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Pollen Flora of Pakistan - X. *Leguminosae* (Subfamily: *Caesalpinioideae*)

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Abstract: The pollen morphology of 11 species representing 5 genera of the subfamily *Caesalpinioideae* from Pakistan was examined by light and scanning electron microscope. *Caesalpinioideae* is ± a eurypalynous subfamily. The pollen grains are generally radially symmetrical, isopolar, tricolporate and triangular-trilobed. The tectum is commonly reticulate-rugulate or fossulate-foveolate, and often striate. The pollen morphology of the subfamily is significantly useful at the generic and specific levels. On the basis of apocolpium, mesocolpium and tectum features, three pollen types were recognized, namely, *Bauhinia variegata* - type, *Caesalpinia pulcherrima* - type and *Senna holosericea* - type.

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

Pakistan'ın Çiçektozu Florası - X. *Leguminosae* (Altaile: *Caesalpinioideae*)

Özet: Pakistan *Caesalpinioideae* alt ailesindeki 5 cinsede 11 türün çiçektozu morfolojisi, ışık ve taramalı elektron mikroskopu ile incelenmiştir. *Caesalpinioideae* aşağı yukarı öripalinöz bir altailedir. Çiçektozları genellikle ışınal simetrikli, izopolar, trikulpurat ve tri-angular-triloblu'dur. Tektum çoğunlukla retikulat-rugulat veya fossulat-foveolat ve sıklıkla striatıdır. Altailenin çiçektozu morfolojisi cins ve tür düzeyinde kullanışlıdır. Apokolpiyum, mezokolpiyum ve tektum özelliklerine dayanılarak üç polen tipi tanımlanmıştır: *Bauhinia variegata*-tipi, *Caesalpinia pulcherrima*-tipi ve *Senna holosericea*-tipi.

Anahtar Sözcükler: Çiçektozu morfolojisi, *Leguminosae: Caesalpinioideae*, Flora, Pakistan.

Introduction

Caesalpinioideae represents approximately 11% of the known legume flora (1), with c. 152 genera and c. 2800 species, mostly tropical and subtropical in distribution (2). In Pakistan it is represented by 17 genera and 54 species (3). Polhill & Raven (4) divided the subfamily *Caesalpinioideae* into 5 tribes, namely, *Caesalpinieae*, *Cassieae*, *Cercideae*, *Detarieae* and *Amherstieae*.

The pollen morphology of the subfamily has been examined by a number of researchers (5-11). However, the most significant study of *Caesalpinioideae* pollen is that of Graham & Baker (12).

Literature dealing with the pollen of *Caesalpinioideae* from Pakistan is very scarce. Khan and Memon (13) described only a few species of *Caesalpinioideae* using light microscopy. Thus, the

present study was carried out to provide palynological information on 10 species representing 5 genera, belonging 4 tribes, distributed in Pakistan.

Materials and Methods

Pollen samples were obtained from the Karachi University Herbarium (KUH) or collected from the field. The list of voucher specimens was deposited at KUH. The pollen grains were prepared for light and scanning microscopy by the standard methods described by Erdtman (14). 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 onto a metallic stub using

Table 1. General pollen characters of different species included in *Senna holosericea*-type

Name of taxa	Shape	P/E ratio	Polar length (P) in μm	Equatorial Diameter (E) in μm	Colpus length in μm
<i>Senna alaxandria</i> L.	Prolate spheroidal	1.01	28.7(34.18±0.75) 35.9	28.7(33.86±0.52) 35.59	25.1(29.61±0.89) 35.9
<i>S.holosericea</i> (Fresen) Greuter	Oblate spheroidal	0.98	25.1(29.13±0.61) 32.31	26.9(30.27±0.52) 32.31	23.33(25.0±0.20) 26.62
<i>S.italica</i> (Mill.) Brum. f.	Prolate spheroidal	1.03	32.3(35.03±0.31) 35.08	30.5(33.96±0.79) 37.14	23.72(28.07±1.27) 32.14
<i>C.occidentalis</i> L.	Sub-prolate	1.17	37.5(41.0±0.65) 46.25	32.5(34.32±0.49) 38.5	31.25(36.04±0.52) 41.25
<i>S.tora</i> (L.) Roxb	Prolate spheroidal	1.01	23.7(25.1±0.25) 27.7	23.0(24.3±0.18) 27.5	17.5(20.38±2.22) 22.5
<i>C.pumila</i> Lenk.	Sub-prolate	1.30	35.0(39.9±5.17) 42.5	28.7(30.63±0.12) 32.15	32.5(38.5±0.39) 40.25
<i>S.surattensis</i> Burm. f.	Prolate spheroidal	1.07	39.43(41.01±0.41) 43.08	35.9(38.21±1.79) 47.14	24.72(30.07±1.11) 40.32
<i>Parkinecnia aculeate</i> L.	Sub-oblate	0.80	23.0(44.5±1.1) 48.5	23(35.0±1.2) 47.5	17.5(28.5±2.1) 40.01

