

POLLEN FLORA OF PAKISTAN–LXV. BERBERIDACEAE

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Abstract

Pollen morphology of 12 species representing 2 genera of the family Berberidaceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains usually radially symmetrical, isopolar or apolar, spheroidal or sub-prolate. Spiroaperturate rarely colpate (3-more), sexine thicker than nexine. Tectal surface mostly foveolate-fossulate or sub-psilate, often rugulate - reticulate. On the basis of apertural types and exine ornamentation four distinct pollen types are recognized, viz., *Berberis calliobotrys*-type, *Berberis jaeschkeana*-type, *Berberis kunawurensis*-type and *Epimedium elatum*-type.

Introduction

Berberidaceae is a small family of c. 13 genera, approximately 650 species, widely distributed in the world but more in North Hemisphere and South America (Mebberley, 1987). It is represented in Pakistan by 3 genera and c. 20 species (Jafri, 1975).

The family is characterized by perennial herbs and shrubs, leaves alternate or basal simple or compound often spiny, exstipulate. Flowers bisexual, actinomorphic. Calyx 3-6, corolla 3-6., regular, with isomerous stamens attached to the corolla tube and inferior ovary having two or more locules with axile placentation. The family is economically important as a source of garden ornamentals like *Berberis thunbergii* (Japanese barberry), the common barberry (*Berberis vulgaris*) is the host of wheat stem rust. The important genera of Berberidaceae are *Berberis*, *Nandina* and *Mahonia*. Pollen morphology of the family has been examined by Erdtman (1952), Kosenko (1980), Nowicke and Skvarla (1982). Nowicke & Skvarla (1981) examined pollen morphology and phylogenetic relationships of Berberidaceae. Blackmore & Heath (1984) examined the pollen morphology of northwest European species of the family Berberidaceae. There are no reports on pollen morphology of the family Berberidaceae from Pakistan. Present investigations are based on the pollen morphology of 12 species representing 2 genera of the family Berberidaceae by light and scanning electron microscope.

Materials and Methods

Polleniferous material was obtained from Karachi University Herbarium (KUH) or fresh material was collected from the field. The list of voucher specimens is deposited in KUH. The slides were prepared for light (LM) by the standard method described by Erdtman (1952) and the pollen grains were mounted in unstained glycerine jelly. Observations were made with a Nikon Type-2 microscope under (E40, 0.65) and oil immersion (E100, 1.25), using 10x 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 15 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 length (P) and equatorial diameter (E), and exine thickness were measured (Tables 1-2).

Table 1. General characters of pollen found in pollen type *Berberis jaeschkeana*.

Name of taxa	Diameter of pollen in μm	Exine thickness in μm
<i>Berberis baluchistanica</i> Ahrendt.	31.72 (33.5 $\pm$ 0.57) 36.50	1.72 (1.27 $\pm$ 0.13) 1.79
<i>Berberis brevissima</i> Jafri	21.11 (22.5 $\pm$ 0.12) 24.51	1.22 (1.37 $\pm$ 0.14) 1.41
<i>Berberis jaeschkeana</i> Schneid	38.75 (41.5 $\pm$ 0.41) 45.01	2.25 (2.71 $\pm$ 0.36) 2.53
<i>Berberis orthobotrys</i> Bien, ex Aitch.	48.12(49.12 $\pm$ 0.21)49.50	c. 2.6
<i>Berberis pseudumbellata</i> Parker	31.33 (33.6 $\pm$ 0.51) 35.9	c.2.11
<i>Berberis ulicina</i> Hook.f. & Thoms.	32.50(33.1 $\pm$ 0.25) 33.5	1.34 (2.10.12 $\pm$ 0.17) 1.07
<i>Berberis vulgaris</i> L.	21.81 (23.6 $\pm$ 0.18) 25.16	c.2.23

Table 2. General characters of pollen found in pollen type *Berberis kunawurensis*.

