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Pollen Flora of Pakistan - XI. *Leguminosae* (Subfamily: *Mimosoideae*)

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Abstract: The pollen morphology of 14 species representing 5 genera of the subfamily *Mimosoideae* from Pakistan has been examined using light and scanning electron microscopy. *Mimosoideae* are eurypalynous subfamily. The pollen grains are united (polyads) or free. Single grains are tricolporate and triangular - trilobed. The pollen morphology of the subfamily is significantly useful at generic and tribal level. The 3 pollen types recognized ie, *Acacia nilotica* - type, *Mimosa hamata* - type and *Prosopis juliflora* - type, correspond closely with tribal classifications.

Key Words: Pollen morphology, *Leguminosae: Mimosoideae*, Flora, Pakistan.

Pakistan'ın Çiçektozu Florası - XI. *Leguminosae* (Altaile: *Mimosoideae*)

Özet: Pakistan'dan *Mimosoideae* altailesindeki 5 cinse ait 14 türün çiçektozu morfolojisi, ışık ve taramalı elektron mikroskobu ile incelenmiştir. *Mimosoideae* öripalinoz bir altailedir. Çiçektozları birleşmiş halde (polyadlar) veya serbesttir, tek tek taneler trikolporat, üçgensiz-üçlopludur. Altailenin çiçektozu morfolojisi, cins ve oymak (tribus) düzeyinde oldukça kullanışlıdır. 3 çeşit çiçektozu tipi belirlenmiştir: *Acacia nilotica*-tipi, *Mimosa hamata*-tipi ve *Prosopis juliflora*-tipi. Bu tipler altailenin oymak düzeyindeki sınıflandırması ile uyuşum içindedir.

Anahtar Sözcükler: Çiçektozu morfolojisi, *Leguminosae, Mimosoideae*, Flora, Pakistan

Introduction

Mimosoideae are a subfamily of about 4 genera and 200 species, mostly tropical or sub tropical in distribution and found mainly in dry regions (1, 2). In Pakistan it is represented by 11 genera and 49 species (3).

Polhill & Raven (4) divided the *Mimosoideae* subfamily into 5 tribes. Bentham (5) recognized 6 tribes *Ingeae*, *Acacieae*, *Mimosieae*, *Adenanthereae*, *Piptadenieae* and *Parkieae*.

The pollen morphology of *Mimosoideae* has been examined by Coetzee (6); Brenan (7, 8); Caccavari (9), Caratani & Guinet (10); Guinet (11, 12); Guinet & Salard-Cheboldaeff (13); Guinet & Lugardon (14); Sorsa (15); Burkart (16); Polhill & Raven (4).

However, the detailed study of *Mimosoideae* pollen was carried out by Guinet (17). Literature concerning pollen morphology of the subfamily *Mimosoideae* from Pakistan very scarce, although pollen of a few species of *Mimosoideae* has been examined by Khan & Memon (18) using only light microscopy.

This study was carried out to provide palynological information about the subfamily *Mimosoideae* from Pakistan belonging to 4 tribes distributed in 5 genera and 14 species which will be helpful to understanding the subfamilial relationships.

Materials and Methods

Pollen samples were obtained from Karachi University Herbarium (KUH) or collected from the

