

POLLEN FLORA OF PAKISTAN-LVIII. CELASTRACEAE

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Abstract

Pollen morphology of 6 species of the family Celastraceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains are usually radially symmetrical, isopolar, colpate, sub-prolate to oblate-spheroidal. Sexine slightly thicker or thinner than nexine or as thick as nexine. Tectum mostly reticulate or sub-psilate. On the basis of exine pattern two distinct pollen types viz., *Celastrus paniculatus*-type and *Maytenus senegalensis*-type are recognized.

Introduction

Family Celastraceae is a large tropical or subtropical family of some 90 genera and about 1000 species (Mabberly, 1987). In Pakistan it is represented by 4 genera and 10 species (Siddiqi, 1977). The family is characterized by woody vines, shrubs and trees. Leaves simple, opposite or alternate, flowers small, 4-5 sepals and petals; alternating between the petals, stamens rise from a usually conspicuous nectar disk. Gynoecium 3-5, ovules usually two in each cells. Fruit variable capsule, samara drupe or berry. Family is best known for ornamental forms of the genera *Euonymus* and *Celastrus*.

Pollen morphology of the family has been examined by Erdtman (1952), Ikuse (1956), Halle (1962), Moore & Webb (1978). The most comprehensive survey on pollen morphology of Celastraceae is that of Lobreau-Callen (1977). Moore *et al.*, (1991) examined the pollen morphology of some genera of the family Celastraceae. Kubitzki (2004) examined pollen morphology of the family Celastraceae. There are no reports on pollen morphology of the family Celastraceae from Pakistan. Present investigations are based on the pollen morphology of 6 species representing 4 genera of the family Celastraceae by light and scanning electron microscope.

Materials and Methods

Polleniferous material was obtained from Karachi University Herbarium (KUH) or 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 150 Å. The S.E.M examination was carried out on a Jeol microscope JSM-6380A. The measurements are based on 15-20 readings from each specimen. Polar axis (P) and equatorial diameter (E), aperture size, apocolpium, mesocolpium and exine thickness were measured (Tables 1 & 2).

Table 1. General character of pollen grains found in pollen type-*Celastrus paniculatus*.

Name of species	Shape	Length in μm	Equatorial diameter μm	Colpus length in μm	Mesocolpium μm	Apocolpium μm	Exine thickness μm
<i>Cassine glauca</i> (Rottl.) O.Ktze	Sub-Pr	21.05 (24.4 \pm 1.08)	17.70 (20.91 \pm 0.85)	22.10 (23.7 \pm 0.06)	17.5 (20.1 \pm 0.73)	10.20 (15.9 \pm 0.59)	1.09
		28.10	23.4	25.40	22.01	11.50	
<i>Celastrus paniculatus</i> Willd.	Sub-Pr	33.11(34.65 \pm 06.7)	28.32 (30.47 \pm 0.85)	21.10 (22.7 \pm 0.58)	16.5 (16.9 \pm 6.73)	7.81 (8.41 0.54)	3.15
		36.20	29.70	23.40	17.10	9.06	

Table 2. General character of pollen grains found in pollen type-*Maytenus senegalensis*.

Name of species	Shape	Length in μm	Equatorial diameter μm	Colpus length in μm	Mesocolpium μm	Apocolpium μm	Exine thickness μm
<i>Euonymus echinatus</i> Wall.	Sub-Pr	28.05 (31.66 \pm 1.09)	24.70 (27.91 \pm 0.85)	23.10 (22.7 \pm 0.56)	22.40 (24.9 \pm 0.73)	13.20 (15.9 \pm 0.59)	7.09
		32.10	29.70	24.11	28.31	18.2	
<i>E. hamiltonianus</i> Wall.	Sub-Pr	28.3 (394.65 \pm 0.1)	24.7 (27.7 \pm 0.85)	23.1(22.7 \pm 0.58)	21.40 (24.9 \pm 6.73)	13.2 (15.4 \pm 0.54)	4.72
		29.97	29.70	24.40	28.30	18.10	
<i>Maytenus royleanus</i> (Wall. ex Lawson) Cuf.	Ob-Sp	22.50	22.50 (22.8 \pm 0.09)	17.50	12.50	c.12	2.25 (2.4 \pm 0.02)
			23.75		(14.19 \pm 0.21)	15.0	2.50
<i>M. senegalensis</i> (Lam.) Excell.	Sub-Pr	21.20 (24.5 \pm 0.24)	17.50 (19.8 \pm 0.14)	17.50 (19.66 \pm 0.4)	12.50 (12.76 \pm 0.2)	---	2.25 (4.60 \pm 0.39)
		25.0		22.50	16.5		5.01

Abbreviations: Subpr = Sub-prolate, Ob-Sp = Oblate-spheroidal

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

General pollen characters of the family Celastraceae

Pollen grains are usually radially symmetrical, isopolar, colpate, sub-prolate to oblate-spheroidal. Sexine slightly thicker or thinner than nexine. Tectum mostly reticulate rarely sub-psilate. On the basis of exine pattern two distinct pollen types are recognized viz., *Celastrus paniculatus*-type and *Maytenus senegalensis*-type.

