



Psilotum hazaricum a new contribution to the flora of Pakistan

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Abstract

Psilotum species, is of considerable importance in palaeobotany considering its age of evolution i.e. Devonian. *P. hazaricum* is a new contribution to the cryptogamic Flora of Pakistan. The population of *P. hazaricum* is restricted to the rock crevices in Nandiar Khuwar catchment area. The aerial stem is hexagonal, with alternate phylotaxy and bifid bracts of synangia on aerial shoot. Synangia borne alternately above fourth dichotomy. The anatomy of stem, leaf and synangia were studied. Spores are raniform to oval. The population size was affected due to habitat loss, introduction of exotic species as well as the growth of native species in same rock crevices, and therefore conservation of this species is suggested in Nandiar valley and adjacent localities having same type of environmental conditions.

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Introduction

The diversity of plants increased in the Devonian period with the appearance of vascular plants (Rahman *et al.*, 2015). Ferns having the first vessels can be regarded as an evidence of evolution of plants (Nazarian *et al.*, 2010).

A small group of vascular plants in which the vegetative and reproductive structures remained undeveloped, one living member of that group is known as *Psilotum* (Ray *et al.*, 1983). "*Psilotum*" is a Greek word means "naked" (Nazarian *et al.*, 2010). *Psilotum* known as Whisk Fern is a Pteridophyte belonging to family Psilotaceae of the division Psilophyta and is one of the most primitive vascular plants (Qiu and Palmer, 1999).

It is the single living member of a populated division of the primitive times and has survived for about 400 million years (Yamazaki *et al.*, 2001).

The species of *Psilotum* grows as an epiphyte in the tropics and occupies rock crevices in the more temperate areas like south-eastern Australia (Fairley and Moore, 1989). In Pakistan, *Psilotum nudum* has been previously reported from Buner and Hazara (Rahman *et al.*, 2015; Haq, 2015).

Psilotum hazaricum is a new contribution to the flora of Pakistan. The aim of the study was to explore the population of *Psilotum hazaricum* based on taxonomic and anatomical description.

Materials and methods

Plant collection

The plant samples were collected during 2016 from the subtropical *Pinus roxburghii* forests in the rock crevices on north east facing slopes of Nandiar Khuwar catchment District Battagram.

The specimens were photographed and observed under microscope for morphological features.

Morphological and anatomical studies

The morphological and anatomical studies were carried out in the botany laboratory, degree college Battagram.

The morphological properties of the plant samples were examination through USB digital microscope and compared with the existing authentic sources (Singh *et al.*, 2003).

The anatomical studies were carried out through manual exact cross-sectioning of stem, synangium and sporangium. Mature spores were mounted on slides and observed under compound microscope.

Identification

The morphological and anatomical results were compared with *Psilotum nudum* L., *P. flaccidum*, *P. complanatum*, and *P. triquetrum* species. The existing authentic sources were used for such comparison (Jones and Luchsinger, 1986; Gifford and Foster, 1988; Jeffrey *et al.*, 2005).

Results and discussion

Morphological studies

Morphological studies were conducted on this plant and the following results were achieved. The plant lives in the rock crevices mostly on north east facing slopes (Fig. 1).

Plant body is profusely branched. Perennial small or medium size herb, rhizome prostrate, rhizoids present; stem green, herbaceous, erect, dichotomously branched, glabrous and glaucous. The main axis is 10-20cm long.

The first dichotomic branch is 2-4 cm, second 1-2cm, third 1-2cm, fourth 1-1.5cm, fifth 1.1-2cm and the last branch is 3-6cm long. The stem and branches are hexagonal in outline.

The apex of last dicotomic branches are acute and introse. The Aerial axis bears small scale like leaves (prophylls) originating alternately from ridges.

The prophylls are 0.5mm-3mm in length and 0.5-1mm in width. The synangia borne alternately on dicotomic scale. A maximum of 6 synangia were recorded on each branch. Synangium is composed of three connected sporangia separated by three longitudinal and arched depressions. Numerous spores are in the sporangia. The spores are white when young and become slightly yellow when mature.

Anatomical studies.

The outer layer in the aerial stem is epidermis with cuticle layer. Below the epidermis 3-4 layers is of chlorenchyma followed by 5-8 layers of sclerenchyma and 5-8 layers of parenchyma. Stele is surrounded by clear layer of endodermis.

