

A PALYNOLOGICAL STUDY OF MONOCOTS FROM KARACHI (EXCLUDING GRAMINEAE)

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Abstract

Pollen morphology of 25 monocotyledonous species belonging to 14 genera distributed in 8 families from Karachi have been investigated by light and scanning electron microscope. Pollen occur either singly or in tetrads. In most of the species simple apertures are found i.e., colpate and porate. However, in some cases ill-defined apertures or no apertures as in Commelinaceae are also found. Tectum of these families are also quite variable which ranges from reticulate, rugulate, striate, fossulate-echinate or scabrate/areolate.

Introduction

Monocots represent considerable part of the world flora. Literature dealing with the pollen morphology of monocots is rather scarce as compared to dicots. Nevertheless, there are some reports available on the pollen morphology of some of the monocot families from various parts of the world, such as Typhaceae (Nair, 1961; Raj & Saxena, 1966, Cook, 1988). Hydrocharitaceae and Pontederiaceae (Raj & Saxena, 1966). Walker & Doyle (1975) studied the pollen morphology of Cyperaceae. Few genera of the family Commelinaceae have been studied by Poole & Hunt (1979). Landolt (1986) examined the pollen morphology of Lemnaceae. Few species of the families Cyperaceae, Liliaceae, Lemnaceae, Juncaceae, Typhaceae and Potamogetonaceae were also analysed by Moore *et al.*, (1991).

The flora of Karachi is represented by 413 plant species of which 162 monocots and 251 dicots are distributed in 60 dicot and 15 monocot families (Jafri, 1966). Pollen morphology of the family Gramineae from Karachi has been studied by Siddiqui & Qaiser (1988). However, no information on the pollen grains are available on the rest of the monocot families from Karachi. In the present work 25 species belonging to 14 genera distributed in 8 families have been studied.

Material and Methods

Freshly polleniferous material of 25 species were collected from Karachi. In case of non-availability of fresh material, herbarium materials were also used. The voucher specimens have been deposited in Karachi University Herbarium (KUH). A list of specimens investigated is given in Appendix-I.

For the preparation of pollen grain slides, pollen materials were processed by the standard acetolysis method of Erdtman (1952, 1960) but this technique has resulted in the collapsing of pollen grains due to their delicate and thin wall. Hence, to avoid shrinkage, pollen grains were directly treated with 1 to 2 drops of distilled water instead of acetolysis.

Table 1. Some important pollen morphological characters of monocot taxa.

| NAME | SHAPE | LENGTH | BREADTH | APERTURES TYPES | SIZE | EXINE THICKNESS | TECTUM |
|--|------------------------------|-------------------------------|-------------------------------|----------------------|---------------------------------------|--|-----------------------|
| POTAMOGETONACEAE | | | | | | | |
| <i>Potamogeton pectinatus</i> L. (Fig. 1A, B; 4B) | Spheroidal | — | 21.45 (24.48 ±0.71) 30.11 | non-aperturate | — | 0.50 (0.83 ±0.22) 1.25 | Reticulate |
| <i>P. perfoliatus</i> L. (Fig. 4A) | -do- | — | 32.50 (35.11 ±1.87) 37.51 | -do- | — | c. 0.12 | -do- |
| LILIACEAE | | | | | | | |
| <i>Asparagus dumosus</i> Baker (Fig. 1 E, F; 4D) | Elliptic | 25.25 (32.37 ± 1.03) 39.51 | 25.25 (28.03 ±0.71) 30.11 | mono-colpate | 17.50 (22.85 ±1.64) 27.71 | c. 1.25 | Fossulate-rugulate |
| <i>Asphodelus tenuifolius</i> Cavan (Fig. 1C, D; 4C) | 52.50 (54.51 ±0.63) 56.25 | 50.25 (51.51 ±0.56) 52.12 | -do- | 31.46 (49.37 -do- | 1.25 (1.32 ±0.63) 50.11 c. 17.5 | Coarsely ±0.17) 1.82 1.50 (1.75 ±0.21) 2.37 | reticulate Striate |
| <i>Dipcadi erythraeum</i> Webb. & Benth. (Fig. 1G, H) | -do- | 65.50 (69.37 ±2.11) 77.51 | 97.50 (98.87 ±2.01) 101.12 | -do- | — | — | — |
| PONTERIACEAE | | | | | | | |
| <i>Eichhornia crassipes</i> (Mart.) Sloms (Fig. 2A, B; 4E) | Oblong | 37.07 (39.25 ±0.75) 42.52 | 47.50 (50.98 ±1.20) 57.51 | mono-bicolpate | 0.50 (2.25 ±0.21) 2.52 | 0.50 (2.25 ±0.21) 2.52 | Areolate |
| JUNCACEAE | | | | | | | |
| <i>Juncus maritimus</i> Lam. (Fig. 2C, D; 4F) | Tetrahedral | 32.50 (40.25 ±2.83) 42.51 | 37.50 (40.04 ±1.29) 47.91 | non-aperturate | — | 1.25 (1.35 ±0.05) 1.75 | Lophoreticulate |

