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Research Article

Pollen Flora of Pakistan-XXXI *Capparidaceae*

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Abstract: The pollen morphology of 14 species belonging to seven genera viz., *Cadaba* Forssk., *Capparis* L., *Cleome* L., *Dipterygium* Decaisne, *Gynandropsis* DC., *Maerua* Forssk., of the family *Capparidaceae*, was investigated using a light microscope and scanning microscope. The results confirm the eurypalynous nature of the family. However, palynology is significantly helpful at the specific level. Pollen grains usually radially symmetrical, isopolar, sub-prolate to prolate, generally tricolporate, often tetra-colporate. Tectum generally spinulose, or striate-rugulate, or rugulate-reticulate often sub-psilate.

Key Word: *Capparidaceae*, Pollen morphology and Pakistan Flora

Pakistan Polen Florası XXXI-*Capparidaceae*

Özet: *Capparidaceae* familyasına dahil 7 cinse (*Cabada* Forssk., *Capparis* L., *Cleome* L., Diptergium Decaisne, *Gynandropsis* DC. ve *Maerua* Forssk.) ait 14 türün polen morfolojisi ışık ve taramalı elektron mikroskopları ile incelenmiştir. Sonuçlar familyanın öripalinoz olduğunu göstermiştir. Bununla birlikte, palinoloji tür düzeyinde yararlı olmaktadır. Polenler radyal simetrili, izopolar, sub-prolat ile prolat, genellikle trikolpoorut, tetrakolporattır. Tektum genellikle spinoloz, striat-rugulat ya da rugulat-retikulat, çoğunlukla subpsilatdır.

Anahtar Sözcükler: *Capparidaceae*, polen morfolojisi, Pakistan Florası

Introduction

Capparidaceae is a family with c. 45 genera, and nearly 600 species are distributed mostly in the tropical and subtropical regions (Willis, 1973). It is represented in Pakistan by seven genera and 23 species (four cultivated species (Mabberley, 1987; Jafri, 1974)).

The pollen morphology of the family *Capparidaceae* has been examined by Erdtman (1952), Narayana (1962, 1965), Mitra (1970, 1978), Fatima and Kusumakumari (1970) and Moore and Webb (1978). The present pollen data are based on 14 species belonging to seven genera from Pakistan examined by scanning and light microscopes.

Materials and Methods

Polliniferous materials 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 glycerine 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 were suspended in a drop of water and directly transferred with a fine pipette 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 150A. The SEM examination was carried out on a Jeol microscope JSM-T200. The measurements were based on 15-20 readings from each specimen. Polar length, equatorial diameter, colpi length and exine thickness were measured.

In general, the terminology of Erdtman (1952), Faegri & Iversen (1964), Kremp (1965) and Walker & Doyle (1976) was followed.

Observations and Results

General pollen characters of the family *Capparidaceae*

Pollen grains usually radially symmetrical, isopolar, sub-prolate to prolate, or prolate-spheroidal rarely oblate-spheroidal, generally tricolporate, tetra-colporate, colpal membrane psilate to sub-psilate, or granulated, often spinulose or perforated. Sexine thicker or thinner than nexine, often slightly thicker at the polar region than at the equator. Tectum generally spinulose, or striate-rugulate, or rugulate-reticulate often subpsilate.

Pollen Descriptions

Cadaba fruticosa (L.) Druce. (Figs. 1 A & B).

Pollen grains subprolate, tricolporate, trilobed, size: Polar axis P (25.2-) 28.2 ± 0.47 (-30.8) µm, and equatorial diameter E (16.8) 22.4 ± 0.84 (26.6) µm. P/E ratio: 1.25, colpi (16.8-) 22.8 ± 1.0 (-28) µm long, with costae, colpal membrane psilate, ora lo-longate. Mesocolpium (12.6) 14.7 ± 0.37 (16.8) µm. Apocolpium (1.68-) 1.96 ± 0.28 (-2.8) µm. Exine (1.4) 1.55 ± 0.03 (-1.68) µm thick, sexine slightly thicker at the poles than at the equator. Tectum densely spinulated. P.A.I. 0.66.

Cadaba heterotricha Stocks ex Hook. (Figs. 1 C & D).

