

POLLEN FLORA OF PAKISTAN–LVI. VALERIANACEAE

ANJUM PERVEEN AND MUHAMMAD QAISER

*Department of Botany, University of Karachi,
Karachi -75270, Pakistan.*

Abstract

Pollen morphology of 13 species representing 2 genera of the family Valerianaceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains usually radially symmetrical, isopolar, mostly prolate-spheroidal to sub-prolate, often oblate-spheroidal rarely prolate. Tricolpate sexine thicker or thinner than nexine. Tectal surface mostly spinulose rarely scabrate or echinate. On the basis of exine ornamentation 3 distinct pollen types are recognized viz., *Valeriana jatamansi*-type, *Valeriana hardwickii*-type, *Valerianella dentata*-type.

Introduction

Valerianaceae is a family of about 13 genera and more or less 400 species, chiefly confined to temperate regions with exception of Andes of South America (Mabberley, 1987). It is represented in Pakistan by 3 genera and c. 22 species (Nasir, 1976).

Valerianaceae originally described by Linneaus (1753, 1754), is divided into three tribes viz., 1) Patrinieae, 2) Triplostegieae and 3) Valerianeae by Graeber (1906). Backlund (1996) suggested that the family Valerianaceae is comprised of 14 genera, distributed in two in tribe Patrinieae (*Patrinia* and *Nardostachys*), a single genus (*Triplostegia*) in the tribe Triplostegieae, and the 11 remaining genera are grouped into five sub tribes in the Valerianeae. Plants mostly herbs or shrubs. Annual to perennial; with or without basal aggregation of leaves, when perennial, the rhizome usually strongly scented. Leaves simple or compound, exstipulate. Flowers bisexual usually clusters with bract or bracteoles. Fruit achene-like with wing or plumose.

Many members of the Valerianaceae have a distinctive odor due to the presence of valerianic acid and its derivatives. Several species have medicinal properties, and root and leaf extracts are used in treating nerve complaints. A few species are used for perfumes and dyes. Some European species of *Valerianella* are used in salads. However, some plants contain poisons in high concentrations.

Pollen morphology of the family has been examined by Ting (1949), Erdtman (1952, 1966), Wang (1960), Taranvski *et al.*, (1966). Kuprianova & Alyoshina (1978). Nowicke & Skvarla (1979), Patel & Skvarla (1979), Blackmore & Cannon (1983), Backlund & Nilsson (1997). Clarke (1978) examined pollen morphology of family Valerianaceae in relationship to taxonomy. Clarke & Jones (1981) studied pollen morphology of the family Valerianaceae from North Western Europe. There are no reports on pollen morphology of the family Valerianaceae from Pakistan. Present investigations are based on the pollen morphology of 13 species representing 2 genera of the family Valerianaceae by light and scanning electron microscope.

Materials and Methods

Polleniferous material was obtained from Karachi University Herbarium (KUH) or fresh material 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 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 150A. 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 and exine thickness were measured (Tables 1).

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

General pollen characters of the family Valerianaceae

Pollen grains usually radially symmetrical, isopolar. Shape mostly prolate-spheroidal, to sub-prolate rarely oblate-spheroidal. Tricolpate, sexine thicker or thinner than nexine. Tectal mostly spinulose rarely echinate or scabrate.

On the basis of exine ornamentation 3 distinct pollen types are recognized viz., *Valeriana jatamansi*-type, *Valeriana hardwickii*-type and *Valerianella dentata*-type.

Key to the pollen type

- 1 + Tectum scabrate *Valerianella dentata*-type
 - Tectum not as above 2
- 2 + Tectum spinulose *Valeriana hardwickii*-type
 - Tectum echinate *Valeriana jatamansi* type 4

Pollen type: *Valeriana hardwickii*-type (Fig. 1 A-F).

Pollen class: 3-colpate.

P/E ratio: 99-128.

Shape: Prolate-spheroidal to sub-prolate often oblate-spheroidal.

Apertures: Colpus long narrow with acute ends.

Exine: Sexine thinner than nexine.

Ornamentation: Spinulose

Measurements: Size: Length = (28.72-) 44.80 ± 0.52 (-61.03) μm , and breadth (25.01) 32.87 ± 0.59 (40.74) μm , colpi (17.95.0-) 34.10 ± 0.42 (50.26) μm in long. Mesocolpium 25.01-35.5 μm . Apocolpium 7.2 (8.12 ± 0.16) 8.0 4 μm . Exine 2.5 (3.55 ± 0.12) 4.51 μm thick, sexine thicker than nexine. Tectum spinulose.