Table 1 (Cont'd)

| NAME | SHAPE | LENGTH | BREADTH | APERTURES TYPES | SIZE | EXINE THICKNESS | TECTUM |
|---|------------|------------------------------|------------------------------|--------------------|------------------------------|---------------------------|-----------------------------------|
| CYPERACEAE | | | | | | | |
| <i>Ascolepis brasiliensis</i> (Kunth) | Triangular | 15.73 (18.38 ±0.81) 20.02 | 12.87 (17.09 ±1.80) 18.59 | 4-aperturate | 7.15 (15.16 ±0.52) 11.44 | 1.43 | Scabrate, Punctate |
| Benth. ex C. B. Clarke (Fig.3A,B;4J) | | | | | | | |
| <i>Cyperus arenarius</i> Retz. | -do- | 15.11 (18.75 ±1.40) 27.51 | 15.23 (17.68 ±0.81) 20.25 | -do- | 5.01 (6.25 ±0.84) 7.51 | c. 1.25 | Scabrate |
| <i>C. atkinsoni</i> C.B. Clarke (Fig.2E,F) | -do- | 22.50 (28.30 ±0.44) 33.75 | 17.50 (22.11 ±1.03) 25.11 | -do- | 5.91 (7.51 ±0.67) 10.41 | 0.25 (0.32 ±0.12) 0.51 | Scabrate- scabrac fine |
| <i>C. bulbosus</i> Vahl (Fig.4H) | -do- | 25.74 (30.50 ±0.70) 34.32 | 14.30 (19.83 ±0.77) 24.31 | -do- | 11.44 (18.88 ±1.05) 25.74 | 1.43 | Scabrate punctate |
| <i>C. conglomeratus</i> Rottb. | -do- | 25.51 (26.85 ±0.37) 27.75 | 17.50 (20.75 ±0.35) 25.11 | -do- | 17.50 (20.12 ±1.44) 22.51 | 0.21 (0.31 ±0.81) 0.51 | Areolate |
| <i>C. laevigatus</i> L. (Fig.4G) | -do- | 22.50 (24.08 ±0.46) 25.25 | 18.75 (21.60 ±0.54) 25.11 | -do- | 10.11 (16.22 ±1.30) 20.71 | c. 0.5 | Scabrate, sparsely punctate |
| <i>C. rotundus</i> L. (Fig.4I) | -do- | 27.70 (30.75 ±2.64) 32.51 | 21.25 (25.11 ±2.89) 26.11 | -do- | 10.11 (19.21 ±0.81) 23.21 | 0.25 (0.37 ±0.31) 0.51 | Areolate with scabrac |

Table 1 (Cont'd)

| NAME | SHAPE | LENGTH | BREADTH | APERITURES TYPES | SIZE | EXINE THICKNESS | TECTUM |
|--|-----------------------|------------------------|------------------------|---------------------|------------------------|----------------------|--------------------------|
| <i>Eleocharis capitata</i> (L.) R.Br. | -do- | 20.02 (24.78 ±0.65) | 17.16 (21.92 ±0.72) | -do- | 11.44 (15.59 ±0.80) | 0.71 (1.24 ±0.07) | Scabrate, punctate, |
| <i>Fimbristylis dichotoma</i> (L.) Vahl | -do- | 22.50 (23.91 ±0.49) | 17.50 (20.13 ±0.96) | -do- | 17.11 (20.11 ±0.21) | 0.25 (0.31 ±0.05) | Areolate with scabrae |
| <i>Scirpus littoralis</i> Schrad (Fig.2G,H) | -do- | 25.01 (27.16 ±1.12) | 15.12 (24.87 ±1.98) | -do- | 10.11 (15.50 ±0.14) | c. 0.5 | Areolate with scabrae |
| <i>S. tuberosus</i> Desf. | -do- | 41.25 (48.80 ±1.38) | 25.11 (26.11 ±1.21) | -do- | 10.11 (16.11 ±0.61) | 0.25 (0.64 ±1.42) | Areolate with scabrae |
| COMMELINACEAE | | | | | | | |
| <i>Commelina albescens</i> Hassk. (Fig.3C,D) | Oblong | 40.32 (41.80 ±0.95) | 65.32 (69.18 ±2.64) | monocolpate | c. 17.5 | 2.25 (2.35 ±0.12) | Spinulose- punctate |
| <i>C. paludosa</i> Blume | -do- | 32.50 (43.01 ±3.27) | 52.50 (63.11 ±2.30) | -do- | colpus indistinct | 3.01 (4.11 ±0.34) | Spinulose- punctate |
| LEMNACEAE | | | | | | | |
| <i>Lemna acquinoc-tialis</i> Welw. | Spheroidal | — | 19.69 (21.22 ±0.62) | monoporate | — | 0.66 (1.76 ±0.41) | Spinulose- punctate |
| <i>L. gibba</i> L. (Fig.4K) | -do- | — | 20.0 (21.13 ±0.37) | -do- | c. 0.05 | 1.25 (1.42 ±0.15) | Spinulose |
| TYPHACEAE | | | | | | | |
| <i>Typha angustifolia</i> L. | -do- | — | 22.50 (23.11 ±0.38) | monoporate | 3.01 (4.12 ±0.70) | 1.11 (1.13 ±0.11) | Reticulate - rugulate |
| <i>T. domingensis</i> Pers. (Fig.3E,F) | -do- | — | 20.11 (22.61 ±0.43) | -do- | 4.75 (5.32 ±0.36) | 1.01 (1.15 ±0.13) | Coarsely reticulate |
| <i>T. elephantina</i> Roxb. (Fig.3G,H,4L) | Tetragonal tetrads | 33.21 (35.12 ±1.19) | 35.21 (38.33 ±1.15) | -do- | 2.75 (3.93 ±0.49) | 2.01 (2.25 ±0.14) | Densely foveolate |

