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POLLEN FLORA OF PAKISTAN -XL. FUMARIACEAE

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Abstract

Pollen morphology of 9 species of the family Fumariaceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains are usually radially symmetrical, isopolar rarely apolar 3-6 colpate occasionally porate, prolate-sub-prolate or oblate-spheroidal rarely sub-oblate. Sexine thinner or thicker than nexine. Tectum rugulate - fossulate or fossulate-foveolate. On the basis of apertural type, two distinct pollen types are recognized viz., *Corydalis diphylla*- type and *Fumaria indica* - type. Playnological data has been useful at generic and specific level.

Introduction

Fumariaceae is a small family of about 19 genera and 400 species (Mabberley, 1987) occurring mainly in north America, Europe, Asia and Africa. In Pakistan it is represented by 2 genera and 30 species (Jafri, 1974).

Most of the systematists treated Fumariaceae as a subfamily of Papaveraceae. However, although a few taxa are morphologically intermediate, the members of Fumariaceae generally are quite distinct from those of Papaveraceae in floral symmetry, sap character, stamen number and fusion. In this family plants are usually herbs with watery juice, the perennials in the family have swollen corm like root-stocks; leaves usually variously divided. Species of *Dicentra* (Dutchman's breeches, bleeding heart) are grown as garden perennials. Some species of *Fumaria* are weeds. (Gagneepain, 1898; Nair, 1962; Erdtman, 1945, 1963; Layka, 1973; Dimbleby, 1974; Rachele, 1974; Kuprianova & Alyoshina, 1978). Rydberg (1960) examined the pollen morphology of family Fumariaceae in his monographic studies. Moore & Webb (1978) also examined pollen morphology of few species of the family Fumariaceae. There are no reports on pollen morphology of family Fumariaceae from Pakistan. Present investigations are based on the pollen morphology of 9 species representing two genera of the family Fumariaceae by light and scanning electron microscope.

Materials and Methods

Pollen samples were obtained from Karachi University Herbarium (KUH) or collected from the field. The list of voucher specimens is deposited in KUH. The pollen grains were prepared for light (LM) and scanning microscopy (SEM) by the standard methods described by Erdtman (1952). For light microscopy, the pollen grains were mounted in unstained glycerine jelly and observations were made with a Nikon Type-2 microscope, under (E40, 0.65) and oil immersion (E100, 1.25), using 10 x eye piece. For SEM studies, pollen grains suspended in a drop of water were directly transferred with a fine pipette to a metallic stub using double sided cello tape and coated with gold in a sputtering chamber (Ion-sputter JFC-1100). Coating was restricted to 150 A. The S.E.M examination was carried out on a Jeol microscope JSM-2. The measurements are based on 15-20 readings from each specimen. Pollen diameter, polar axis (P) and equatorial diameter (E), aperture size, apocolpium, mesocolpium and exine thickness were measured (Table 1).

Table 1. General pollen characters of family Fumariaceae.

Name of taxa	Shape	P/E ratio	Polar length (P) µm	Equatorial diameter (E) µm	Colpus length (L) µm	Exine thickness in µm	Tectum
Corydalis falconeri Hook.f. & Thoms	Pr-Sp	1.01	30.0 (33.43 ± 0.93) 37.5	30.0 (32.81 ± 0.74) 35.0	22.50 (26.58 ± 27.50) 27.50	1.25 (1.75 ± 0.28) 2.25	Rugulate-fossulate
C. cornuta Royle	Sub-Ob	0.85	27.75 (28.93 ± 0.61) 30.0	32.50 (33.75 ± 0.72) 35.0	22.50 (23.33 ± 0.52) 25.0	2.0 (2.10 ± 0.15) 2.25	Rugulate
C. stewartii Fedde.	Ob-Sp	0.98	27.50 (29.50 ± 0.85) 30.0	27.50 (29.87 ± 0.87) 31.25	20.0 (23.12 ± 0.62) 25.0	2.0 (2.10 ± 0.15) 2.25	Rugulate
Corydalis adiantifolia Hook.f. et Thoms var. *adiantifolia*	Ob-Sp	0.90	21.66 (22.88 ± 0.13) 26.66	19.99 (25.21 ± 0.21) 28.33	16.66 (18.66 ± 0.12) 19.99	1.66 (1.75 ± 0.01) 1.99	Rugulate-fossulate
C. govaniana var. *swatensis* (Kitam) Jafri	Sub-Pr	1.16	41.22 (43.03 ± 0.10) 44.87	32.31 (31.92 ± 0.12) 37.69	28.72 (33.55 ± 0.17) 34.10	1.78 (2.39 ± 0.03) 3.23	Rugulate to fossulate
C. rupestris Kotschy ex Boiss	Pr-Sp	1.73	28.30 (30.96 ± 0.15) 33.30	24.37 (27.30 ± 0.16) 29.77	19.98 (21.47 ± 0.59) 24.97	0.99 (1.23 ± 0.01) 1.33	Rugulate
C. diphylla Wall.	Ob-Sp	0.92	32.50	35.0	27.5	1.25 (2.0 ± 0.26) 2.50	Rugulate-fossulate
C. gortschakovii Schrenk	Sp	1.00	30.0	30.0	20.0 (21.25 ± 1.25) 22.50	1.25 (1.37 ± 0.01) 1.50	Rugulate-fossulate
Fumaria indica (Hausskn.) Pugsley	Ob-Sp	0.99	32.50 (37.10 ± 0.78) 37.50	35.0 (37.2 ± 0.48) 40.0		1.2	Fossulate-foveolate

Abbreviations: Pr-Sp = Prolate-Spheroidal, Sub-Pr = Sub-prolate, Ob-Sp = Oblate-Spheroidal, Sub-Ob = Sub-Oblate, Sp = Spheroidal

The terminology used is in accordance with Erdtman (1952), Kremp (1965), Faegri & Iversen (1964) and Walker & Doyle (1975).

