

POLLEN FLORA OF PAKISTAN–MALVACEAE- GREWIOIDEAE–LII

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Abstract

Pollen morphology of 12 species distributed in 3 genera viz., *Corchorus*, *Grewia* and *Triumfetta* were examined by light microscope (LM) and scanning electron microscope (SEM). Pollen grains generally tricolporate, prolate, sexine thicker or thinner than nexine. Exine ornamentation reticulate or rugulate to reticulate often rugulate. On the basis of exine pattern three pollen types are recognized viz., 1) *Corchorus aestuans*-type, 2) *Corchorus depressus* type, 3) *Corchorus tridens*-type.

Introduction

In our earlier paper (Perveen *et al.*, 1994) while dealing the pollen flora of Pakistan, we accepted Malvaceae (s.str.) in its traditional sense as accepted by Adanson (1763) and other workers like Cronquist (1968, 1981, 1988); Takhtajan (1969, 1997); Throne (1983, 1992). However, recently some closely related but arbitrarily delineated families like Sterculiaceae, Tiliaceae, Bombacaceae and Malvaceae have been merged into an expanded family Malvaceae by Judd & Manchester (1997), Bayer *et al.*, (1999) and Bayer & Kubitzki (2003). Their conclusion is based on number of morphological and molecular data. The large and expanded family divided into nine subfamilies viz., Byttnerioideae, Grewioideae (including most of the genera of Tiliaceae), Tilioideae (only with a single genus *Tilia*), Helicteroideae, Sterculioideae, Brownlowioideae, Dombeyoideae, Malvoideae Bombacoideae. The genera formerly included in *Tiliaceae* are now distributed in subfamilies Brownlowioideae, Dombeyoideae, Grewioideae and Tilioideae of Malvaceae s.l. Morphological and molecular data show that Brownlowioideae and Grewioideae include the vast majority of 'tiliaceous' genera, the rest being in Tilioideae (Bayer & Kubitzki, 2003). In the present investigation Bayer *et al.*, (1999) classification is adopted and according to this all the studied taxa belong to the subfamily Grewioideae.

Alverson *et al.*, (1999) based on molecular data suggested that the Malvalian complex is composed of four groups: 1) Four core families (Bombacaceae, Malvaceae, Sterculiaceae & Tiliaceae) 2) Bixoid families Bixaceae, Cochlospermaceae and Sphaeroseplaceae 3) The Thymelaealan family (Thymelaceae and the 4 Cistales complex included families: Cistaceae, Dipterocarpaceae, Sarcolaenaceae and the newly proposed Muntingiaceae. Members of the subfamily Grewioideae are tree shrub or rarely herb, pubescent mainly with stellate hairs or peltate scales, leaves alternate or rarely opposite, deciduous or occasionally evergreen, simple, entire or more commonly lobed or toothed with deciduous stipules. As far as pollen morphology of the subfamily is concerned number of workers described the pollen of subfamily Grewioideae while studying the Tiliaceae pollen such as, pollen morphology of the genus *Corchorus* has been examined by Datta (1956). Pollen morphology of North European species of the family Tiliaceae has also been studied by Christensen & Blackmore (1988). Qaiser & Perveen (1997) also

described pollen morphology of some species of the family Tiliaceae (Grewioideae), during the palynological survey from Pakistan. The pollen morphology of the subfamily Grewioideae has also been examined by Rao & Rao (1952), Mai (1961); Chaudhuri (1965), Chambers & Godwin (1971); Anderson (1976); Moore & Webb (1978); Kasartseva (1982); De Castells *et al.*, (1985); Zhuge (1990), Tang & Goa (1993); Tirel *et al.*, (1996). Present data is based on pollen morphology of 12 species of subfamily Grewioideae by light microscope and scanning electron microscope which will be helpful to assessing the familial and interfamilial classification.

Materials and Methods

Pollen samples were 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 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 subfamily Grewioideae

Pollen grains usually radially symmetrical, isopolar. prolate. Tricolporate, sexine thicker or thinner than nexine. Tectal surface mostly reticulate often rugulate or rugulate-reticulate. On the basis of exine ornamentation three distinct pollen types are recognized viz., 1) *Corchorus aestuans*-type, 2) *Corchorus depressus* type, 3) *Corchorus tridens*-type.