For light and scanning microscopy the material was divided into two parts. For S.E.M., the pollen material was mounted on metallic stub, with a fine capillary tube and coated with gold, in sputtering chamber (Ion sputter JFC - 1100). Coating was restricted to 15 A° and S.E.M. examination were carried out using Jeol (JSM-T-200) microscope.

For light microscopy second part of the polleniferous material was centrifuged for 3-5 minutes in 50% glycerine, then glycerine was decanted. The pollen material was mounted on slides in unstained glycerine jelly (Kisser's Method, 1937). The slides were examined using Nikon Type 102 using 10x eye piece under (E'40,0.65). From each slide pollen length, pollen breadth, aperture size and exine thickness of 10-15 pollen were measured.

The terminology used is in accordance with Erdtman (1952), Kremp (1965), Faegri & Iversen (1964), Andersen & Bertelsen (1972) and Walker & Doyle (1975).

Results

The monocots pollen are quite variable. Pollen grains are generally heteropolar, rarely apolar and subisopolar, spheroidal, oblong rarely triangular, aperture mostly colpate, porate, rarely non-aperturate, sexine thinner or thicker than often as thick as nexine. A wide range of tectum is found within various families i.e., striate, reticulate, fossulate, scabrate, areolate and spinulose-punctate. Detailed description of all the taxa studied is given in Table 1.

Discussion

Pollen of monocotyledons are least specialized than dicots, particularly in their apertural types. Simple apertural grains are fairly common viz., monocolpate, porate or sometimes even with ill defined apertures. However, the monocot pollen grains show great variation in their shape, size and exine pattern. Walker & Doyle (1975) suggested that like Magnoliidae monocotyledons were basically monosulcate group, the ancestors of the monocots were some dicotyledonous with primitive monocolpate pollen (Takhtajan, 1969).

Potamogetonaceae is a stenopalynous family in which pollen grains are generally apolar, non-aperturate, with reticulate tectum. Within this family 2 taxa have been studied, representing a single genus *Potamogeton*. However, both the species can be separated on the basis of lumina diameter i.e., *P. perfoliatus* has 0.5-1.0 μm lumina, while in *P. pectinatus* 0.4-1.3 μm lumina are found.

As compared to Potamogetonaceae, family Liliaceae is quite heterogeneous, more especially in their tectal surface. Pollen data is based on 3 genera each representing a single taxon. All these genera are distinct in their pollen types, for instance, in *Asphodelus* oblate-spheroidal grains with reticulate tectum, while the genus *Asparagus* is easily delimited by their elliptic grain with fossulate tectum. In *Dipcadi* pollen grains are elliptic with striated tectum. In *Eichhornia crassipes* of the family Pontederiaceae, monocolpate pollen are observed but with areolate tectum as also found in Liliaceae. According to Takhtajan (1969) evidently the Pontederiaceae is related to Liliaceae. Our palynological findings are also in agreement with Takhtajan (1969) as both the families have similar type of heteropolar, monocolpate pollen

