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POLLEN FLORA OF PAKISTAN –XLIV. RHAMNACEAE

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Abstract

Pollen morphology of 11 species representing 5 genera of the family Rhamnaceae from Pakistan have been examined by light and scanning electron microscope. Rhamnaceae is a stenopalynous family. Pollen grains are generally free, radially symmetrical, isopolar, colporate. Shape of pollen grains are sub-prolate or oblate-spheroidal rarely prolate. Sexine thicker or thinner or as thick as nexine. Tectum striate to striate-rugulate or rugulate to reticulate often psilate.

On the basis of tectum types, 5 distinct pollen types viz., *Berchemia pakistanica* –type, *Rhamnus prostrata* – type, *Sageretia thea*-type, *Ziziphus mauritiana* type and *Ziziphus oxyphylla* – type are recognized. The pollen morphology of the family Rhamnaceae is significantly helpful at generic and specific level.

Introduction

Rhamnaceae is a family of about 55 genera and 900 species, cosmopolitan in distribution, especially warm temperate regions. *Rhamnus*, *Ceanothus* and *Ziziphus* are the chief genera of this family (Mabberley, 1987). In Pakistan it is represented by 7 genera and 13 species (Qaiser & Nazimuddin, 1981). Many species of *Ceanothus* are cultivated as ornamentals. Plants mostly shrubs and trees, sometimes lianoid, rarely herb (*Crumenaria*). Leaves usually simple, flowers small and unisexual. Erdtman (1952) examined pollen morphology of the family Rhamnaceae. Papagiannes (1974) examined the pollen of many genera of family Rhamnaceae by electron microscope. El-Ghazaly (1991) studied pollen morphology of the family Rhamnaceae from Qatar. Punt & Marks (1995) examined palynology of some North West European species of the family Rhamnaceae. Pollen morphology of family Rhamnaceae has also been examined by Wang (1962), Aykut *et al*., (1971), Huang (1972), Shimarkura (1973), Roa & Shukla (1975), Lobreau-Callen (1976), Markgraf & Antoni (1978), Moore & Webb (1978) and Schirarend & Kohler (1993). There are no reports on the pollen morphology of the family Rhamnaceae from Pakistan. Present study is based on pollen morphology of 11 species of the family Rhamnaceae by light and scanning electron microscope.

Materials and Methods

Pollen samples were obtained from Karachi University Herbarium (KUH) or collected from the field. The list of voucher specimens are 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 was 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 150A. 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, colpus length and exine thickness are given in Tables 1-4.

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 Rhamnaceae

Pollen grains usually radially symmetrical, isopolar, colporate. Shape of pollen grains are sub-prolate or oblate-spheroidal often prolate. Sexine thicker or as thick as nexine. Tectum striate or striate-rugulate rarely reticulate - rugulate often psilate.

Key to the pollen types

1 + Tectum psilate ..…….…… *Rhamnus prostrata*-type
- Tectum not as above ……..... 2

2 + Tectum striate or striate–rugulate …… 3
- Tectum reticulate or rugulate …….. 4

3 + Tectum finely striate …..……. *Ziziphus oxyphylla*-type
- Tectum striate-rugulate ……..…… *Sageretia thea*-type

4 + Tectum rugulate often rugulate-striate …….…… *Ziziphus mauritiana*-type
- Tectum reticulate ……. *Berchemia pakistanica*-type

Berchemia pakistanica– type

Pollen class: Tricolporate.
P/E ratio: semi- erect or sub-transverse.
Shape: Sub-prolate or oblate-spheroidal.
Aperture: Long elliptic, acute ends.
Exine: Sexine thicker than nexine.
Ornamentation: Tectum medium to finely reticulate.
Outline: More or less triangular.
Measurements: Polar axis (P) 17 (19.1 ± 1.0) 21.6 µm long. Equatorial diameter (E)15 (18.5 ± 1.25) 22 µm, colpi 12 (14.5 ± 0.31) 17µm long. Sexine thicker than nexine. Exine 2- (5.0) 8 µm thick.
Species included: *Berchemia edgeworthii* Lawson, *Berchemia pakistanica* Browicz,

Key to the species

1 +Tectum medium reticulate ……..…….. *Berchemia edgeworthii*
-Tectum finely reticulate…….……..……..… *Berchemia pakistanica*

Table 1. General pollen characters of species found in the pollen type *Ziziphus oxyphylla*.

