

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

XIAOJUAN LI, YUQIN LIU AND JIANXIU LI^{1*}

Shandong Xiandai University, Jinan 250104, China

Keywords: Hypodematium jianxiuii sp. nov., *Hypodematium sinense*, Spore ornamentation, SEM

Abstract

Hypodematium jianxiuii is closer to *Hypodematium sinense* K. Iwats., but differs greatly from it which is illustrated and described by using LM and SEM characters. It differs mainly by its plant height along with laminae broad ovate-pentagonal, 40 × 40 cm, 4-pinnate. The lower part of the stalk and rachis of *Hypodematium jianxiuii* is nearly smooth; the middle and upper part of the rachis, the costae and the lower part of the laminae has glandular hairs and sparsely short acicular hairs, the upper part of the laminae is covered with short acicular hairs and sparsely covered with glandular hairs, the dorsal surface of the indusia are densely covered with short acicular hairs and sparsely covered with glandular hairs; and spore is reniform with tuberculate protrusions and granular ornamentation.

Introduction

Hypodematium Kunze is the only genus of Hypodematiaceae Ching (Ching 1975). Iwatsuki (1964) first reviewed the genus and recognised four species. Then Zhang and Iwatsuki (2013) recognized 12 species known from China. The genus is characterised by a swollen scaly stipe base and grows on limestone habitat (Zhang and Iwatsuki 2013). To date, over 25 species of *Hypodematium* have been described (Tsai and Shieh 1994, Zhang and Iwatsuki 2013) including the three most recently described species from China and Japan, respectively (Li *et al.* 2018, Fan *et al.* 2020, 2021). Previous study on palynology and biogeography of the genus (Ching 1935, 1940, 1963, 1975, 1978, Li *et al.* 1988, Shing *et al.* 1999, Zhou *et al.* 1999, Wang *et al.* 2010, Zhang 2013, Li *et al.* 2018, Fan *et al.* 2020, 2021) provided some important information that allowed the recognition of the species new to science.

Materials and Methods

The newly identified *Hypodematium* fronds and spores (collected in October 2021) were collected from Weizhuang, Pingyi County, Linyi City, Shandong Province and all specimens were preserved at the PE, and then examined under a light microscope. After spraying gold particles for 2 min, fronds and spores were placed under SUPRATM55 thermal field emission scanning electron microscope (SEM) to observe the ornamentations. When the voltage was stable, focal length was adjusted to collect the pictures, following Wen and Nowicke (1999).

Hypodematium jianxiuii X. J. Li, sp. nov.

The newly identified of *Hypodematium jianxiuii* is found closer to *H. sinense* K. Iwats., from which it differs greatly by its plants: 60-70 cm tall, laminae broad ovate-pentagonal, 40 × 40 cm, the lower part of the stalk and rachis of *Hypodematium jianxiuii* is nearly smooth, the middle and upper part of the rachis, the costae and the lower part of the laminae has rod-shaped glandular

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

hairs and sparsely acicular hairs, the upper part of the laminae covered with short acicular hairs and sparsely covered with rod-shaped glandular hairs, the dorsal surface of the indusia are densely covered with short acicular hairs and sparsely covered with rod-shaped glandular hairs; spore reniform with tuberculate protrusions, and surface with granular ornamentation.

Specimen information Type: Shandong Provincex, Linyi City, 34°43'10.79"N, 118°33'26.81"E, 93.20 meters above sea level, 5 October 2021, J. X. Li 20211005-050828-1, 050828-2 (Fig. 1).



Fig. 1. *Hypodematium jianxiuii* X. J. Li, sp. nov.

Plants 60-70 cm tall. Scales narrowly lanceolate, 1.2 cm × 1-2 mm membranaceous, the upper part with linear-long teeth, apex acuminate, single line of cells. Fronds approximate; stipe stramineous, 25-40 cm × 2-2.4 mm, above base sparsely covered with narrowly lanceolate scales and golden rod-shaped glandular hairs, nearly glabrous upward; laminae broad ovate-pentagonal, 27-40 × 35-40 cm, apex acuminate and pinnatifid, base broad cordate, 4-pinnate; pinnae 10-12 pairs, opposite, slightly oblique, basal pinnae largest, 27-28 × 12-15 cm, triangular-lanceolate, pinnae tapered, base cordate, with a 3-3.5 cm stalk, 3-pinnate, 5-6 cm apart; pinnules 10-12 pairs, anadromous, slightly oblique, approximate, proximal basicopic pair largest, 8-10 × 3.5 cm, long-lanceolate, pinnules short-tapered, base cuneate, 2-pinnate; secondary pinnules 8-10 pairs, alternate, anadromous, triangular-lanceolate, basicopic pair largest, 2-2.5 × 1-1.2 cm, upper pairs of pinnules gradually shorter, obtuse tapered, base broad cuneate, with a short stalk, 1-1.2 mm long, 1-pinnate; ultimate pinnules 5-6 pairs, connected to each other, oblique, base cuneate and