Star shaped vessel tissue is surrounded by phloem. Stem pith is wooden and sclerenchymatous. Stele in anatomized aerial shoot is of siphonostele type (Fig. 2). The outer layer of prophylls is epidermis with elongated cells covered by cuticle layer.



Fig. 1. *Psilotum hazaricum* in rock crevices.

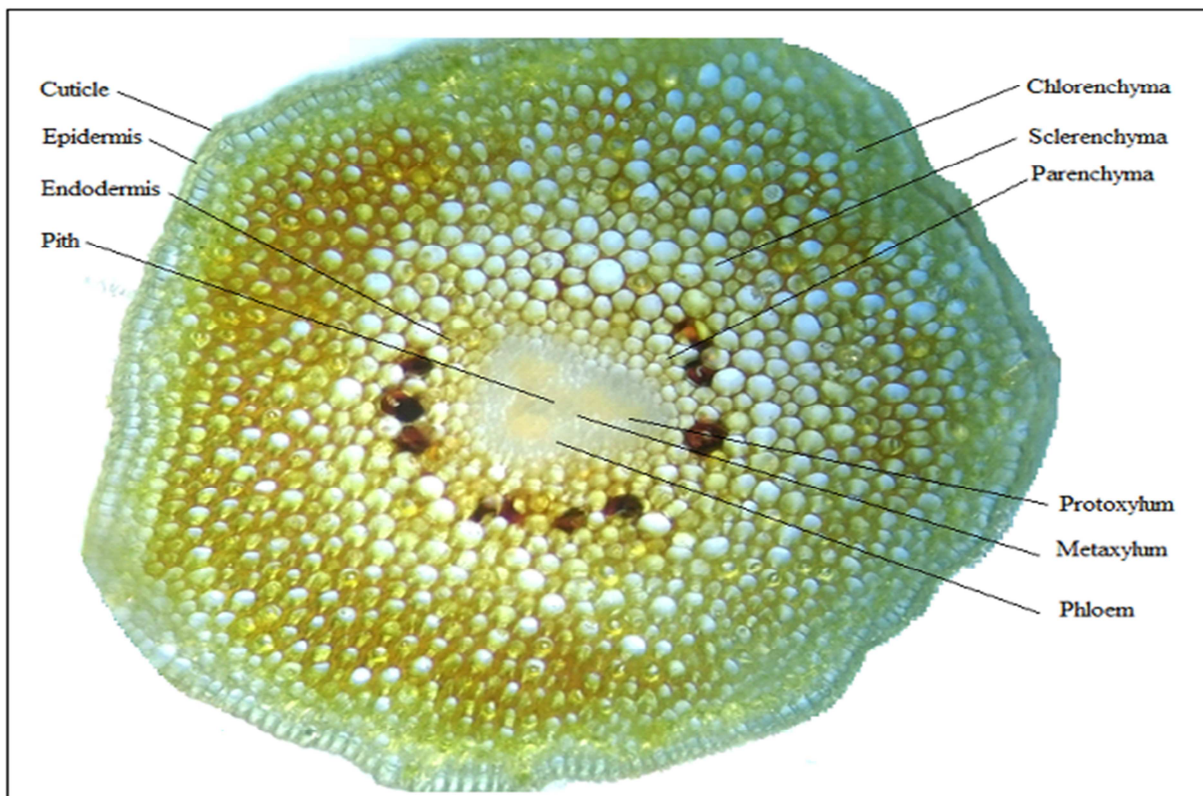


Fig. 2. Anatomy of aerial stem.