Pollen grains prolate, trilobed, tricolporate, fossaperturate, size: Polar axis P (19.6-) 23.4 ± 0.56 (-26.6) µm, and equatorial diameter E (12.6-) 15.5 ± 0.79 (-21) µm. P/E ratio: 1.50, colpi (16.8-) 19.4 ± 0.78 (-22.4) µm long. Mesocolpium (9.8-) 10.96 ± 0.8 (-14) µm. Apocolpium c.2.66 µm. Exine (1.4-) 1.56 ± 0.06 (-2.1) µm thick, sexine thicker than nexine. Tectum densely spinulose, spinules unequal in size, acute ± straight. P.A.I. 0.70.

Capparis decidua (Forssk.) Edgew.

Pollen grains prolate, tricolporate, trilobed, size: Polar axis P (18.2-) 20.16 ± 0.28 (-22.4) µm, and equatorial diameter E (11.2-) 13.9 ± 0.45 (-16.11) µm. P/E ratio: 1.44, colpi (16.8-) 17.78 ± 0.55 (-21.01) µm long, with costae, colpal membrane sparsely granulated. Mesocolpium (8.4-) 9.66 ± 0.25 (- 11.2) µm. Apocolpium C. 1.48 µm. Exine (1.4) 1.47 ± 0.07 (-2.1) µm thick, sexine slightly thicker at the polar region than at the equator. Tectum finely reticulate lumina 0.05-0.15 µm in diameter, ± circular in shape. P.A.I. 0.69

Capparis spinosa L. (Figs. 1 E & F).

Pollen grains subprolate, tricolporate, trilobed, size: Polar axis P (18.2-) 19.4 ± 0.23 (-21.02) µm, and equatorial diameter E (14.01-) 15.6 ± 0.2 (-16.81) µm. P/E ratio 1.27, colpi (16.8-) 17.4 ± 0.22 (-18.2) µm long, with long narrow costae, colpal membrane psilate. Mesocolpium (7-) 7.9 ± 0.32 (-9.8) µm. Syncolpate. Exine (0.84-) 1.27 ± 0.056 (-1.4) µm thick, sexine as thick as nexine. Tectum sub-psilate. P.A.I: 0.51

Cleome ariana Hedge & Lamond. (Figs. 1 G & H).

Pollen grains subprolate, tricolporate, trilobed, size: Polar axis P (17.5-) 19.63 ± 0.32 (-22.5) µm, and equatorial diameter E (14.5-) 16.39 ± 0.84 (-19.75) µm. P/E ratio: 1.19, colpi (15.01-) 17.20 ± 0.28 (-20.01) µm long. Mesocolpium (18.11-) 11.67 ± 0.28 (-15) µm. Apocolpium (1.5-) 1.62 ± 0.12 (-1.75) µm. Exine c. 2.25 µm thick, sexine thicker than nexine. Tectum rugulate-reticulate. P.A.I. 0.71.

Cleome brachycarpa Vahl ex DC. (Fig. 1 I; Figs. 2 A-D).

Pollen grains subprolate, tetracolporate, weakly trilobed, size: (16.8-) 19.4 ± 0.35 (-21.11) µm, and equatorial diameter E (15.4-) 16.7 ± 0.44 (-21) µm. P/E ratio: 1.15, colpi (14.01-) 14.6 ± 0.22 (-15.4) µm long, colpal membrane densely granulated, tapering at both the ends. Mesocolpium (9.8-) 12.8 ± 0.74 (-16.8) µm. Apocolpium c. 2.22 µm. Exine (2.1-) 2.60 ± (-2.66) µm thick, sexine thinner than nexine. Tectum densely spinulose-verrucate. P.A.I. 0.76.

Cleome oxypetala Boiss. (Fig.2 E & F).

Pollen grains prolate-spheroidal, tricolporate, trilobed, fossaperturate, size: Polar axis P (18.75-) 19.7 ± 0.50 (-20) µm, and equatorial diameter E (17.5-) 18.18 ± 1.6 (-18.75) µm. P/E ratio: 1.08, colpi (16.25-) 16.87 ± 0.62 (-17.5) µm long, colpal membrane sub-psilate. Mesocolpium (10-) 11.75 ± 1.62 (-15) µm. Apocolpium c. 0.25 µm. Exine c. 2 µm thick, sexine thicker than nexine. Tectum supra reticulate. P.A.I. 0.64.