decurrent. Veins obvious on both surfaces, side veins usually single, 2-3 pairs lobes, oblique, reaching at margin. Papery fronds, yellowish green when dry, the lower part of the stalk and rachis nearly smooth. Sori orbicular, at middle of veinlets; indusia reniform, pale grey, membranaceous. Spores reniform, with tuberculate protrusions, and surface with granular ornamentation.

Results and Discussions

There were two types of hairs on the *Hypodematum*, one type is rod-shaped glandular hairs, the other type is non-glandular hairs, non-glandular hairs are divided into pubescent hairs and acicular hairs, which vary in length and density. The type of hair in the same group is very stable, but it varies significantly in different groups. The morphological characters comparison of two species is presented in Table 1 and Fig. 3.

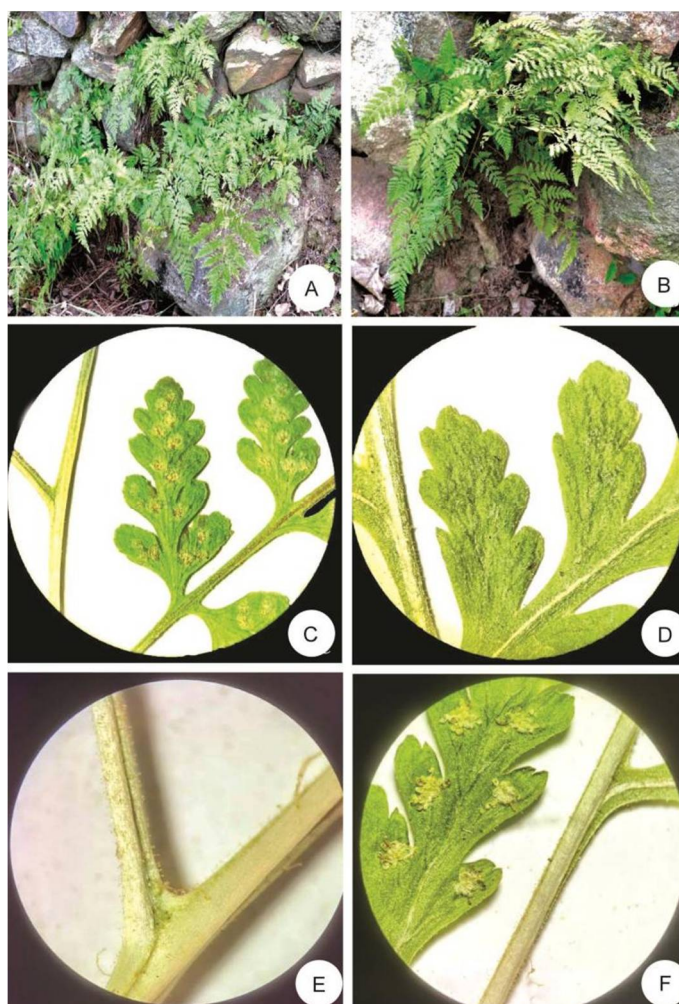


Fig. 2. A-D *Hypodematum jianxiuui* X. J. Li A-B Habit and habitat C-D Rachis, costae and lower and upper sides of the ultimate pinnules E-F Rachis, costae and the lower side of the ultimate pinnules of *H. sinense*.