Name of taxa	Diameter of pollen in μm	Exine thickness in μm
<i>Berberis lycium</i> Royle	38.71 (41.5 $\pm$ 0.57) 45.5	2.25 (2.42 $\pm$ 0.34) 2.59
<i>Berberis kunawurensis</i> Royle	37.51 (41.51 $\pm$ 0.44) 45.8	2.10 (2.17 $\pm$ 0.26) 2.25
<i>Berberis pachyacantha</i> Koehne	40.5 (40.05 $\pm$ 0.12) 41.55	2.00 (2.4 $\pm$ 0.1 6) 2.85

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

General pollen characters of the family Berberidaceae

Pollen grains usually radially symmetrical, apolar rarely isopolar. Mostly spheroidal, often sub-prolate. Spiroaperturate rarely tricolpate to pantacolpate, sexine thicker than nexine. Tectum foveolate-fossulate or sub-psilate often rugulate-reticulate. On the basis of exine ornamentation and apertural types four distinct pollen types are recognized viz., *Berberis calliobotrys*-type, *Berberis jaeschkeana*-type, *Berberis kunawurensis*-type and *Epimedium elatum*-type.

Key to the pollen types

- 1 + Pollen grains isopolar..... *Epimedium elatum*-type
- Pollen grains apolar 2
- 2 + Pollen grains pantocolpate *Berberis calliobotrys*-type
- Pollen grains spiroaperturate3
- 3 + Tectum sub-psilate *Berberis kunawurensis*-type
- Tectum foveolate-fossulate *Berberis jaeschkeana*-type

Pollen type: *Berberis calliobotrys*-type (Fig. 1 A & B).

Pollen class: Pantocolpate

P/E ratio: 100

Shape: Spheroidal

Apertures: Colpi small, acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Foveolate-fossulate

Measurements: Size: Pollen diameter = $(42.5-)$ 48.6 ± 0.2 (-54.8) μm , Exine 2.25 $(2.3.0 \pm 0.5)$ 2.5 μm thick, sexine thicker than nexine. Tectum foveolate-fossulate.

Species included: *Berberis calliobotrys* Aitch.

Pollen type: *Berberis jaeschkeana*-type (Fig. 1C-E; Fig. 2 A-D).

Pollen class: Spiroaperturate

P/E ratio: 100.

Shape: Spheroidal

Apertures: Spiral long.

Exine: Sexine thicker than nexine.

Ornamentation: Foveolate-fossulate.

Measurements: Size: Length = $(35.5-)$ 47.1 2 ± 0.2 (-58.75) μm , Exine 2.25 (4.0 ± 0.5) 5.75 μm thick, sexine thicker than nexine. Tectum foveolate-fossulate often scabrate.

Species included: *Berberis jaeschkeana* Schneid., *Berberis baluchistanica* Ahrendt, *Berberis brevissima* Jafri, *Berberis orthobotrys* Bien, ex Aitch., *Berberis vulgaris* L. , *Berberis ulicina* Hook.f. & Thoms., and *Berberis pseudumbellata* Parker

Key to the species

- 1 + Pollen 21-25 μm in diameter group-I
(*Berberis vulgaris* L., and *Berberis brevissima* Jafri)
- Pollen 31-49 μm in diameter group-II

Berberis jaeschkeana Schneid., *Berberis baluchistanica* Ahrendt., *Berberis orthobotrys* Bien, ex Aitch., *Berberis ulicina* Hook.f. & Thoms. and *Berberis pseudumbellata* Parker.

Pollen type: *Berberis kunawurensis*-type

Pollen class: Spiroaperturate.

P/E ratio: 100

Shape: Spheroidal

Apertures: Spiral, long

Exine: Sexine thicker than nexine.

Ornamentation: Sub-psilate

Measurements: Size: Length = $(37.5-)$ 45.15 ± 0.2 (-52.8) μm , Exine 2.10 (2.34 ± 0.5) 2.91 μm thick, sexine thicker than nexine. Tectum subpsilate.