Cleome rupicola Vicary

Pollen grains subprolate, tricolporate, trilobed, fossaperturate, size: Polar axis P (17.75-) 22.60 ± 0.59 (-27.25) µm, and equatorial diameter E (15-) 17.51 ±

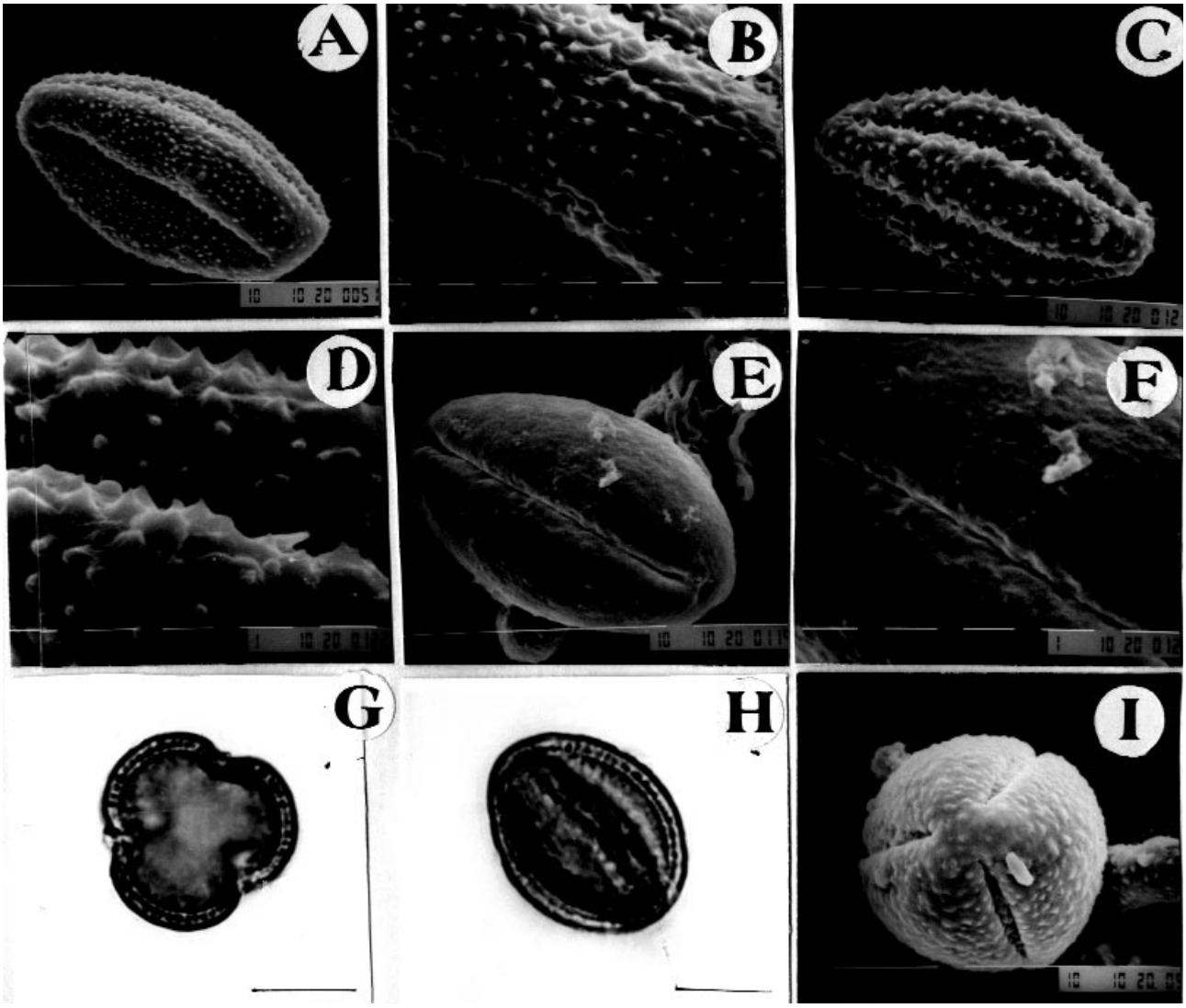

Fig. 1. A-F & I = Scannign Electron micrographs of pollen grains: G & H = Light micrographs of pollen grains. Cabada froticosa A, equatorial view; B, Exine pattern. Capparis spinosa: E, Equatorial view; F, Exine pattern; Cleome ariana G, polar view; H, Equatorial. Cleome brachycarpa: I, Polar view.