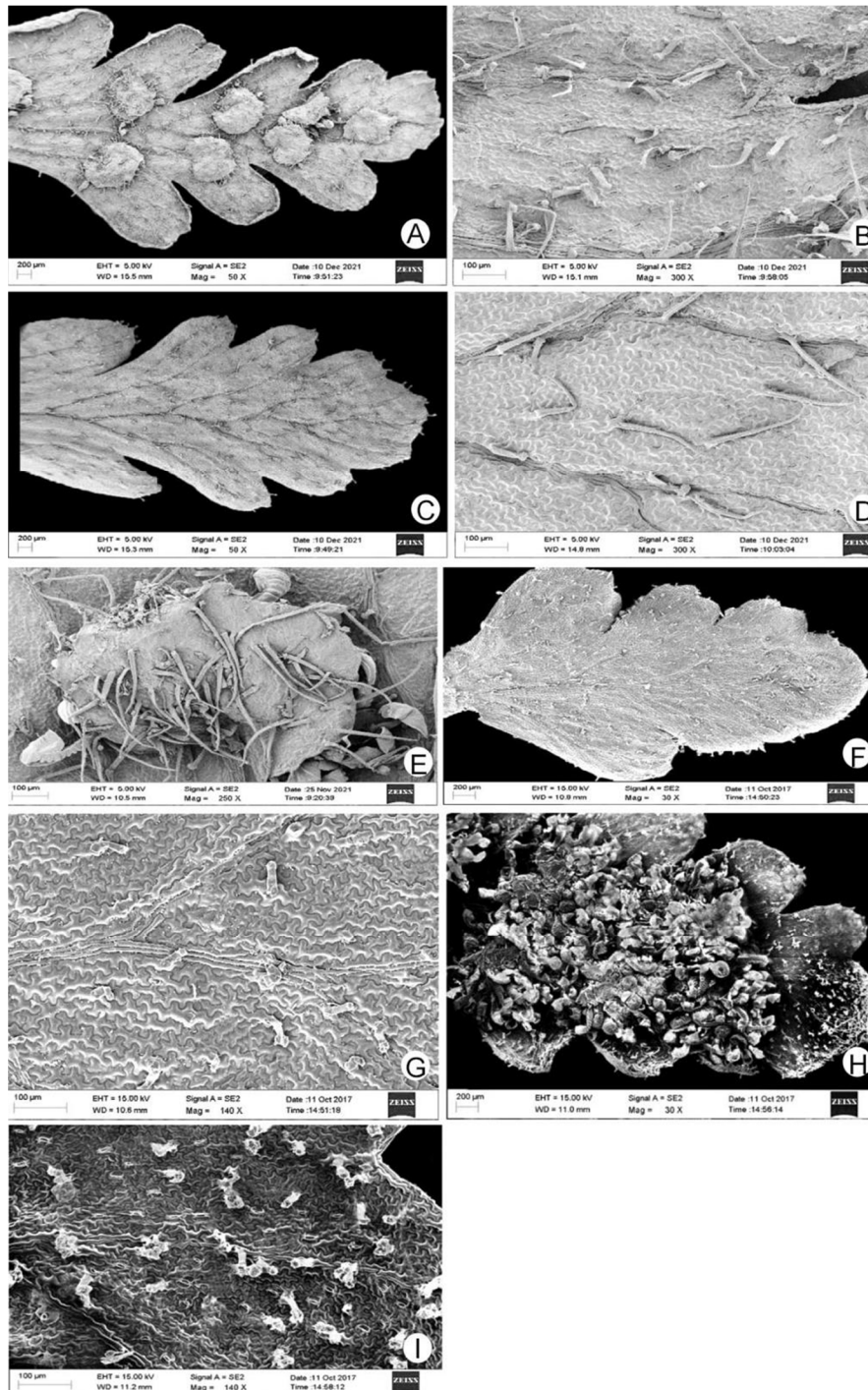


Fig. 3. A-E *Hypodematum jianxiuui* X. J. Li A-B Abaxial laminae C-D Adaxial laminae E Dorsal surface of the indusia F-I *H. sinense* F-G Adaxial laminae H-I Abaxial laminae.

