

A NEW SPECIES OF *DRYOPTERIS* (DRYOPTERIDACEAE) FROM CHINA

XIAOJUAN LI¹, MEILING ZHANG² AND JIANXIU LI^{3*}

Shandong Agriculture and Engineering University, Jinan, 250100, China

Keywords: *Dryopteris*, *Dryopteris songyinghuensis*, new species, perispore ornamentation, SEM

Abstract

A new species of *Dryopteris songyinghuensis* was reported in the study. It is closer to *D. peninsulae* Kitag. for its morphological and palynological characters of LM and SEM studies but differs by a number of characters, such as, stipe base densely covered with dark-brown, margin dentate lanceolate scales, margin dentate oval scales above middle stipe, rachis and costae with dark brown, margin dentate oval and lanceolate scales, leaves triangular oblong, lower pair of pinnae slightly longer, upward pair of pinnae gradually shortened, bipinnatifid or tripinnatifid, sori spread abaxially, each pinna is lined on either side of the midvein, occurs between the midvein and the margin, perispore with curved strip ridge, semi-ring ornamentation. The *sp. nov.* is described with LM and SEM characters of spore and fronds, compared with that of *D. peninsulae* Kitag. and provided with photographs.

Introduction

Dryopteris is a natural taxon belonging to the Dryopteridaceae, about 230 species were recorded in Flora of China 5(1), spread all over the world, with the Asian continent as the distribution center, especially in China and the Himalayas, 127 species of ferns are produced in China, which is one of the large genera of ferns in China. The northern region of China, especially Shandong, is also the main distribution area, and more than 20 species are known to be distributed in Shandong. In recent years, scholars have studied *Dryopteris* from the perspectives of resource, taxonomy, morphological anatomy and palynology. In resource and taxonomy, published new species of *D. laoshanensis* and *D. shandongensis* in 1984 (Li and Ma 1984) and 1988, respectively, Li (1985) studied *D. parchinensis*, Li *et al.* (2021) studied *D. lijianxiuii* and Li *et al.* (2024) studied *D. mengshanensis*, Li *et al.* (2022) published the Atlas of Medicinal Pteridophytes in Shandong Province, which collected the spores of 14 species of *Dryopteris* distributed in Shandong, Li and Li (2024) published the Atlas of spore morphology of Medicinal Lycophytes and Ferns in Shandong Province, which collected the spores of 18 species of *Dryopteris* distributed in Shandong. At the same time, some new records were collected from Shandong Province, such as the *D. erythrosora*, *D. tsoongii* and *D. crassirhizoma*. In morphological anatomy, Zhou *et al.* (1985) and Ding *et al.* (1990) made morphological anatomy observations on the stipe base of *Dryopteris*, they found two types of intercellular glandular hairs, Li *et al.* (2019) found that the characteristics of intercellular glandular hairs regularly existed in the Subgen. *Dryopteris* and the Subgen. *Erythrovariae*, intercellular glandular hairs for the first time provide a scientific basis of morphology and anatomy for the taxonomy of two subgenera. In palynology, Lu *et al.* (2007) studied the spores of 10 species of *D. erythrosora*, Wang and Dai (2010) examined the spores of 28 species of *Dryopteris*, Li and Li (2022) studied the spores of *Dryopteris* distributed in Shandong by scanning electron microscopy, *D. laoshanensis* perispore with ridged ornamentation, *D. lijianxiuii* perispore with tuberculiform-rugulates ornamentation, *D. erythrosora* and *D. tsoongii* perispore with tuberculiform ornamentation, *D. crassirhizoma*

*Author for correspondence: <jianxiu_li@163.com>. ¹College of Forestry Engineering, Shandong Agriculture and Engineering University, Jinan 250100, China. ²Shandong Xiandai University, Jinan 250104, China. ³Shandong University of Traditional Chinese Medicine, Jinan 250014, China.

perispore with tuberculiform and verrucate-rugulate ornamentation. These studies laid a foundation for the establishment of a new species of *Dryopteris songyinghuensis*.

Materials and Methods

Dryopteris songyinghuensis was collected from the of Songyinghu of Linshu County, Linyi City. The six mature spores were examined under an optical microscope. At the same time, the size of the polar and equatorial axes of the spores was measured, and the spore size was recorded. The specimen was sprayed with gold and coated for 2 min. The relevant materials were observed under SUPRATM55 scanning electron microscope (SEM). When the voltage was stabilized at 10-15 KV, spore polar view and equatorial view were selected respectively, magnification by 5000 and 10000 times (Table 1).

Table 1. Data on studied material.