Name of taxa	Shape	Polar axis (P) µm	Equatorial diameter (E) µm	Colpus length (L) µm	Exine thickness µm	Tectum
Helinus lanceolata Wall. ex Brandis	Ob.Sp.	27.5 (27.6 ± 0.35) 30.5	30 (32.14 ± 1.01) 35	0.25	0.5(1.03 ± 0.14) 1.25	Striate
Ziziphus oxyphylla Edgew	Sub-Pr.	27.5 (29.15 ± 0.13) 31.52	28.64 (30.05±0.87) 31.0	23.8 (25.2 ± 31.58)	c. 3.94	Finely striate
Ziziphus spina - christi (L.) Willd.	Ob-Sp.	16.8-266	19.6-28	16.8-24	2.6-2.68	Finely striate

Table 2. General pollen characters of species found in the pollen type *Berchemia pakistanica*.

Name of taxa	Shape	Polar axis (P) µm	Equatorial diameter (E) µm	Colpus length (L) µm	Exine thickness µm	Tectum
Berchamia edgeworthii Lawson.	Sub.Pr.	19.7 (20.5 ± 0.34) 21.67	15.76 (16.8±0.53) 18.91	15.9(16.5 ± 0.15) 16.9	8.36	Reticulate
Berchemia pakistanica Browicz	Ob-Sp.	17.5	15(17.91±1.0) 22.5	12.5(16.0±0.81) 17.5	c1.25	Finely Reticulate

Abbreviations: Ob-Sp= Oblate-spheriodal, Sub-Pr= Sub-prolate, Pr= Prolate

Table 3. General pollen characters of species found in the pollen type *Sageretia thea*.

Name of taxa	Shape	Polar axis (P) µm	Equatorial diameter (E) µm	Colpus length (L) µm	Exine thickness µm	Tectum
Rhamnus triquetra Wall. ex Roxb	Sub-Pr	22.5 (25.5±1.2) 27.5	17.5 (20.1±0.60) 22.5	15.1 (21.1 ± 0.70) 22.5	c. 2.25	Striate - Reticulate
Sageretia thea (Osbeck) MC. *Johnston*	Ob-Sp.	25 (27.18±0.31) 27.5	25(27.50±0.21) 28.5	0.20	3.75(4.25±0.49) 4.75	Striate - Reticulate
Zizyphus runmularia (Burm. J.) Wr & Arn.	Ob-Sp	19.74(22.6±0.44) 25.13	21.54(26.6±0.85) 32.31	16.15(19.5±0.62) 21.54	0.71(1.14±0.14) 1.79	Strio-Rugulate

Table4. General pollen characters of species found in the pollen type *Ziziphus mauritiana*.

Name of taxa	Shape	Polar axis (P) µm	Equatorial diameter (E) µm	Colpus length (L) µm	Exine thickness µm	Tectum
Ziziphus mauritiana Lamk..	Pr.	15(21.07±1.07) 22.5	15(18.57±1.71) 25.0	15(16.42±0.74) 20.0	11.5(1.6±0.15) 2.5	Rugulate - Striate
Zizyphus mauritiana var. *spontanea* (Edgew.) Qaiser & Nasim	Sub-Pr.	19.5(19.71±0.05) 20.0	14.9(15±0.37) 15.2	18.9(19.1±0.10) 19.5	2.63	Rugulate

Abbreviations: Ob-Sp= Oblate-spheriodal, Sub-Pr= Sub-prolate, Pr= Prolate

Rhamnus prostrata– type
Pollen class: Tricolporate.
P/E ratio: Semi- erect.
Shape: Sub-prolate.
Aperture: Long elliptic, acute ends.
Exine: Sexine thicker than nexine.
Ornamentation: Tectum psilate.
Outline: More or less triangular.
Measurements: Polar axis (P) 23.11 (24. 7 ± 1.0) 27.5 µm long. Equatorial diameter (E) 19.5 (21.5 ± 1.25) 23.64 µm, colpi 22.8 (23.7 ± 0.31) 24.5 µm long. Sexine as thick as nexine. Exine 3.94 µm thick.
Species included: *Rhamnus prostrata* Jacq. ex Parker

Sageretia thea– type (Fig. 1A -C)
Pollen class: Tricolporate.
P/E ratio: Semi- erect or sub-transverse.
Shape: Sub-prolate to oblate-spheroidal
Aperture: Long elliptic, acute ends.
Exine: Sexine thicker than nexine.
Ornamentation: Tectum striate - rugulate.
Outline: More or less circular.
Measurements: Polar axis (P) 19 (23.7 ± 1.0) 27.5 µm long. Equatorial diameter (E)17 (24.5 ± 1.25) 32 µm, colpi 15 (18.7 ± 0.31) 22.5 µm long. Sexine thicker than nexine. Exine 0.7- (2.0) 4.75 µm thick.
Species included: *Rhamnus triquetra* Wall. ex Roxb. *Sageretia thea* (Osbeck) M.C. Johnston, *Ziziphus nummularia* (Burm.f.) Wr. & Arn.