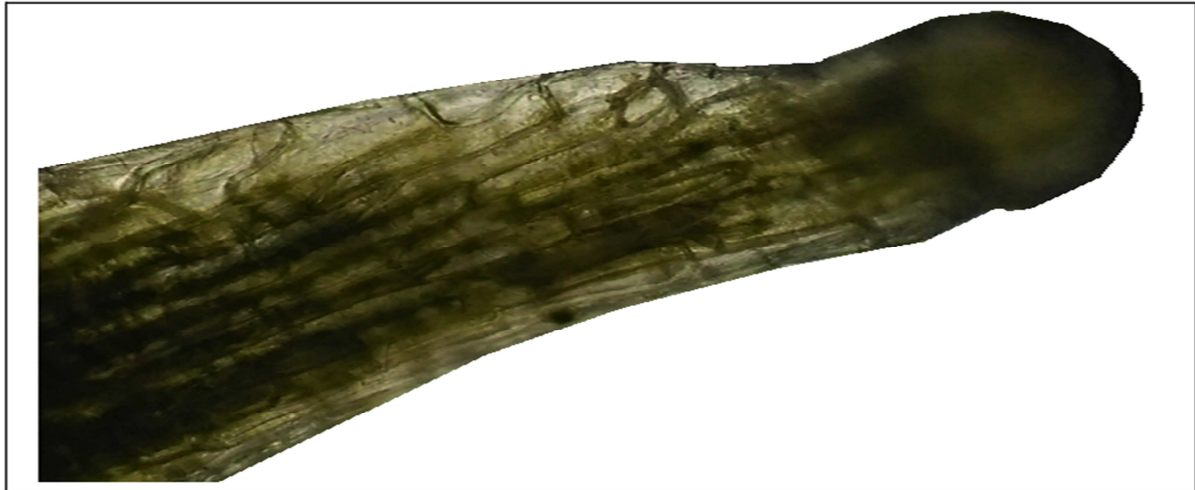


Fig. 3. Anatomy of prophylls.

The mesophyll cells are large and elongated. There is no vascular tissue in the prophylls. The growth is from apical cell (Fig. 3). Each synangium composed of three fused sporangia, sporangia yellowish,

orbicular, smooth, glaucous, dehisce by single suture, bearing clusters of spores; spores white, appearing like powder, compactly arranged inside sporangia (Fig. 4).



Fig. 4. Anatomy of Synangia.

The spores are homosporous and mostly raniform or oval shaped. A deep cleft is present on inner side. Length of the spores varies from 0.3 to 0.6 μ m while width varies from 0.2 to 0.3 μ m. Outer layer is exine and inner is intine (Fig. 5).

Discussion

Psilotum hazaricum collected from Nandiar Khuwar catchment were studied through morphological and anatomical research.

The results of our research conform to the research made by Gifford and Foster (1988). In our research, which is in conformity with Singh *et al.*, (2003), middle cortex is multi-layered and sclerenchymatous with thick walls.

They also reported that these layers are responsible for mechanical protection of the plant. In our observations we found out that outer cortex is parenchymatous with thin walls,

that was compressed and rather darker than middle cortex. Singh *et al.* (2003) have also introduced outer cortex as parenchymatous and rich in starch.

It seems abundant starch in the cells results in darkness of this part.

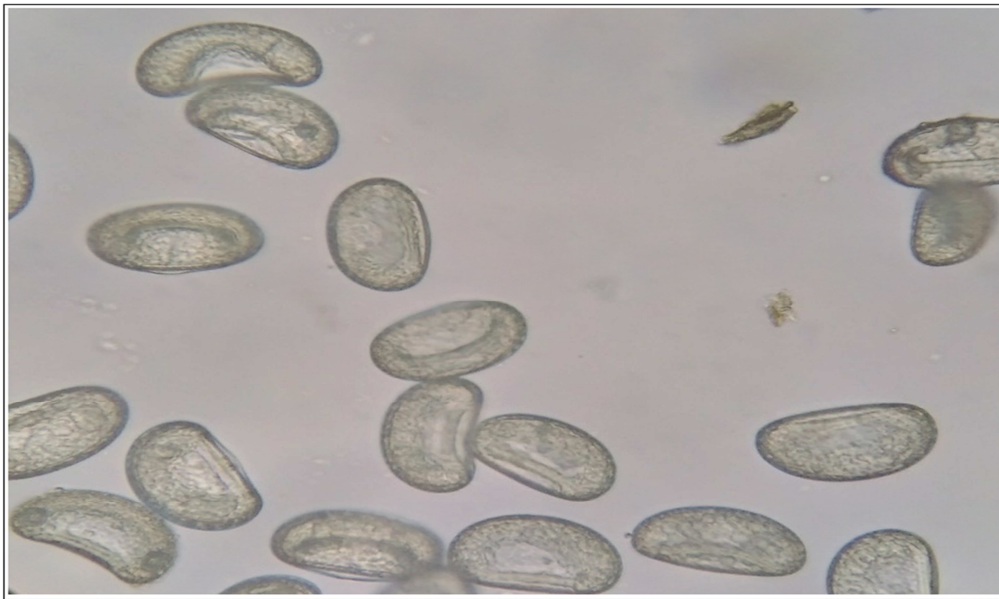


Fig. 5. Spore morphology.

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