

Spore morphology of Pteridaceae in Iran

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Abstract: The spore of nine species of five genus in Pteridaceae family were examined under SEM. The spores are trilete, triangular to circular shapes. Depending on the species, the main different ornamentations were baculate, Gemmate, regulate, wizeden or triradiate. Based on these results, the identification key of nine species is presented. The spore characteristics presented here maybe useful for systematic purpose.

Key words: Cheilanthoid ferns, sculpture, spore, Iran.

INTRODUCTION

Pteridaceae, comprises over 50 genera and more than 6000 species, accounting for roughly 10% of extant Leptosporangiate fern diversity (Smith *et al.*, 2006; Schuettpetz *et al.*, 2006). Clearly monophyletic in earlier phylogenetic analyses (Gastony and Johnson, 2007; Schenider *et al.*, 2004). This family is characterized by sporangia born along veins or in marginal coenosori, often protected by reflexed segment margins. Historically, many Taxa were segregated and variously recognized as tribes, subfamilies or even as distinct families (Copeland, 1947; Pichi sermolli, 1977). Smith *et al.*, (2006). divided this family into two families, the Pteridaceae and Vittariaceae, with the Pteridaceae subsequently segregated into six sub families (Adiantoideae, Pteridoideae, Ceratopteridoideae, Cheilantioideae, Platyzomatoideae and Taenitidoideae). On the other hand, there is much disagreement on the taxonomy and generic delimitation of Cheilanthoid ferns. Nayar (1970). placed some of the Gymnogrammeoid ferns in the Pteridaceae, some in Adiantaceae and rest to the Cheilanthaceae. Pichi sermoli (1977). placed the Cheilanthoid genera in the Sinopteridaceae. Smith *et al.*, (2006). in his classification based on recent systematic studies, in addition to morphological data, placed the Cheilanthoid ferns under the family Pteridaceae. According to Mazooji and Salimpour (2011). Pteridaceae family has nine species belonging to five genera in Iran. These species are distributed in the northern and southern parts of country. There are similarities between some these species. eg. *Cheilanthes persica* and *Cheilanthes acrostica* are similar in leaflet, shape of scales and *C. acrostica* has pseudo-indusium broad, irregularly ciliate with short cilia and *C. persica* has pseudo-indusium narrow, densely covered with long cilia. Also, *Cosentinia vella* was one of the *Cheilanthes* species in the past. The aim of this study is to analyze the spore's characters of these species using scanning electron microscopy and assess if these characteristics could be useful for systematic purpose specially in *Cheilanthes* species.

MATERIAL AND METHODS

Spore materials were obtained from Herbarium Vezarate Jahad Keshavarzi. Herbarium (IRAN) voucher specimens examined are given in table 1. For SEM study, the material dusted into SEM stubs and coated with platinum using the JEOL ISML-100. Shape, ornamentation, the equatorial and polar diameter, and the number of cells in annulus were studied (table 2). The Terminology used for spore sculpturing is based on the work by Moore (1991).

Table 1: Origin of the species and voucher no.

Species	Province	City Collection	Height(m)	Name of collection	Voucher no
<i>Adiantum capillus-veneris</i> L.	Khozestan	Mey davood	761	Mazooji	45980
<i>Anogramma leptophylla</i> L.	Fars	Kazeroon	800	safavi	45955
<i>Cheilanthes acrostica</i> Balbis	Lorestan	Khoram abad	722	eskandari	45261.2
<i>Cheilanthes persica</i> Bory.	Kermanshah	Gilan gharb	805	Eskandari-iranshahr-jalali-esfandiyari	45072
<i>Cosentinia vellea</i> (Aiton)	Fars	Firooz abad	1325	partovi	45066
<i>Onychium melanolepis</i> (Decne)	Fars	kazeron	800	safavi	45957
<i>Cheilanthes marantae</i> L.	Azarbayejane sharghi	kiliber	1500	eskandari	45604
<i>Pteris cretica</i> L.	Mazandaran	Janat rodbar	700	eskandari	56262
<i>Pteris dentate</i> Thunb.	Gilan	Rezvan shahr	50	Eskandari-ghanbari	45569

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Table 2: spore's characters of Pteridaceae species.

characters	Shape	Ornamentation	Equitorial view	Polar view	Cell number of annulus
species					
<i>Adiantum capillus-veneris</i>	Circular	Rugulate-Gemmate	41.43	35.43	19-23
<i>Anogramma leptophylla</i>	Triangular	Verrucate-Gemmate	34.36	37.73	14-15
<i>Cheilanthes acrostica</i>	Circular	triradiate	42.97	42.57	9-11
<i>Ch. marantae</i>	Elliptic	Baculate	26.03	38.72	8-10
<i>Ch.persica</i>	Circular	wizened	33.52	33.86	8-10
<i>Cosentinia vella</i>	Triangular	Rugulate	36.07	46.98	8-10
<i>Onychium melanolepis</i>	Circular	Echinate-perforate	37.44	36.90	6-8
<i>Pteris cretica</i>	Circular	Rugulate	28.28	29.88	19-21
<i>Pteris dentata</i>	Circular	Gemmate-Baculate	37.15	39.18	16-19

