

## POLLEN FLORA OF PAKISTAN–LXXII. ERICACEAE

ANJUM PERVEEN AND MUHAMMAD QAISER\*

Centre for Plant Conservation, Department of Botany,  
\*University of Karachi, Karachi-75270, Pakistan

### Abstract

Pollen morphology of three genera representing 5 species of the family Ericaceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains usually tetrads, radially symmetrical, isopolar, mostly prolate-spheroidal, olate-spheroidal rarely spheroidal, trizonocolporate, sexine thicker or thinner than nexine. Tectal surface mostly rugulate with viscin threads or aerolate-scabrate or subsilate-reticulate. On the basis of size and tectum types 3 distinct pollen types are recognized, viz., *Cassiope fastigiata*-type and *Rhododendron lepidotum*-type and *Rhododendron hypenanthum*-type.

### Introduction

Ericaceae is family of about 125 genera and 3500 species of cosmopolitan in distribution except in desert, confined to high elevations in the tropics (Mabberley, 2008). Plant shrubs or rarely small trees, leaves mostly alternate, simple, often evergreen, stipules absent, solitary or racemose, flowers bisexual, calyx 4-5, corolla 4-5 free or united, fruit capsule, berry or drupe.

Chief genera of the family are *Erica* (Heath), *Kalmia* (mountain laurel), *Rhododendron*, *Vaccinium* (Blueberry). Economically, the family is important for its ornamentals: blue berries and Canberries. It is represented in Pakistan by 4 genera (Ali, 19871). Kron *et al.*, (2002) recognized nine subfamilies viz., Enkianthoideae, Pyroloideae, Monotropeoideae, Arbutoideae, Cassiopoideae, Ericoideae, Harrimanelloideae, Styphelioideae and Vaccinioideae, on the basis of molecular data (nuclear chloroplast DNA), morphological data, anatomy and embryology.

Pollen morphology of the family has been examined by Erdtman (1952), Yang (1952), Oldfield, (1959), Frank and Watson 1963), Warner & Chinnappa (1986), Vasanthi & Pocock (1987), Foss & Doyle (1988) Takahashi (1988) and Moore *et al.*, (1991), Pollen morphology of Ericaceae-like pollen from tertiary period has been examined by Zetter & Hesse (1996). Gao *et al.*, (2002) studied the pollen morphology of some species of the genus *Rhododendron*. Zhang & Anderberg (2002) studied the pollen morphology in the ericoid clade of the order Ericales. Yang *et al.*, (2003) examined leaf anatomy and pollen morphology of *Rhododendron mkranthum* of the family Ericaceae. Pollen morphology and taxonomy of twenty six species of *Rhododendron* has been carried out by Li *et al.*, (2008). Yue-Jiao *et al.*, (2009) studied the pollen morphology of the genus *Rhododendron* subgenera Tsutsusi and its systematic implication. There are no reports on pollen morphology of the family Ericaceae from Pakistan. Present investigations are based on the pollen morphological studies of 5 species representing 2

genera of the family Ericaceae by light and scanning electron microscope.

### Materials and Methods

Polleniferous material was obtained from the specimens of Karachi University Herbarium (KUH). 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 glycerin jelly and 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 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), equatorial diameter (E), aperture size and exine thickness were measured.

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

### General pollen characters of the family Ericaceae

Pollen grains usually tetrahedral tetrads, single pollen radially symmetrical, isopolar. Shape mostly prolate-spheroidal rarely spheroidal. Pollen are 3-zonocolporate often apertural membrane granulate, sexine thicker or thinner than nexine. Tectal areolate-scabrate or subsilate-reticulate often rugulate with viscin threads. On the basis of size and tectum types three distinct pollen types are recognized viz., *Cassiope fastigiata*-type, *Rhododendron lepidotum*-type and *Rhododendron hypenanthum*-type.