Key to the species

1 + Polar length 25-27.5 µm ……...…… 2
Polar length 19-25……...… *Ziziphus nummularia*

2 + Pollen grains oblate-spheroidal ……...……. *Sageretia thea*
\- Pollen grains sub-prolate ……...…… *Rhamnus triquetra*

Ziziphus mauritiana– type
Pollen class: Tricolporate.
P/E ratio: Erect to semi- erect.
Shape: Prolate to sub-prolate.
Aperture: Long elliptic, acute ends.
Exine: Sexine thinner than nexine.
Ornamentation: Tectum rugulate to rugulate-striate.
Outline: More or less circular small.
Measurements: Polar axis (P) 15 (18.7 ± 1.0) 22.5 µm long. Equatorial diameter (E)15 (20.5 ± 1.25) 25 µm, colpi 15 (17.7 ± 0.31) 20.5 µm long. Sexine thicker than nexine. Exine 1.5- (2.0) 2.6 µm thick.
Species included: *Ziziphus mauritiana* Lamk., *Ziziphus mauritiana* Lamk. var. *spontanea* (Edgew.) Qaiser & Nazim

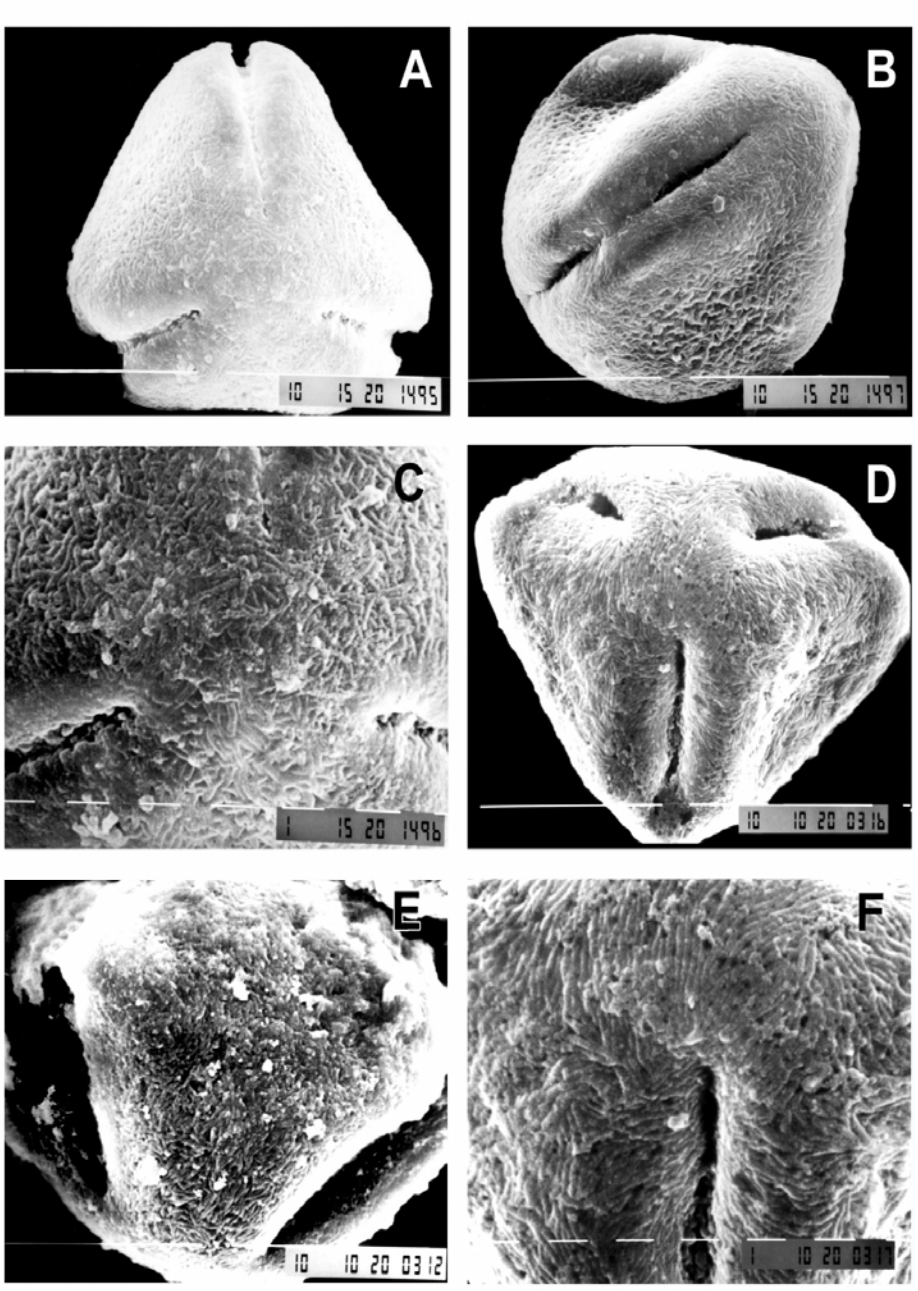

Fig. 1. Scanning micrographs: *Ziziphus nummularia*: A. Polar view. B. Equatorial view, C. Exine pattern. *Zizyphus spina – christi*: D. Polar view, E. Equatorial view, F. Exine pattern.
Scale bar = A, B, D & E = 10; C& F= 1 µm.

Key to the species

1 +Tectum rugulate-striate ……..…… *Ziziphus mauritiana*
-Tectum rugulate …..…….…… *Ziziphus mauritiana*. var. *spontanea*

Ziziphus oxyphylla– type (Fig. 1. D-F).
Pollen class: Tricolporate.
P/E ratio: Sub-transverse or semi- erect.
Shape: Oblate-spheroidal or sub-prolate.
Aperture: Long elliptic, acute ends.
Exine: Sexine thicker than nexine or as thick as nexine.
Ornamentation: Tectum striate.
Outline: More or less circular.
Measurements: Polar axis (P) 15 (30.7 ± 1.0) 45.5 µm long. Equatorial diameter (E)10 (22.5 ± 1.25) 35 µm, colpi 12 (22.7 ± 0.31) 32.5 µm long. Sexine thicker than nexine. Exine 3- (4.0) 5 µm thick.