Name of taxa	Length in μm	Breadth in μm	Exine thickness in μm	Tectum
<i>Acacia senegal</i> (L.) Willd.	35.9(42.7 \pm 1.06) 46.67	37.6(41.65 \pm 1.24) 48.4	1.43(1.61 \pm 0.06) 1.79	Sub-psilate
<i>A.leucophloea</i> (Roxb.) Willd.	35.0(38.6 \pm 0.85) 42.5		1.25(2.55 \pm 0.9) 2.25	Foveolate
<i>A.hydaspica</i> Drum e Parker	37.5(43.12 \pm 2.78) 50.0	42.75(44.37 \pm 0.56) 45.0		Foveolate
<i>A.nilotica</i> subsp subalata (Vatake) Brenan	36.2(46.5 \pm 1.57) 53.8	43.08(46.5 \pm 3.0) 57.44	0.72(2.5 \pm 0.5) 3.95	Foveolate
<i>A.nilotica</i> subsp. indica (Benth.) Brenan	43.08(49.48 \pm 0.94) 53.8	43.08(50.08 \pm 1.78) 55.84	0.72(2.47 \pm 0.3) 3.20	Foveolate-rugulose sparsely scabrate
<i>A.nilotica</i> subsp. hemispherica Ali & Farugi	28.7(41.2 \pm 1.28) 46.67	30.3(40.76 \pm 1.11) 43.08	0.71(1.44 \pm 0.32) 3.23	Foveolate
<i>A.jacquemontii</i> Benth.	39.4(53.3 \pm 1.98) 57.4	50.26(55.4 \pm 1.5) 66.03	1.79(2.37 \pm 0.30) 3.6	subpsilate with indistinct punctate
<i>Albizia lebbeck</i> (L.) Benth.	28(45.2 \pm 1.11) 57.4	30.5(39.17 \pm 11.0) 43.08	0.71(1.21 \pm 0.21) 3.11	Foveolate-rugulate
<i>Pithecellobium</i> (Roxb.) Benth.	29.0(46.1 \pm 0.23) 56.11	32.1(39.1 \pm 0.24) 45.08	0.72(1.25 \pm 0.11) 3.61	Foveolate-rugulate

Table 1. General pollen characters of the species found in *Acacia nilotica*-type

field. The list of voucher specimens is deposited in KUH. The pollen grains were prepared for light and scanning microscopy by the standard methods described by Erdtman (19). 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 a 10x eye piece. For SEM, studies pollen grains suspended in a drop of distilled water were transferred on to a metallic stub using double-sided adhesive tape and coated with gold in a sputtering chamber (Ion-sputter JFC-1100). Coating was restricted to 150Å. S.E.M examination was carried out on a Jeol microscope JSM-T200. The measurements were based on 15-20 readings from each specimen. The general pollen characters of the species examined are resented in Tables 1 & 2.

The terminology used is in accordance with Erdtman (19) Faegri & Iversen (20) and Walker & Doyle (21).

Observation

Pollen grains were polyads, or monads (*Prosopis* L.). Single grains were oblate-spheroidal to prolate-spheroidal or sub-prolate, triangular-trilobed in polar view. Colpi were broad, the colp membrane was granulated and the sexine was either thicker or thinner than the nexine. The tectum was foveolate-fossulate or fossulate-foveolate and rarely sub-psilate. On the basis of monads versus polyads, 3 distinct pollen types were recognized: *Acacia nilotica*-type, *Mimosa hamata*-type and *Prosopis juliflora*-type.

Key to the pollen types

1. + Pollen grains polyads 2
 – Pollen grains monads *Prosopis juliflora*-type
2. + Pollen grains 8-celled *Mimosa hamata*-type
 – Pollen grains 12-16-celled *Acacia nilotica*-type

Acacia nilotica-type (Fig. 1 A - B; Fig. 2 A).

Pollen class: 12-16 celled polyads

Apertures: Non-aperturate.

Exine: Sexine thicker or thinner than nexine.

Ornamentation: Tectum usually foveolate or foveolate-rugulate, often sub-psilate.

Outline: Polyads 12-16-celled, \pm circular single cell rectangular.

Measurements: Length (L) 28 (45.9 \pm 1.28) 57.4 μm . Breadth (B) 30.3 (47.2 \pm 0.56) 66.03 μm . Exine 0.72 (1.88 \pm 0.31) 3.6 μm thick (Table 1).

Key to the species groups

- + Tectum sub-psilate *Acacia senegal*-group
 (*Acacia senegal*, *A.jacquemontii*)
- Tectum foveolate or foveolate - rugulate
Acacia hydaspica - group
 (*A. leucophloea*, *A. hydaspica*, *A. nilotica* ssp. *subalata* *A. nilotica* ssp. *hemispherica*, *Albizia lebbeck*, *Acacia nilotica* ssp. *indica*, *Pithecellobium dulce*)

Mimosa hamata-type (Fig.1 C & D; Fig.2 B).