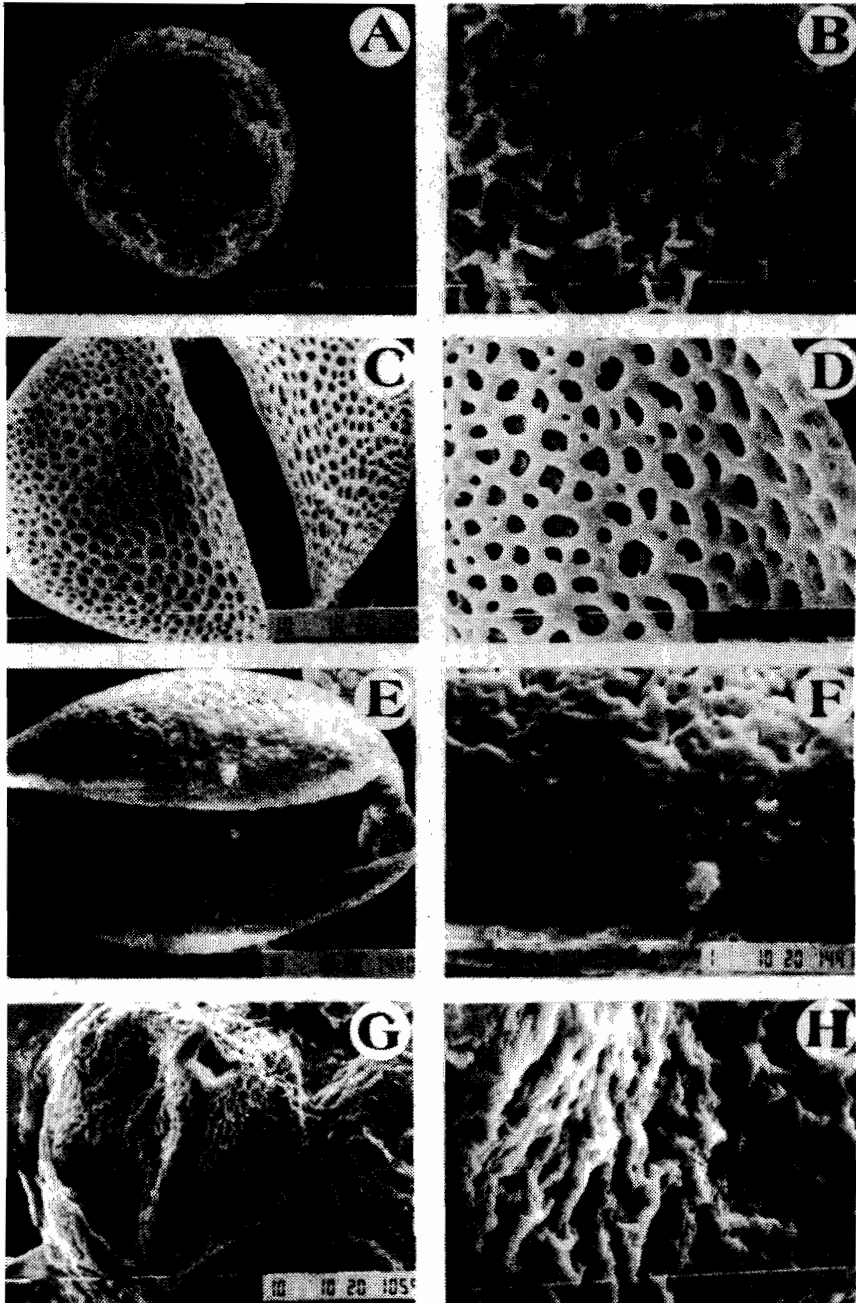


Fig. 1. Scanning Electron micrographs (S.E.M) of the pollen grains. *Potamogeton perfoliatus*: A, pollen grain; B, Exine, pattern. *Asphodelus tenuifolius*: C, pollen grain; D, Exine pattern. *Asparagus dumosus*: E, pollen grains, F, Exine pattern. *Dipcadi erythraeum*: G, pollen grain; H, Exine pattern. Scale bar (A,C-E, G,H). = 10 μ m; (B & F) = 1 μ m.