Species included: *Berberis lycium* Royle, *Berberis kunawurensis* Royle and *Berberis pachyacantha* Koehne.

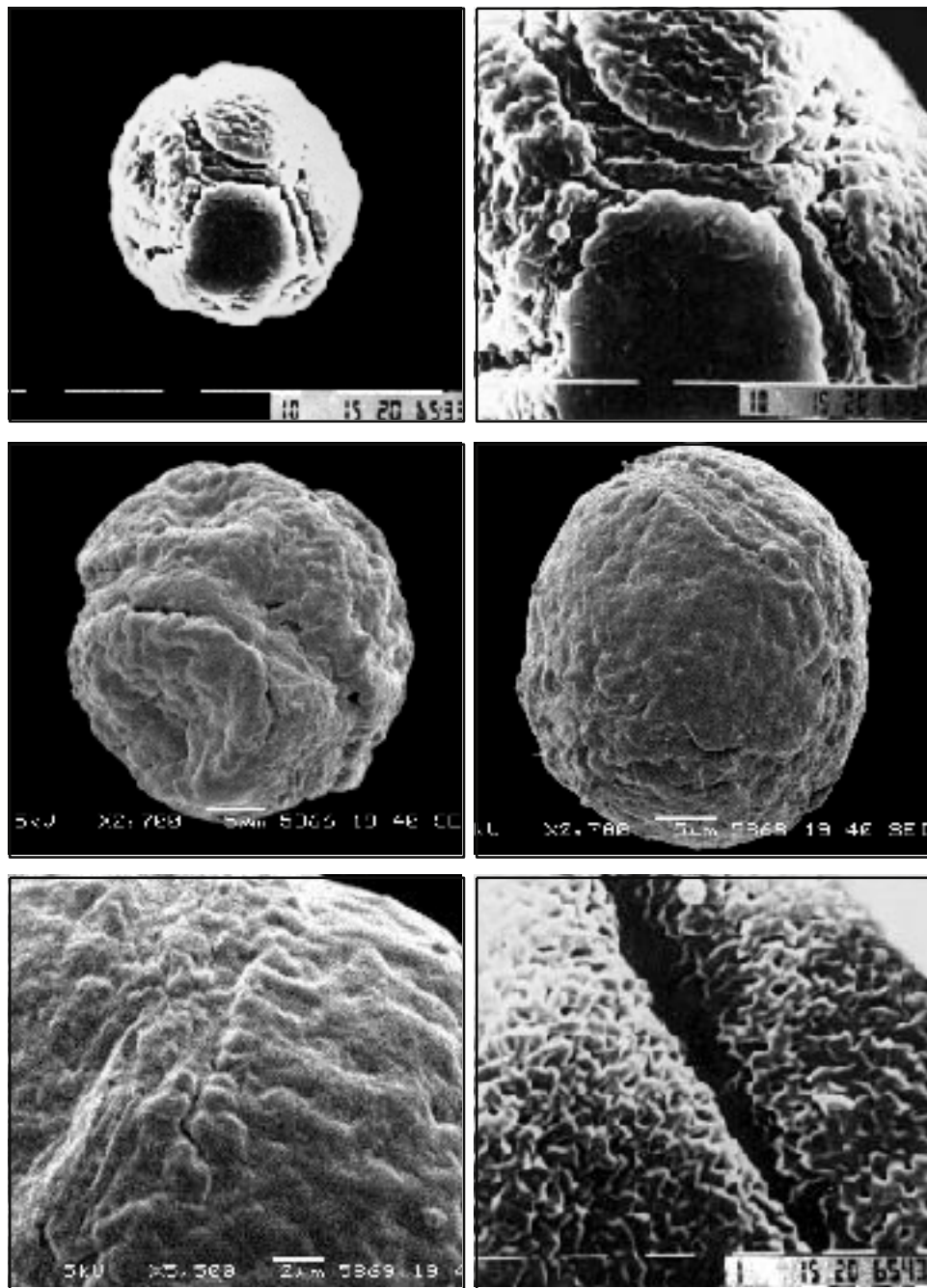


Fig. 1. Scanning Electron micrographs of pollen grains. *Berberis calliobotrys*: A, Pollen grain, B, Exine pattern. *Berberis ulicina* C, Pollen grain. *Berberis baluchistanica*: D, Pollen grain E, Exine pattern. *Epimedium elatum* F, Exine pattern.