Scale bar = A, C, E, G - I = 10; B, D, F = 1 µm.

0.51 (-20.5) µm. P/E ratio: 1.29, colpi (15-) 19.61 ± 0.61 (-25) µm long, colpal membrane scabrate. Mesocolpium (10.01-) 11.75 ± 0.30 (-13.75) µm. Apocolpium (1.25-) 2.14 ± 0.15 (-2.5) µm. Exine (2.25) 2.38 ± 0.05 (-3.0) µm thick, sexine thicker than nexine. Tectum rugulate-striate. P.A.I. 0.67.

Cleome scaposa DC. (Figs. 2 G & H).

Pollen grains subprolate, tricolporate, trilobed, size: Polar axis P (14.12-) 16.4 ± 0.56 (-18.2) µm, and equatorial diameter E (12.6) 13.6 ± 0.28 (-14.7) µm. P/E ratio: 1.21, colpi (9.8-) 11.6 ± 0.44 (-14) µm long, ora lolongate indistinct, colpal membrane sub-psilate. Mesocolpium (7.11-) 10.6 ± 0.43 (-12.6) µm. Apocolpium (2.8-) 3.2 ± 0.20 (-4.2) µm. Exine (2.1-) 2.6 ± 0.076 (-2.8) µm thick, sexine thicker than nexine. Tectum densely spinulated. P.A.I. 0.77.

Cleome viscosa L. (Fig. 2 I; Fig. 3 A).

Pollen grains subprolate, tricolporate, weakly trilobed, size: Polar axis P (23.8-) 29.9 ± 0.61 (-32.2) µm, and equatorial diameter E (16.8-) 22.6 ± 0.44 (-28)