double-sided adhesive tape and coated with gold in a sputtering chamber (Ion-sputter JFC-1100). Coating was restricted to 150Å. The S.E.M examination was carried out on a Jeol microscope JSM-T200. The measurements were based on 15-20 readings from each specimen. General pollen characters of the species examined are presented in Table 1.

The terminology used is in accordance with Erdtman (14); Kremp (15); Faegri & Iversen (16) and Walker & Doyle (17).

Observations

General pollen characters of the family *Caesalpinioideae*

Pollen grains were generally radially symmetrical, isopolar, oblate-spheroidal to prolate-spheroidal, rarely sub-prolate, and tricolporate. The sexine tended to be either thicker or thinner than the nexine, rarely being the same thickness. The tectum ranged from reticulate to rugulate or fossulate-foveolate, and was often striate.

Key to the pollen types

1. + Para syncolpate, different apocolpium and mesocolpium texture

II: *Caesalpinia pulcherrima*-type

- non para syncolpate, similar apocolpium and mesocolpium texture 2
- 2. + Pollen grains striate or striate rugulate tectum

I: *Bauhinia variegata*-type

- Pollen grains reticulate or fossulate-foveolate or rugulate tectum

III: *Senna holosericea*-type

Pollen type-I: *Bauhinia variegata*-type (Fig. 1 A-D)

Pollen class: Tricolporate, zonoaperturate.

P/E ratio: Subtransverse to semierect.

Shape: Oblate-spheroidal to sub-prolate.

Apertures: Ectoaperture - colpi medium, narrow with acute ends. Endoaperture la-longate, ± circular in shape.

Exine: Sexine thicker or thinner than nexine.

Measurements: Polar length (P) 27.12 (38.5±0.11) 50.9 μm , Equatorial diameter (E) 28.1 (45.5 ± 1.11) 55.11 μm , colpus 26.5 (34 ± 1.24) 42.6 μm ong. Mesocolpium 23.11 (40.6 ± 0.21) 50.2 μm . Exine c. 2.12 μm thick.