### Key to the pollen types

1. + Pollen grains 27-30  $\mu\text{m}$  ..... *Cassiope fastigiata*-type
- Pollen grains more than 30  $\mu\text{m}$  ..... 2
2. + Exine ornamentation aerolate-scabrate ..... *Rhododendron lepidotum*-type
- Exine ornamentation sub-psilate-reticulate ..... *Rhododendron hypenanthum*-type

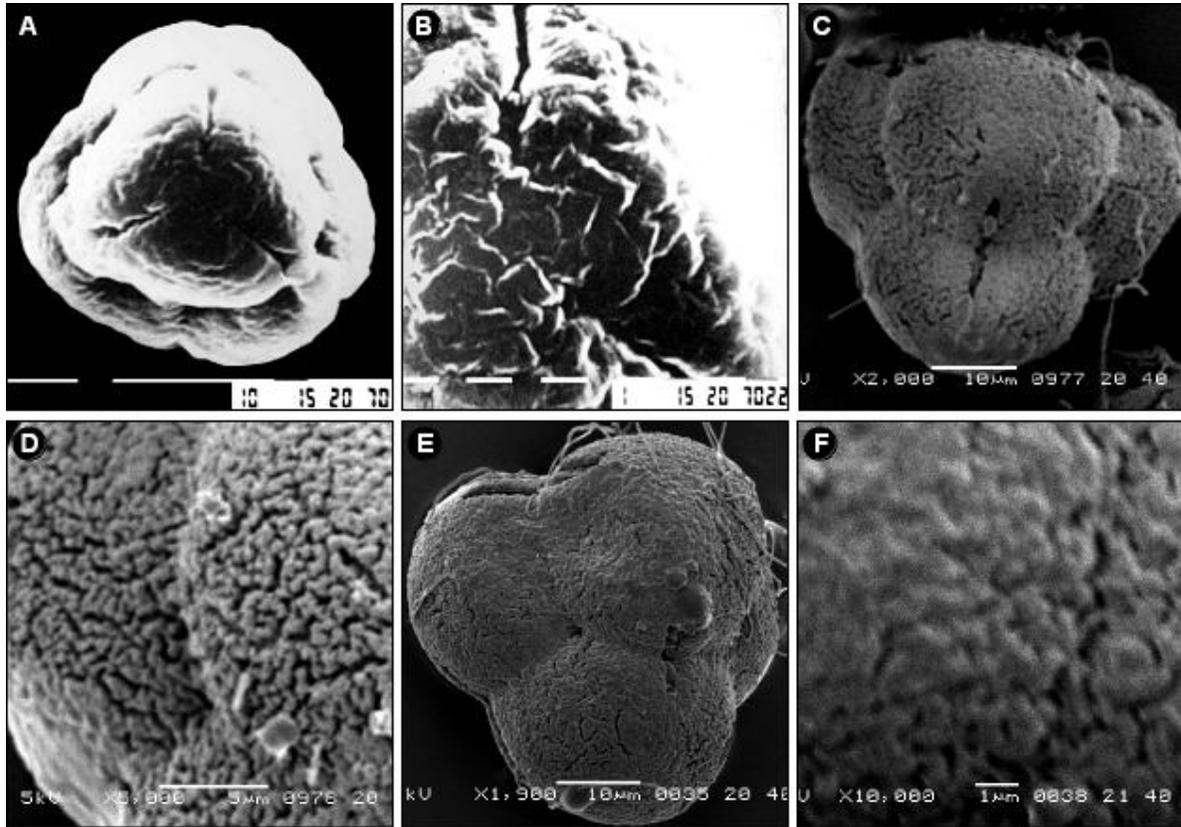


Fig. 1. Scanning electron micrograph: *Cassiope fastigiata*: A, Tetrad, B, Exine pattern. *Rhododendron afghanicum*: C, Tetrad, D, Exine pattern. *Rhododendron hypenanthum*: E, Tetrad, F, Exine pattern.

**Pollen type:** *Cassiope fastigiata*-type (Fig. 1A & B)

**Pollen class:** 3-zonocolporate

**P/E ratio:** 0.99

**Shape:** Oblate-spheroidal

**Apertures:** Tricolporate

**Exine:** Sexine thicker than nexine

**Ornamentation:** Finely rugulate with fine scabrae.

**Measurements: Size:** P = (27.5-) 28.5±0.22 (-30) µm, and breadth (27.5) 29.3±0.38 (32.5) µm, Exine (1.25-) 1.62±0.22 (-2.25) µm thick, sexine thicker than nexine. Tectum finely rugulate with viscin threads.

**Species included:** *Cassiope fastigiata* (Wall.) D. Don.

**Pollen type:** *Rhododendron lepidotum*-type (Fig. 1C & D)

**Pollen class:** 3-zonocolporate

**P/E ratio:** 1.01

**Shape:** Prolate-spheroidal

**Apertures:** Small colpi

**Exine:** Sexine thicker than nexine.

**Ornamentation:** Areolate with fine scabrae with viscin threads.

**Measurements: Size:** Length = (42.5-) 46.01±1.43 (-52.7) µm and breadth (35.10) 45.01±0.11 (50.01) µm, Exine (3.5) 4.7±2.01 (5.01) µm thick, sexine thicker than nexine. Tectum areolate- scabrate with fine scabrae with viscin threads.