Species	Collection time	Locality	Specimen
<i>D. songyinghuensis</i>	2021.10.05	Linshu County (Songying lake)	J. X. Li-05-01 (Typus)
<i>D. peninsulae</i>	2021.07.22	Taian (Culai mountain)	J. X. Li -07-01(Voucher)

Taxonomy: *Dryopteris songyinghuensis* J. X. Li and X. J. Li, sp. nov.

Diagnosis: *Dryopteris songyinghuensis* is similar to *D. peninsulae* but differs for its height (45-60 cm), stipe base densely covered with dark brown, margin dentate lanceolate scales, margin dentate oval scales above middle stipe, rachis and costae with dark brown, margin dentate oval and lanceolate scales, leaves triangular oblong, lower pair of pinnae slightly longer, upward pair of pinnae gradually shortened, sori spread abaxially, each pinna is lined on either side of the midvein.

Type: China, Shandong Province, Songyinghu of Linshu County, Linyi City, growing underneath forest wetlands, 34°43'37.13"N, 118°33'41.81"E, 390 m a. s. l., 5 October 2021, J. X. Li and X. J. Li-106-1-10 (Holotype: PE, Isotype: SDCM). (Fig. 1).



Fig. 1. *Dryopteris songyinghuensis* J. X. Li and X. J. Li, sp. nov.

Description: Plant height 45-60 cm. Rhizome short coarse and erect, densely blackish-brown, margin sparsely denticulate, ovate and lanceolate scales. Leaves fascicled; stipe 20-25 cm long, straw-colored, margin densely sparsely coarsely ovate-lanceolate and lanceolate brown scales; leaves triangular oblong, 30-45 cm long, 15-20 cm wide, apex long acuminate and pinnatifid, bipinnatifid; pinnae 8 to 10 pairs, leaf base 1-3 pairs, isomorphic and nearly equal in length, long lanceolate, 10-13 cm long, about 3 cm wide, subopposite, with short handle, upper each pair of pinnae gradually shortened, pinnae are at a 45-degree angle to the rachis, pinnule 10-12 pairs, subopposite, oblong, about 2 cm long and 1 cm wide, apex round head with 2-3 denticulate, basal pinnately lobed, upper and lower lobes auricular, with 1-2 denticulates, both edges serrated, pinnate veins not visible above, visible below. Leaves yellowish-green after drying, rachis and costae densely covered with brown ovate-lanceolate and narrow lanceolate and linear scales. Sori rounded, abaxially covered with pinnule, arranged in a line on each side of the midvein of the pinnule, located between the midvein and the edge, slightly adjacent to the edge; indusium reniform, edge irregularly serrate, pubescent surface, indusium separated from each other. Spore reniform, single crack, perispore banded ridges protrusion, curved semi-ring, surface with scaly, reticulate sculpture ornamentation (Figs 2-3, Table 2).

Results and Discussion

Sori belongs to the reproductive organs of ferns, its characteristics are restricted by genetic material DNA, and its characteristics are very stable and not easily affected by external factors. In Subgen. *Dryopteris*, the underside of the leaves are covered with sori of many species, such as *D. gymnohylla* and *D. chinensis*, in some species, the sori are only distributed on the back side of the pinnae above the middle of the leaf, and there are a regular arrangement on both sides of the midvein of the small pinnae. The middle and lower pinnae of the leaf are sterile, and there are no differentiation of the sori, such as *D. peninsulae*, *D. lacera*, *D. crassirhizoma* and so on. This important characteristics is very stable within the species and significant difference between the species, which is of great significance in species identification and classification. *Dryopteris songyinghuensis* and *D. peninsulae* are similar in plant form, stipe, rachis and costae have lanceolate scales, perispore banded ridges curved semi-ring ornamentation, both morphologically and palynologically, they are closely related. Therefore, *Dryopteris peninsulae* can be regarded as a relative species of *Dryopteris songyinghuensis*, there were obvious differences between the two species the sori of *D. songyinghuensis* was located on the back of the leaves, while the sori of *D. peninsulae* was only located above the middle of the leaves. The distribution of sori provided an important scientific basis for the establishment of new species of *Dryopteris songyinghuensis*.

Table 2. Comparison of the main features of *D. songyinghuensis* and *D. peninsulae*.

