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POLLEN MORPHOLOGY OF FAMILY SOLANACEAE FROM PAKISTAN

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Abstract

Pollen morphology of 20 species representing 7 genera viz., *Datura, Lycium, Hyoscymus, Nicotiana, Physalis, Solanum* and *Withania* of the family Solanaceae from Pakistan has been examined by light and scanning electron microscope. Solanaceae is a eurypalynous family. Pollen grains usually radially symmetrical, isopolar, prolate-spheroidal to oblate-spheroidal or sub-oblate to sub-prolate, tricolporate, colpi generally with costae, colpal membrane psilate to sparsely or densely granulated, ora la-longate, sexine as thick as nexine, or slightly thicker or thinner than nexine. Tectal surface commonly scabrate to verrucate or striate to reticulate rarely rugulate-fossulate. On the basis of exine pattern 6 distinct pollen types are recognized viz., *Datura fastuosa*-type, *Lycium dasytemum*-type, *Nicotiana plumbaginifolia*-type, *Physalis divaricata*-type, *Solanum nigrum*-type and *Withania somnifera*-type. Pollen morphology of the family is significantly helpful at the generic and specific level.

Introduction

Solanaceae is a family of about 94 genera and 2950 species, sub cosmopolitan in distribution, more especially in tropical America (Willis, 1973; Mabberley, 1987). In Pakistan it is represented by 14 genera and 50 species (Nasir, 1985). Plants are herbs, trees and shrubs. Flowers bisexual, usually actinomorphic or weakly zygomorphic. Calyx of five united sepals, persistent. Corolla of five united petals, rotate to tubular. Androecium of five stamens, inserted on the corolla tube and alternate with its lobes, anther opening by terminal pores. Gynoecium a compound pistil of 2 carples, sometimes divided by a false septum, with two locules, fruit berry or capsule. Some chief genera of Solanaceae are *Solanum* (Potato, nightshade), *Datura* (Jimsonweed), *Nicotiana* (tobacco), *Lycium* (kaffir thron), *Atropa* (belladonna), *Hyoscyamus* (henbane), *Capsicum* (pepper chili), *Lycopersicon* (tomato) and *Petunia*. Many Solanaceae contain powerful alkaloids: *Atropa belladonna* (deadly night shade), *Nicotiana tobacum* (tobacco) etc. Pollen morphology of various members of the family Solanaceae have been studied by different workers from time to time, such as Natarjan (1957), Murray &. Eshbaug (1971), Raghuvanshi (1974), Sharma, 1974, Anderson. & Gensel (1976), Palri & Koche (1976), Anderson (1977), Srivastava (1977), Edmonds (1984), Gentry (1986), Plowman (1998), Persson *et al*., (1999). However, no information is available on the pollen morphology of various species of Solanaceae found in Pakistan. In the present studies an attempt has been made to provide complete information on pollen morphology of the family Solanaceae comprising of 7 genera and 20 species from Pakistan.

Materials and Methods

Pollen samples were obtained from herbarium specimens housed in Karachi University Herbarium (KUH) or from fresh specimens collected from the field. (Annexure-1). The pollen grains were prepared for light (LM) by the standard method

Annexure 1.

Taxa	Locality	Collector
Datura fastuosa L.	Botany Department, Karachi University Campus	Anjum Perveen 227 (KUH)
	University Campus, Karachi	Abrar Hussain s.n. (KUH)
D. innoxia Miller	University Campus, Karachi	Anjum Perveen 100 (KUH)
	Near Plant Protection Department	Anjum Perveen 150 (KUH)
D. stramonium L.	Defence Society	Anjum Perveen 244 (KUH)
Hyoscyamus niger L.	Khyber Agency (Turicham) Thano	M. A. Kazmi 1036 (KUH)
	C-4 miles from Rahnjoota, kerther Range	Kamal A. Malik, Saood Omer & Abdul Wahid 2517.
	Between Panjgur & Chich, Makran Dist.	Tahir Ali 1002 (KUH)
	C.1 km west of Nal on way to Turbat	A. Ghafoor & Steve, M. Goodman
Lycium dasystemum Pojark	C. 2 miles from Shigar on way to Power House, Shiger	Saood Omer, S. Nazim & Abdul Wahab 892 (KUH)
Lycium depressum Stocks	Hoshab-Awaran Road Makran	S. Omer, M. Qaiser & Y. Nasir 2149 (KUH)
	Between Bela and Ghazabad C. 20 km to North of Quetta	Abdul Ghafoor & Rizwan Yusuf 1320 (KUH)
Lycium edgeworthii Dunal	University Campus, Karachi	Anjum Perveen 100 (KUH)
	Near Plant Protection Dept., Karachi University Campus	Anjum Perveen 150 (KUH)
Lycium makranicum Schoenbeck- Temesy	Giwam, C. 2 Km towards Okar Village on way to Sunstar	Abdul Ghafoor & S. Omer 1854 (KUH)
Lycium ruthenicum Murra	19 miles from Quetta on Quetta-Chaman Road.	S. A. Farooqi & M. Qaiser 2292 (KUH)
	Mastung near Rest House	S. M. H. Jari 1805 (KUH)
Nicotiana plumbaginifolia Viv.	Near Physcs Dept. University Campus, Karachi	Anjum Perveen 240 (KUH)
	P. E. C. H. Society, Karachi	Abrar Hussain s.n. (KUH)
Solanum anquivi Lam.	Palm Garden, 5 miles from Turbat on way to Mund	Sultan-ul-Abedin & Abrar Hussain 6117 (KUH)
	8 miles from Kaghan on way to Balakot	Collect. Ignot 5259 (KUH)
S. cordatum Forssk.	Near Physics Dept. Karachi University Campus	Anjum Perveen 143 (KUH)
	Hub river	J. R. Kazmi s.n. (KUH)
Solanum erianthum D. Don	Muzzafferabad Dist.	M. Qaiser & Rizwan Yousuf 7659 (KUH)
S. forskalii Dural	Near Library, University Campus, Karachi	Anjum Perveen 114 (KUH)
	Near Library, University Campus, Karachi	Anjum Perveen 321 (KUH)
S. incanum L.	Malir Colony, Karachi	Abrar Hussain s.n. (KUH)
	Near Teachers Training College, Malir, Karachi	Surayya Khatoon & N. Ahmad 52 (KUH)
Solanum nigrum L.	Near Physiology Department	Anjum Perveen 4 (KUH)
	Karachi University Campus Botany Department	Anjum Perveen 234 (KUH)
Solanum seaforthianun Ardrews		Sultan-ul-Abedin 125-2 (KUH)
S. surattense Burm. f.	Safari Park, Karachi	Anjum Perveen 111 (KUH)
	Roadside opposite NILAT, University Campus, Karachi	Surayya Khatoon 112 (KUH)
Physalis divaricata D. Don	Memmon Goth	Anjum Perveen 215 (KUH)
	University Campus, Karachi	Abrar Hussain s.n. (KUH)
Withania coagulans (Stocks) Dunal	University Campus, Karachi	Fatima Feeroza s. n. (KUH)
	University Campus, Karachi	Qamer s.n. (KUH)
Withania somnifera (L.) Dunal	Near Chemistry Dept., University Campus, Karachi	Anjum Perveen 98 (KUH)
	Near Library, University Campus, Karachi	Anjum Perveen 279 (KUH)

