

POLLEN FLORA OF PAKISTAN -XLV. RUTACEAE

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Abstract

Pollen morphology of 7 species of the family Rutaceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains are usually radially symmetrical, isopolar 3-5 colporate, prolate-spheroidal to sub-prolate or prolate often oblate-spheroidal. Sexine thinner or thicker than nexine. Tectum striate-reticulate or reticulate-rugulate often striate-foveolate. On the basis of tectum types three distinct pollen types are recognized viz., *Haplophyllum dubium* - type and *Limonia acidissima* - type and *Murraya paniculata* - type. Palynological data has been useful at generic and specific level.

Introduction

Rutaceae is a family of about 150 genera and 15000 species (Mabberley, 1987), temperate and tropical in distribution, mostly in southern Africa and Australia. In Pakistan it is represented by 11 genera and 27 species (Hassan-ud-Din & Ghazanfar, 1980).

Cronquist (1968) treated this family under the order Sapindales. However, Engler (1964), Dahlgren (1989) and Takhtajan (1996) separated Rutaceae from the Sapindales and kept under separate order i.e., Rurales.

The members of the family are strongly aromatic, containing essential oils. Many genera show hardy and xerophytic character. The family is of considerable importance as a source of citrus fruits, curry, bitters and several ornamentals. Some chief genera of Rutaceae are *Citrus*, *Zanthoxylum*, *Ruta*, *Ptelea*, *Murraya* and *Fortunella*.

Pollen morphology of family has been examined by Erdtman (1952), Shimakura (1973), Rao & Shukla (1975). Kuprianova & Alyoshina (1978) examined pollen morphology of few species of the family Rutaceae. There are no reports on pollen morphology of the family Rutaceae from Pakistan. Present investigations are based on the pollen morphology of 7 species representing 4 genera of the family Rutaceae by light and scanning electron microscope.

Materials and Methods

Pollen samples were obtained from Karachi University Herbarium (KUH) or collected from the field. The voucher specimens are 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 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) and equatorial diameter (E), aperture size and exine thickness were measured (Table 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 Rutaceae

Pollen grains are usually radially symmetrical, 3 colporate rarely 4-5 colporate, prolate-spheroidal to sub-prolate or prolate rarely oblate-spheroidal. Sexine thinner or thicker than nexine. Tectum striate-reticulate or reticulate-rugulate often striate-foveolate. On the basis of exine ornamentation three distinct pollen types are recognized viz., *Haplophyllum dubium* - type and *Limonia acidissima* - type and *Murraya paniculata* - type.

Key to the pollen types

1. + Tectum striate-reticulate *Haplophyllum dubium* - type
 - Tectum not as above 2
2. + Tectum reticulate-rugulate *Limonia acidissima* - type
 - Tectum striate-foveolate *Murraya paniculata* - type

Pollen type: *Haplophyllum dubium* - type - (Fig. 1 A-D).

Pollen class: Tricolporate, 3 colporate.

P/E ratio: 101-138.

Shape: Prolate-spheroidal to sub-prolate rarely oblate-spheroidal or -prolate.

Apertures: Colpus long sunken with acute ends.

Exine: Sexine thicker or thinner than nexine.

Ornamentation: Striate-reticulate.

Measurements: Size: Polar axis $p = 23 (32 \pm 1.2) 52$, and equatorial diameter $E = 17 (28 \pm 2.1) 52 \mu\text{m}$. Colpi $17.61 (34 \pm 1.4) 52 \mu\text{m}$ long. Exine $1.5-2.5 \mu\text{m}$ thick, sexine thicker or thinner nexine. Tectum striate-reticulate.

Species included: *Haplophyllum acutifolium* (DC.) G.Don, *H. dubium* Korov, *H. erythraeum* Boiss., *H. tuberculatum* (Forssk.) Juss., *Boenninghausenia albiflora* (Hook.) Reichb. ex Heynh.