Species included: *Valeriana clarkei* Briq., *Valeriana hardwickii* Wall., *Valeriana pyrolifolia* Decne., *Valeriana himalayana* Grub., *Valeriana fedtschenkoi* Coincy, *Valeriana joeschkei* C.B. Clarke, *Valeriana ficariifolia* Boiss., *Valeriana stracheyi* C.B. Clarke, *Valerianella muricata* (Stev.) Baxt., *Valerianella oxyrrhyncha* Fisch., *Valerianella szovitsiana* Fish & May.

Table 1. General characters of pollen grains found in the pollen type-*Valeriana hardwickii*.

Name of taxa	Shape	Polar axis (P) in μm	Equatorial diameter (E) μm	Colpus length in μm	Exine thickness in μm	Tectum
<i>Valeriana pyrolifolia</i> Deene.	Pr-Sp	40.10 (41.70 \pm 0.34) 42.50	36.25 (39.77 \pm 0.62) 43.75	30.10 (30.11 \pm 0.10) 31.25	2.25 (3.02 \pm 0.17) 4.0	Spinulose/Scabrate
<i>Valeriana hardwickii</i> Wall.	Sub-Pr	36.50 (37.40 \pm 0.10) 37.50	25.0 (30.07 \pm 1.0) 35.0	20.0 (22.75 \pm 0.78) 22.50	2.25 (2.57 \pm 0.06) 3.0	Spinulose, subpsilate
<i>Valeriana himalayana</i> Grubov.	Pr-Sp	37.50 (39.85 \pm 0.44) 41.50	37.50 (39.17 \pm 0.44) 40.10	27.50 (27.85 \pm 0.35) 30.0	2.25 (2.42 \pm 0.04) 2.50	Spinulose/ Scabrate
<i>Valeriana fedtschenkoi</i> Coiney	Pr-Sp	43.75 (44.08 \pm 0.56) 45.75	32.50 (41.04 \pm 2.29) 47.50	25.10 (26.87 \pm 0.77) 30.10	3.0 (3.77 \pm 0.12) 3.75	Spinulose/ Scabrate
<i>Valerianella muricata</i> (Stev.) Baxt	Pr-Sp	32.50 (34.60 \pm 1.09) 37.50	31.25 (32.30 \pm 0.31) 33.25	20.0 (21.10 \pm 1.0) 25.0	3.25 (3.80 \pm 0.14) 4.0	Spinulose/ Subpsilate
<i>Valerianella oxyrrhyncha</i> Fisch. & C.A. May	Pr-Sp	41.25 (43.95 \pm 0.93) 47.50	38.75 (41.16 \pm 0.72) 43.75	26.25 (28.95 \pm 1.18) 32.50	3.50 (4.16 \pm 0.17) 4.50	Spinulose
<i>Valerina clarkei</i> Briq.	Sub-Pr	35.90 (37.89 \pm 0.64) 43.0	25.13 (32.30 \pm 0.70) 35.90	25.0 (26.37 \pm 0.47)	2.87 (3.34 \pm 0.06) 3.59	Spinulose
<i>V. stracheyi</i> C.B. Clarke	Sub-Pr	28.72 (32.80 \pm 0.42) 35.90	25.13 (27.26 \pm 0.54) 32.31	21.54 (22.66 \pm 0.42) 25.13	2.51 (3.05 \pm 0.0056) 3.23	Spinulose
<i>V. jaeschkeyi</i> C.B. Clarke	Sub-Pr	50.26 (58.75 \pm 1.0) 61.03	38.17 (45.60 \pm 1.30) 48.48	39.40 (44.75 \pm 1.04) 50.26	3.59 (3.70 \pm 0.066) 4.30	Spinulose
<i>V. ficariffolia</i> Boiss.	Pr-Sp	28.72 (37.14 \pm 0.80) 39.40	25.13 (34.19 \pm 0.90) 39.48	17.95 (23.93 \pm 0.75) 28.72	3.23 (3.42 \pm 0.04) 3.59	Spinulose
<i>Valerianella szovitsiana</i> F. & M.	Pr	35.90 (44.20 \pm 0.95) 52.05	32.31 (39.37 \pm 1.0) 46.67	25.13 (28.47 \pm 0.67) 35.90	3.59 (3.83 \pm 0.09) 4.66	Spinulose