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 cellotape and coated with gold in a sputtering chamber (Ion sputter JFC-1100). Coating was restricted to 150^{o}A. The S.E.M examination was carried out on a Jeol microscope JSM-T200. The measurements are based on 15-20 readings from each specimen. Polar length, equatorial diameter, colpi length and exine thickness were measured.

The terminology used is in accordance with Erdtman (1952); Faegri & Iversen (1964); Kremp (1965) and Walker & Doyle (1976).

Observations

General pollen characters of the family Solanaceae

Pollen grains usually radially symmetrical, isopolar, prolate-spheroidal, or sub-prolate to prolate often oblate-spheroidal. Generally tri- colporate (rarely 4-colporate), colpi with costae, colpal membrane psilate to sparsely or densely granulated, ora la-longate, sexine as thick as nexine, or slightly thicker or thinner than nexine. Tectal surface commonly scabrate or verrucate. On the basis of aperture number, exine pattern and pollen shape class, 6 distinct pollen types are recognized viz., *Datura fastuosa*-type, *Lycium dasytemum*-type, *Nicotiana plumbaginifolia*-type *Physalis divaricata*-type, *Solanum nigrum*-type and *Withaina somnifera*-type

Key to the pollen types

1 + Tectum scabrate or verrucate ……..…….. 2
- Tectum not as above ...…… 3

2 + Tectum verrucate ……..…….. *Physalis divaricata*-type
- Tectum scabrate ……..…… *Solanum nigrum*-type

3 + Tectum different at apocolpium and at mesocolpium …… 5
- Tectum same at apocolpium and at mesocolpium ……...…… 4

4 + Tectum simply striate ……..…….. *Lycium dasystemum*-type
- Tectum striate-rugulate ……..……. *Withania somnifera*-type

5 + Tectum striate at mesocolpium and reticulate-foveolate at apocolpium ……..…….. …….. *Datura fastuosa*-type
- Tectum reticulate to foveolate at mesocolpium and psilate at apocolpium …… …….. *Nicotiana plumbaginifolia*-type

I. *Datura fastuosa*-type (Fig. 1 A-F)
Pollen class: 3-colporate, zonoaperturate
P/E ratio: 0.87-0.93
Aperture: Ectoapertue-colpus not sunken small margin irregular, end acute Endoaperture: circular.