**Species included:** *Rhododendron lepidotum* Wall. ex D. Don., *Rhododendron afghanicum* Aitch. and Hemsl., *R. collettianum* Aitch. and Hemsl.

**Pollen type:** *Rhododendron hypenanthum*-type (Fig. 1E-F).

**Pollen class:** 3-zonocolporate

**P/E ratio:** 100

**Shape:** Oblate-spheroidal

**Apertures:** More or less circular

**Exine:** Sexine thicker than nexine

**Ornamentation:** Sub-psilate-reticulate

**Measurements: Size:** Length = (31.35-) 32.87±1.31 (-35.4) µm and breadth (31.21) 33.51±0.67 (36.35) µm, Exine 5.15 (8.56±0.12) 6.12 µm thick, sexine thicker than nexine. Tectum subpsilate-reticulate.

**Species included:** *Rhododendron hypenanthum* Balf.f.

**Discussion**

Ericaceae pollen are easily recognized by having tetrahedral tetrads, single grain trizonocolporate, triangular, Ericaceae like pollen (tetrahedral tetrads and viscin threads) in fossil record of various Eocene/Oligocene/Miocene localities in Europe, North America, and Asia have been reported by Zetter & Hesse (1996). Present pollen data is based on pollen morphology of 5 species representing two genera viz., *Cassiope* and *Rhododendron*. Pollen shows a considerable variation particularly in exine ornamentation and pollen size. On the basis of pollen size and exine pattern three different pollen types are recognized viz., *Cassiope fastigiata*-type, *Rhododendron hypenanthum*-type and *Rhododendron lepidotum*-type.

Pollen grains usually radially symmetrical, isopolar, trizonoporate, pollen generally sheds in tetrads. However, Sarwar (2007) also reported monads and polyads along with tetrads, in the family Ericaceae, Tectum of the pollen is also significantly variable. For instance, in *Rhododendron hypenanthum* subsilate-reticulate tectum is observed, whereas, remaining species i.e., *Rhododendron lepidotum* Wall. ex D. Don, *Rhododendron afghanicum* Aitch. and Hemsl., *Rhododendron colletianum* Aitch., and Hemsl., *Rhododendron collettianum* Aitch., and Hemsl., have areolate-scabrate exine pattern. However, *Cassiope fastigiata* is easily recognized by having subsilate-rugulate exine ornamentation. Shape class is oblate-spheroidal to prolate-spheroidal or spheroidal. Similar pollen shape class has also reported by Yue *et al.*, (2009).

Sarwar (2011) also suggested that the qualitative pollen characters (e.g., exine sculpture ornamentation) were found to be taxonomically more important than quantitative characters (e.g., tetrad diameter). Furthermore, they also suggested that the family Ericaceae is eurypalynous enough to clarify the differentiation of species and genera, but has limited potential for clarification of the demarcation and relationships of higher taxa. However, Li *et al.*, (2008) studied the pollen morphology of 26 wild *Rhododendron* species in southwest mountain region of Sichuan, distributed in three subgenera viz., i) Subgen. *Rhododendron*, ii) Subgen. *Hymenanthes*, iii) Subgen. *Pseudorhodorastrum*, 4 sections and 12 subsections they suggested that the diameter of the tetrahedral tetrads is more significant pollen character for classifying the subgenera of the family Ericaceae as compared the exine ornamentation and size of the aperture.

Our results are in agreement with that of Sarwar *et al.*, (2011), exine ornamentation is the significant pollen character to delimit the taxa of the family Ericaceae. Perveen & Qaiser (2013) reported tetrads pollen with viscin threads in the family Onagraceae.