Key to the pollen types

1. + Tectum reticulate *Corchorus depressus* - type
- Tectum not as above 2
2. + Tectum rugulate-reticulate *Corchorus tridens* -type
- Tectum rugulate *Corchorus aestuans*-type

Pollen type: *Corchorus aestuans* -type (Fig. 1 C & D)

Pollen class: Tricolporate

P/E ratio: 1.52

Shape: Prolate

Apertures: Ectocolpus long narrow with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Rugulate

Table 1. General pollen morphology of taxa found in pollen type-*Corchorus depressus*.

Taxa	Shape	Polar length in μm	Equatorial diameter μm	Colpus length μm	Apocolpium μm	Mesocolpium in μm	Exine thickness
<i>Corchorus depressus</i> (L.) Stocks	Pr	32.31(33.92 \pm 0.40) 35.90	21.54(23.50 \pm 0.41) 25.13	21.54(23.51 \pm 0.40) 25.13	4.2(5.61 \pm 1.2) 6.60	-	1.79
<i>C. olitorius</i> L. var. <i>incisifolius</i>	Pr	35.90(39.11 \pm 0.29) 41.28	25.13(28.63 \pm 0.30) 30.50	25.13(27.70 \pm 0.50) 32.30	5.38(6.64 \pm 0.16) 7.80	17.95(20.19 \pm 0.30) 18.11	1.40(1.89 \pm 0.05) 2.50
<i>Grewia villosa</i> Willd.	Pr	39.50(42.70 \pm 0.79) 46.60	25.10(30.80 \pm 1.32) 39.50	28.70(34.40 \pm 1.83) 39.50	c. 5.64	25.10(29.60 \pm 4.80) 34.10	0.71(1.42 \pm 0.17) 1.71
<i>Corchorus capsularis</i> L.	Pr	32.31(34.28 \pm 9.0) 35.90	21.54(24.95 \pm 0.40) 28.12	21.54(23.69 \pm 0.40) 25.13	-	-	1.44(1.65 \pm 0.30) 1.74
<i>Corchorus trilocularis</i>	Pr	32.31(35.36 \pm 0.20) 37.69	21.50(24.47 \pm 0.30) 26.92	23.33(27.34 \pm 0.30) 30.15	3.59(4.78 \pm 0.50) 5.38	16.15(17.40 \pm 0.19) 19.70	1.49
<i>C. olitorius</i> L. subsp. <i>olitorius</i>	Pr	32.31(36.39 \pm 0.40) 39.49	21.54(24.06 \pm 0.50) 28.12	25.13(25.75 \pm 0.29) 28.72	-	17.95(20.40 \pm 0.30) 21.54	1.48(1.81 \pm 0.05) 16.0
<i>C. optiva</i> Drummond ex Burret.	Pr	32.85(34.71 \pm 1.64) 64.82	32.31(39.13 \pm 0.1) 39.10	28.72(36.97 \pm 1.33)	-	-	1.79
<i>Triumfetta rotundifolia</i> A. Rich.	Pr	39.50(42.70 \pm 0.76) 46.60	25.10(30.80 \pm 1.33) 39.50	28.70(34.40 \pm 1.63)	c. 5.64	25.1(29.60 \pm 4.46) 34.10	0.71(1.42 \pm 0.17) 1.79
<i>T. pentandra</i> Lam.	Pr	37.69(45.25 \pm 0.80) 50.26	21.56(25.36 \pm 0.40) 28.72	21.54(34.04 \pm 1.30) 43.08	5.38(9.08 \pm 0.04) 12.55	16.15(19.90 \pm 0.06) 3.23	2.15(2.64 \pm 0.60) 3.23

Measurements: Size: Polar axis (P) = (28.5-) $32.13.8 \pm 0.6$ (-35.5) μm , and equatorial diameter (E) = (17.9 5) 21.5 ± 0.11 (25.13) μm , colpi (21.54-) 23.51 ± 0.6 2 (28.72) μm in long. Exine 1.25 (2.0 \pm 0.5) 2.75 μm thick, sexine thicker than nexine. Tectum rugulate
Species included: *Corchorus aestuans* L.

Pollen type: *Corchorus depressus*-type (Fig.1 A, B & E, F).

Pollen class: Tricolporate

P/E ratio: 130 -1.78

Shape: Prolate

Apertures: Ectocolpus long narrow with acute ends.

Exine: Sexine thicker or thinner than nexine.

Ornamentation: Reticulate medium-coarse.

