

***DRYOPTERIS MENGSHANENSIS* (DRYOPTERIDACEAE) FROM CHINA: A NEW SPECIES**

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Keywords: *Dryopteris*, *D. mengshanensis*, *D. laoshanensis*, Spore ornamentation, SEM

Abstract

Dryopteris mengshanensis J. X. Li & X. J. Li, sp. nov. of *Dryopteris* Adans. belonging to Dryopteridaceae from Tashan mountain of Fei County, Linyi City, China is described and illustrated. It is closer to *D. laoshanensis* J. X. Li *et al.* S. T. Ma but differs for its height (60-78 cm), rhizome apex and stipe base densely covered with dark brown, margin brown, entire narrowly lanceolate scales, the upper middle of the stipe and the rachis densely covered with two types of small scales: 1) dark brown, entire narrowly lanceolate scales and 2) margin toothed, ovate-lanceolate scales. Leaves are ovate, bipinnate, pinnules oblong or rectangular circular, apex obtuse or flat, subentire margin. The lower middle of the rachis and stipe are castaneous, costae and rachiole have two kinds of small scales: 1) margin toothed lanceolate scales and 2) cystiform, apex caudate scales. Sori orbicular, larger, dorsal on both sides of the main vein below the middle of the pinnule, each in a line 4 to 5 pairs, located between the margin and midvein, less near the midvein. Spores perispore with massive ornamentation are very distinct.

Introduction

Dryopteris Adans. belongs to the Dryopteridaceae, is a natural taxon established according to *Dryopteris filix-mas* (L.) Schott as the type species, and contains about 400 species, widely distributed all over the world, with the Asian continent as the distribution center. According to the Flora of China 5 (1), 167 species are now known to China. In recent years, some scholars have conducted multidisciplinary studies on *Dryopteris*: A taxonomic study of *Dryopteris*, for example, Li and Ma (1983) studied *D. laoshanensis*, Li (1985) studied *D. parchinensis*, and Li *et al.* (2021) studied *D. lijianxiu*; Zhou *et al.* (1985) and Ding *et al.* (1990) studied the genesis, morphology and anatomy of intercellular glandular hairs at the base of stipe of *Dryopteris*. Li *et al.* (2019) conducted anatomical study on the taxonomic significance of intercellular glandular hair in *Subgen. Dryopteris* and *Subgen. Erythrovariae*; Wang and Dai (2010) examined the spores of 28 species of *Dryopteris*, Li *et al.* (2022) studied the spores of *Dryopteris* distributed in Shandong by scanning electron microscopy. Recently Li and Li (2022) recorded the distribution of 14 species of *Dryopteris* in Shandong, the monograph of Atlas of Spore Morphology of Medicinal Lycophytes and Ferns in Shandong Province recorded 18 species of *Dryopteris* (Li and Li 2023). According to the 5 (1) classification system of the Flora of China, the plants of this genus were divided into three subgenera, the new species of *Dryopteris mengshanensis* has significant features and belongs to *Subgen. Erythrovariae*.

Materials and Methods

Dryopteris mengshanensis was collected from the Tashan mountain of Fei County, Linyi City (Table 1). Select 10 well-developed spores were examined under an optical microscope. The polar axis and equatorial diameter of spores were measured, their average values were taken respectively, and the spore size was recorded. Each specimen should be sprinkled with only one

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sample, strictly prevent contamination, after spraying gold particles for 2 mins, and then observed under SUPRATM55 thermal field emission scanning electron microscopy (SEM). When the voltage was stabilized at 15 KV, spore polar view and equatorial view were selected respectively, magnification by 1500 and 5000 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)
<i>D. mengshanensis</i>	Fei County (Tashan mountain)	2021.10.06	J. X. Li-104-01 (typus)	PE
<i>D. laoshanensis</i>	Qingdao (Laoshan)	1982.09.16	J. X. Li-2013-1 (typus)	PE

***Dryopteris mengshanensis* J. X. Li & X. J. Li, sp. nov.**

Dryopteris mengshanensis is similar to *D. laoshanensis* J. X. Li *et* S. T. Ma but differs for its height (60-78 cm), rhizome apex and stipe base densely covered with dark brown, margin brown, entire narrowly lanceolate scales, the upper middle of the stipe and the rachis were densely covered with two types of small scales: 1) dark brown, entire narrowly lanceolate scales and 2) margin toothed, ovate-lanceolate scales. Leaves are ovate, bipinnate, pinnules oblong or rectangular circular, apex obtuse or flat, subentire margin. The lower middle of the rachis and stipe were castaneous, costae and rachiole have two kinds of small scales: 1) margin toothed lanceolate scales and 2) cystiform, apex caudate scales. Sori are orbicular, larger, dorsal on both sides of the main vein below the middle of the pinnule, each in a line 4 to 5 pairs, located between the margin and the midvein, less near the midvein. Spores perispore with massive ornamentation are very distinct (Figs. 2-3).