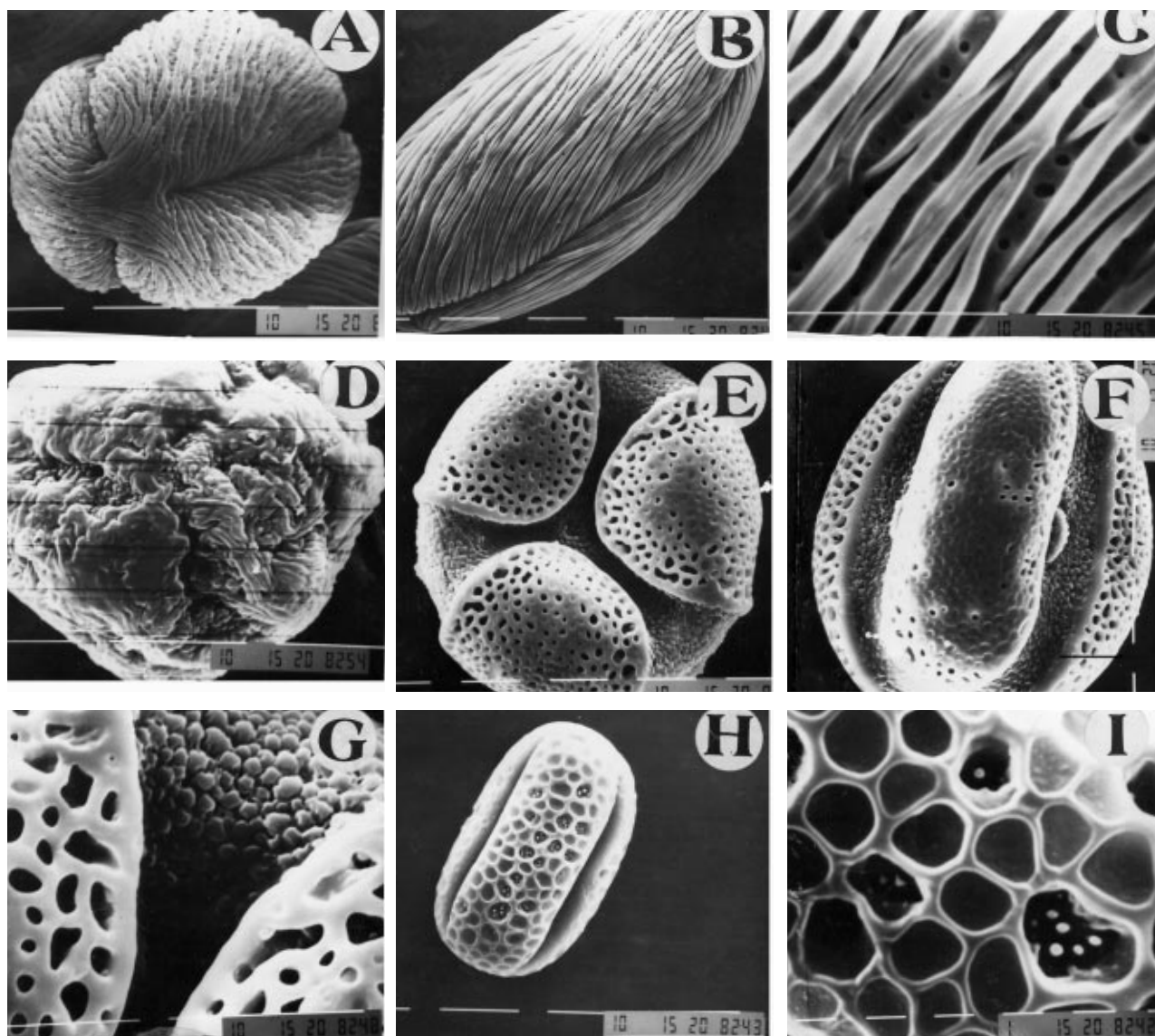


Figure 1. Scanning Electron micrographs of pollen grains. *Bauhinia variegata*: A, Polar view; B- Equatorial view; C, Exine pattern. *Tamarindus indica*: D, Polar view. *Caesalpinia pulcherrima*: E, Polar view; F, Equatorial view; G, Exine pattern. *Parkinsonia aculeata*: H, Equatorial view; I, Exine pattern. Scale bar = A-H = 10 μ m; I = 1 μ m.

Key to the species

- + Pollen grains sub-prolate, tectum striate
Bauhinia variegata
- Pollen grains oblate-spheroidal, tectum striate-rugulate
Tamarindus indica

Pollen type-II: *Caesalpinia pulcherrima*-type (Fig.1 E-G).

Pollen class: Tricolporate, zonoaperturate.

P/E ratio: suberect.

Shape: Prolate-spheroidal.

Apertures: Ectoaperture - colpi medium, para syncolpate. Endoa-perture la-longate, \pm circular in shape.

Exine: Sexine thicker than nexine.

Ornamentation: Tectum coarsely reticulate with distinct colpal margin, apocolpium finely reticulate.