Key to the species

1. + Pollen grains prolate-spheroidal or sub-prolate 2
 - Pollen grains prolate *Boenninghausenia albiflora*
2. + Pollen grains sub-prolate *Haplophyllum acutifolium*
 - Pollen grains prolate-spheroidal *Haplophyllum erythraeum*-group
 (*H. dubium*, *H. erythraeum*, *H. tuberculatum*)

Table 1. General pollen characters of species found in the pollen type *Haplophyllum dubium*.

Name of taxa	Shape	Polar length in μm (P)	Equatorial diameter μm (E)	Colpus length μm (L)	Exine thickness μm	Tectum
<i>Haplophyllum dubium</i> Korov.	Pr-Sp	40 (44.16 \pm 0.56) 47.5	40 (43 \pm 0.78) 47.5	35.1 (37.18 \pm 0.53) 40.1	0.2.5	Striate-Reticulate
<i>H. erythraeum</i> Boiss.	Pr-Sp	45 (48.57 \pm 1.07) 52.5	42.5 (47.6 \pm 1.36) 52.5	35.1 (39.64 \pm 1.01) 42.5	2.5 (2.71 \pm 0.14) 3.5	Striate-Reticulate
<i>H. tuberculatum</i> (Forsk.) Juss.	Pr-Sp	42.5 (45.07 \pm 0.48) 47.5	37.5 (41.54 \pm 0.6) 45.0	32.6 (31.5 \pm 0.64) 42.5	2.5 (2.52 \pm 0.01) 2.75	Striate-Regulate
<i>H. acutifolium</i> (DC.) G. Don	Sub-Pr	32.5 (33.75 \pm 0.72) 35.0	27.5 (29.16 \pm 0.83) 30.0	25 (27.5 \pm 1.44) 30.0	2.5 (2.58 \pm 0.08) 2.75	Striate-Reticulate
<i>Boeninghausenia albiflora</i> (Hook.) Reichb. ex Heynh	Pr.	23.75 (25.61 \pm 0.26) 27.5	17.5 (18.48 \pm 0.21) 20.0	17.5 (20.56 \pm 0.33) 22.5	1.5 (1.78 \pm 0.03) 2.0	Striate-Reticulate