General pollen characters of the family Fumariaceae

Pollen grains are usually radially symmetrical, isopolar rarely apolar, 3-6 colpate occasionally porate in *Fumaria*, prolate to sub-prolate or oblate-spheroidal rarely sub-oblate, colpate Sexine thinner or thicker than nexine. Tectum rugulate - fossulate or fossulate - foveolate. On the basis of apertural types two distinct pollen types are recognized viz., *Corydalis diphylla* - type and *Fumaria indica* - type.

Key to the pollen types

+ Pollen grains colpate ……...…… *Corydalis diphylla* – type
- Pollen grains porate ……..……... *Fumaria indica* – type

Pollen type: *Corydalis diphylla* - type - (Fig. 1 A-F; Fig. 2 A-D)
Pollen class: Tricolpate, 4-6 colpate.
P/E ratio: 0.85-1.73
Shape: Prolate-spheroidal to oblate-spheroidal rarely sub-prolate to sub-oblate**.**
Apertures: Colpus long sunken with acute ends.
Exine: Sexine as thick as nexine.
Ornamentation: Rugulate-fosulate or fossulate-foveolate.
Measurements: Size: Polar axis P = 21 (32 ± 1.2) 44, and equatorial diameter E =19 (28 ± 2.1) 37 µm colpi 16.61 (25 ± 1.4) 34 µm long. Exine 0.9-2.5 µm thick, sexine as thick as nexine. Tectum rugulate-fossulate or fossulate-foveolate.
Species included: *Corydalis falconeri* Hook. F. Thoms., *C. cornuta* Royle., *C. stewartii* Fedde, *C. adiantifolia* Hook.f. et Thoms *var. adiantifolia, C. govanian* var. *swartensis* (Kitam.) Jafri, C. *rupestris* Kotschy ex Boiss., *C. diphylla* Wall, *C.gortschakovii Schrenk.*

Key to the species

1. + Pollen grains prolate-spheroidal or sub-prolate ……. 2
   - Pollen grains oblate-spheroidal or sub-oblate …… 4
2. + Pollen grains subprolate ……...…….... *C. govanian* var. *swartensis*
   - Pollen grains prolate-spheroidal ……. 3
3. + Pollen grains 6-colpate, rugulate ……... *C. rupestris*
   - Pollen grains tricolpate, rugulate-fossulate ……...…… *C. falconeri*
4. + Pollen grains 32.5 µm in polar length ……... *C. diphylla*
   - Pollen grains less than 32 µm in polar length …… 5
5. + Pollen grains sub-oblate …….. *C. cornuta*
   - Pollen grains oblate-spheroidal ……..……. 6
6. + Colpi 20-25 µm in length ……..……..…… 7
   - Copli 16-19 µm in length …….. *C. adiantifolia*
7. + Tectum simple rugulate ……...…….……... *C. stwertii*
   - Tectum rugulate-fossulate ……...…….. *C. gortschakovii*

Fig. 1. Scanning Electron micrographs of pollen grains. *Corydalis cornuta*: A, Polar view, B, Exine pattern. *C. diphylla*: C, Polar view; D, Exine pattern. *C. falconeri*: E, Polar view; F, Exine pattern. Scale bar = 10 µm.

Fig. 2. Scanning Electron micrographs of pollen grains. *Corydalis gortschakovii*: A, Equatorial view; B, Exine pattern. *C. stwertii*: C, Polar view; D, Exine pattern. *Fumaria indica*: E, Polar view; F, Exine pattern. Scale bar = 10 µm.

Pollen type: *Fumaria indica* - type (Fig. 2E & F).
Pollen class: Tri-porate
P/E ratio: 0.99
Shape: Oblate-spheroidal
Apertures: Pore more or less circular, operculate, annulate
Exine: Sexine thicker than nexine.
Ornamentation: Fossulate-foveolate
Measurements: Size: Length = 32.5 (34.1 ± 0.78) 37.5 µm and breadth 35.1 (37± 0.82) 40 µm, pore 7.5 (10.11 ± 0.42) 12.5 µm in diameter. Exine 2.5 µm thick, sexine thicker than nexine. Tectum fossulate - foveolate
Species included: *Fumaria indica* (Hausskn.) Pugsley

Discussion

Fumariaceae is a eurypalynous family. However, considerable variation in apertural types and exine pattern has been observed. The genus *Fumaria* is distinct by having porate pollen thus included in the separate pollen type i.e., *Fumaria indica* pollen type. Erdtman (1952) also reported similar type of pollen within this genus whereas, second pollen type i.e., *Corydalis diphylla* - type is easily delimited by having colpate pollen. However, 8 species of this type are easily separated on the basis of shape, size, apertural number and exine pattern (see key to the species). Fumariaceae is considered to be closely related to Papaveraceae and even sometimes considered as its subfamily i.e., Fumarioideae. However, Fumariaceae is distinguished from Papaveraceae by its watery juice and zygomorphic flower. Erdtman (1952) also divided the family Papaveraceae into three subfamilies viz., Fumarioideae, Papaveroideae and Hypecoideae and according to him all these subfamilies are quite heterogeneous palynologically, more especially subfamily Fumarioideae (in the genus *Fumaria* porate pollen are found). Palynology also support its exclusion from Papaveraceae. The tectum in Papaveraceae is quite different, it is reticulate or scabrate - punctate to spinulose (Perveen & Qaiser, 2001).

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