## References

- Ali, Z. 1971. Ericaceae. *Flora of Pakistan* (Eds.): E. Nasir and S.I. Ali, 5: 1-9. Rawalpindi.
- Warner, B.G. and C. Chinnappa. 1986. Taxonomic implications and evolutionary trends in pollen of Canadian Ericales. *Can. J. of Bot.*, 64(12): 3113-3126.
- Fægri, K. and J. Iversen. 1964. *Text Book of Pollen Analysis*. Munksgaard.
- Foss, P.J. and G.J. Doyle. 1988. A palynological study of the Irish Ericaceae and Empetrum. *Pollen et Spores*, 30: 151-178.
- Frank, J.W. and L. Watson. 1963. The pollen morphology of some critical Ericales. *Pollen Spores*, 5: 51-66.
- Gao Lian-Ming, Zhang Chang-Qin, LI De-Zhu and WEI Zhong-Xin. 2002. Pollen Morphology of *Rhododendron* subgenus *azaleastrum*. *J. of Wuhan Bot., Research*, 20(3): 177-181.
- Jia-ning, M.A.O. 2000. A study on pollen morphology of 4 Azalea (*Rhododendron* species). *J. of Southwest Agricultural University*.
- Kremp, G.O.W. 1965. *Encyclopaedia of Pollen Morphology*. Univ. Arizona Press, Tuscon, U.S.A.
- Kron, K.A., W.S. Judd, P.F. Stevens, D.M. Crayn, A.A. Anderberg, P.A. Gadek, C.J. Quinn and J.L. Luteyn. 2002. Phylogenetic Classification of Ericaceae: Molecular and Morphological Evidence. *The Bot. Rev.*, 68(3): 335-423.
- Li, Zhou Lanying Wang Yongqing Zhang. 2008. Pollen morphology and its taxonomy of twenty-six species in *Rhododendron Scientia Silvae Sinicae*, 2: 02.
- Mabberley, D.J. 1997. *The Plant Book, a Portable Dictionary of Higher Plants.*, Cambridge University Press, Cambridge.
- Moore, P.D., J.A. Webb and M.E. Collinson. 1991. *Pollen Analysis.* – London.
- Oldfield, F. 1959. The pollen morphology of some of the West European Ericales-Pollen Spores 30: 151-178.
- Perveen, A. and M. Qaiser. 2013. Pollen flora of Pakistan-LXXI. Onagraceae. *Pak. J. Bot.*, 45(1): 241-245
- Sarwar, A.K.M. Golam. 2011. Pollen morphology of Ericaceae and its systematic significance Germany: Lambert Academic Press: 978-3-8443-8550-2.
- Sarwar, A., K.M. Golam and H. Takahashi. 2007. An overview of pollen morphology and its systematic significance within the blueberry tribe Vaccinieae (Vaccinioideae; Ericaceae). *Jap. J. Palynol.*, 53(2): 87-104.
- Takahashi, H. 1988. Pollen morphology and systematic in two sub-families of Ericaceae: Pyroloideae and Monotropoideae. *Korean J. Plant Tax.*, 18: 9-17.
- Ueno, J. 1962. Palynological notes on Ericaceae and Pyrolaceae from Japan and its neighbors. *Acta Phytotax Geobot.*, 20: 101-112.
- Vasanthy, G. and S.A.J. Pocock. 1987. On the pollen tetrads of the south Indian Ericaceae, Gaultheria, *Rhododendron* and *Vaccinium* with special reference to *R. nilagiricum*. *Zenk. Bull. Jard. Bot. Nat. Belg.*, 57: 213-245.
- Walker, J.W. and J.A. Doyle. 1975. The basis of Angiosperm phylogeny: Palynology. *Ann. Mo. Bot. Gard.*, 62: 666-723.
- Yang Rui Lin, Wei Xue-Zhi and Bi Run-Cheng. 2003. A study on the leaf epidermis and the pollen morphology of *Rhododendron mkranthum* Acta Botanica Boreali-Occidentalia Sinica, 23(5): 806-810.
- Yang, B.Y. 1952. Pollen grain morphology in the Ericaceae. *Quar. J. Taiwan Mus.* 5: 1-24.
- Yue-Jiao Zhang, Xiao-Feng Jin, Bing-Yang Ding and Jing-Ping Zhu. 2009. Pollen morphology of *Rhododendron* subgen. *Tsutsusi* and its systematic implications. *J. of Syst. and Evol.*, 47(2): 123-138.
- Zetter, R. and M. Hesse. 1996. The morphology of pollen tetrads and viscin threads in some tertiary, *Rhododendron*-like Ericaceae. *Grana*, 35: 285-294.
- Zhang, X.P. and A.A. Anderberg. 2002. Pollen morphology in the ericoid clade of the order Ericales, with special emphasis on Cyrillaceae. *Grana*, 41: 201-215.

(Received for publication 9 March 2012)