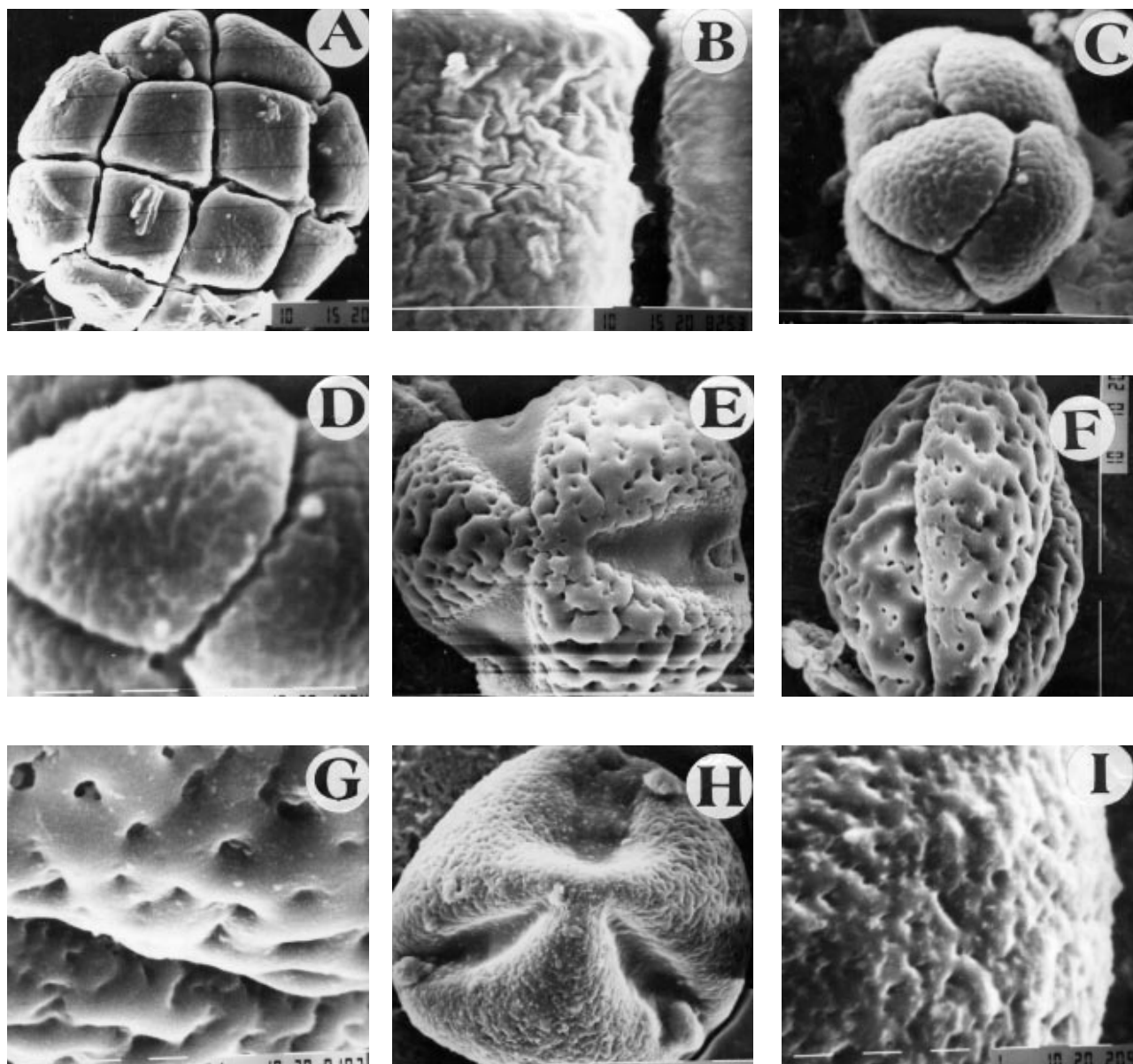


Figure 1. Scanning Electron micrographs of pollen grains.
 Albizia lebbek: A, Polyads; B, Exine pattern. Mimosa hamata: C, Polyads; D, Exine pattern. Prosopis cineraria: E, Polar view; F, Equatorial view; G, Exine pattern. P. juliflora: H, Polar view; I, Exine pattern.
 Scale bar = A, B, C, E, F & H = 10 μm; D, G, I = 1 μm

Pollen class: 8-celled polyads.

Apertures: Non-aperturate

Exxine: Sexine thicker or thinner than nexine.

Ornamentation: Tectum foveolate to fossulate.

Outline: Prolate shape, single cell rectangular.