Species included: *Helinus lanceolatus*Wall. ex Brandis, *Ziziphus oxyphylla* Edgew, *Ziziphus spina – christi* (L.) Willd

Key to the species

1 + Pollen grains oblate-spheroidal ……..…… 2
- Pollen grains sub-prolate …….. *Ziziphus oxypylla*

2 + Exine 0.5-1.25 µm thick ...…… *Helinus lanceolatus*
- Exine c. 2.68 µm thick …….. *Ziziphus spina- christi*

Discussion

Rhamnaceae is a stenopalynous family (Erdtman, 1952). Pollen data is based on 11 species representing 5 genera. Pollen grains generally isopolar, tricolporate or with striate or striate-rugulate or reticulate often psilate. However, the little variation is found in the exine ornamentation and shape class. On the basis of tectum types, 5 distinct pollen types viz., *Berchemia pakistanica*–type, *Rhamnus prostrata*–type, *Sageretia thea*-type, *Ziziphus mauritiana* type and *Ziziphus oxyphylla*–type are recognized. Erdtman (1952) also reported similar types of pollen in the family Rhamnaceae. Punt & Marks (1985) divided the family into two types. Schirarend & Kohler (1993) divided the family into 12 pollen types on the basis of exine pattern viz., (1) ***Colletia-type*** (fossulate-insulate (2) ***Crumenaria-type*** (radiate-rugulate), (3) ***Gouania-type*** (tectum perforate), (4) ***Helinus-type*** (striate), (5) ***Hovenia-type*** (striate-rugulate), (6) ***Lasiodiscus-type*** (rugulate), (7) ***Maesopsis-type*** (baculate), (8) ***Phylica-type*** (reticulate), (9) ***Pomaderris-type*** (verrucate), (10) ***Reissekia-type*** (striate-reticulate), (11) ***Rhamnus-type*** (suprareticulate-rugulate) and (12) ***Sageretia-type*** (fossulate-perforate).