Abbreviation: Pr-Sp= Prolate-Spheroidal, Sub-Pr= Sub-Prolate, Pr= Prolate

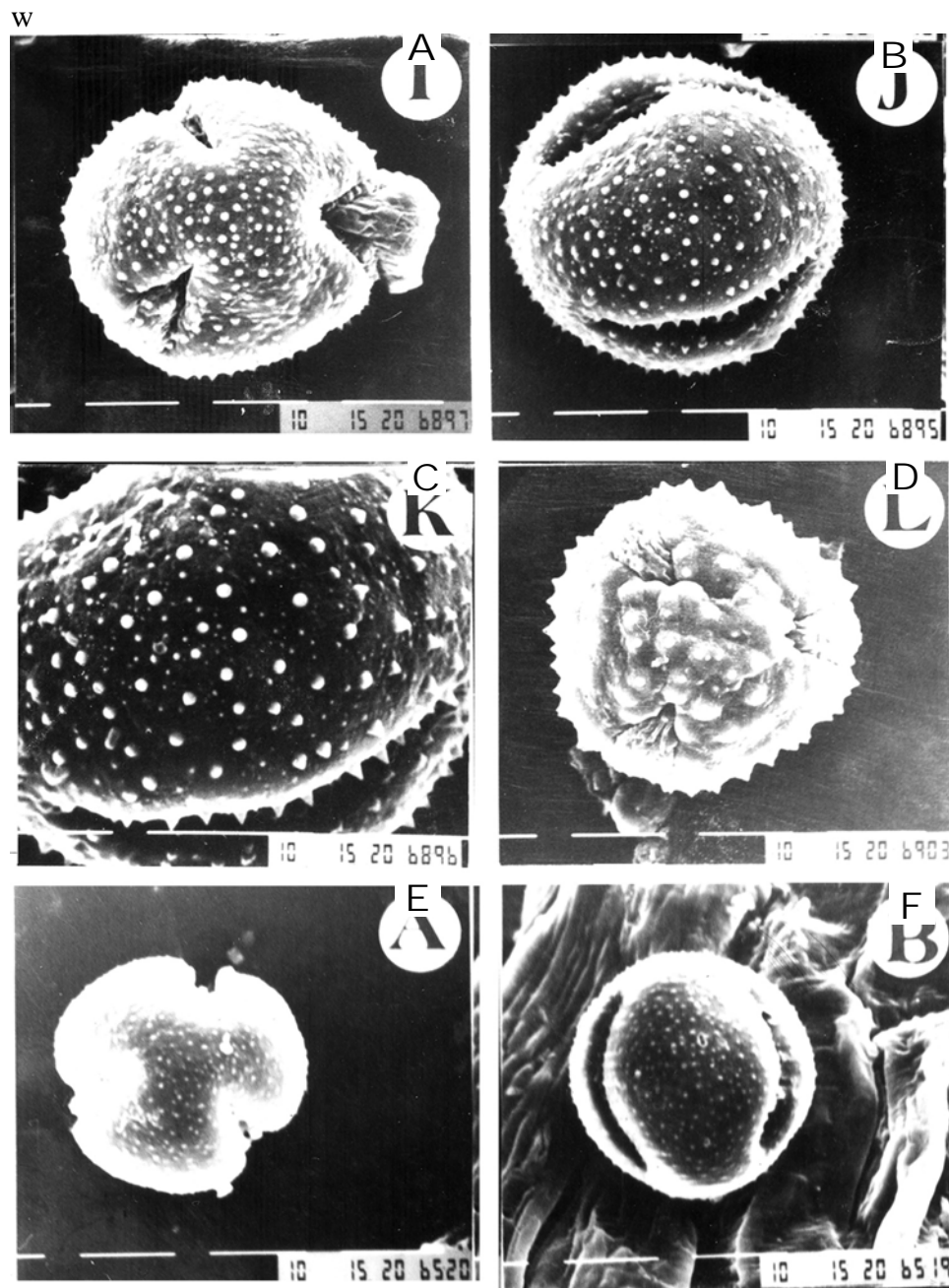


Fig. 1. Scanning Electron micrographs of pollen grains. *Valeriana fedtschenkoi*: A, Polar view; B, Equatorial view; C, Exine pattern. *V. pyrolifolia*: D, Polar view. *Valerianella muricata*: E, Polar view; F, Equatorial view.