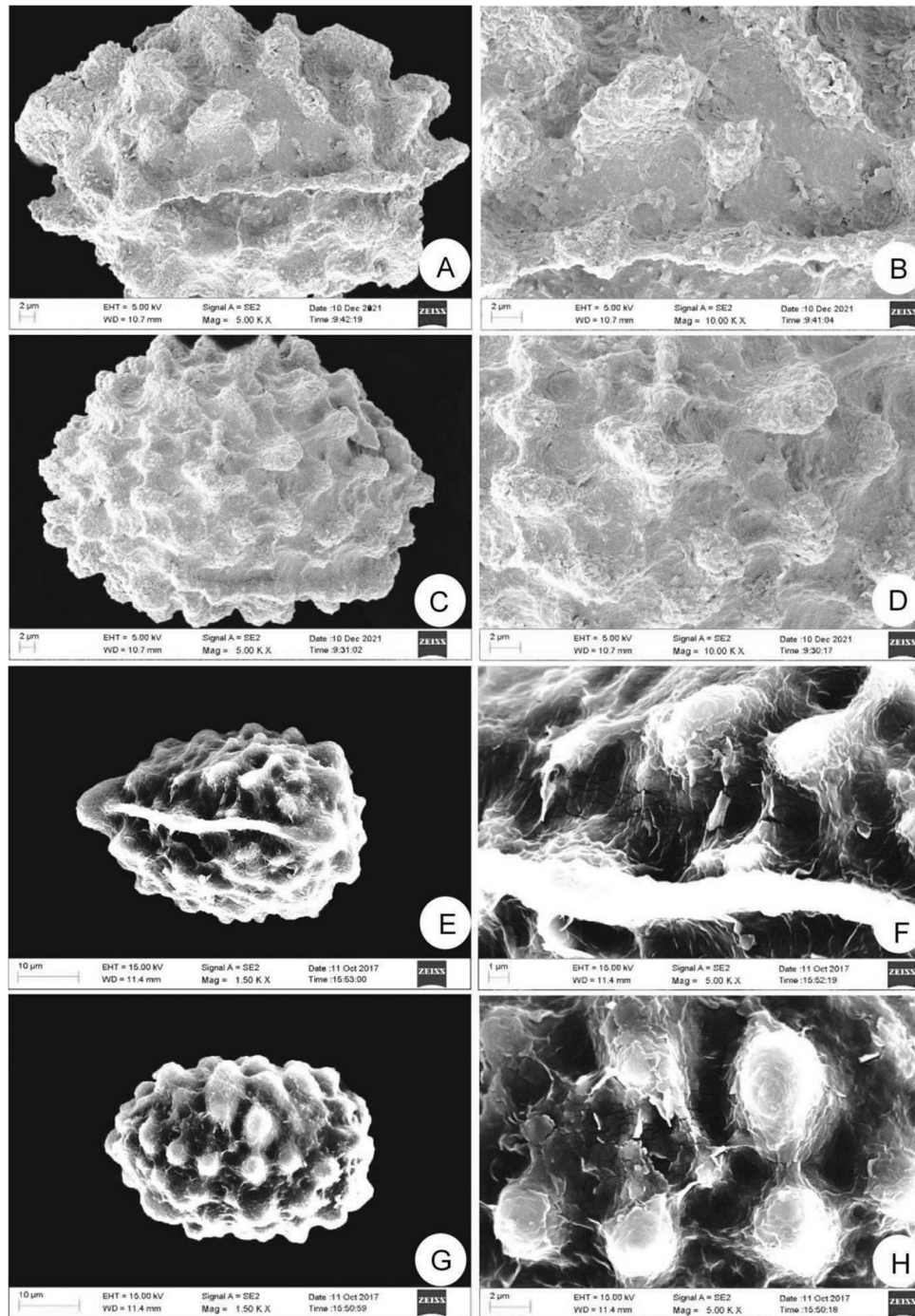


Fig. 4. *Hypodematium* species spore (SEM) A, B *H. jianxiuii* polar view (5000 \times) (10000 \times) C, D *H. jianxiuii* equatorial view (5000 \times) (10000 \times) E, F *H. sinense* polar view (1500 \times) (5000 \times) G, H *H. sinense* equatorial view (1500 \times) (5000 \times).

Table 1. Morphological comparison of *Hypodematium jianxiuii* with *H. sinense*.