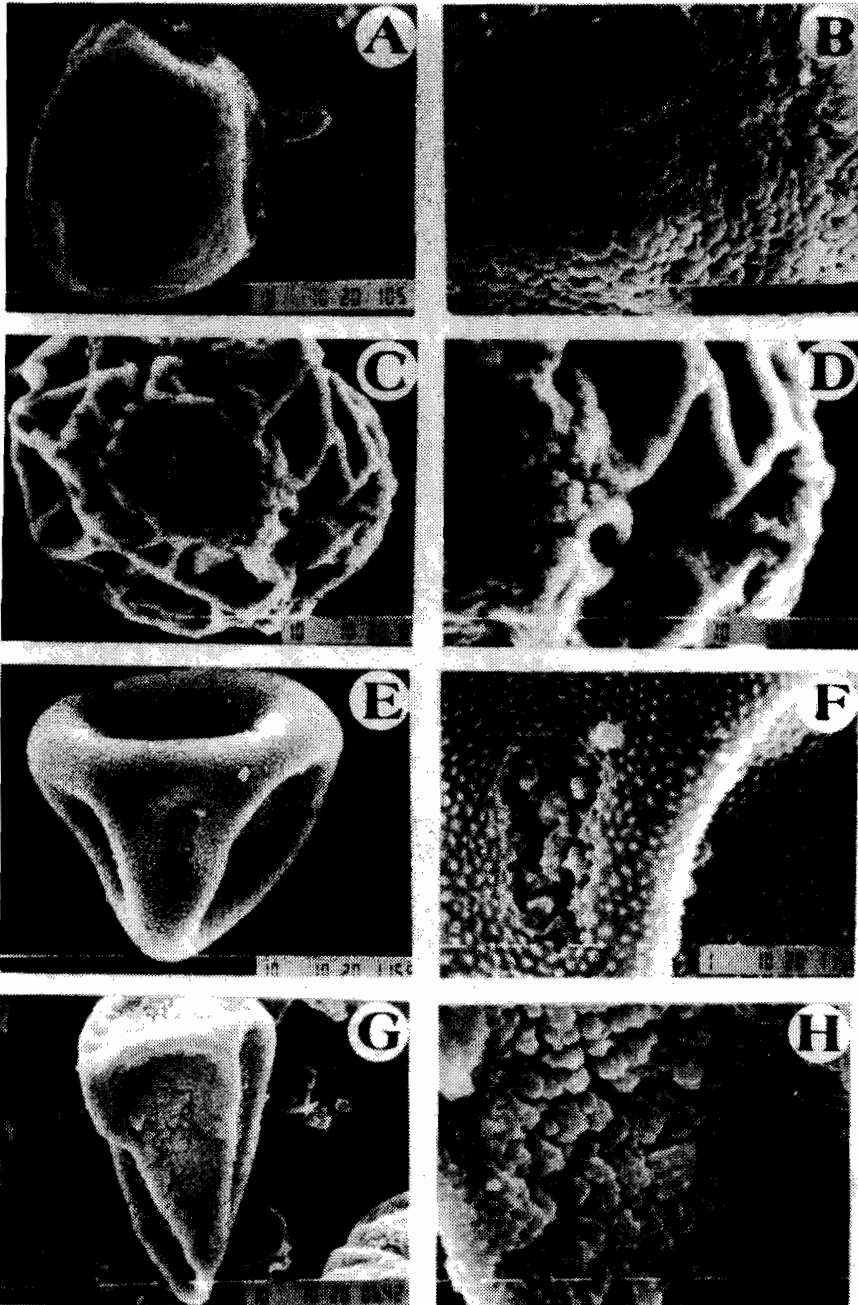


Fig.2. Scanning Electron micrographs (S.E.M) of the pollen grains. *Eichhornia crassipes*: A. pollen grain; B. Exine pattern. *Juncus maritimus*: C, pollen grains; D, Exine pattern. *Cyperus atkinsoni*: E, pollen grains; F, Exine pattern. *Scirpus littoralis*: G, pollen grain; H, Exine pattern. Scale bar (A-E, G) = 10 μ m; (F & H) = 1 μ m.