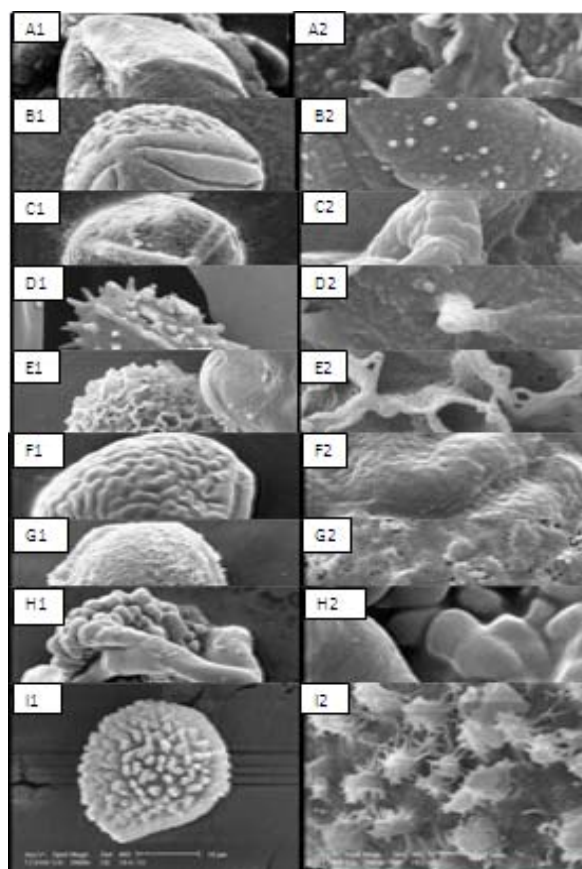


Fig. 1: scanning electron micrographs of shape and ornamentation in Pteridaceae species : A,2: *Adiantum capillus-veneris*; B1,2: *Anogramma leptophylla*; C1,2: *Cheilanthes acrostica*; D1,2: *Cheilanthes marantae*; E1,2: *Cheilanthes persica*; F1,2: *Cosentinia vella*; G1,2: *Onychium malanolepis*; H1,2: *Pteris cretica*; I1,2: *Pteris dentate*.

According to our observation, the spore characters could be useful for distinguishing the closer species. Comparison between *Ch. acrostica* and *Ch. persica* shows that spore shapes and leaflet are not an important diagnostic morphological characters to separate them, but the size of spores and ornamentation can separate them. Also, the spore sculpture is useful for distinguishing of *Cosentinia vella* and Cheilanthoid ferns. This species was named *Cheilanthes vella* in the past but the scales of pinnate, ornamentation and shape of spore in this taxon, confirmed that this is a separate genus from *Cheilanthes*. *Pteris* is one of the other genus in Pteridaceae family that has two species in Iran. Based on Table 2 and Fig 1, the shape, ornamentation and cell number of annulus are very similar by with the different mean of size can separate them. The results derived from our studies point at the need of further researches on spore specially by using TEM in order to obtain more information about ultrastructure in this family.

RESULTS AND DISCUSSION

The spore sizes vary from 26.03 micro meter to 42.97 micro meter. The spores are monolet or trilete and have circular, elliptic or triangular shapes (Fig. 1-9). The largest spore is showed in *Cheilanthes acrostica* and the smallest one is in *Pteris cretica*. The ornamentation of spores are variated such as rugulate, verrucate, gemmate or baculate (Table 2).

Based on our results, the identification key is devised using spore characteristic as followed:

1. + spore triangular shape.....2
 _ spore circular or elliptic shape.....3
2. + cell number of annulus is > 10.....*Anogramma leptophylla*
 _ cell number of annulus is < 10.....*Cosentinia vella*
3. + spore rugulate-gemmate.....*Adiantum capillus-veneris*
 _ spore different from above.....4
4. + the equatorial diameter is > 30 micro meter.....6
 _ the equatorial diameter is < 30 micro meter.....5
5. + spore rugulate.....*Pteris cretica*
 _ spore baculate.....*Cheilanthes marantae*
6. + cell number of annulus is < 10.....7
 _ cell number of annulus is > 10.....*Pteris dentata*
7. + the polar diameter > 40.....*Cheilanthes acrostica*
 _ the polar diameter < 40.....8
8. + spore echinate-perforate.....*Onychium melanolepis*
 _ spore wizened.....*Cheilanthes persica*

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