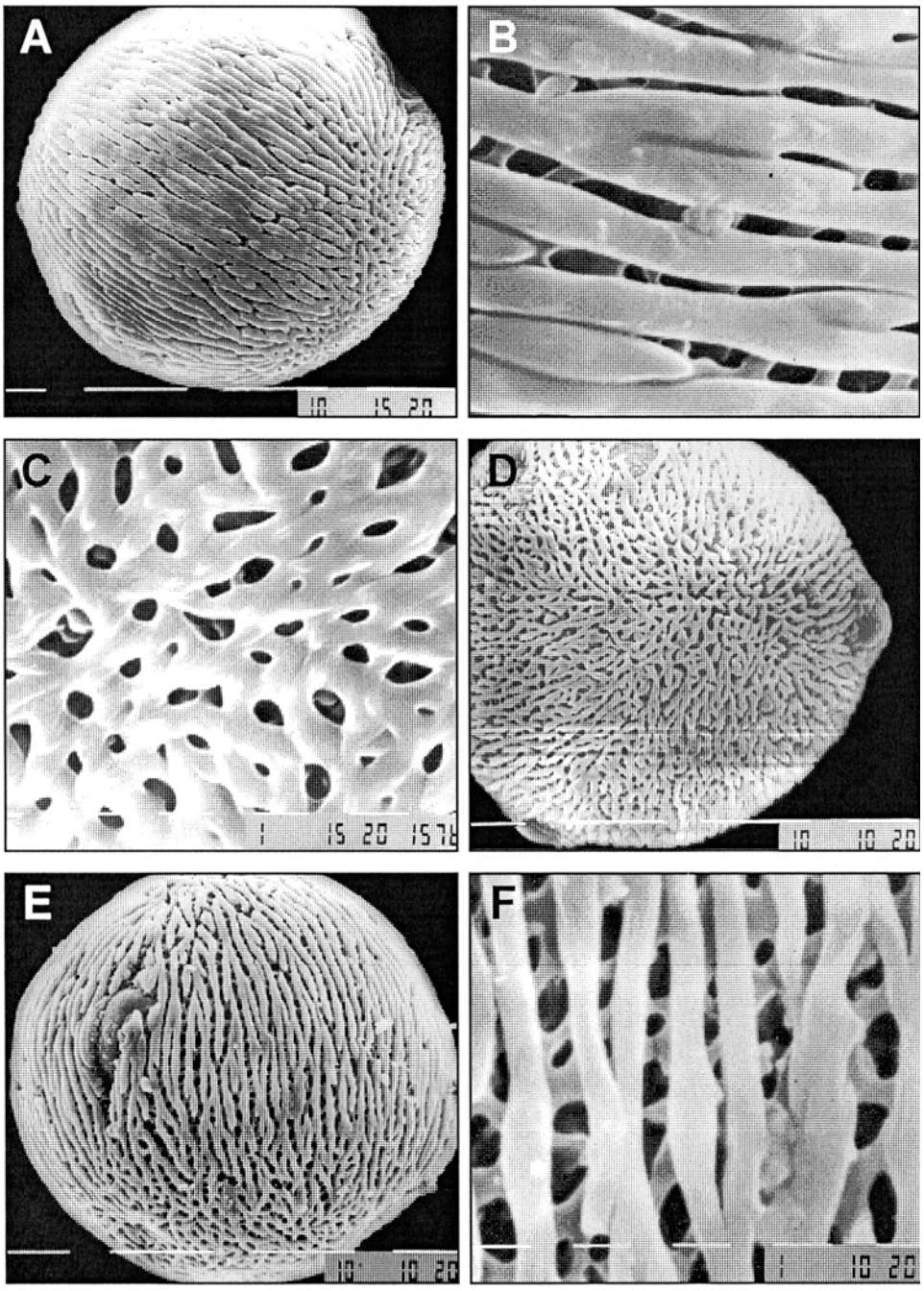

Fig. 1. Scanning micrographs: *Datura stramonium:* A, Equatorial view; B, Exine pattern at mesocolpium, C, Exine pattern at apocolpium. *Datura innoxia*: D, Polar view, E, Equatorial view, F, exine pattern.
Scale bar = A, D, E = 10; B, C& F= 1 µm.

Exine: Sexine as thick as nexine.
Ornamentation: Tectum striate at mesocolpium with distinct perforations in between the lirae, ornamentation coarsely reticulate-rugulate towards apocolpium region, lumina with columella.
Outline: Equatorial view elliptic, polar view rounded trilobed.
Measurements: Polar axis (P)35 (48.91±0.4) 61.5 µm. Equatorial diameter E 41.70 (54.6±0.49) 68.2 µm and colpus length 21.4 (28.4±0.57) 35.9 µm long. Colpal membrane granulated. Exine 1.79 (2.69±0.06) 3.61 µm thick.
Species included: *Datura fastuosa* L., *D. innoxia* Miller, *D. stromonium* L.

Key to the species and species group

1 + Pollen grains sub-oblate ……... *Datura fastuosa*
- Pollen grains oblate-spheroidal ……....…..… Subtype-I (*Datura innoxia*, *D. stromonium*)

II: *Lycium dasystemum*-type
Pollen class: 3-colporate, 3-zonocoporate.
P/E ratio: 0.85-0.93.
Aperture: Ectoaperture-colpus long, sunken, narrow, end acute. Endoaperture circular
Exine: Sexine thicker than sexine or nexine.
Ornamentation: Striate.
Outline: Equatorial view elliptic, polar view triangular.
Measurements: Polar axis (P) 15.1 (26±0.61) 37.2 µm. Equatorial diameter (E) 15.26 (28.5.12±0.1) 42.21 µm. Mesocolpium 12.5 (24.5±0.12) 37.5 µm, colpus 13.5 (24.2± 0.25) 32.5 µm. Exine 0.5 (2.7±0.37) 3.59 µm thick.
Species included: *Hyposcyamus niger* L., *Lycium dasystemum* Pojark, *L. depressum* L.

Key to the species

1 + Pollen grains sub-oblate ……... *Hyoscyamus niger*
- Pollen grains oblate-spheroidal ……...……. 2

2 + Polar length of pollen grains 21-25 µm ……..….... *Lycium dasystemum*
- Polar length of pollen grains 15-17 µm ……... *Lycium depressum*

III: *Nicotiana plumbaginifolia*-type (Fig. 2 A & B).
Pollen class: 3-colporate, 3-zonocolporate.
P/E ratio:1.11.
Shape: Prolate-spheroidal.
Aperture: Ectoaperture-colpus not sunken long margin irregular, end acute Endoaperture: circular.
Exine: Sexine thinner than nexine.
Ornamentation: Tectum rugulate-fossulate, densely punctuate more or less psilate towards the apocolpial region.
Outline: Equatorial view elliptic, polar view trilobed, 3-lobed.