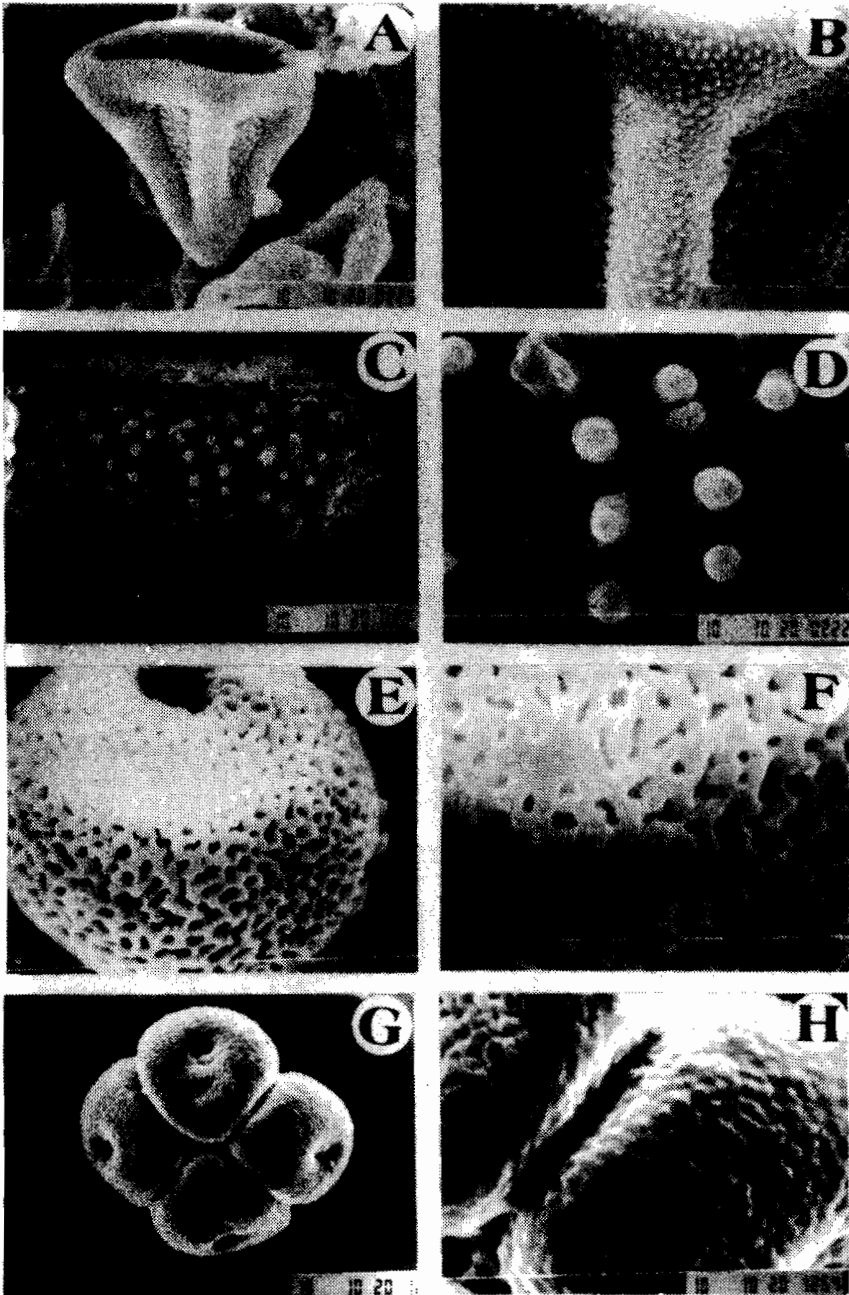


Fig.3. Scanning Electron micrographs (S.E.M) of the pollen grain. *Ascolepis brasiliensis*; A, Pollen grain; B, Exine Pattern. *Commelina albescens*. C, pollen grains; D, Exine pattern. *Typha domingensis*: E, pollen grain; F, Exine pattern. *T. elephantina*: G, tetrads; H, Exine pattern. Scale bar (A, C-E, G,H) = 10 μ m; (B & F) = 1 μ m.