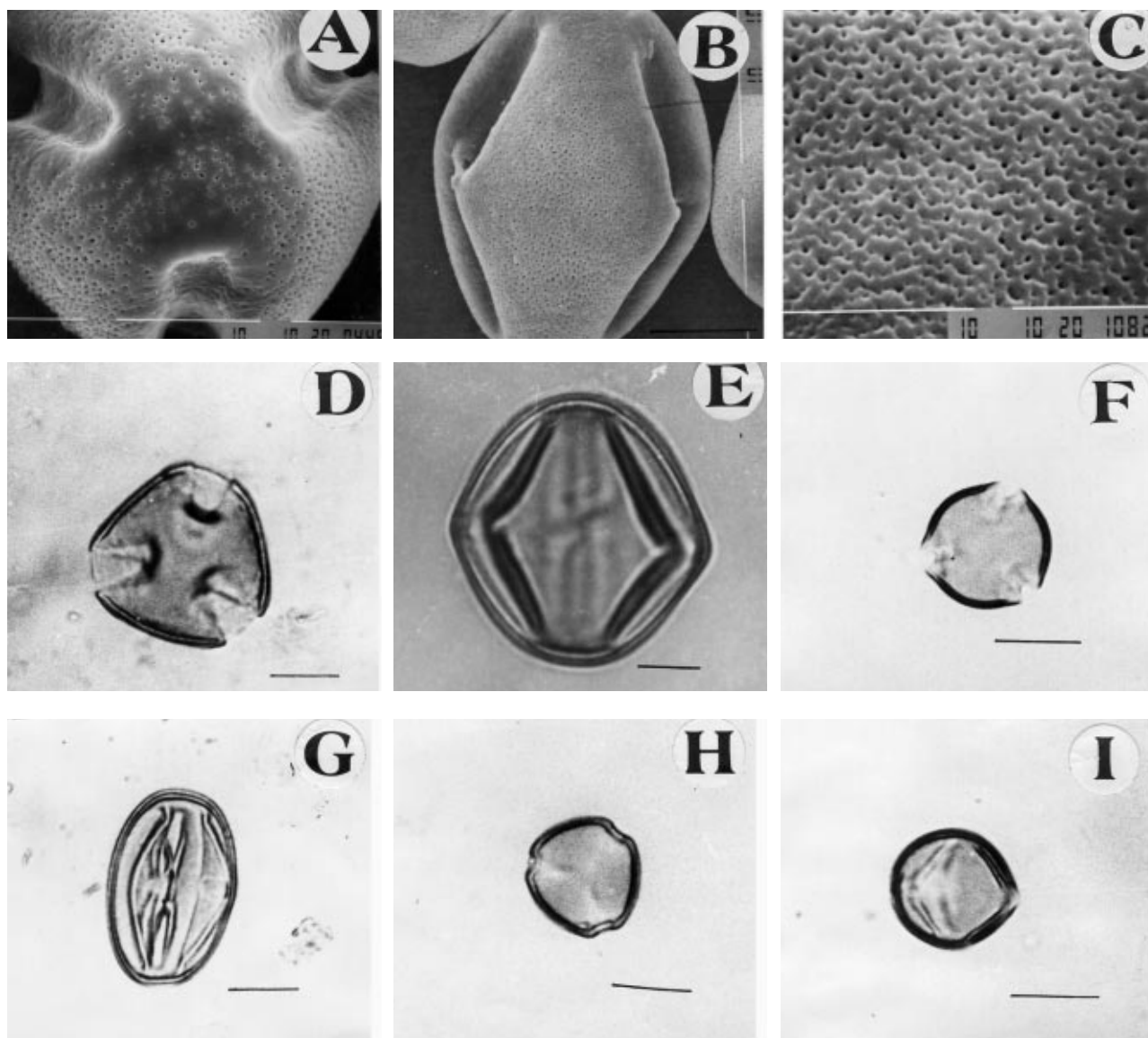


Figure 2. Scanning Electron micrographs of pollen grains (A-C). *Senna suranttensis*: A, Polar view; B, Equatorial view; C, Exine pattern. Light micrograph of pollen grains (D-I). *Senna suranttensis*: D, Polar view; E, Equatorial view. *Senna alexandrina*: F, Polar view; G, Equatorial view. *S. holosericea*: H, Polar view, I, Equatorial view. Scale bar A-I = 10 μ m.

Measurements: Polar length (P) 52.11 (58.8 \pm 0.13) 59.9 μ m, equatorial diameter (E) 51.11 (57.1 \pm 1.41) 58.27 μ m, colpus 39.11 (50.12 \pm 1.94) 52.12 μ m long. Mesocolpium 38.11 (49 \pm 0.22) 50.21 μ m. syncolpate. Exine c. 2.11 μ m thick.

Species included

Caesalpinia pulcherrima (L.) Swartz

Pollen type-III: *Senna holosericea*-type (Fig.1 H & I; Fig.2 A-I).

Pollen class Tricolporate, zonoaperturate.

P/E ratio: Suberect to semierect, rarely sub-transverse.

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

Apertures: Ectoaperture - colpi medium, narrow with

acute ends. Endoaperture la-longate, \pm circular in shape.