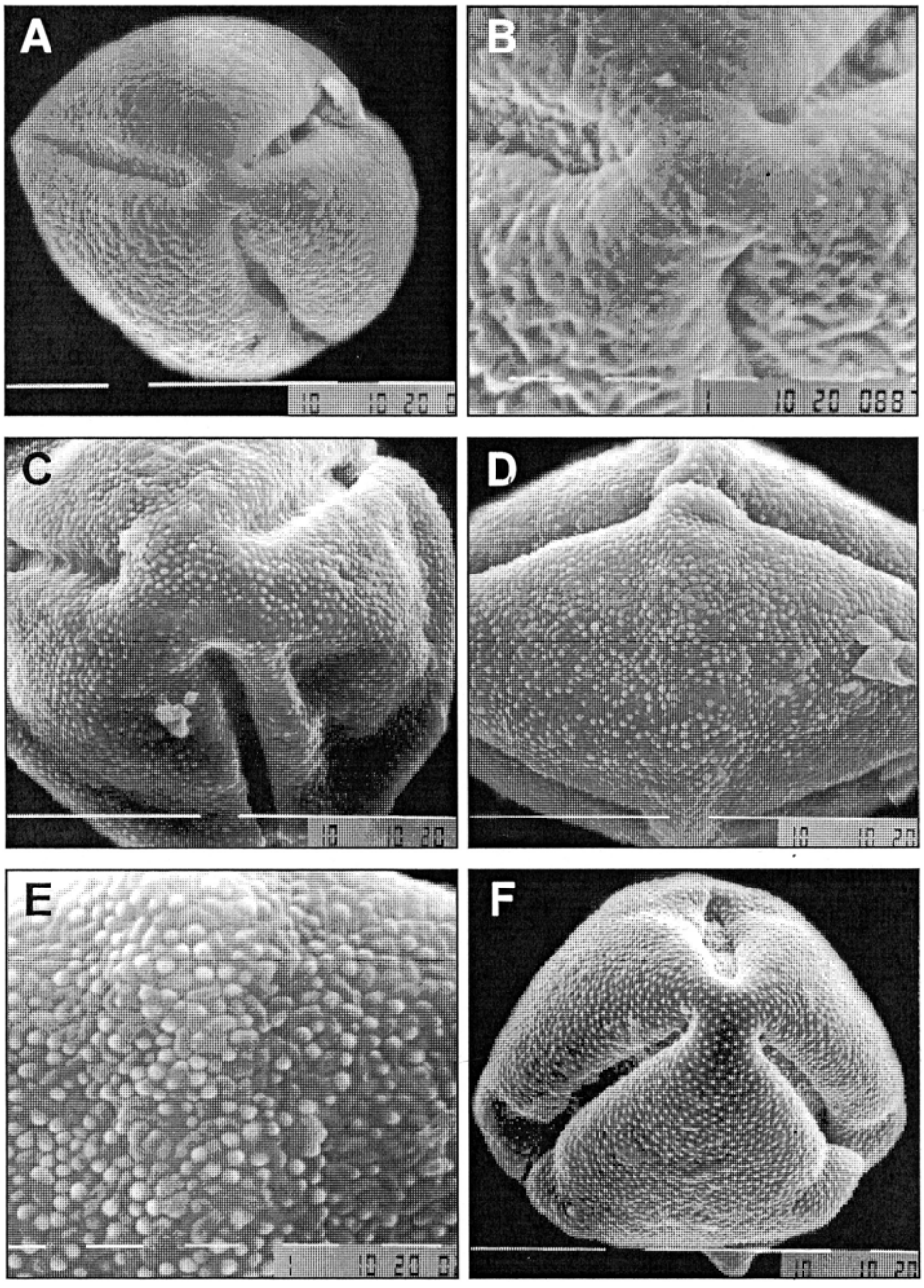

Fig. 2. Scanning micrographs: *Nicotiana plumbaginifolia:* A, Polar view; B, Exine pattern. *S. incanum*: C, Polar view, D, Equatorial view, E, Exine pattern. *Physalis divaricata*: F, Polar view Scale bar = A–D & F = 10; B & E = 1 µm.

Measurements: Polar axis (P)25.13 (28.25±1.25)34.10 µm, and colpus length 25.13 (25.2±1.31) 32.25 µm long. Colpal membrane granulated. Mesocolpium 17.9 (21.89±0.61) 24.5 µm. Apocolpium 0.35 (0.59±1.43) 1.07 µm. Exine 0.72 (0.84 ±1.10) 1.7 µm. P.A.I. 1.30
Species included: *Nicotiana plumbaginifolia* L.

IV: *Physalis divaricata*-type (Fig. 2.C -F; Fig. 3 A &B, Fig. 4 A & B).
Pollen class: 3-colporate, 3-zonocolporate.
P/E ratio: 0.87-1.20
Shape: Oblate-spheroidal to Prolate-spheroidal or sub-prolate
Aperture: Ectoaperture-colpus not sunken long margin irregular, end acute Endoaperture: circular.
Exine: Sexine thicker or thinner than nexine or as thick as nexine.
Ornamentation: Tectum verrucate.
Outline: Equatorial view elliptic, polar view trilobed.
Measurements: Polar axis (P) 11 (34.5±1.25) 57.5 µm, Equatroial diameter 12.8 (30.10±1.25) 47.5 µm and colpus length 14.5 (42±0.31) 50 µm long. Colpal membrane granulated. Mesocolpium 7.5 (12.5±1.11) µm. Apocolpium 2.5 (5.0±0.11) 7.5 µm. Exine 2.2 (4.11±1.11) 6.5. P.A.I. 3.23.
Species included: *Physalis divaricata* D.Don., *Solanum. cordatum* and *Solanum incanum* L.

