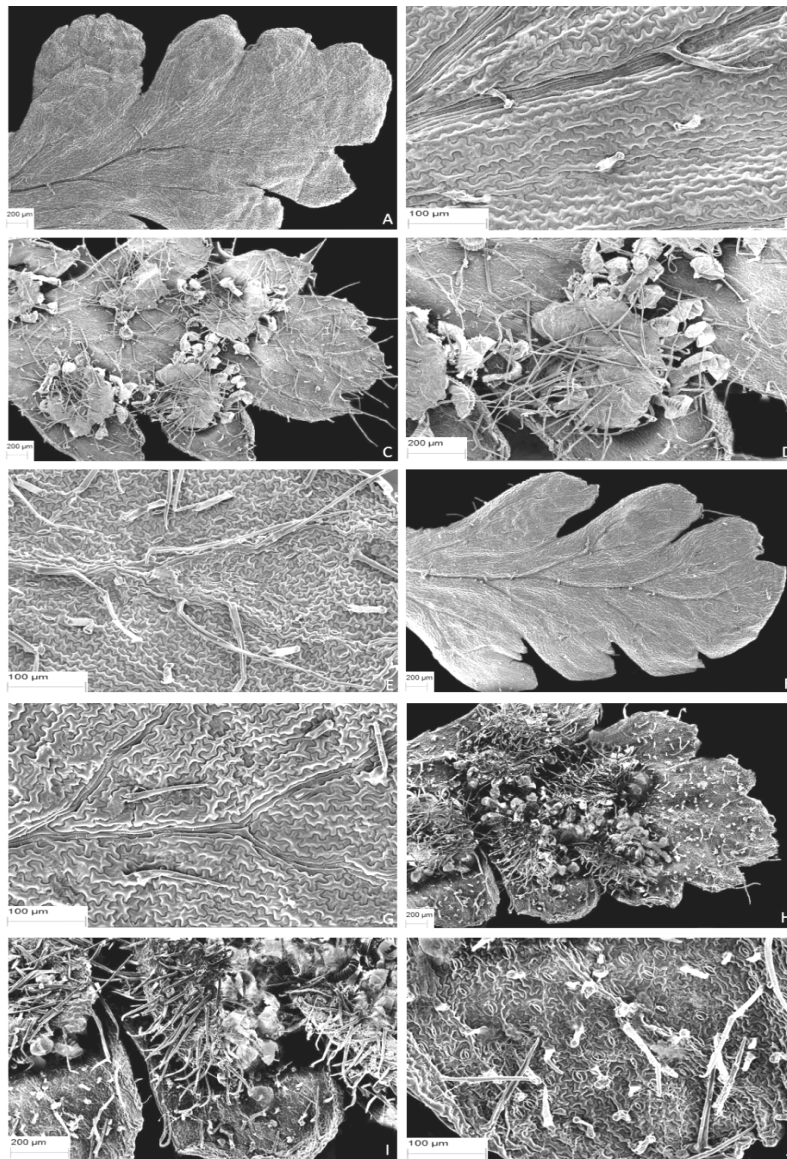


Fig. 3. The fronds and indusia of *H. mengshanense* sp. nov. and *H. gracile* Ching (SEM). A. *H. mengshanense* fronds sparsely covered with acicular hairs and rod-shaped glandular hairs adaxially (30 \times). B. Close-up view of *H. mengshanense* fronds covered with acicular hairs and rod-shaped glandular hairs adaxially (140 \times). C. *H. mengshanense* fronds sparsely covered with villose and rod-shaped glandular hairs abaxially, vein densely covered with hairs (30 \times). D. *H. mengshanense* indusia densely covered with villose abaxially and sparsely rod-shaped glandular hairs on its edges (60 \times). E. Close-up view of *H. mengshanense* fronds covered with villose and rod-shaped glandular hairs abaxially, vein covered with hairs (140 \times). F. *H. gracile* fronds sparsely covered with acicular hairs and rod-shaped glandular hairs adaxially (30 \times). G. Close-up view of *H. gracile* fronds covered with acicular hairs and rod-shaped glandular hairs adaxially (140 \times). H. *H. gracile* fronds sparsely covered with long-acicular hairs and densely rod-shaped glandular hairs abaxially (30 \times). I. *H. gracile* indusia densely covered with long-acicular hairs abaxially and sparsely glandular hairs near the center (60 \times) and J. Close-up view of *H. gracile* fronds covered with long-acicular hairs and rod-shaped glandular hairs abaxially (140 \times).

Table 1. Comparison of spore morphological features between two closer species of *Hypodematium*.