Type: China, Shandong Province, Linyi City, Fei County, Tashan Mountain, rocky edge under the forest, 35°33'59.80"N, 117°51'29.71"E, 500-900 m a. s. l., 6 October 2021, J. X. Li-104-01 (Holotype: PE, Isotype: SDCM) **(Fig. 1)**

Plant height 60~78 cm. Rhizome short, suberect, stipe base densely covered with dark brown, margin brown, entire narrowly lanceolate scales, scales 10-12 mm long and about 2 mm wide; upper middle of the stipe and the rachis were densely covered with two types of small scales: 1) dark brown, entire narrowly lanceolate scales and 2) margin toothed, ovate-lanceolate scales. Fronds clustered, stipe 26 cm long, castaneous brown, lamina oval, 30-35 cm long and 20-25 cm wide, apex acuminate and pinnatifid, base unstricted, bipinnate; pinnae 8-10 pairs, alternate or subopposite, slightly sloping upward, with a short stalk, lower 3 to 4 pairs of larger pinnae, sickle-lanceolate, 12 to 14 cm long, 4 cm wide, apex caudate acuminate; the other upward pairs of pinnae gradually shortened, lanceolate; pinnules 10-12 pairs, alternate, oblong or rectangular circular, with a short shank, usually asymmetrical; lowest pair of pinnae, base underside pinnule short, 1.5 cm long and 0.8 cm wide at the base, rectangular circular, upward 3-4 pieces longer, 3.0-3.2 cm long, sickle-oblong, with sparse teeth at the edge, the remaining pairs of pinnules rectangular circular, gradually shortened, subentire; leaves papery, smooth on both sides, grassy green after drying; rachis castaneous, with two small scales; costae and rachiole margin toothed lanceolate and with cystiform scales. Sori orbicular, dorsal on both sides of the main vein below the middle of the pinnule, each in a line, each pinnule 4 to 5 pairs, located between the margin and midvein; indusium round reniform, brown, thick, persistent. Spores single crack, symmetrical, round reniform, perispore with massive ornamentation (Figs. 2-3, Table 2).



Fig. 1. *Dryopteris mengshanensis* J. X. Li & X. J. Li, sp. nov.

Table 2. Main distinguishing features of two species.

Species	Stipe scale	Leaves	Pinnule	Rachis scale	Costae and rachiole scales	Sori location	Perispore ornamentation
<i>D. mengshanensis</i>	Densely dark brown, margin light brown, entire, narrowly lanceolate scales; above the middle with dark brown, narrowly lanceolate scales and base margin toothed, ovate-lanceolate scales	Oval	Rectangular circular	Dark brown lanceolate and margin toothed oval scales	Margin toothed lanceolate and vesiculate scales	Located between the margin and midvein of the pinnule, less close to the midvein	Massive
<i>D. laoshanensis</i>	Reddish-brown, base toothed lanceolate scales	Triangular circular or oval oblong	Sickle-lanceolate	Margin toothed, lanceolate scale	Margin toothed oval and vesiculate scales	Close to pinnule midvein, far from margin	Long, curved ridge



Fig. 2. Comparative structures (LM) of *Dryopteris mengshanensis* (A, C, E) and *D. laoshanensis* (B, D, F). A-B: Pinnae sickle-lanceolate; C: Pinnule rectangular circular, sori located below middle pinnule; D: Pinnule lanceolate, near pinnule midvein; E: Costae with lanceolate and vesiculate scales; F: Costae with narrowly lanceolate and margin toothed oval scales.