Species name	Lamina	Rachis and costae	Adaxial laminae	Abaxial laminae	Indusia	Perispore ornamentation	Fig.
<i>H. jianxiuii</i> sp. nov.	Broad ovate-pentagonal, 4-pinnate	Lower part of the rachis nearly smooth, the middle and upper part of the rachis, the costae had rod-shaped glandular hairs and sparsely short acicular hairs	Short acicular hairs; sparsely rod-shaped glandular hairs	Rod-shaped glandular hairs; sparsely short acicular hairs	Short acicular hairs; sparsely rod-shaped glandular hairs	Tuberculate processes, surface granular with	2: A-D 3: A-E 4: A-D
<i>H. sinense</i> K. Iwats.	Ovate-pentagonal, 4-pinnatifid	Rod-shaped glandular hairs; absent non-glandular hairs	Only rod-shaped glandular hairs; non-glandular hairs absent	Only rod-shaped glandular hairs; non-glandular hairs absent	Only rod-shaped glandular hairs; non-glandular hairs absent	Tuberculate processes, surface nearly smooth, with few scaly	2: E-F 3: F-I 4: E-H

The spore morphology of ferns was of great significance in taxonomic and phylogenetic studies. There were great differences in the types of sporopollen outer wall and perispore ornamentation among different groups, 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). A comparison of *H. jianxiuii* and *H. sinense* is presented in Table 1 and Fig. 4.

Acknowledgments

This work was supported by the Shandong Provincial Natural Science Foundation Project (ZR2020QC021) and the TCM Public Health Service Special Subsidy in 2019 “the National Traditional Chinese Medicine Resources Survey Project” ([2019] No. 39) (2019-1024).

References

- Ching RC 1935. On the genus *Hypodematium* Kunze. Sunyat. **3**(1): 3-15. [pl. 2]
- Ching RC 1940. On natural classification of the family Polypodiaceae. Sunyat. **5**(4): 201-268.
- Ching RC 1963. A reclassification of the family the Lypteridaceae from the mainland of Asia. Acta Phytotaxon. Sinica **8**(4): 289-335.
- Ching RC 1975. Two new fern families. Acta Phytotaxon. Sinica **13**(1): 96-98.
- Ching RC 1978. The Chinese fern families and genera: systematic arrangement and historical origin. Acta Phytotaxon. Sinica **16**(3): 1-19.
- Fan XP, Gao XF and Zhang LB 2020. Taxonomy of the fern genus *Hypodematium* (Pteridophyta: Hypodematiaceae) from Japan. Phytotaxa **455**(2): 161-166.
- Fan XP, Zhang L, Ralf K, *et al.* 2021. *Hypodematium shingii* sp. nov. (Hypodematiaceae; Polypodiales): Replacing the misapplied “*H. crenatum*”, a widespread fern from Asia. Phytotaxa **482**(1): 87-92.
- Iwatsuki K 1964. On *Hypodematium* Kunze. Acta Phytotaxon. et Geobot. **21**: 43-54.
- Li JX, Zhou FQ and Zhang YL 1988. Studies on the spore morphology of *Hypodematium* in China. Proc. Intern. Sym. Systematic Pteridology. pp. 269-272.
- Li XJ, Li JX and Meng FY 2018. A new species of *Hypodematium* (Hypodematiaceae) from China. Phytokeys **92**: 37-44.
- Shing KS, Chiu PS and Yao GH 1999. Hypodematiaceae. Flora Reipublicae Popularis Sinicae, Vol. 4(1). Sci. Press, 151-191.

- Tsai JL and Shieh WC 1994. Aspidiaceae. *In*: Huang, T.C. (ed.) Flora of Taiwan, 2nd Edi. Vol. 1. Editorial Committee of the Flora of Taiwan, Taipei, 290.
- Wen J and Nowicke JW 1999. Pollen ultrastructure of *Panax* (the ginseng genus, Araliaceae), an eastern Asian and eastern North American disjunct genus. *Amer. J. Bot.* 86: 1624-1636.
- Wang FG, Liu DM and Xing FW 2010. Two new species of *Hypodematium* (Hypodematiaceae) from limestone areas in Guangdong, China. *Bot. stud.* 51(1): 99-106.
- Zhou FQ, Gao CF, Zhang ZR, *et al.* 1999. Studies on the morphology and anatomy of Hypodematiaceae from Shandong and its taxonomic significance. *In*: Shing K-H (Ed.) Ching Memorial Volume. China Forestry Publishing House 357-369.
- Zhang GM and Iwatsuki K 2013. *Hypodematium* Kunze. Flora of China, Vol. 2-3. Science Press, Beijing & Missouri Botanical Garden Press, St. Louis 535-539.

(Manuscript received on 15 June, 2022; revised on 28 September, 2022)