Key to the species

1 + Pollen grains sub-prolate to prolate-spheroidal ……... 2
- Pollen grains oblate-spheroidal ……..……..…… *Solanum cordatum*

2 + Pollen grains sub-prolate ……...…..…..…..…..… *Physalis divaricata*
- Pollen grains prolate-spheroidal ……... *Solanum incanum*

V: *Solanum nigrum*-type (Fig. 3 C-F; Fig. 4 A-C)
Pollen class: 3-colporate, 3-zonocolporate.
P/E ratio: 0.92-1.24.
Apertures: Ectoapertures-colpus long, sunken, narrow, margins, sub-psilate end actue. Endoaperture circular.
Exine: Sexine thicker or thinner than nexine.
Ornamentation: Tectum scabrate.
Outline: Equatorial view elliptic, Polar view trilobed with aperture on the angles of the outline of the grains in polar view.
Measurements: Polar axis (P)14.3 (20.5±0.22)27.7 µm. Equatorial diameter 13.4 (20.5±0.22) 28.12 µm. Colpus length 14.5 (19.4±0.11) 25.5 µm. Mesocolpium 10 (15.5±0.11) 21.5µm. Apocolpium 0.75-5.55 µm. Exine 0.25 (1.75±0.11) 3.25 µm thick.
Species included: *Lycium makranicum* Schoenbeck-Temesy, *S. ruthenicum* Murray, *Solanum anguivi* Lam., *S. nigrum* L., *S. saeforthianum* Andrews, *S. surattense* Burm.f., *Withania coagulans* (Stocks) Dunal.

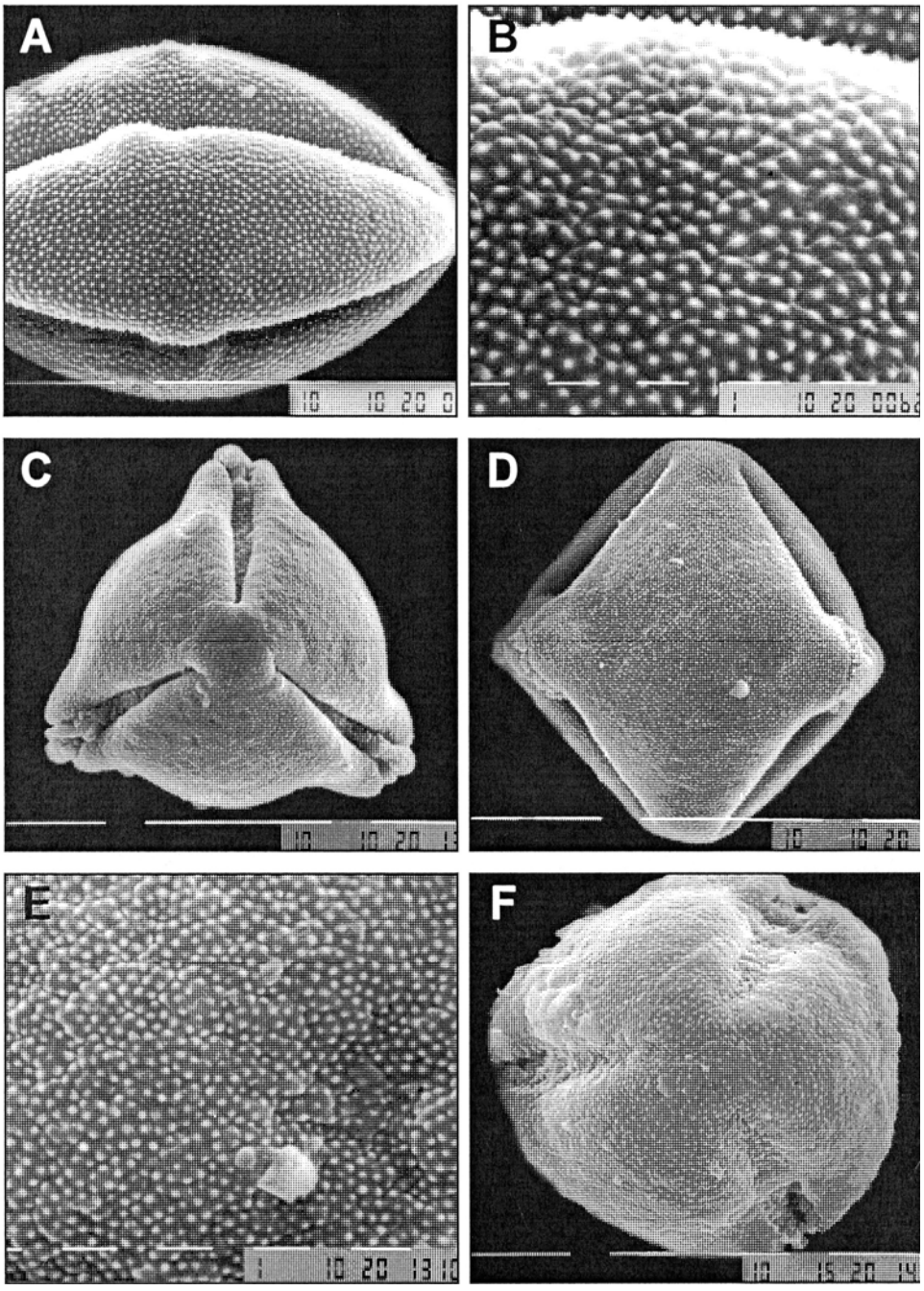

Fig. 3. Scanning micrographs: *Physalis divaricata* A, Equatorial view; B, Exine pattern. *Solanum nigrum:* C, Polar view; D, Equatorial view, E, Exine pattern. *Solanum surattense:* F, Polar view. Scale bar = A–D & F = 10; B & E = 1 µm.