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

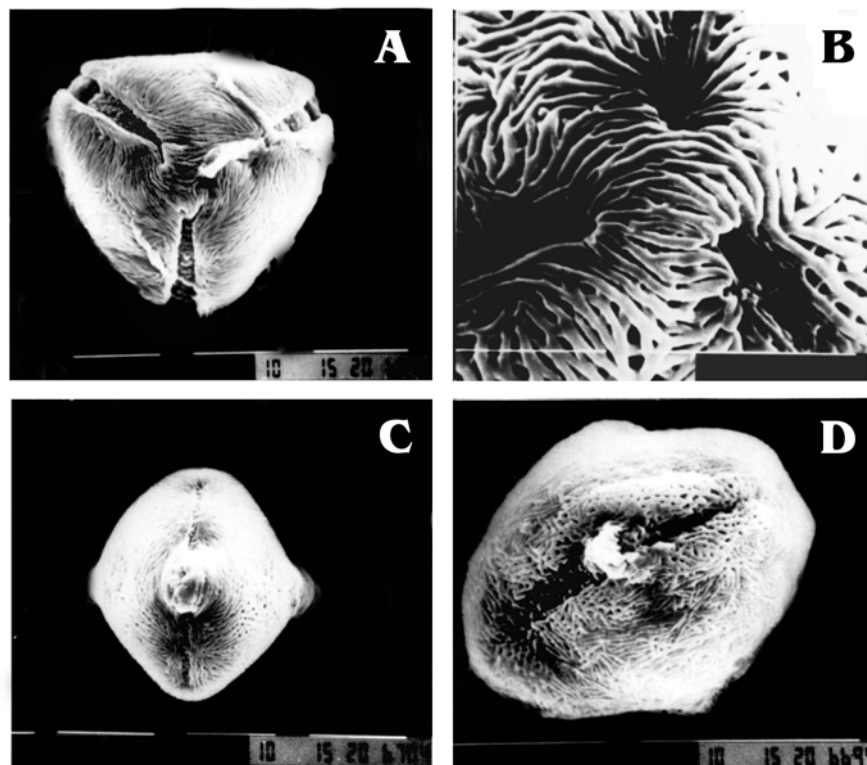


Fig. 1. Scanning Electron micrographs of pollen grains. *Haplophyllum dubium*: A, Polar view. *H. erythraeum* B, Exine pattern. *H. acutifolium*: C, Equatorial view. *Boenninghausenia albiflora*: Equatorial view.

Scale bar =A, C & D = 10 μ m. B= 1 μ m

Pollen type: *Limonia acidissima*- type (Fig. 2 A & B).

Pollen class: Tri-colporate, 4-5 colporate.

P/E ratio: 97.

Shape: Oblate-spheroidal.

Apertures: Ectocolpus long narrow with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Reticulate-rugulate

Measurements: Size: Length = (17.5-) 19.52 ± 0.2 (-20.5) μ m and breadth (18.75) 20 ± 0.11 (21.25) μ m, colpi (12.5-) 13.75 ± 0.42 (15.5) μ m in long. Mesocolpium 10.5 (10.83 ± 0.25) 3.75 μ m. Apocolpium 1.25 (2.5 ± 1.24) 3.75 μ m. Exine 1.75 (2.08 ± 0.5) 2.5 μ m thick, sexine thicker than nexine. Tectum reticulate-rugulate.

Species included: *Limonia acidissima* L.

Pollen type: *Murraya paniculata*- type (Fig. 2 C-E).

Pollen class: Tri-colporate

P/E ratio: 1.02

Shape: Prolate-spheroidal

Apertures: Ectocolpus long narrow, ora small, more or less circular.