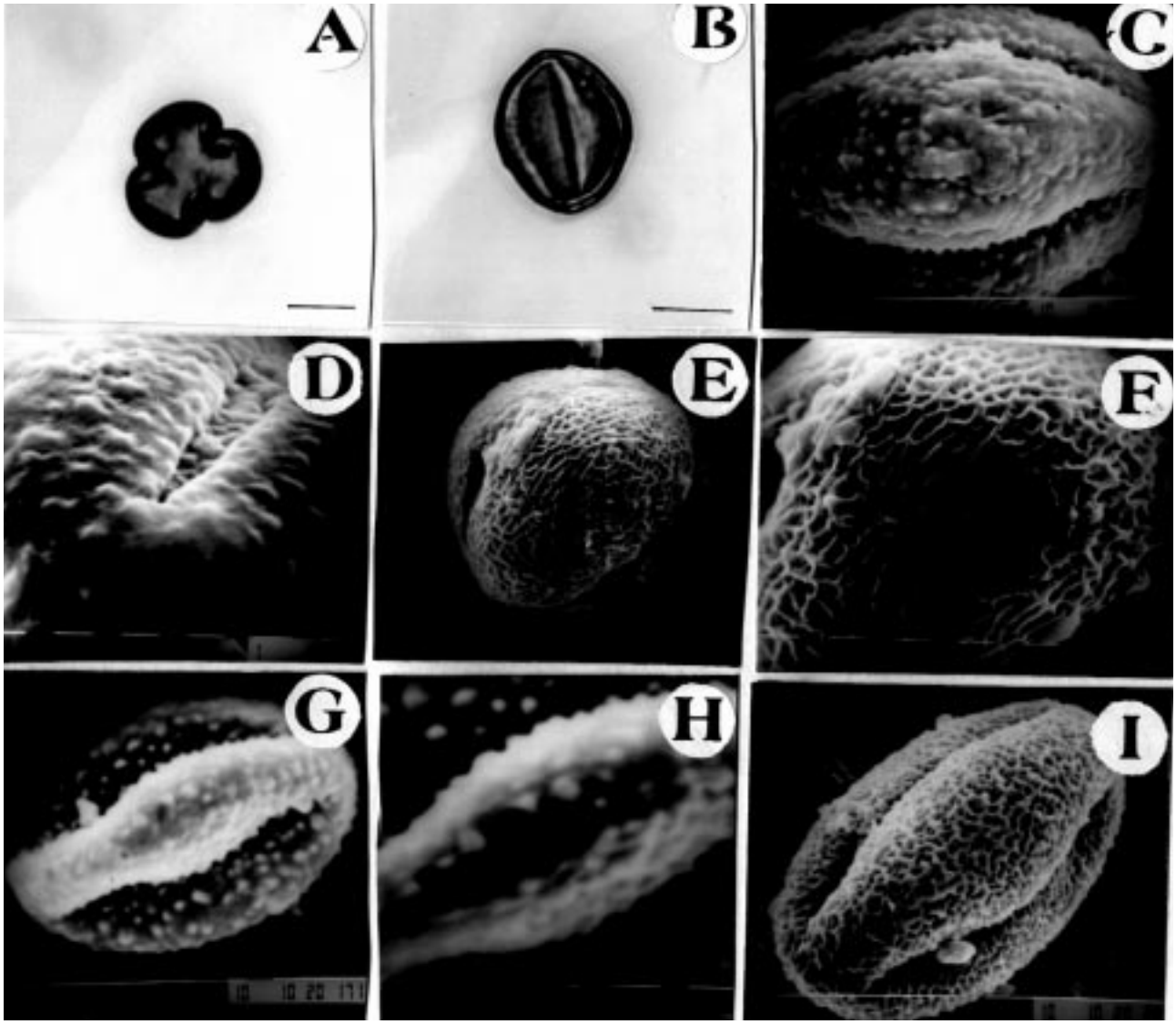

Fig. 2. A & B = Light micrographs. C-I = Scanning Electron micrographs of pollen grains.

Cleome brachycarpa: A, Polar view; B & C, Equatorial view; D, Exine pattern. Cleome oxypetala: E, Equatorial view; F, Exine pattern. Cleome scaposa: G, Equatorial view; H, Exine pattern. Cleome viscosa: I, Equatorial view.

Scale bar = A, C, E, G - I = 10; D, F & H = 1 µm.

µm. P/E ratio: 1.32, colpi (22.4-) 27.02 ± 1.06 (-32.2) µm long, with costae, ora lalongate. Mesocolpium (14.11-) 18.2 ± 1.25 (-21.12) µm. Apocolpium (2.8) 3.5 ± 0.7 (-4.2) µm. Exine (1.4-) 1.54 ± 0.041 (-1.68) µm thick, sexine slightly thinner than nexine. Tectum rugulate-reticulate. P.A.I. 0.85.

Dipterygium glaucum Decne. (Figs. 3 B & C).

Pollen grains prolate-spheroidal, tricolporate, trilobed, size: Polar axis P (15.11-) 17.59 ± 1.51 (-20.25) µm, and equatorial diameter E (12.5-) 15.08 ± 0.33 (-18.75) µm. P/E ratio: 1.16, colpi (12.5-) 15.08 ± 0.4 (-17.5) µm long, colpal membrane subpsilate with large granules. Mesocolpium (11.25-) 12.2 ± 0.15 (-12.75) µm. Apocolpium (2.0-) 2.7 ± 0.23 (-2.75) µm. Exine (1.25-) 1.63 ± 0.09 (-2.25) µm thick, sexine thicker than nexine. Tectum spinulose. P.A.I. 0.80.