Exine: Sexine thicker than, rarely thinner than nexine, often as thick as nexine.

Ornamentation: Tectum fossulate-rugulate or rugulate-fossulate, rarely finely-coarsely reticulate, often foveolate.

Measurements: Polar length (p) 23.7 (36.1 \pm 0.11) 48.5 μm , equatorial diameter (E) 23 (35.25 \pm 1.41) 47.5 μm , colpus 17.5 (31.32 \pm 1.94) 47.11 μm long. Mesocolpium 15.2 (23.6 \pm 0.12) 32.5 μm . Apocolpium 2.5 (7.5 \pm 0.36) 12.5 μm . Exine 0.75 (2.11 \pm 0.12) 1.25 μm thick.

Key to the species and groups

1. + Tectum finely-coarsely *reticulate* 2
 - Tectum foveolate-fossulate or rugulate 4
2. + Pollen grains sub-prolate, tectum coarsely reticulate *Parkinsonia aculeata*
 - Pollen grains prolate-spheroidal, finely medium reticulate 3
3. + Polar length 39.49-43.06 μm *S. surrattensis*
 - Polar length 23.7-27.7 μm *S. tora*
4. + Pollen grains oblate-spheroidal, tectum finely rugulate *S. holosericea*
 - Pollen grains prolate-spheroidal, to sub-prolate, tectum fossulate to rugulate-fossulate 5
5. + Apocolpium 7.18-8.79 μm 6
 - Apocolpium 2.5-3.75 μm *C. pumila*
6. + Tectum fossulate densely breached by perforation *S. alexandrina*
 - Tectum rugulate-fossulate *C.occidentalis*

Results and Discussion

Caesalpinioideae is \pm eurypalynous in nature. In the present study the three pollen types recognized do not correspond with the tribal classification (4). However, palynology of the subfamily is significant at the generic and the specific levels. Graham & Baker (12) described palynology of the subfamily *Caesalpinioideae* in relation to their tribal classification. Pollen grains are generally radially symmetrical isopolar, tricolporate, and triangular - trilobed. The shape is prolate-spheroidal to oblate-spheroidal, and rarely sub-prolate. The tectum is commonly

reticulate-rugulate or fossulate-foveolate, and often striate. However, apocolpium, mesocolpium and tectum types are the most important pollen characters. On the basis of these characters, 3 distinct pollen types are recognized, namely, I: *Bauhinia variegata* - type; II: *Caesalpinia pulcherrima*-type; and III: *Senna holosericea*-type. The pollen type-I is easily delimited by its striate or striate-rugulate tectum. Two genera viz., *Bauhinia* L., (Cercideae) and *Tamarindus* L., (*Amherstieae*), each representing a single species, are included in this pollen type. However, these two genera can easily be distinguished on the basis of pollen shape. For example, in *Bauhinia* L., (*Bauhinia variegata* L.) sub-prolate pollen is found (11), whereas the pollen of *Tamarindus* L., (*Tamarindus indica* L.) is oblate-spheroidal in shape.

Pollen type-II is characterized by having parasyncolpate pollen grains, with different apocolpium and mesocolpium textures. A single species of *Caesalpinia pulcherrima* (L.) Swartz is included in this pollen type. Pollen type-III is readily recognized by its rugulate-fossulate to fossulate-foveolate or finely-coarsely reticulate tectum. It comprises seven species (*Cassia pumila* Lamk, *C. occidentalis* L., *S. holosericea* (Fersen) Greuter, *S. tora* (L.) Roxb., *S. surattensis* (Brum. f.) Irwin & Barneby, *S. italica* Miller and *Parkinsonia aculeata* L.) distributed in three genera, namely *Parkinsonia* L., *Senna* Mill. and *Cassia* L.,

The genus *Cassia* has long been recognized to be a heterogeneous taxon (18). Bentham (19) has identified three groups in this genus. Irwin & Barneby (20) recognized three distinct genera within the heterogeneous taxon *Cassia* L., namely *Cassia* L. (s.str.) *Senna* Miller and *Chamaecrista* Moech.

In this pollen type, *Parkinsonia aculeata* L., *Senna surrattensis* Brum. f., *S. tora* (L.) Roxb, can easily be delimited from the rest of the species by its finely to coarsely reticulate tectum. These species are further classified on the basis of pollen shape, polar length and apocolpium (see key to the species).

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