Species	Stipe scale	Leaves	Pinnules of the lower part of the leaf	Rachis and costae scales	Distribution of sori on the dorsal side of leaves	Perispore ornamentation
<i>D. songyinghuensis</i>	Ovate-lanceolate and narrow lanceolate brown scales	Triangular oblong	1-3 pairs pinnae, isomorphic and nearly equal in length, upper each pair of pinnae gradually shortened	Ovate and lanceolate	Sori spread on the back of each pair of pinnae	Curved strip ridge, ring or semi-ring protrusion
<i>D. peninsulae</i>	Lanceolate scales	Oblong	1 pair of pinna slightly shortened	Lanceolate	Dorsal sori above middle leaf, lower pinnae sterile	Curved strip ridge, ring protrusion

Scales are part of the protective organs of ferns, in some families, it has unique characteristics, morphological features such as scale shape, color, texture, margin whole or dentate, there are different parts, in different populations, intra-population stability, significant differences between populations, it is the most commonly used and important basis for classical

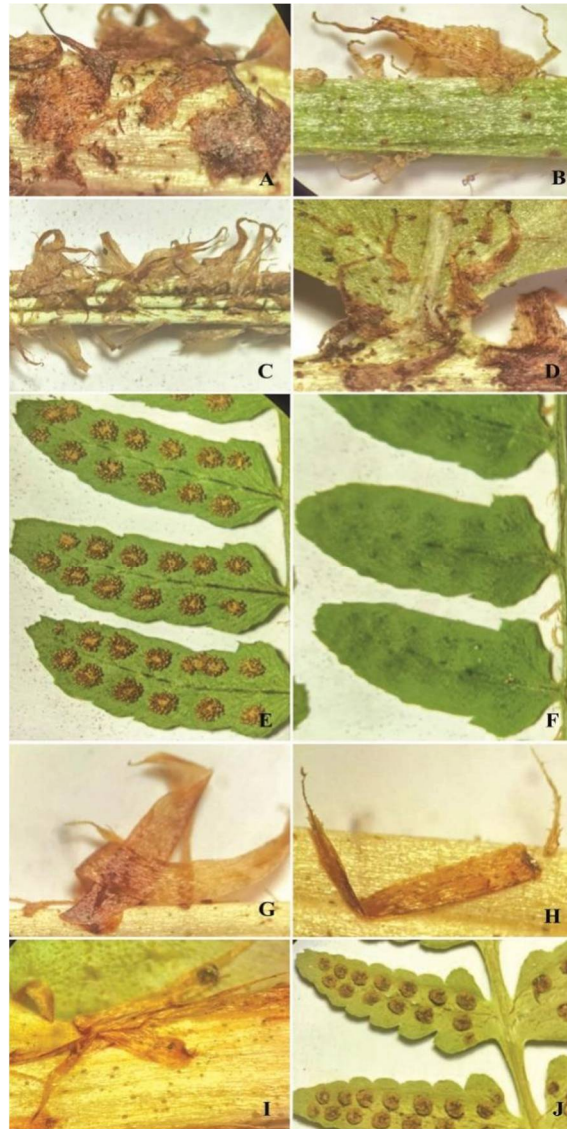


Fig. 2. (A-F) *Dryopteris songyinghuensis* and (G-J) *Dryopteris peninsulae*. (A) Ovate scales on the upper part of the stipe, (B-C) Rachis lanceolate and ovate-lanceolate scales, (D) Costae and pinnac base with scales, (E) Sori on the underside of pinnules, (F) Ventral pinnate, (G-H) Stipe lanceolate scales, (I) Rachis with scales and (J) Sori near the abaxial surface of pinnules.

taxonomy. It is classified as Subgen. *Dryopteris* in *Dryopteris*, based on flat lanceolate scales on rachis and costae, rachis and costae with vesicular scales are divided into Subgen. *Erythrovariae*. A total of 83 species and 4 varieties of Subgen. *Dryopteris* were recorded in Flora of China 5(1). Many closely related species in Subgen. *Dryopteris*, the scale shape and color of the stipe or rachis were used as the basis for identification and classification, such as *D. scottii* stipe and rachis sparsely covered with black or black-brown linear-lanceolate small scales, the stipe and rachis of *D. liangkwanensis* are densely covered with dark brown or brown broad lanceolate scales. One of