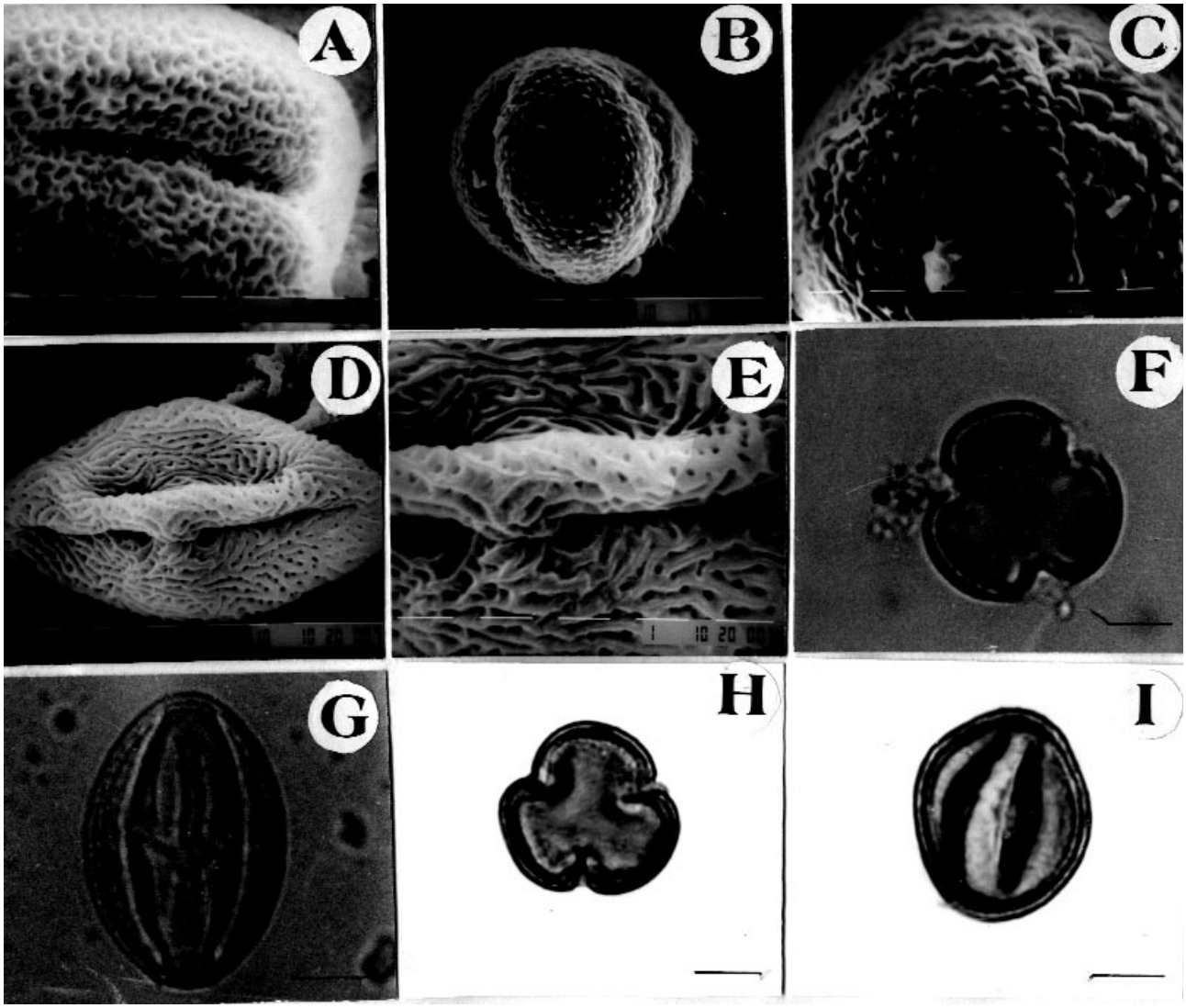

Fig. 3. C - I = Scanning micrographs; A-B = Light micrographs of pollen grains. Cleome viscosa: A, Exine pattern. Dipterygium glaucum: B, equatorial view; C, Exine pattern. Gynandropsis gynandra: D, Equatorial view; E, Exine pattern. Maerua crassifolia: F, polar view; G, Equatorial view. Maerua crassifolia: H, polar view; I, Equatorial view.

Scale bar = A, C, E, G - I = 10; A, C & E = 1 µm.

Gynandropsis gynandra (L.) Brig. (Figs. 3 D & E).

Pollen grains prolate, tricolporate, triangular, size: Polar axis P (19.6-) 20.3 ± 0.20 (-21.7) µm, and equatorial diameter E (14.11-) 14.7 ± 0.16 (-15.4) µm. P/E: 1.38, colpi long, intruding, (14.6-) 21.4 ± 0.29 (-22.4) µm long, with costae, ora slightly lo-longate. Mesocolpium (11.2-) 11.28 ± 0.28 (-32.3) µm. Apocolpium (0.28-) 0.49 ± 0.21 (-0.71) µm. Exine (1.26-) 1.37 ± 0.08 (-1.4) µm thick, sexine slightly thicker at the polar region than at the equator. Tectum striate-rugulate, breached by perforation in between the lirae. P.A.I. 0.76.