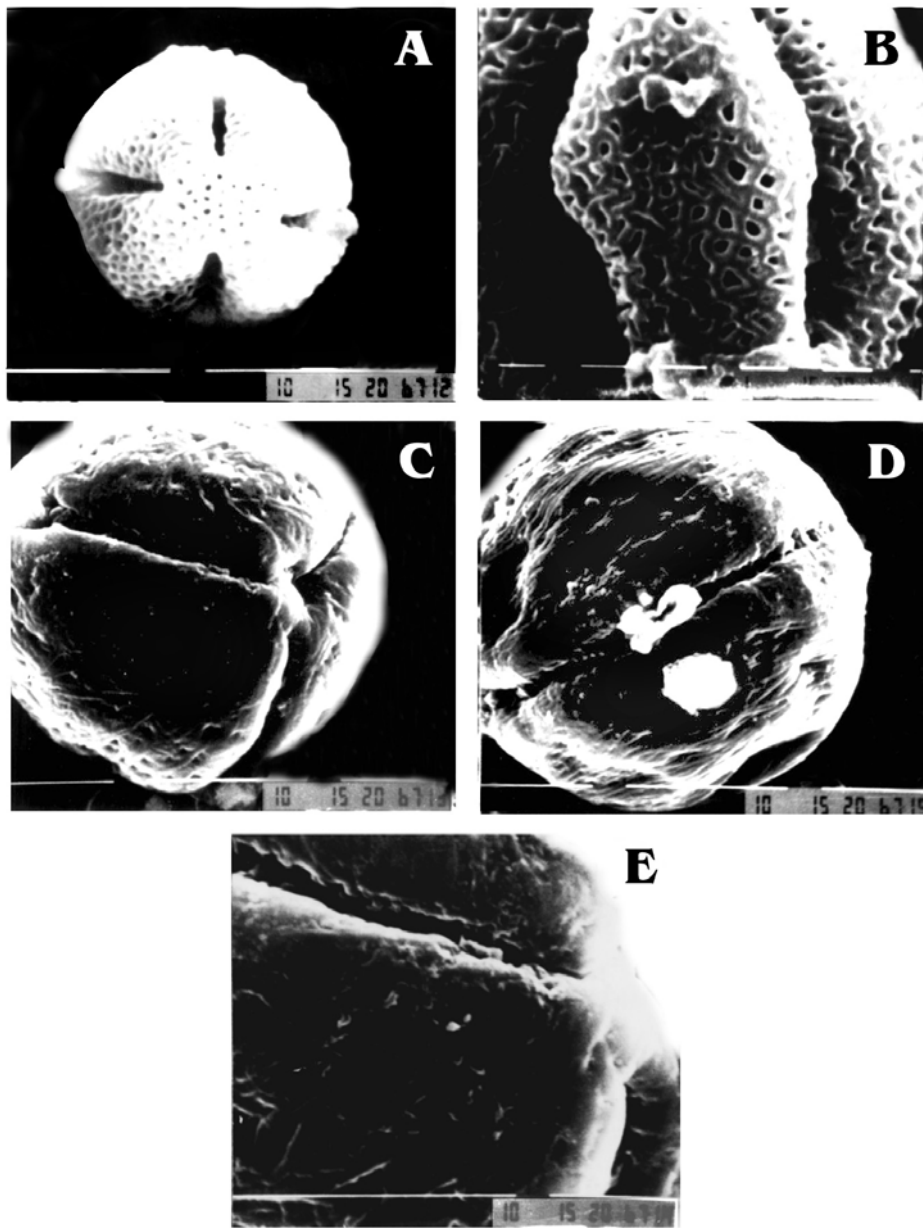


Fig. 2. Scanning Electron micrographs of pollen grains. *Limonia acidissima*: A, polar view; B, Exine pattern. *Murraya paniculata*: C, Polar view; D, Equatorial view, E, Exine pattern. Scale bar = A, C & D = 10 μm. B & E = 1 μm

Exine: Sexine thicker than nexine.

Ornamentation: striate-foveolate

Measurements: Size: Length = (37.5-) 39.12 ± 0.62 (-40.5) μm , and Breadth (35.1) 38 ± 1.38 (41.25) μm , colpi (30.5-) 33.75 ± 0.42 (35.5) μm long. Mesocolpium 27.5 (30 \pm 2.5) 32.5 μm . Apocolpium 1.25 (2.5 \pm 1.24) 3.75 μm . Exine 1.75 (2.81 \pm 0.5) 2.5 μm thick, sexine thicker than nexine. Tectum striate-foveolate

Species included. *Murraya paniculata* (L.) Tack

Discussion

Rutaceae is an eurypalynous family (Erdtman, 1952). Pollen grains are generally prolate-spheroidal to sub-prolate rarely oblate-spheroidal, 3-colporate rarely 4-5 colporate with striate-reticulate tectum rarely striate-foveolate or reticulate-rugulate. Yunus & Nair (188) reported that the rugulate-striate and rugulo-striate-reticulate and other ornamentation are significant character for distinguishing different genera of the family Rutaceae. On the basis of exine ornamentation three distinct pollen types are recognized. The pollen type *Haplophyllum dubium* is easily delimited by striate-reticulate tectum. Five species representing two genera i.e., *Haplophyllum* and *Boeninghausenia* are included in this pollen type, these species are further delimited on the basis of pollen shape classes (see key to the species). Erdtman (1952) also reported similar type of pollen within family. *Limonia acidissima* - type is characterized by its reticulate-rugulate tectum, only single species is found in this pollen type, whereas *Murraya paniculata*-type is readily distinguished by having striate-foveolate tectum, in this type also only one species is found i.e., *Murraya paniculate*. The family Rutaceae is generally placed under the order Sapindales. However, Dahlgren (1989) and Takhtajan (1996) kept the family under separate order Rutales. Pollen morphology of the family supports the placement of family under separate order Rutales. Sapindaceae pollen grains are different from Rutaceae (Qaiser & Perveen, 1997).

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