

**MORPHOPALYNOLOGICAL AND ANATOMICAL STUDIES ON
FAN FERN *SCHIZAEA DICHOTOMA* (L.) SMITH FROM
NEELUM VALLEY, AZAD KASHMIR**

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Abstract

The specimens of *Schizaea dichotoma* (L.) Smith were collected from Neelum Valley to investigate its morphology, anatomy and spore morphology. The rachis was observed as triangular and dichotomized stele was protostele and “Y” shaped. The sporangium was stalked and annulus consisted of 16-19 cells containing 256 spores. The spores were convex-plane with exine of 0.5 µm. All these characters suggested that *Schizaea dichotoma* is more primitive than the *Lygodium japonicum*.

Introduction

The Schizaeaceae (order Filicales), a primitive and small family, comprise an estimated 170 living species predominantly tropical or southern-temperate ferns (Smith, 1990). The family has four genera: *Schizaea* with 30 species, *Anemia* with 90 species, *Lygodium* with 40 species and *Moharia* with 3 species (Smith, 1979). Schizaeaceae are morphologically diverse, but characteristic sporangia, borne singly on abaxial leaf surface and with an apical or subapical annulus, led early workers to recognize family as monophyletic (Christ, 1897; Diels, 1900).

The molecular data and the antiquity of the Schizaeaceae suggest that the group diverged at an earlier time than other groups of ferns (Smith, 1995). The family is poorly represented in Pakistan. Only *Lygodium japonicum* has been reported (Sheikh, 1962; Stewart, 1957) and investigated in detail by Murtaza *et al.*, (2004). The plains of Pakistan are quite dry for ferns and only a few fern species like *Adiantum*, *Goniopteris*, *Pteris* and *Ophioglossum* are found in these areas. The number of ferns increases with increase in height where temperature decreases and moist conditions are favorable. Ferns of Filicales have been studied extensively (Collinson, 1994; Herrero *et al.*, 2001; Duckett & Ligrone, 2003; Yatabe *et al.*, 2001; Carlquist & Schneider, 2001; Pigg & Rothwell, 2001).

The fern flora of Pakistan has not been studied completely. Since the list of ferns published by Stewart (1957), the only reference can be made of Sheikh (1962) who described certain fern species from Kaghan Valley. The morphology, anatomy and palynology of the ferns are still to be investigated although some data on these aspects are available (Murtaza *et al.*, 2004, 2006). The present study is an effort to add some information about the rare fern *Schizaea dichotoma* collected from Neelum Valley, Azad Kashmir.

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Materials and Methods

Fresh specimens of fan fern *Schizaea dichotoma* (L.) Smith were collected Neelum Valley, Muzaffarabad along with rhizomes. The material was preserved in acetic alcohol (1:3) till further use. For anatomical studies, the transverse sections of the rachis were prepared. The sections were stained with 2% saffranin. The sporangia were detached from the fertile fronds with the help of needle under binocular microscope and mounted in glycerin jelly on a glass slide. For spore investigations, the sori were crushed with glass rod and passed through 4 cm diameter funnel placed in a centrifuge tube and plucked with loosely placed glass wool. The sieved spores were treated with 5% KOH solution to remove the oils and humic acid. The spores were chlorinated as suggested by Bhutta & Sadiq (1987) and mounted in 2 % glycerin jelly already stained with 2% saffranin. The mounted slides were sealed using synthetic enamel on a ringing disc. After staining with 2% saffranin solution, the sections were mounted in Euperal for microscopic studies. Microphotographs were taken on a photomicroscope (Kyowa Medilux-12). All the specimens and other material used during this study were deposited in the Department of Botany, Azad Jammu and Kashmir University, Muzaffarabad.

Results and Discussion

Morphology: Stipes 11-15 cm long, erect tufted, older fronds brownish in colour. General outline of the frond was fanlike. All stipes bear fertile leaves which were slightly coiled and twisted. Their growing form was in tufts directed from the root stalk. Venation of the fertile fronds was parallel. Scales were present at the base of each stipe. Monosporangial sori borne on one side of the fertile leaf and were long stalked. No prominent midrib. Fertile fronds were divided at their distal end into 2-4 hair like projections (Fig. 1).

Anatomy of rachis: The rachis was almost triangular, running up to the tip of the frond. The inner side was slightly grooved facing axis. Cutinized epidermis was single layered. The cells of the epidermis were broader than longer. Hypodermis consisted of 4-6 layers of almost rounded and dark coloured cells. The endodermis was followed by pericycle. Single Y shaped stele was present in the center. Two arms of the stele were long while the other was bifurcated and the arms were surrounded by phloem. The cells of the phloem were very smaller than xylem cells (Fig. 2).

The *S. dichotoma* had the leaf form appeared as fan, called as fan comb ferns. Venation of the leaves was parallel without a prominent midrib. Immature frond could not be distinguished from surrounding grasses. The rachis was three layered and looked to be a distinguishing character of the members of family Schizaeaceae. The stele was triangular almost similar to that of the *Lygodium japonicum* although the arms of stele were more dichotomized (Murtaza *et al.*, 2004). These characters suggested that the *S. dichotoma* is primitive than the *L. japonicum*.