Measurements: Length (L) 12.59 (15.31 ± 0.21) 18.51 μm, Breadth (B) 10.2 (11.22 ± 0.46) 14 μm. Exine 0.23 (0.69 ± 0.40) 1.26 μm thick.

Name of taxa	Shape	Polar (P) μm	Equatorial length (E) in μm	P/E ratio	Colpus length (C) in μm
<i>Prosopis cineraria</i> (L.) Druce	Sub-oblate	25.1(31.7 \pm 1.5) 35.4	32.3(36.6 \pm 1.04) 39.4	0.88	25.1(27.5 \pm 0.25) 39.5
<i>P.farcta</i> (Banks & Sol.) Macbride	Sub-prolate	27.3(37.7 \pm 0.79) 42.5	30.(31.97 \pm 0.63) 37.5	1.88	20.(32.9 \pm 1.25) 35
<i>P.juliflora</i> (Swartz) DC.	Sub-oblate	25.13(26.4 \pm 0.60) 28.7	28.7(30.33 \pm 0.61) 34.1	0.87	21.5(23.5 \pm 0.49) 25.1
<i>P.glandulosa</i> Torr.	Sub-prolate	32.2(36.8 \pm 0.45) 39.5	17.9(25.6 \pm 1.03) 32.3	1.29	30.5(32.13 \pm 0.17) 32.3

Table 2. General pollen characters of the species found in *Prosopis juliflora*-type

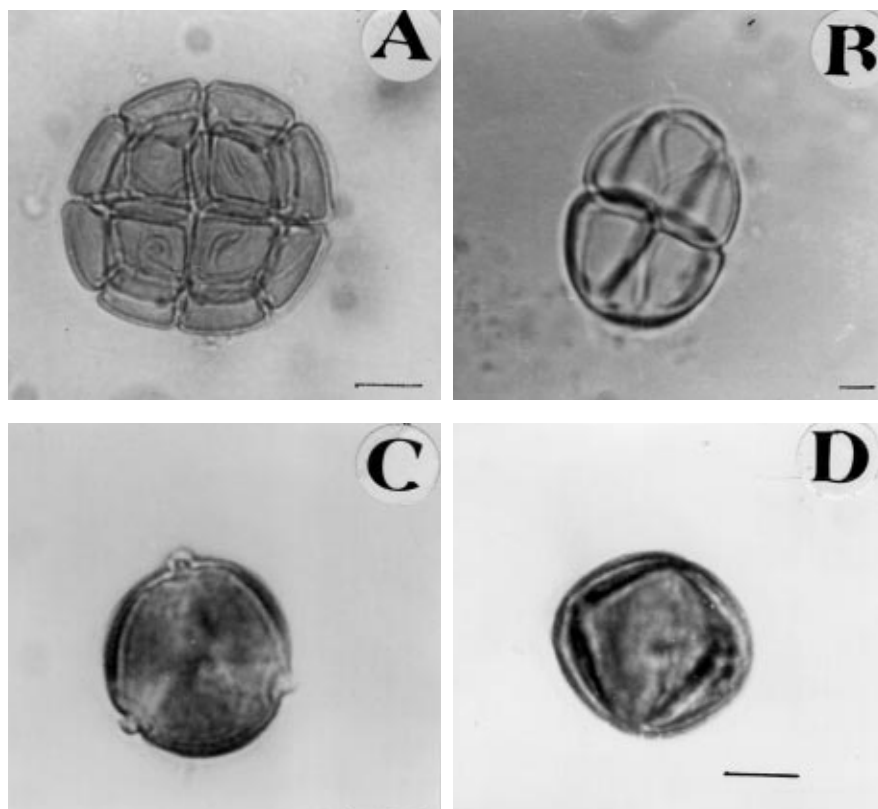


Figure 2. Light micrographs of pollen grains. *Acacia senegal*: A, Polyads. *Mimosa hamata*: B, Polyads. *Prosopis juliflora*: C, Polar view; D, Equatorial view.

Scale bar = A - D = 10 μm .

Key to the species

- + Tectum foveolate *Mimosa himalayana*
- Tectum fossulate *M.hamata*

Prosopis juliflora - type (Fig.1 E-I; Fig.2 C & D).