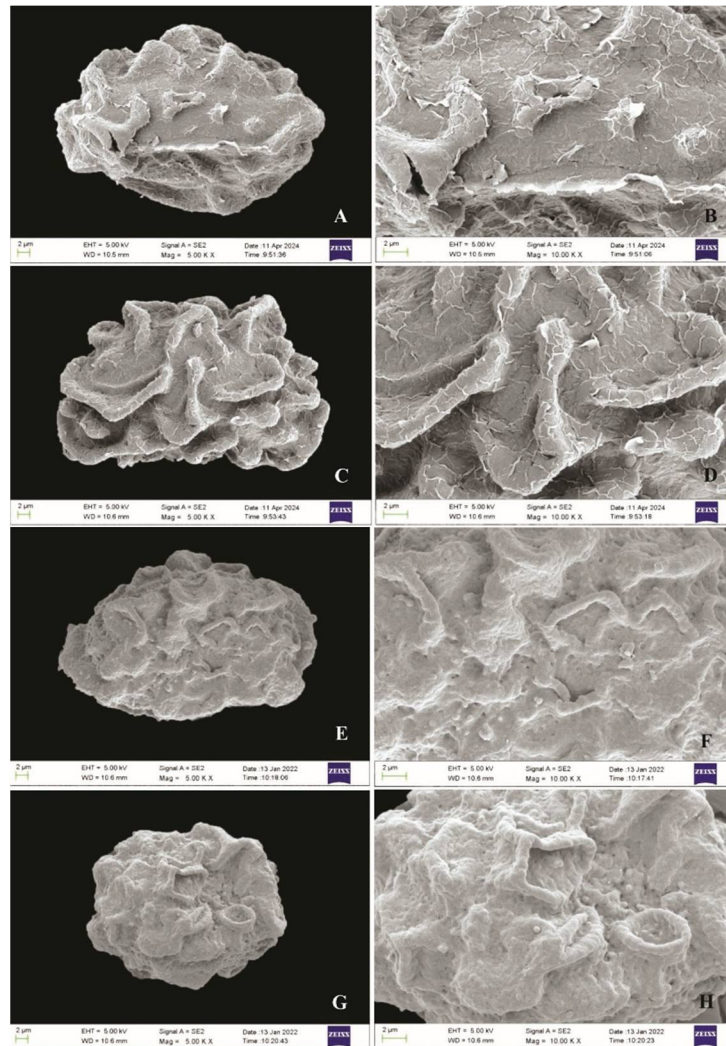


Fig. 3. (A-B) Spore in polar view of *D. songyinghuensis* (5000x, 10000x), (C-D) Spore in equatorial view of *D. songyinghuensis* (5000x, 10000x), (E-F) Spore in polar view of *D. peninsulae* (5000x, 10000x), and (G-H) Spore in equatorial view of *D. peninsulae* (5000x, 10000x).

the important differences between *D. songyinghuensis* and *D. peninsulae* is that the stipe of *D. songyinghuensis* was densely covered with toothed light brown ovate scales, while the stipe of *D. peninsulae* was sparsely covered with brown serrulate lanceolate scales. Therefore, the morphological characteristics of scales provide an important morphological basis for the establishment of new species.

Acknowledgment

This work was supported by the Shandong Agriculture and Engineering University Start-Up Fund for Talented Scholars (2025GCCZR-14).

References

- Ding ZC, Zhou FQ and Li JX 1990. Study on the morphogenesis of intercellular space glandular hairs of *Dryopteris*. Shandong University of Tradition. Chinese Med. **14**(1): 45-46.
- Li FZ 1985. A new species of *Dryopteris* from Shandong. Bull. Bot. Res. **5**(1): 157-159.
- Li JX, Li XJ and Liu Q 2022. Atlas of Medicinal Pteridophytes in Shandong Province. Beijing: China Medi. Sci. Press. pp. 277-324.
- Li JX and Ma ST 1984. One new species of *Dryopteris* from Laoshan, Shandong Province. Bull. Bot. Res. **3**(4): 139-141.
- Li XJ, Ding JJ and Li JX 2019. Palynology and anatomy of *Dryopteris* Adans. from Shandong, China and their significance in classification. Bangladesh J. Bot. **48**(3): 877-884.
- Li XJ and Li JX 2022. SEM study of leaf epidermis and spores of nine species of *Dryopteris* Adans. from Shandong province, China. Bangladesh J. Bot. **51**(4): 951-960.
- Li XJ and Li JX 2024. Atlas of Spore Morphology of Medicinal Lycophytes and Ferns in Shandong Province. Beijing: China Text. App. Press. pp. 223-258.
- Li XJ, Li YN, Li JX and Shu J 2024. *Dryopteris mengshanensis* (Dryopteridaceae) from China: a new species. Bangladesh J. Bot. **53**(3): 711-716.
- Li XJ, Wang X and Liu W 2021. *Dryopteris lijianxiuii* (Dryopteridaceae), a new species from China. Bangladesh J. Bot. **50**(3): 747-753.
- Lu JM, Li DZ and Wu D 2007. Spore morphology of the family Dryopteridaceae. Acta Bot. Yunnanica **29**(4): 397-408.
- Wang QX and Dai XL 2010. Study on the spore morphology of Polypodiales (Filicales) from China. Beijing Sci. Press. pp. 224.
- Zhou FQ, Li JX and Ding ZC 1985. Preliminary observation on the anatomy of the petiole base of *Dryopteris* from Shandong. J. Shandong Univ. Tradition. Chinese Med. **9**: 38-42.

(Manuscript received on 26 April 2025; revised on 14 October 2025)