Key to the pollen types

1. + Tectum reticulate *Maytenus senegalensis*-type
 - Tectum sub-psilate *Celastrus paniculatus*-type

Pollen type: *Celastrus paniculatus*- type

Pollen class: Tricolporate

P/E ratio: 1.13-1.22.

Shape: Sub-prolate

Apertures: Colpus long sunken with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Sub-psilate-punctate

Measurements: Size: Polar axis P = 21.00 (48.75 ± 1.2) 36.0, and equatorial diameter E = 17 (28 ± 2.1) 32.8 µm. Colpi 17.61 (24 ± 1.4) – 24 µm long. Exine 1.7-4.0 µm thick, sexine as thick as nexine. Tectum sub-psilate-punctate.

Species included: *Cassine glauca* (Rottb.) O.Ktze., *Celastrus paniculatus* Willd.

Key to the species

1. + Exine 3.15 µm thick *Celastrus paniculatus*
 - Exine 1.17 µm thick *Cassine glauca*

Pollen type: *Maytenus senegalensis*-type (Fig. 1A & B).

Pollen class: Tricolporate.

P/E ratio: 99.0-1.24.

Shape: Sub-prolate rarely oblate-spheroidal.

Apertures: Colpus short sunken with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Reticulate.

Measurements: Size: Polar axis P = 35.75 (37.75 ± 1.2) 40.25 and equatorial diameter E = 40 (42.22 ± 2.1) 45.5 µm. Colpi 11.61 (14.87 ± 1.4) –17.25 µm long. Exine 2.5-3.75 µm thick, sexine thicker than nexine. Tectum reticulate.

Species included: *Euonymus echinatus* Wall., *Euonymus hamiltonianus* Wall., *Maytenus royleanus* (Wall. ex Lawson) Cuf. and *Maytenus senegalensis* (Lam.) Excell.