Pollen class: Tricolporate, zonoaperturate.

P/E ratio: Semi-transverse to semiercet

Apertures: Ectoapertures-colpus, long, narrow with tapering ends; colpal membran scabrate or granulate, often sub-psilate. Endoaperture \pm circular, or elongate.

Exine: Medium, sexine thicker or thinner than nexine.

Ornanemtation: Tectum fossulate-foveolate, often sparsely to densely foveolate.

Outline: Equatorial view - elliptic, polar view trilobed or triangular.

Measurements: Polar axis (P) 25.1 (32.05 \pm 0.60) 42.5 μm . Equatorial diameter (E) 17.9 (31.15 \pm 0.1) 39.01 μm . Colpus length 20.01 (28.2 \pm 0.17) 39.5 μm . Mesocolpium 17.9 (21.3 \pm 0.52) 35.1 μm . Apocolpium 1.79 (2.96 \pm 0.71) 5.01 μm . Exine 0.36 (2.05 \pm 0.13) 4.01 μm thick.

Key to the species

- 1. + Pollen grains sub-oblate 2
- Pollen grains sub-prolate 3
- 2. + Exine 3.23-3.6 μm thick *P.cineraria*
- Exine 0.71-2.5 μm thick *P.juliflora*

3. + Apocolpium c.179 μm *P.glandulosa*
 – Apocolpium 2.5-5 μm *P.farcta*

Results and Discussion

Mimosoideae ara eurypalynous taxon (19). The pollen grains are polyads or monads (*Prosopis* L.), the symmetrical grains are isopolar, oblate-spheroidal to prolate-spheroidal, or sub-prolate. They are triangular-triboled in polar view, the colpi are broad, the colpal membrane is granulated and the sexine is thicker or thinner than the nexine. The tectum foveolate-fossulate or fossulate-foveolate and rarely subsilate. On the basis of monads versus polyads, 3 distinct pollen types were recognized i.e., Pollen type-I: *Acacia nilotica*-type, Pollen type-II: *Mimosa hamata*-type and Pollen type-III: *Prosopis juliflora*-type.

The *Acacia nilotica*-type is easily distinguished by its 12-16 celled polyads. This type is similar to that of the *Mimosa hamata*-type, but the latter type has 8-celled, small sized (10 x 12 μm) polyads. In *Acacia nilotica*-type large sized polyads were found (11, 12). Species of 3 genera i.e., *Acacia* Mill., *Albizia* Durazz. and *Pithecelobium* Mart., are included. All these species have similar pollen characters. However, a little variation was found in their exine pattern, which is helpful for delimiting the species into two groups i.e., *Acacia senegal* - group and *Acaia hydaspica* - group (see the key to the species groups).

The *Mimosa hamata* - type is characterized by 8-celled polyads (12.5 10.36) μm . Erdtman (19) and Herngreen (22) reported 8-10 μm polyads in *Mimosa indica*. The two species with this pollen type are easily delimited by their tectal surface (see key to the species.).

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Prosopis juliflora-type is easily distinguished by its tricolporate monads grains. Four species of *Prosopis* L., are included in this type. i.e. *Prosopis cineraria* (L.) Druce, *P. farcta* (Banks & Sol.) Macbride, *P. juliflora* (Swartz.) DC. and *P. glandulosa* Torr. These species have considerable variation in their pollen characters, and can easily be separated from each other on the basis of shape, exine thickness and apocolpium (see the key to the species, Table 2).

The present data revealed that the pollen morphology of the subfamily is significant at the generic and tribal level. The three pollen types recognized correspond closely with Benthams (5) tribal classification, i.e. monad pollen grains were found in *Prosopis* L., of tribe *Adenanthereae*. In the *Mimosa* L., 8-celled polyads were found, belonging to the tribe *Mimosieae*. In *Acacia nilotica*-type, 12-16 celled polyads were found. This pollen type is restricted to two different tribes: *Ingeae* (*Albizia* Durazz., and *Pithecelobium* Mart.) and *Acacieae* (*Acacia* Mill.). The floral morphology of these tribes is also very similar. However, they differ slightly in their arrangement of stamens, i.e. free in *Acacieae* and united in *Ingeae* (23). Hence, palynology also shows a close relationship between these genera within the *Mimosoideae* subfamily.

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