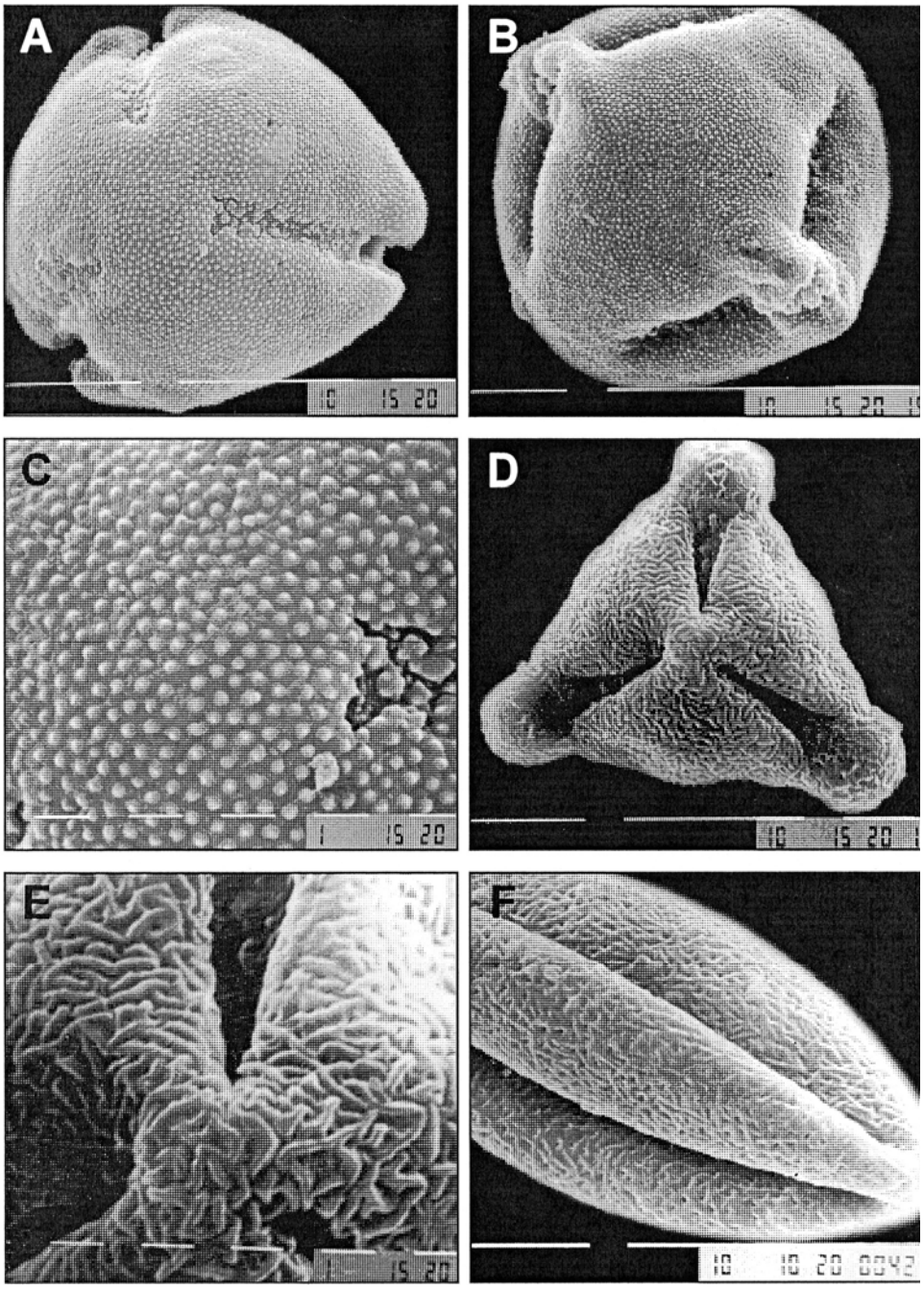

Fig. 4. Scanning micrographs: *Solanum cordatum:* A, Polar view; B, Equatorial view; C, Exine pattern. *Withaina somnifera*: D, Polar view, E, Exine pattern. *Lycium edgeworthii*: F, Equatorial view. Scale bar = A, B, D & F = 10; C, E = 1 µm.

Table 1. Pollen character of the species included in pollen type-*Datura fastuosa*.

Name of species	Shape	Polar length of pollen in µm (P)	Equatorial diameter in µm (E)	Colpus length in µm	Apocolpium in µm	Mesocolpium in µm	Exine thickness in µm
Datura stramonium L.	Ob-sp	43.08 (47.81±1.78) 50.26	43.08 (51.23±1.28) 57.44	21.54 (24.87±1.48) 32.30	17.95 (20.9±1.12) 23.3	35.9 (40.51 ±2.44) 53.86	1.79 (2.69±0.31) 3.59
Datura innoxia Miller	Ob-sp	46.67 (57.4±1.69) 61.07	50.26 (62.1±2.27) 68.21	28.7 (32.3±2.07) 35.90	21.54	43.08 (45.13±1.59) 53.8	1.43 (2.26±0.26) 3.23
Datura fastuosa L.	Sub-ob	35.9 (42.8±0.84) 44.80	41.3 (43.4±1.33) 53.80	c. 21.5	35.9 (36.7±0.89) 43.10	10.77 (15.9±1.83) 25.10	3.22 (3.44±0.08) 3.60

Table 2. Pollen character of the species included in pollen type-*Lycium dasystemum*.