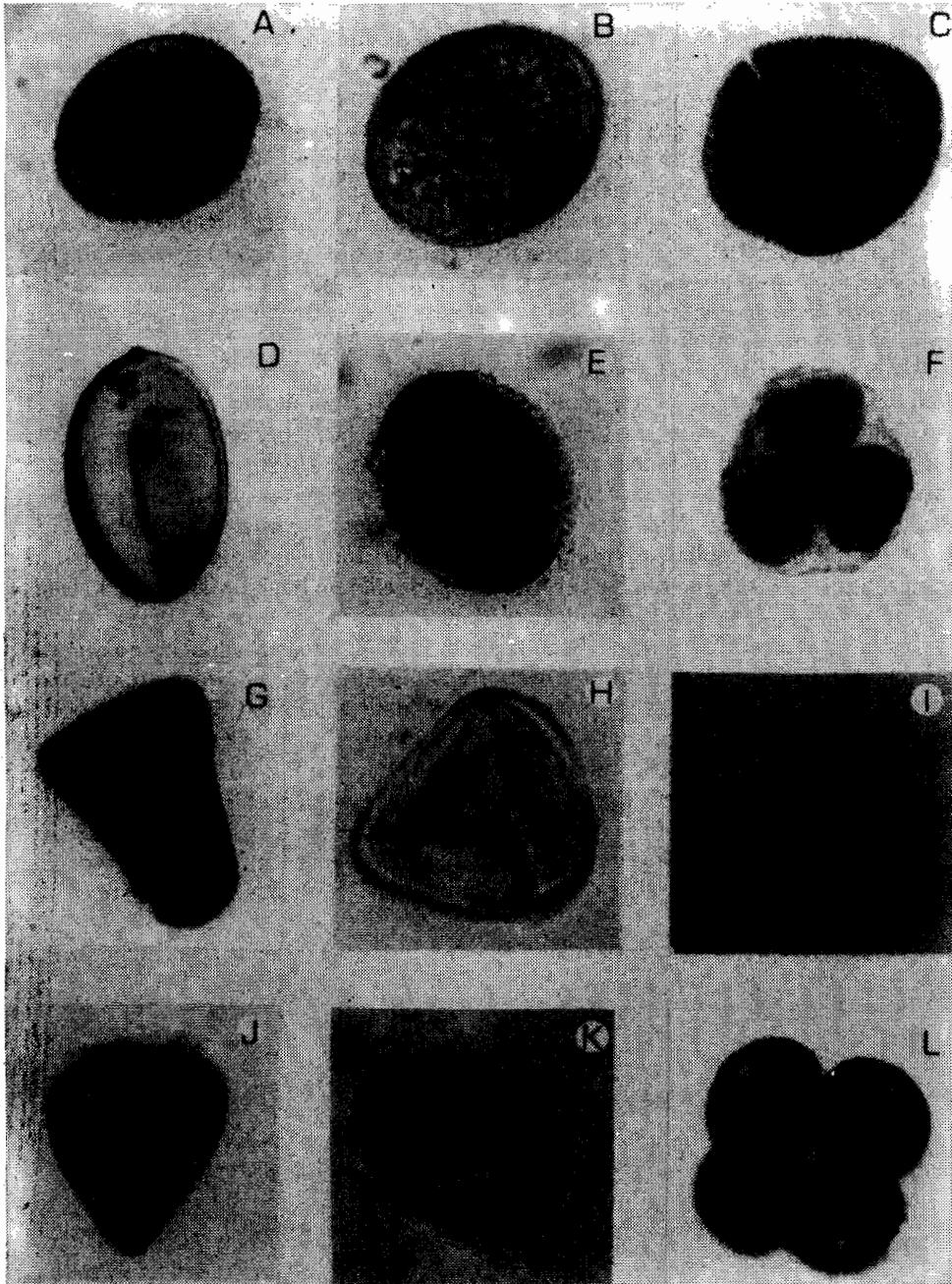


Fig.4. Light micrographs (L.M) of the pollen grains. *Potamogeton perfoliaius*: A, pollen grain. *P. pectinaius* B, pollen grain. *Asphodelus tenuifollius*: C, pollen grain. *Asparagus dumosus*: D, pollen grain. *Eichhornia crassipes*: E, pollen grain. *Juncus maritimus*: F, tetrad. *Cyperus laevigatus*: G, pollen grain. *C. bulbosus*: H, pollen grains. *C. rotundus*: I, pollen grain. *Asclepis brasiliensis*: J, pollen grain. *Lemna gibba*: K, pollen grain. *Typha elephantina*: L, tetrads. All figures = x 400.

grains. From Juncaceae, only one species *Juncus maritimus* was examined. This family is quite different than the others, by having non-aperturate tetrads with lopho-reticulate tectum.

Cyperaceae is a fairly advanced family and probably originated from primitive Juncaceae (Takhtajan, 1969). It is a stenopalynous family. Pollen grains are generally heteropolar, (4-aperturate) with scabrate or areolate tectum. Walker & Doyle (1975) reported asymmetrical, ovoid grain with one or four blotchy (ill-defined) apertures, which are referred to as pseudomonads (cryptotetrads), since each grain is derived from one pollen mother cell by degeneration of three of the haploid nuclei. They also considered that pseudomonads or cryptotetrads are evolved from permanent tetrads, thus confirming the earlier view of Takhtajan's that Juncaceae has tetrads, while in Cyperaceae monads are found.

Commelinaceae is uniform in their pollen type. Pollen grains are heteropolar, monocolpate (colpus-like) with spinulose-punctate tectum. Pollen data is based on 2 taxa, palynologically both are similar, but they can be separated on the basis of spinules distance, for instance in *Commelina albescens* Hask., and in *C. paludosa* Blume, spinules are 2 μm and 4 μm apart respectively. Similar types of pollen grains have also been reported in the other species of the genus *Commelina* by Poole & Hunt (1979). In this family pollen are relatively least specialized, which are quite compatible with Liliaceae, in both the families grains are monocolpate but Commelinaceae is distinct from Liliaceae by having spinulose tectum.

From Lemnaceae 2 taxa have been studied. Pollen grains are apolar, monoporate with spinulose tectum. Landolt (1986) reported spiny pollen grain which are often less than 20 μm in diameter in the genus *Lemna*. Walker & Doyle (1975) also reported spinulose grains in this family but with reduced apertures.

Typhaceae is a monotypic family, but their pollen are quite variable. For instance, in *Typha domingensis* and *T. angustifolia* pollen occur singly with reticulate or reticulate-rugulate tectum, while in *T. elephantina* grains are in the form of tetrads with densely foveolate tectum. However, they are similar in their apertural type i.e. monoporate. Cook (1988) also reported similar type of grains in other species of *Typha*.

Palynologically, Typhaceae is relatively more specialized family than Lemnaceae.

APPENDIX - 1
List of Voucher specimens

| Taxa | Locality | Collector |
|---|--|---|
| <i>Cyperaceae</i> | | |
| <i>Ascolepis brasiliensis</i> (Kunth) Benth. ex C.B. Clarke | Near Physiology Dept., Karachi University Campus, Karachi. | Seema Sultan 102 (KUH). |
| <i>Cyperus arenarius</i> Retz. | Near Applied Economics Dept., Karachi University Campus, Karachi. | Rizwan Yusuf & Abrar Husain 98 (KUH). |
| <i>C. atkinsoni</i> C.B. Clarke | Near Urdu Science College, Karachi. Manghopir, Karachi. | Tufail Ahmed s.n. (KUH). S.M.H. Jafri 1522 (KUH). |
| | Drigh Road, Karachi. | S.M.H. Jafri, 2487 (KUH). |
| <i>C. bulbosus</i> Vahl | Safari Park, Karachi. | Seema Sultan 187 (KUH). |
| <i>C. conglomeratus</i> Rottbl. | Paradise Point, Karachi. | Seema Sultan 87 (KUH). |
| | Paradise Point, Karachi. | S.M.H. Jafri 1477 (KUH). |
| <i>C. laevigatus</i> L. | Karachi University Campus, Karachi. | Seema Sultan 190 (KUH). |
| | Kerther Park, C.16 Km from Ghaibi Dero on way to Kute-ji Qabar, Tharparkar. | Kamal A. Malik, Saood Omer & A. Wahid 2263 (KUH). |
| <i>C. rotundus</i> L. | Karachi University Campus Karachi. | Seema Sultan 194 (KUH). |
| <i>Eleocharis capitata</i> (L.) R.Br. | c. 15 miles from Kakar Goth on way to Seeta Goth, Kerther Range. Khadeji Fall, Karachi. | K.A. Malik, Saood Omer & Abdul Wahid 2498 (KUH). Coll. Ignot. s.n. (KUH). |
| | 3 miles from Nai-Gaj, Dadu. | K.A. Malik, M. Qaiser & Saood Omer 2189 (KUH). |
| <i>Fimbristylis dichotoma</i> (L.) Vahl | Gulshan-e-Iqbal, Karachi. | Abrar Husain s.n. (KUH). |
| | Thatta Cement Factory, | Seema Sultan 191 (KUH). |
| <i>Scirpus littoralis</i> Schrad | Thatta Cement Factory, | Seema Sultan 191 (KUH). |