Scale bar = A & B = 10 µm; C&D = 5 µm; E = 2 µm; B&F = 1 µm

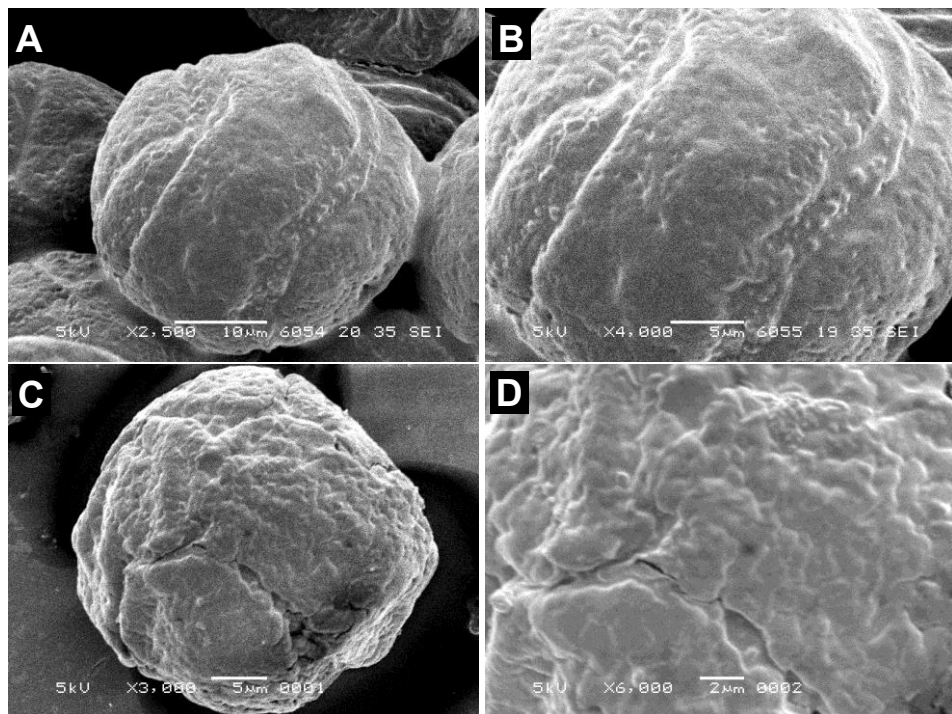


Fig. 2. Scanning Electron micrographs of pollen grains. *Berberis brevissima*: A, Pollen grain, B, Exine pattern. *Berberis orthobotrys* C, Pollen grain. D, Exine pattern.

Scale bar = A = 10 µm; D = 2 µm; BC = 5 µm.

Pollen type: *Epimedium elatum* - type (Fig. 1 F).

Pollen class: Tricolpate

P/E ratio: 1.21

Shape: Sub-prolate.

Apertures: Colpus long sunken with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Rugulate-fossulate.

Measurements: Size: Polar axis P = 32.75 (35.48±1.2) 38.25 and equatorial diameter E = 28.5 (30.22±2.1) 31.25 µm. colpi 30.61 (31.66±1.4) –35.25 µm long. Exine 1.75-2.75 µm thick, sexine slightly thicker than nexine. Tectum rugulate-fossulate.

Species included: *Epimedium elatum* Morr., & Decne.