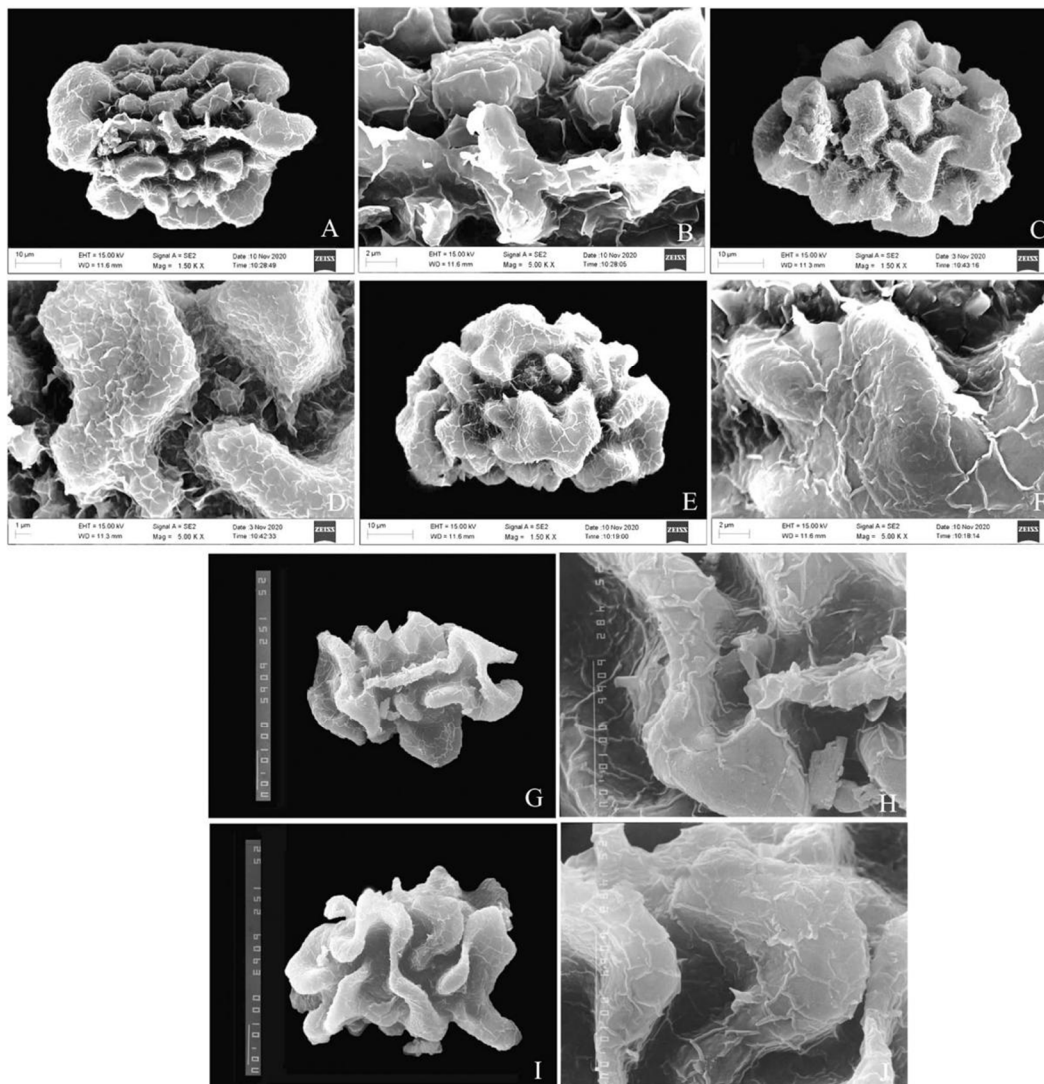


Fig. 3. Palynology *Dryopteris* spore (SEM) A-D. *D. mengshanensis* polar view (1500×) (5000×) and E-F. *D. mengshanensis* equatorial view (1500×) (5000×); G-H. *D. laoshanensis* polar view (1500×) (5000×) and I-J. *D. laoshanensis* equatorial view (1500×) (5000×).

Results and Discussion

The stipe, rachis and costae of *Dryopteris* covered with scales, which was a distinctive feature of this genus. The characteristics of scale size, shape, colour and margin entire or tooth of scale in different parts were very stable within species and significantly different between the species, which was an important feature of taxonomic identification of this genus; especially the small scales on rachis and costae and rachiole. According to the shape characteristics of the small scales: the small scales were flat, that is, the base was not vesiculate, called flat scale on the rachis, costae and rachiole, and the group with flat scale is called *Subgen. Dryopteris*; on the other hand a group

of scales bases with vesiculate or enlarged bases and hairy tips, called *Subgen. Erythrovariae*. Flat or vesiculate scales of the rachis, costae and rachiola were the only basis for the classification of *Subgen. Dryopteris* and *Subgen. Erythrovariae*. In the subgenera, the small-scale margin with tooth or entire was of great significance in the classification and identification of species. According to the characteristics of scales on the top of the rhizome and the base of the stipe, the apex of rhizome and the middle and lower part of stipe of *Dryopteris mengshanensis* were densely dark brown, margins light brown, entire narrowly lanceolate scales, while the apex of rhizome and the stipe base of *D. laoshanensis* were densely reddish-brown, margins large toothed scales, which was one of the important distinguishing features between the two.

Acknowledgment

This work was supported by the introduction, screening and intensive breeding of *Ziziphus jujuba* varieties (GG202402).

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(Manuscript received on 30 April, 2024; revised on 18 September, 2024)