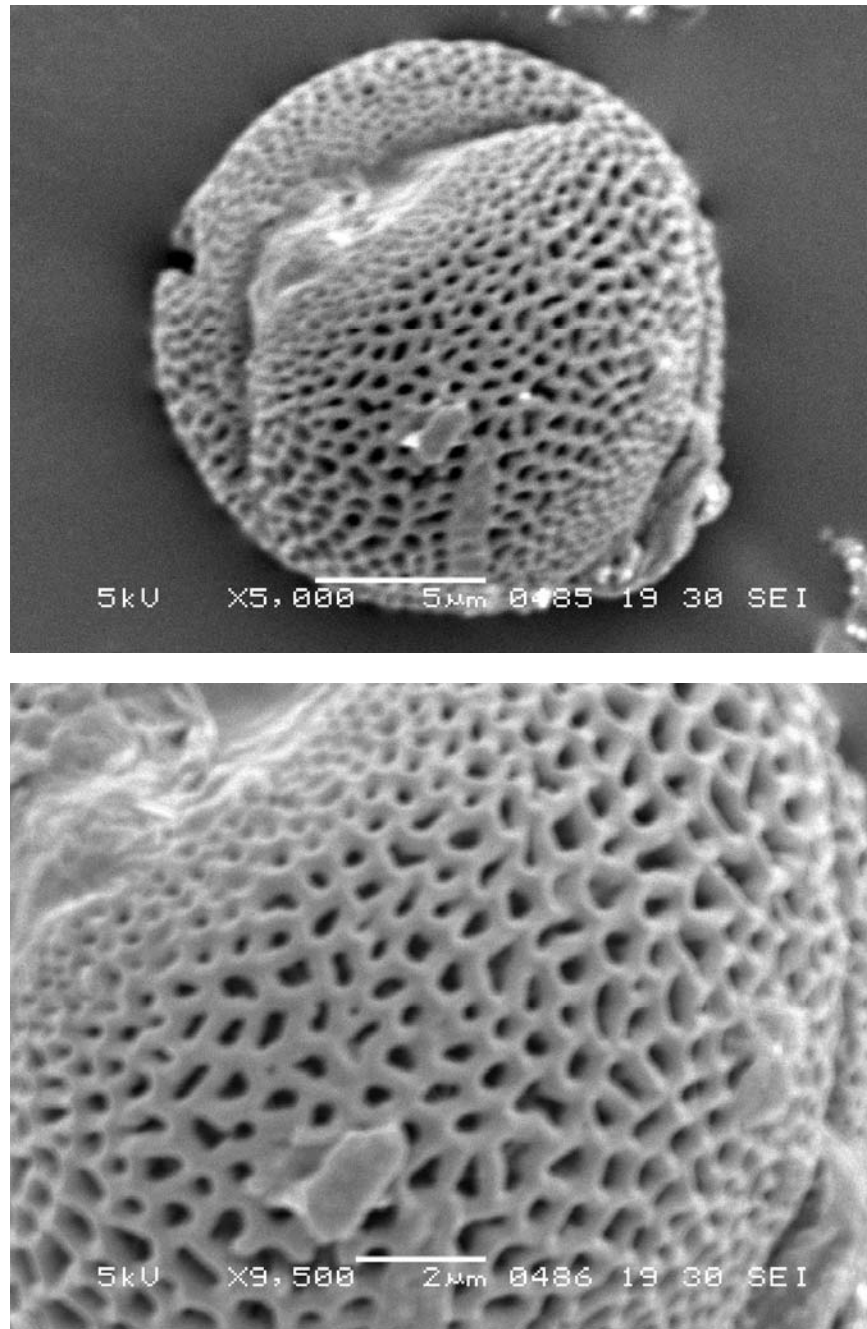


Fig. 1. Scanning Electron Micrographs of pollen grains. *Maytenus royleanus*: A, Equatorial view; B, Exine pattern.
Scale bar = A 5μ, B 2μ.

Key to the species and species groups

1. + Pollen grains sub-prolate 2
 - Pollen grains oblate-spheroidal *Maytenus royleanus*

2. + Exine 7.0 μm thick *Euonymus echinatus*
 - Exine 2.5-3.15 μm thick 3

3. + Polar length 21.5-25 μm *Maytenus senegalensis*
 - Polar length 28.5-29 μm *Euonymus hamiltonianus*

Discussion

Celastraceae is a more or less eurapalynous family. It shows considerable variation in their tectum type. Present investigations are based on 6 species representing 4 genera i.e., *Celastrum*, *Cassine*, *Euonymus* and *Maytenus*. On the basis of tectum two distinct pollen types are recognized viz., *Celastrus paniculatus*-type and *Maytenus senegalensis*-type. *Celastrus paniculatus*-type is characterized by sub-psilate exine ornamentation. Two genera i.e., *Celastrum* and *Cassine* are included in this pollen type. However, these two genera have significant differences in their pollen grains size (see key to the species).

Maytenus senegalensis-type is distinguished by its reticulate tectum. It comprises of two genera such as, *Euonymus* (*Euonymus echinatus* Wall., *Euonymus hamiltonianus* Wall.), and *Maytenus* (*Maytenus royleanus* (Wall. ex Lawson) Cuf. and *Maytenus senegalensis* (Lam.) Excell.). However, *Maytenus royleanus* (Wall. ex Lawson) Cuf., is easily separated by having oblate-spheroidal pollen, while remaining three species have sub-prolate pollen. The most comprehensive taxonomic treatments of Celastraceae s.s. and Hippocrateaceae were conducted by Loesener (1942) and Halle (1986).

The family Celastraceae s.l (including Hippocrateaceae), members of the family exhibit substantial variation in stamen, fruit and seed characters, which have been used to subdivide the family. Lindley (1853) and Loesener (1942) recognized Hippocrateaceae as distinct from Celastraceae s.s. based on a single character such as number of stamens 4-5 in Celastraceae s.s., whereas three (rarely two) in Hippocrateaceae.

However, Simmons *et al.*, (2001) on the basis of recent phylogenetic analysis of Celastraceae from phytochrome B gene sequence, *rbcL*, *atpB* and morphology data suggested that the family Hippocrateaceae was a monophyletic group nested within a paraphyletic family Celastraceae sensu stricto. Present pollen data also shows the paraphyletic nature of the family Celastraceae. Within the same family two distinct type of tectum is found (see key to the pollen types). Therefore, palynology of the family is quite significantly helpful at generic and specific level.

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