Discussion

Berberidaceae is a eurapalynous family. Meacham (1980) recognized four generic groups viz., *Leontice*-group, *Berberis*-group, *Epimedium*-group and *Podophyllum*-group. Loconte (1993) divided the Berberidaceae into two subfamilies: Nandinoideae and Berberidoideae, he further divided the subfamily Berberidoideae into two tribes i.e., Leonticeae and Berberideae. Both the studied genera i.e., *Berberis* and *Epimedium* are placed into two separate subtribes Berberidineae and Epimediineae of the tribe

Berberideae. In the genus *Berberis* most of the species (10 out of the 11 studied species) have spiroaperturate pollen. Whereas in the *Berberis calliobotrys*-type pollen are pantocolpate. In the genus *Epimedium* pollen are tricolpate, thus indicating close link with the *Berberis*. Pollen grains generally spiroaperturate rarely colpate (tri-pantocolpate). In the present study on the basis of exine ornamentation and apertural types four distinct pollen types are recognized viz., *Berberis calliobotrys*-type, *Berberis jaeschkeana*-type, *Berberis kunawurensis* -type and *Epimedium elatum*-type. However, Blackmore and Heath (1984) divided the family Berberidaceae in three pollen types such as, *Berberis vulgaris*-type, *Epimedium alpinum*-type and *Mahonia aquifolium*-type. Loconte & Stevenson (1991) indicated the close relationship of Berberidaceae, Menispermaceae, Papaveraceae and Ranunculaceae on the basis of shared possession of nuclear endosperm development. Palynologically Berberidaceae also shows its relationship with these families by sharing common types i.e., tricolpate and pantocolpate in some genera of Berberidaceae such as *Epimedium* and even few species of *Berberis*.

References

- Blackmore, S. and G.L.A. Heath. 1984. Berberidaceae. In: *The northwest European pollen flora IV* . (Ed.): W. Punt & G.C.S. Clarke. pp. 7-21. Elsevier, Amsterdam
- Erdtman, G. 1952. *Pollen Morphology and Plant Taxonomy. Angiosperms*. Chronica Botanica Co., Waltham, Massachusetts.
- Fægri, K. and J. Iversen. 1964. *Text book of Pollen Analysis*. Munksgaard,
- Jafri, S.M.H. 1975. Berberidaceae. In: *Flora of Pakistan*. (Eds.): E. Nasir & S.I. Ali. 87: 1-31. Karachi.
- Kosenko, V.N. 1980. Comparative palynomorphological study of the family Berberidaceae. 2. Morphology of the pollen grains of the genera *Gymnospermium*, *Leontice*, *Caulophyllum*, *Bongardia*, *Epimedium*, *Vancouveria*, *Achlys* and *Jeffersonia*. *Botanicheskii zhurnal* (Moscow & Leningrad), 65: 1412-1423.
- Kremp, G.O.W. 1965. *Encyclopaedia of Pollen Morphology*, Univ. Arizona Press, Tuscon, U.S.A.
- Loconte, H. 1993. Berberidaceae. *The Families and Genera of Vascular Plants. II. Flowering Plants-Dicotyledons*. (Eds.): K. Kubitzki, J.G. Rohwer & V. Bittrich. Springer-Verlag: Berlín.
- Loconte, H. and D.W. Stevenson. 1991. Cladistics of the Magnoliidae. *Cladistics*, 7: 267-296.
- Mabberley, D.J. 1987. *The plant-book*. Cambridge University Press, Cambridge.
- Meacham, C.A. 1980. Phylogeny of the Berberidaceae with an evaluation of classifications. *Syst. Bot.*, 5: 149-172.
- Nowicke, J.W. and J.J. Skvarla. 1981. Pollen morphology and phylogenetic relationships of the Berberidaceae. *Smithsonian Contributions to Botany*, 50: 1-30.
- Nowicke, J.W. and J.J. Skvarla. 1982. Pollen morphology and the relationships of Circaeaster of Kingdonia and of Sargentodoxa to the Ranunculales. *American Journal Botany*, 69: 990-998.
- Walker, J.W. and J.A. Doyle. 1975. The basis of Angiosperm phylogeny: Palynology. *Ann. Mo. Bot. Gard.*, 62: 666-723.

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