Scale bar = A-F= 10 μ m

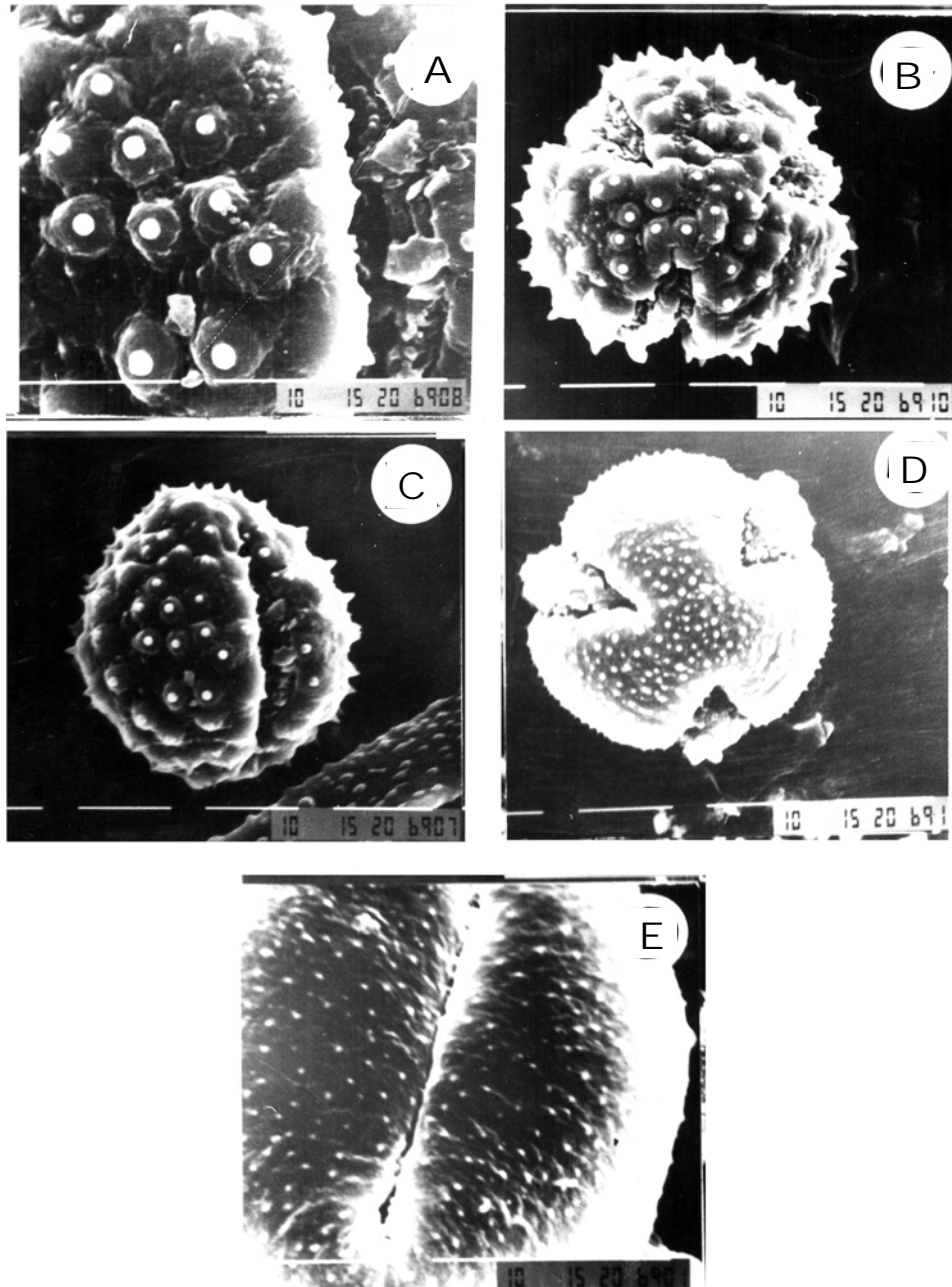


Fig. 2. Scanning Electron micrographs of pollen grains. *Valeriana jatsmania*: A, Exine pattern; B, Polar view; C, Equatorial view. *Valerianella dentata*: D, Polar view; E, Exine pattern. Scale bar = F= 10 μ m