Sporangium and spores: Sporangium was globose with long stalk. Capsule was 200 (210) 220 µm long, 140 (145) 160 µm wide and 130 (135) 140 µm thick. Stalk was bilayered and 160 µm long. Annulus cells were distinct. The average number of annulus cells was 16-20. The individual annulus cells were 15-21 µm long and 12-15 µm wide. Stomium 20-22 µm. the cells of annulus toward the stomium were smaller than the rest of the cells of annulus (Fig. 3).



Fig. 1. *Schizaea dichotoma* with rhizome and fertile fronds.

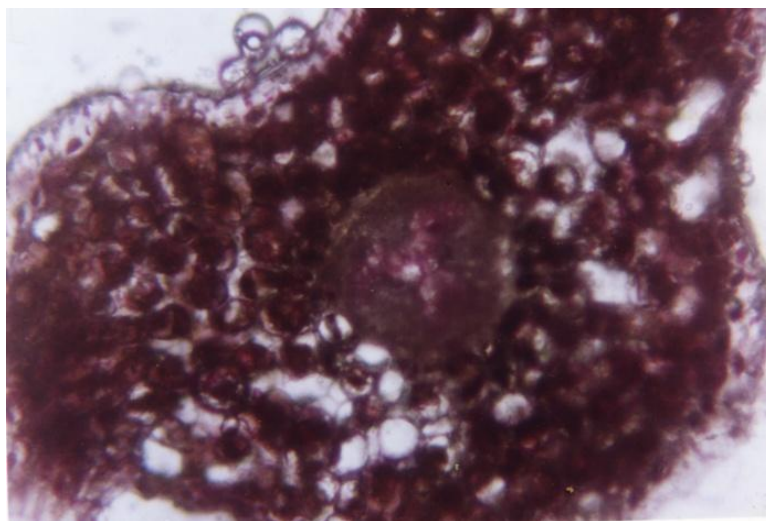


Fig. 2. Transverse section of stipe of *Schizaea dichotoma*.

Spores were bilateral, convex-plane of $27 \times 44 \times 23 \mu\text{m}$ size. Leasurae $20 \mu\text{m}$, perine $0.8 \mu\text{m}$ thick, closely surrounding the exine, with regularly spaced, minutely co-patterned less than $0.5 \mu\text{m}$ in diameter. In addition there are irregularly spaced granules or gemma like processes (diameter $1.0\text{--}1.5 \mu\text{m}$). Exine $2.0 \mu\text{m}$ thick and smooth. Spore dimensions based on 20 specimens are $25 (27) 30 \mu\text{m}$ (Fig. 4).



Fig. 3. Lateral view of the sporangium of *Schizaea dichotoma*, short stalk and annulus are prominent.

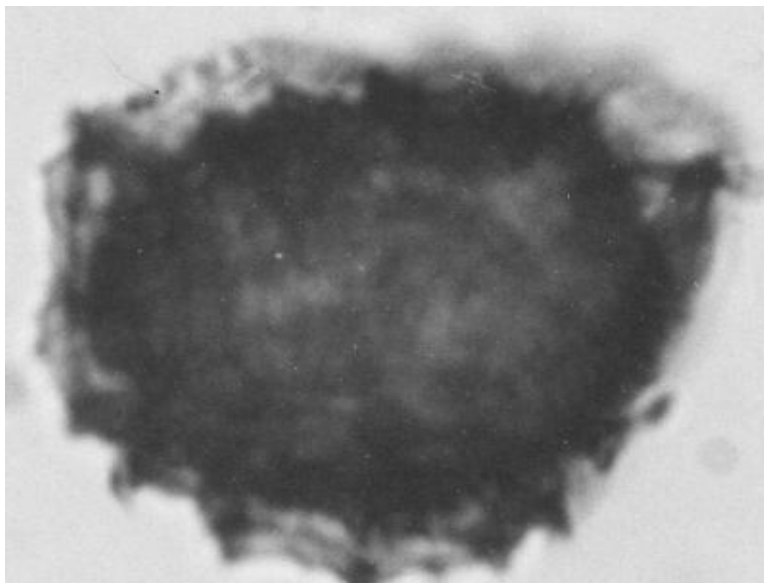


Fig. 4. Spore of *Schizaea dichotoma*.

The sporangium of the *S. dichotoma* was smaller as compared to the sporangium of *L. japonicum* while the spore count was same for the both species per sporangium (Murtaza *et al.*, 2004). Spores were also different in both species and exine was thicker in the spores of *L. japonicum*. Finally the dichotomy of the rachis, presence of protostele and convex-plane spores suggests that the *Schizaea dichotoma* is more primitive than the

other members of the family. It is recommended that the morphology, anatomy and spore morphology of other members of Schizaeaceae found in Pakistan be studied to help the classification.

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(Received for publication 15 May 2007)