Name of species	Shape	Polar length of pollen in µm (P)	Equatorial diameter in µm (E)	Colpus length in µm	Apocolpium in µm	Mesocolpium in µm	Exine thickness in µm
Lycium dasystemum Pojark	Ob-sp	21.2 (23.3±0.34) 25.0	21.5 (24.9±0.37) 25.0	20.0 (21.9±0.57) 25.0	1.25	15.0 (17.10±0.36) 20.0	2.0 (2.18±0.8) 2.25
Hyposcyamus niger L.	Sub-ob	25.0 (33.7±0.97) 37.50	37.5 (39.5±0.99) 42.50	-	1.25 (2.06±0.27) 2.50	20.0 (25.2±0.65) 27.50	1.25 (1.96±0.15) 2.25
Lycium drepressum L.	Ob-sp	15.0 (15.9±0.17) 17.50	15.5 (17.3±0.19) 18.73	c. 30	0.25 (1.33±0.64) 2.50	12.5 (13.67±0.49) 15.29	1.25 (1.96±0.15) 2.25

Table 3. Pollen character of the species included in pollen type-*Physalis divaricata*.

Name of species	Shape	Polar length of pollen in µm (P)	Equatorial diameter in µm (E)	Colpus length in µm	Apocolpium in µm	Mesocolpium in µm	Exine thickness in µm
Solanum forskalii Dunal	Ob-sp	21.54 (25.13±0.35) 28.72	25.13 (28.71±0.3) 32.30	17.90 (20.46±0.47) 21.54	4.3	14.36 (19.14±1.0) 25.13	1.79 (2.08±0.13) 2.15
Solanum incanum L.	Pr-sp.	25.10 (28.1±0.51) 32.30	23.30 (25.6±0.59) 28.70	21.50 (23.1±0.37) 28.70	3.21 (3.35±0.03) 3.60	17.90 (19.7±0.53) 21.50	1.79 (2.40±0.23) 3.60
Physalis divaricata D. Don	Sub-pr	29.40 (31.11±0.45) 33.60	23.80 (25.9±0.37) 26.66	26.60 (28.7±0.52) 32.20	1.40 (15.26±0.38) 16.80	±	1.4 (1.42±0.016) 1.54

Table 4. Pollen character of the species included in pollen type-*Solanum nigrum.*

Name of species	Shape	Polar length of pollen in µm (P)	Equatorial diameter in µm (E)	Colpus length in µm	Apocolpium in µm	Mesocolpium in µm	Exine thickness in µm
Solanum nigrum L.	Ob-sp	19.60 (20.76±33) 23.80	19.60 (22.81±0.59) 25.20	18.20 (19.2±0.46) 19.60	Obscure	18.20 (19.8±0.08) 21.10	0.98 (1.18±0.04) 1.26
Solanum surattense Burm. F.	Ob-sp	14.30 (22.2±0.73) 25.13	21.54 (23.3±0.46) 25.13	14.30 (20.10±0.79) 25.13	0.71 (3.08±0.29) 3.59	10.77 (13.08±0.71) 17.95	0.28 (2.76±0.94) 3.23
Solanum anguivi Lam.	Ob-sp	25.0 (25.9±0.32) 27.50	25.0 (27.8±0.45) 36.0	22.50 (23.8±0.56) 27.50	2.50 (3.33±0.46) 5.20	20.0 (21±1) 25.0	1.25 (1.85±0.54) 2.25
Solanum saeforthianum Andrews	Pr	15.50 (17.2±0.18) 17.50	13.70 (15.2±0.28) 17.50	15.0 (15.3±0.14) 16.25	Obscure	12.50	1.16
Withania coagalans (Stocks) Dunal	Ob-sp	21.50 (24.06±0.47) 25.13	21.50 (24.6±0.98) 28.38	21.50 (23.3±0.65) 25.13	-	14.30 (18.4±0.43) 21.50	0.36 (0.79±0.06) 0.89
Lycium ruthenicum Murray	Ob-sp	22.50 (23.3±1.18) 25.0	22.50 (24.87±3.1) 26.55	17.50 (18.57±0.74) 22.50	1.25 (2.58±0.36) 5.0	15.25 (17.7±0.66) 17.80	1.50 (1.80±0.09) 2.0
Lycium makranicum Schoenbeck_Temesy	Pr-sp.	20.11 (23.3±2.2) 27.50	20.0 (22.7±1.50) 24.11	15.0 (17.18±0.56) 20.0	2.25	15.0 (17.18±0.56) 20.0	1.50 (2.82±0.08) 2.25

Table 5. Pollen character of the species included in pollen type-*Withania somnifera.*

Name of species	Shape	Polar length of pollen in µm (P)	Equatorial diameter in µm (E)	Colpus length in µm	Apocolpium in µm	Mesocolpium in µm	Exine thickness in µm
Withania somnifera (L.) Dunal	Pr-sp.	21.50 (25.81±0.51) 28.72	21.54 (28.80±0.58) 28.72	17.95 (23.12±1.01) 26.90	0.78 (2.33±0.58) 3.59	17.95 (18.6±0.47) 21.54	1.79 (2.2±0.19) 3.23
Lycium edgeworthii Dunal	Pr-sp.	24.33 (25.40±0.34) 28.72	21.54 (25.13±0.49) 28.72	21.54 (23.3±0.59) 25.13	-	3.85 (3.94±0.25) 5.38	1.79 (1.93±0.10) 2.87