Appendix - 1 (cont'd)

| Taxa | Locality | Collector |
|--|---|---|
| <i>S. tuberosus</i> Desf. | Karachi University Campus, Karachi | Abrar Husain s.n. (KUH). |
| | Karachi University Campus, Karachi. | Seema Sultan 192 (KUH). |
| Commelinaceae <i>Commelina albescens</i> Hassk. | Karachi University Campus, Karachi, | Abrar Husain s.n. (KUH). |
| | Physiology Dept., Karachi. University Campus, Karachi. | Seema Sultan 107 (KUH) |
| <i>C. pahudosa</i> Blume | Near Botany Dept., Karachi. University Campus, Karachi. | Anjum Perveen 400 (KUH). |
| | Behind Botany auditorium, Karachi University Campus, Karachi. | S.Khatoon 259 (KUH). |
| | Panjar, Rawalpindi. c.14 miles from Mingora on way to Kalam | Stewart 28618 (KUH). M. Qaiser & A. Ghafoor 4652 (KUH) |
| Juncaceae <i>Juncus maritimus</i> Lam. | Lakishah Saddar near Sehwan. Balochistan | S.M.H. Jafri 2752 (KUH). Rasool Bakhsh 3 (KUH). |
| Lemnaceae <i>Lemna aequinoctialis</i> Welw. <i>L. gibba</i> L. | Botany Dept., Karachi University Campus, Karachi. Near Taj Mahal Hotal, Karachi. | Anjum Perveen 345 (KUH). S.Omer & Hashmi s.n. (KUH). |
| Liliaceae <i>Asparagus dumosus</i> Baker | Near Staff Town, Karachi University Campus, Karachi. c.1 Km from K.D.A Pump Station, Manghopir, Karachi. | Abrar Husain s.n. (KUH). Tahir Ali, S. Khatoon & Zeenat A. Razzaq 1427 (KUH). |
| <i>Asphodelus tenuifolius</i> Cavan | Near Pharmacy auditorium, Karachi University Campus, Karachi. | Seema Sultan 189 (KUH). |

Appendix - 1 (cont'd)

| Taxa | Locality | Collector |
|---|--|--|
| <i>Dipcadi erythraeum</i> Webb. & Benth. | Karachi University Campus, Karachi. | Saood Omer & Abrar Husain s.n. (KUH). |
| | Behind Botany auditorium, Karachi University Campus, Karachi. | S. Khatoon, 571 (KUH). |
| | Drigh Road, Karachi. | S.M.H. Jafri 2488 (KUH) |
| Potamogetonaceae | | |
| <i>Potamogeton pectinatus</i> L. | Kalri Lake, Thatta Distt. | Anjum Perveen s.n. (KUH). |
| | Haleji Lake, Thatta. | Saood Omer s,n. (KUH). |
| | Between village Khaba and Dhadar. | A. Ghafoor & Tahir Ali 3815 (KUH). |
| <i>P. perfoliatus</i> L. | Safari Park, Karachi. | Seema Sultan 108 (KUH). |
| | Bund Murad | S.Khatoon & Raiha Qadri 306 (KUH). |
| | Pathan Kote, Loralai. | Saood Omer 1613 (KUH). |
| Pontederiaceae | | |
| <i>Eichhornia crassipes</i> (Mart.) Sloms | Botany Dept., Karachi University Campus, Karachi. | Seema Sultan 103 (KUH). |
| Typhaceae | | |
| <i>Typha angustifolia</i> L. | Manchar Lake, Thatta. | K.A. Malik & Shaheryar A. Naqvi 1931 (KUH). |
| <i>T. domingensis</i> Pers. | Near Girls Hostel, Karachi University Campus, Karachi. c.1 Km from PCSIR, Karachi. | Seema Sultan 193 (KUH). Saood Omer & Rizwan Yusuf s.n. (KUH). |
| | Gohar Khan Gabol Goth, Karachi. | Abdul Wahid s.n. (KUH). |
| <i>T. elephantina</i> Roxb. | c.25 miles from Mirpur Batharo on way to Tando Mohammad Khan. | Omer 7524 (KUH). |

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(Received for Publication 2 January 1994)