Key to the species and groups

- 1 + Tectum prolate *Valerianella szovitsiana*
 - Tectum prolate-spheroidal to sub-prolate 2
- 2 + Pollen grains sub-prolate *Valeriana clarkei*-group
 (*Valeriana clarkei* Briq., *Valeriana hardwickii* Wall., *Valeriana fedtschenkoii*
 Coincy, *Valeriana jaeschkei* C.B. Clarke)
 - Pollen grains prolate-spheroidal *Valeriana himalayana*-group
 (*Valeriana pyrolifolia* Decne., *Valeriana himalayana* Grub., *Valeriana ficariifolia*
 Boiss., *Valeriana stracheyi* C.B. Clarke, *Valerianella muricata* (Stev.) Baxt.,
Valerianella oxyrrhyncha Fisch.)

Pollen type: *Valeriana jatamansi*-type (Fig. Fig. 2 A-C).

Pollen class: 3-colpate.

P/E ratio: 98.0.

Shape: Oblate-spheroidal.

Apertures: Colpi long rounded acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Echinulate, echines with cushions.

Measurements: Size: Length = (37.5-) 41.05 ± 0.52 (-45.8) μm , and breadth (35.01) 44.55 ± 0.59 (54.74) μm , colpi (26.25.0-) 29.05 ± 0.42 (32.5) μm in long. Mesocolpium 25.35.5 μm . Apocolpium 7.5 (8.12 \pm 0.16) 8.75 μm . Exine 2.5 (3.2 1 \pm 0.11) 4.0 μm thick, sexine thicker than nexine. Tectum echinate, echines with cushions.

Species included: *Valeriana jatamansi* Jones

Pollen type: *Valerianella dentata*-type (Fig. 2 D & E).

Pollen class: 3-colpate.

P/E ratio: 0.97.

Shape: Oblate-spheroidal.

Apertures: Colpus long narrow with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Scabrate.

Measurements: Size: Length = (30.5-) 33.8 ± 0.2 (-37.8) μm and breadth (31.25) 33.5 ± 0.6 (36.25) μm , colpi (18.75-) 21.5 ± 0.76 (25.8) μm long. Mesocolpium 22.5-25 μm . Apocolpium (6.23-) 6.50 ± 0.61 (7.5) μm . Exine 2.5 (3.0 \pm 0.5) 3.5 μm thick, sexine thicker than nexine. Tectum scabrate-punctate.

Species included: *Valerianella dentata* (L.) Poll.

Discussion

Family Valerianaceae is more or less stenopalynous family. Pollen grains generally prolate-spheroidal, rarely oblate-spheroidal or prolate. Tricolporate with spinulose Tectum. However, little variation in exine pattern has been observed. On the basis of exine ornamentation family is divided into three pollen types. Viz., *Valeriana jatamansi*-type *Valeriana hardwickii*-type and *Valerianella dentata*-type. Backlund & Nilsson (1997) reported the spheroidal, tectate, triporate to tricolpate pollen grains in the families Caprifoliaceae, Dipsacaceae and Valerianaceae.

Number of workers like Takhtajan (1980), Cronquist (1981), Throne (1983) and Dahlgren (1989) kept the family Valerianaceae under the order Dipsacales near Dipsacaceae. Molecular data including sequence data from the chloroplast genes *rbcL* (Donoghue *et al.*, 1992) and *ndhF* (Pyck *et al.*, 1999), restriction site data (Downie & Palmer, 1992), support the placement of Valerianaceae as a sister group to Dipsacaceae. Both of these herbaceous groups are united by having distinctive pollen morphology and chlorophyllous embryos, a trait unique within Dipsacales (Backlund and Donoghue, 1996). The close relationship between Valerianaceae and Dipsacaceae is further supported by other morphological characters also like, simple perforated vessel modification of calyx lobes, and reduced endosperm (Judd *et al.*, 1994; Manchester & Donoghue, 1995). Two major lineages have been suggested by Clarke (1978), the *Valeriana* group, with large spines or verrucae and simple, unbranched, and uniform columellae; and the *Valerianella* group, with small to medium-sized spines and branched columellae increasingly longer and more clearly branched below the poles. Van der Hammen (1979), reported *Valeriana* pollen among the elements of the primitive paramo flora originating in the upper Pliocene and lower Pleistocene.

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