Pollen type: *Berchemia pakistanica* is easily distinguished by its reticulate tectum.Two species included in this type are easily distinguished on the basis of shape class (see key to the species). Pollen type: *Rhamnus prostrata* - is recognized by its psilate. Only one species has psilate tectum. Pollen type: *Sageretia thea* is readily distinguished by its striate-rugulate tectum. In this three genera are included each representing a single species, these species are further delimited on the basis of polar length (see key to the species). Pollen type: *Ziziphus mauritiana* is characterized by

having rugulate or rugulate –striate tectum. *Ziziphus mauritiana* Lamk., *Ziziphus mauritiana* Lamk. var. *spontanea* (Edgew.) Qaiser & Nazim have rugulate type tectum.

These taxa are further separated on the basis of exine ornamentation (see key to the species). Pollen type: *Ziziphus oxyphylla*, 3 species have striate pollen. These taxa are easily delimited on the basis of polar length and exine thickness. Pollen morphology of the family Rhamnaceae is somewhat helpful at generic level. *Berchemia* is the only genus which has reticulate species, whereas other genera like *Rhmanus* and *Ziziphus* have two different pollen types. However, at the specific level the pollen morphology seems to be useful in the delimitation.

References

Aykut, S., N. Mereu and G. Edis. 1971. Atlas des pollen des Envirmnt d' Istanbul – Istanbul Universites; Orman Fakuletesi Publication: 1-330.

El-Ghazaly, G. 1991. *Pollen flora of Qatar*. Aio Print Ltd. Odense, Denmark, 429 pp.

Erdtman, G. 1952. *Pollen Morphology and Plant Taxonomy. Angiosperms*. Chronica Botanica Co., Waltham, Massachusettes. 1952.

Faegri, K. and J. Iversen. 1964. *Textbook of Pollen Analysis*. Munksgaard, Copenhagen.

Huang, T.C. 1972. *Pollen Flora of Taiwan*. National Taiwan Univ., Botany. Dept. Press, 297. pp.

Lobreau–Callen, D. 1976. Ultrastructure de l' exine De quelques pollens de celastrales et. Des groupes voisins. *Adansonia*, 16:83-92

Kremp, G.O.W. 1965. *Encyclopaedia of Pollen Morphology*. Univ. Arizona Press, Tuscon, U.S.A.

Kuprianova, L.A. and L.A. Alyoshina. 1978. *Pollen dicotyledoneaerum Florae Partis Europareae. URSS. Lamiaceae, Zygophyllaceae*. (in Russian). Nauka 184 p. Akad. Sci. USSR. L. Komarov. Inst. Bot.

Mabberley, D. I. 1987. *The Plant Book*. Univ. Press, Cambridge, New York.

Markgraf . V. and D.H.L. Artoni. 1978. Pollen Flora of Argentina – ix-1 208 pp. Univ. Arizona. Press, Tucson.

Martin, P.S and Ch.M. Drew. 1969. Scanning electron Photographs of southwestern pollen grains. *J. Arizona Acad. Sci. Tucson*, 5(3): 147-176.

Moore, P. D. and J. A. Webb. 1978. *An Illustrated guide to Pollen Analysis*. Hodder and Stoughton, London.

Papagiannes, E.1974. *Genera of Rhamnaceae*. University of Illinois Chicago, M.S. Thesis.

Punt, W and A. Marks. 1995. *Rhamnaceae*. In: The North West European Pollen Flora-VIII. (Eds.): W. Punt, S. Blackmore, P.P. Hoen and P.J. Stafford.

Qaiser, M. and S. Nazimuddin.1981. *Rhamnaceae*. In: *Flora of Pakistan*. (Eds.): E. Nasir & S.I. Ali, 140: 1-24.

Rao, A. R. and P. Shukla. 1975. Pollen flora of upper Gangetic plain. Today and Tomorrow 's Printers & Publishers, New Delhi , 30 pp.

Schirarend, C. and E. Kohler. 1993. Rhamnaceae Juss. In: *World Pollen and Spores Flora*. (Eds.): S. Nilsson, & G. El-Ghazaly. 17/18:1-58

Shimarkura, M. 1973. *Palynomorphs of Japanese plants* (in Japanese). Spec. Publ. Osaka Mus. Nat. Hist., 5: 1-60.

Walker, J. W. and J. A. Doyle. 1976. The basis of Angiosperm phylogeny: Palynology. *Ann. Mo. Bot. Gard.*, 62: 666-723.

Wang, J.L. 1962. General morphological study of the pollen grains of the Taiwan species. *Information, Taiwan Forestry Research Institute*, 136-137: 1083-1096.

Willis, J.C. 1973. *A Dictionary of the flowering Plants & Ferns*. VII ed. *University Press, Cambridge*.

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