Key to the species and groups

1 + Pollen grains prolate …… 2
- Pollen grains oblate-spheroidal……..….. Subtype-I (*Lycium ruthenicum, Solanum anguivi S.nigrum, S. surattense, Withania coagulans*)

2 + Pollen grains prolate-spheroidal ……...…… *Lycium makranicum*
- Pollen grains prolate …….……...… *Solanum saeforthianum*

VI: *Withania somnifera*-type (Fig. 4 D-F).
Pollen class: 3-colporate, 3-zonocolporate.
P/E ratio: 0.92-1.24.
Apertures: Ectoapertures-colpus long, sunken, narrow, margins, sub-psilate end actue. Endoaperture circular.
Exine: Sexine thicker or thinner than nexine.
Ornamentation: Tectum striate-rugulate.
Outline: Equatorial view elliptic. Polar view trilobed with aperture on the angles of the outline of the grains in polar view.
Measurements: Polar axis (P) 21.5 (25.81±0.51) 28.72 µm. Equatorial diameter 21.54 (28.80±0.58) 28.72 µm. Colpus length 17.95 (23.12±1.01) 26.9 µm. Mesocolpium 10 (15.5±0.11) 21.5 µm. Apocolpium 0.75-5.55 µm. Exine 0.25 (1.75± 0.11) 3.25 µm thick.
Species included: *Lycium edgeworthii* Dunal, *Withania somnifera* (L.) Dunal.

Discussion

The family Solanaceae is one of the most important families of flowering plants economically, floristically, ethnobotanically and scientifically (Olmstead & Palmer, 1992). Pollen morphology of the family is quite heterogeneous (Erdtman, 1952). However, tricolporate grains are universally present. Pollen grains are usually radially symmetrical, isopolar, prolate-spheroidal to sub-prolate or prolate rarely oblate-spheroidal. Usually tricolporate rarely 4-colporate, colpal membrane finely-coarsely granulated or sub-psilate. Tectum is mostly scabrate (coarse-fine). In addition to this, various grades of rugulate-reticulate, reticulate- rugulate often verrucate or striate tectum are also found. However, tricolporate pollen with scabrate tectum are more commonly found within the family. Most striking variation is found in the shape class, apertural types and tectal surface. On the basis of shape, apertures and tectum types, 6 distinct pollen types are recognized viz., *Datura fastuosa*-type, *Lycium dasytemum* - type, *Nicotiana plumbaginifolia*-type, *Physalis divaricata*-type, *Solanum nigrum*-type and *Withania somnifera*-type.

Pollen type-I: *Datura fastuosa*-type is recognized by its tectum type i.e., striate at mesocolpium with distinct perforations in between the lirae, ornamentation coarsely reticulate-rugulate towards apocolpium region, lumina with columella. It comprises of 3 species (see key to the species). Pollen type-II: *Lycium dasytemum*-type is characterized by its striate tectum. Only two species are included in this pollen. Pollen type-III is easily delimited by having rugulate-fossulate, densely punctuate more or less psilate towards the apocolpial region. Only single species is included in this type i.e., *Nicotiana plumbaginifolia*. Pollen type-*Physalis divaricata*-IV: is characterized by verrucate tectum. Pollen of 3 species are included, belonging to two genera i.e., *Physalis* and *Solanum*. However, genera and species of this pollen type are easily separated on the basis of pollen shape class. Pollen type-V: *Solanum*

nigrum is recognized by its scabrate tectum. Seven species are included in this pollen type. Pollen type-VI: is easily delimited by its striate-rugulate tectum.

Solanaceae is divided into 2 subfamilies by Hunziker (1979) D'Arcy (1979, 1991). The subfamily Solanoideae has curved embryos contained in flattened discoid seed and the subfamily Cestoideae with straight or slightly bent embryos in prismatic- subglobose seeds.

Pollen of 5 genera viz., *Solanum, Withania, Lycium, Phvsalis* and *Datura* of the subfamily Solanoideae was studied. Pollen morphology of these genera show considerable variation in exine pattern. The taxonomic significance of pollen morphology in Solanaceae is more or less obscure. Sometimes different tribes or subtribes have similar type of pollen or vice versa Genera referred to same tribe or subtribe may have different type of pollen (Erdtman, 1952). For instance, two species of the genus *Withania* i.e., *W. coagulans* (Stocks) Dunal and *W. somnifera* (L.) Dunal, have quite dissimilar pollen grains and fall under different types. *Withania* (*W. coagulans* (Stocks) Dunal, and *W. somnifera* (L.) Dunal) similarity affinities with the other genera than with each other. Pollen of *W. coagulans* (Stocks) Dunal, are very similar to grains of genus *Solanum*, while *W. somnifera* (L.) Dunal, pollen are closely related to *Lycium* grains.

Eurypalynous nature of subfamily Solanoideae suggest its polyphyletic origin, which is also supported by D'Arcy (1979, 1991). However, the more recent study of subfamily Solanoideae by Olmstead *et al*., (1999) and Knapp (2002) indicates that the Solanoideae is a monophyletic and derived from the Cestoideae.

In contrast to Solanoideae, only a single genus *Nicotiana* of the subfamily Cestoideae has also a different mesocolpium and apocolpium pattern but not so distinct as of *Datura*. In *Nicotiana* more or less subpsilate apocolpium, and fossulate to rugulose mesocolpium region are found.

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