Species name	Size (µm)	Ornamentation of perispore SEM	Locality and voucher	Fig. 2
<i>H. mengshanense</i> sp. nov.	41.4 × 54.2	Curved ridge folds, surface with strips protruding between the folds, forming an irregular mesh	Shandong J. X. Li 026-1 PE	A - D
<i>H. gracile</i> Ching	37.9 × 51.1	Tuberculate-massive and short ridges, surface with granular	Jiangxi Y. G. Xiong 6799 PE	E - H

Table 2. Comparison of fronds and indusia in two closer species of *Hypodematium*.

Species	Adaxial fronds			Abaxial fronds			Indusia		Holotype, voucher and gatherer	Fig. 3
	Non-glandular hairs	Glandular hairs	Glandular hairs	Non-glandular hairs	Glandular hairs	Glandular hairs	Non-glandular hairs	Glandular hairs		
<i>H. mengshanense</i> sp. nov.	Sparsely acicular hairs	Sparsely rod-shaped glandular hairs	Sparsely grayish villose, vein densely covered with hairs	Sparsely rod-shaped glandular hairs	Densely covered with grayish villose hairs on its edges	Densely covered with grayish long-acicular hairs	Sparsely rod-shaped glandular hairs on its edges	Sparsely glandular hairs near the center	Holotype J. X. Li 026-1	A - E
<i>H. gracile</i> Ching	Sparsely acicular hairs	Sparsely rod-shaped glandular hairs	Sparsely grayish long-acicular hairs	Densely covered with rod-shaped glandular hairs	Densely covered with grayish long-acicular hairs	Sparsely glandular hairs near the center	Sparsely glandular hairs near the center	Voucher Y. G. Xiong 6799		F - J

Plants 20-30 cm tall. Rhizomes creeping; densely scaly together with stipe base, scales reddish-brown, lustrous, lanceolate, 8-10 × 1-2 mm, membranaceous, margin entire, apex acuminate. Fronds approximate; stipe stramineous, 8-14 cm × 1-1.5 mm, nearly glabrous upward; laminae ovate-triangular, 18-24 × 12-15 cm, 3-pinnate-pinnatifid, apex acuminate; pinnae 10-14 pairs, lower 2 pairs sub-opposite, 3.5 - 4 cm apart; basal pinnae largest, triangular-lanceolate, 10-12 × 4-4.5 cm, 2-pinnate-pinnatifid, base broadly cuneate, shortly stalked, 1.5-2 cm long, slightly oblique, pinnae tapered; pinnules 8-10 pairs, anadromous, alternate, slightly oblique, proximal basicopic pair largest, 4-6 × 1.5-2 cm; ultimate pinnules oblong, 6-8 pairs, 6-12 × 4-5 mm, base broadly cuneate, apex obtuse, pinnatifid; lobe oblong, base broadly cuneate, apex obtuse, margins obtuse-serrate; second and upper pairs of pinnae gradually shorter, triangular-lanceolate, 2-pinnate-pinnatifid, base cuneate, with a short stalk, apex shortly acute. Veins obvious on both surfaces, pinnate, simple, ending at margin. Laminas chartaceous, fronds sparsely covered with acicular hairs and rod-shaped glandular hairs adaxially, fronds sparsely covered with grayish villose abaxially, rachis, costae and vein densely covered with grayish villose and sparsely mixed with rod-shaped glandular hairs. Veins sparsely covered with grayish villose and rod-shaped glandular hairs. Sori round, dorsal, 1-3 per segment; indusia reniform, pale grey, membranaceous, densely covered with grayish villose and sparsely mixed with rod-shaped glandular hairs on its edge. Spores reniform, with curved ridge folds, and surfaces with strips protruding between the folds, forming an irregular mesh ornamentation. This species is known only from the area around the type locality in Tashan, Shandong. Usually grows in limestone crevices of xeric areas.

Results and Discussion

It has plagued fern scholars for many years that the mature leaves of the *Hypodematium* have many similar characteristics in different groups, making it one of the most difficult families to classify. It is commonly believed that the main basis for the classification of this species is the presence or absence of leaf attachments (rod-shaped glandular hairs and non-glandular hairs). Different scholars have had difficulty concluded on the type of hair on the same specimen, as this is limited by the magnification under an anatomical microscope, leading them to draw different conclusions. In the present study SEM was used to observe a large number of specimens of the Institute of Botany of the Chinese Academy of Sciences in Guangxi and Shandong collected in recent years and accumulated a large number of precious materials. This has provided clear evidence for the submicroscopic structure of palynology and types of hairs, which is useful for the classification and identification of some taxa. The combination of submicroscopic structural features of SEM palynology and types of hairs provide a reliable basis for the palynology and morphology used in the classification and identification of this genus (Li *et al.* 2018). Comparative characters of LM and SEM study of sp. nov. and *H. gracile* Ching are presented in Tables 1-2 and shown in Figs 1-3.

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