Measurements: Size: Polar axis (P) = (32.23-) 41.8 ± 0.2 (-50.5) μm and equatorial diameter (E) = (21.75) 30.6 ± 0.11 (39.5) μm , colpi (21.5-) 32.75 ± 0.42 (43.00) μm in long. Mesocolpium 11.4 (22.70 \pm 0.25) 34.6 μm . Apocolpium 3.25 (7.6 \pm 1.24) 12.02 μm . Exine 0.71 (2.71 \pm 0.5) 3.25 μm thick, sexine thicker than nexine. Tectum medium to coarse reticulate.

Species included: *Corchorus depressus* (L.) Stocks, *C. olitorius* L., *Grewia villosa* Willd., *Corchorus capsularis* L., *Corchorus trilocularis* L., *C. olitorius* subsp. *olitorius*, *Crewia optiva* Drum ex Burret., *Triumfetta rotundifolia* Lam., *T. pentandra* A. Rich

Pollen type: *Corchorus tridens*

Pollen class: Tricolporate

P/E ratio: 1.61

Shape: Prolate

Apertures: Ectocolpus long narrow with acute ends.

Exine: Sexine thicker or thinner than nexine.

Ornamentation: Rugulate - reticulate

Measurements: Size: Polar axis (P) = (34.31-) 20.8 ± 0.2 (-37.69) μm and equatorial diameter (E) (17.9 5) 21.12 ± 0.28 (23.5) μm , colpi (21.8-) 23.68 ± 0.35 (26.94) μm in long. Mesocolpium 14.36 (16.73 \pm 0.25) 19.74 μm . Apocolpium 3.25 (4.35 \pm 1.24) 7.18 μm . Exine c. 1.79 μm thick, sexine thicker than nexine. Tectum rugulate-reticulate.

Species included: *Corchorus tridens* L.

Discussion

Palynologically, subfamily Grewioideae is a stenoplainous taxon. Pollen grains are generally isopolar, radially symmetrical, tricolporate with reticulate often rugulate-reticulate tectum. Subfamily Grewioideae is divided in to three pollen types, based on exine ornamentation. Viz., 1) *Corchorus aestuans*-type, 2) *Corchorus depressus* type, 3) *Corchorus tridens*-type.

Erdtman (1952) divided the family into three types i.e., I. *Tilia*-type, II. *Grewia*-type and III. Other-type. In *Tilia* type pollen grains are usually 3-colporate with short colpi (brevicolpate) and oblate peroblate or suboblate, whereas in the *Grewia*-type pollen grains are prolate and tricolporate with long colpi. Genera like *Ancistrocarpus*, *Belotia*, *Corchorus*, *Desplatsia*, *Grewia*, *Honckenya*, *Lueheopsis*, *Nettoa*, *Sparmannia*, *Entelea*, *Tetralix*, *Trichospermum*, *Triumfetta*, *Vasivaea* and *Vincentia* are included in the type. In

Fig. 1. Scanning micrographs: *Triumfetta rotundifolia*: A, Equatorial view, B, Exine pattern. *Corchorus aestuans*: C, Equatorial view, D, Exine pattern. *Grewia optiva*: E, Equatorial view, F, Exine pattern. Scale bar = A-F = 10 μ m

other-type rest of the genera are included. Perveen *et al.*, (2004) during the study of world pollen and spore flora of Malvaceae (Grewioideae, Tilioideae, Brownlowioideae) (s.lato.) divided the family into three pollen types i.e., *Berrya* - type, *Corchorus*-type and *Mortoniendendron*-type, on the basis of apertural types and exine ornamentation. They reported similar types of pollen in the genus *Corchorus*. The Malvales (s.lat.) is supported by number of characters such as palminerved leaves, stellate hairs, mucilage, layered phloem, valvate calyx and numerous stamens. This is also supported by molecular data (Judd & Manchester, 1997, Bayer *et al.*, 1999). But the merging of four families i.e., Sterculiaceae, Malvaceae, Bombacaceae and Tiliaceae seems to be unjustified. Only Malvaceae (s.str.) is monophyletic whereas other families particularly Tiliaceae is polyphyletic. This is also supported by the pollen characters i.e., in Grewioideae tricolporate prolate or sub-prolate pollen are found, in Tilioideae tricolporate oblate-spheroidal pollen are found whereas the family Malvaceae is characterized by having porate pollen with echinate tectum (Perveen *et al.*, 2004).

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(Received for publication 11 February 2006)