Maerua arenaria (DC.) Hook.f. et Thoms. (Fig. 3 F & G).

Pollen grains prolate, tricolporate, trilobed, fossaperturate, size: Polar axis P (28.11-) 31.8 ± 0.98 (-37.8) µm, and equatorial diameter E (20.3-) 23.5 ± 0.68 (-26.6) µm. P/E ratio: 1.35, colpi (22.4-) 24.7 ± 0.52 (-26.6) µm, long, with costae, colpal membrane perforated, ora slightly lalongate. Mesocolpium (15.4-) 16.1 ± 0.40 (-16.8) µm. Apocolpium (2.8-) 2.09 ± 0.17

(-3.5) µm. Exine (2.66-) 2.76 ± 0.02 (-2.8) µm thick, sexine slightly thinner at the equator. Tectum densely spinulated. P.A.I. 0.68.

Maerua crassifolia Forssk. (Figs. 3 H & I).

Pollen grains oblate-spheroidal, 3 colporate, trilobed, size: Polar axis P (21-) 23.6 ± 2.48 (-31.25) µm, and equatorial diameter E (22.5-) 24.2 ± 0.92 (-30.25) µm. P/E ratio: 0.97, colpi (17.5-) 21.56 ± 0.55 (-25) µm long, colpal membrane spinulose. Mesocolpium (10.5-) 16.88 ± 0.58 (-17.5) µm. Apocolpium (2.25-) 3.13 ± 0.3 (-5) µm. Exine (2.75-) 3.12 ± 0.65 (-4.5) µm thick, sexine thicker than nexine. Tectum spinulose. P.A.I. 0.69.

Discussion

The palynology of the family *Capparidaceae* is remarkably diverse. The most striking variation is found in the tectum types and pollen shape class. Variation has not only been found within the family but within the same genus. Generic delimitation of the family is difficult. However, the pollen morphology of the family is significantly helpful at the specific level (see key to the species). Pollen grains usually radially symmetrical, isopolar, subprolate to prolate, generally tricolporate, rarely tetracolporate as in *Cleome* brachycarpa. Tectum generally spinulose, or striate-rugulate, or rugulate-reticulate, rarely subpsilate. A similar type of pollen grains in the family *Capparidaceae* has been reported by Qaiser and Perveen (1997). Within the family, prolate to subprolate shape classes are more common. However, prolate-spheroidal pollen is also found in a number of species, whereas oblate-spheroidal pollen is found in only one species i.e., *Maerua crassifolia*. Similarly, tectum type also exhibits a wide range of variation viz., subpsilate, reticu-late, rugulate, striate and spinulose. However, the spinulose tectum is the most dominant. A rugulate-reticulate or striate-rugulate tectum is also observed in a considerable number of taxa, whereas *Capparis spinosa* is the only exception in which subpsilate tectum is present. On the basis of tectum types, the family can be divided into four groups. Group I is the largest among all the groups having a spinulose tectum. Seven species are included in this group: *Cadaba fruticosa* , *C. heterotricha*, *Maerua arenaria*, *M. crassifolia*, *Dipterygium glaucum*, *Cleome brachycarpa* and *C. scaposa*. Group II is recognized by its rugulate-reticulate or striate-rugulate tectum. Five species are included in this group: *Cl. oxypetala*, *C. rupicola, C. ariana, C. viscosa* and *Gynandropsis gynandra*. However, *C. viscosa* and *C. ariana* are easily distinguished by their rugulate-reticulate tectum, whereas in the remaning species a striate-rugulate tecum is observed. In Group III only a single species is found with a simple reticulate tectum, i.e., *Capparis decidua*. *C. spinosa* has a sub-psilate tectum and is included in Group IV. Apart from this, the family shows uniformly tricolporate pollen. Pollen grains of the family *Capparidaceae* are similar to those found in *Resedaceae* and *Moringaceae* (Qaiser & Perveen, 1997).

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