

POLLEN FLORA OF PAKISTAN -LV. CAPRIFOLIACEAE

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Abstract

Pollen morphology of 18 species of the family Caprifoliaceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains are usually radially symmetrical, isopolar, oblate-spheroidal to prolate-spheroidal rarely sub-prolate or sub-oblate. Sexine slightly thicker or thinner than nexine. Tectum mostly spinulose to coarsely reticulate or sub-psilate often rugulate-striate. On the basis of exine pattern six distinct pollen types are recognized viz., *Abelia triflora*-type, *Lonicera myrtillus*-type, *Lonicera obovata*-type, *Lonicera quinquelocularis*, *Lonicera webbiana*-type and *Viburnum grandiflorum*.

Introduction

Caprifoliaceae is a small family of about 12 genera and 450 species (Mabberly, 1987) occurring mainly in the temperate regions of the northern hemisphere. In Pakistan it is represented by 4 genera and 27 species (Akhtar, 1986).

Plants mostly shrub, rarely herb. Leaves opposite, usually simple. Flowers bisexual, actinomorphic or zygomorphic, calyx 4-5 united, corolla 4-5 united, epigynous, gynoeceum compound, pistil 2-8 carpel with 2-5 locules, ovules one or more, placentation pendulous or axile, ovary inferior, style terminal, often slender. Fruit berry or drupe.

Family is important for its cultivated ornamental shrubs and vines such as *Lonicera*, *Symphoricarpos*, *Abelia*, *Leycesteria*, *Linnaea*, *Kolkwitzia* and weeds (*Lonicera japonica*).

Pollen morphology of family has been examined by Erdtman (1952), Radulescu (1961), Kapp (1969), Haung (1972), Kuprianova & Alyoshina (1978). Bassett & Crompton (1970) examined the pollen morphology of the family Caprifoliaceae in his monographic studies. Punt *et al.*, (1976) examined pollen morphology of some Northwestern species of the family Caprifoliaceae. Moore & Webb (1978) also examined pollen morphology of few species of the family Caprifoliaceae. There are no reports on pollen morphology of the family Caprifoliaceae from Pakistan. Present investigations are based on the pollen morphology of 18 species representing 4 genera of the family Caprifoliaceae by light and scanning electron microscope.

Materials and Methods

Polleniferous material was 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 electron 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 150A. 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. Polar axis (P) and equatorial diameter (E), aperture size, apocolpium, mesocolpium and exine thickness were measured (Table 1-2).

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

General pollen characters of the family Caprifoliaceae

Pollen grains are usually radially symmetrical, isopolar, colpate or colporate, oblate-spheroidal to prolate-spheroidal rarely sub-prolate or sub-oblate, Sexine slightly thicker or thinner than nexine. Tectum mostly spinulose to coarsely reticulate or sub-psilate often rugulate-striate. On the basis of exine pattern six distinct pollen types are recognized viz., *Abelia triflora*-type, *Lonicera obovata*-type, *Lonicera myrtillus*-type, *Lonicera quinquelocularis*-type, *Lonicera webbiana*-type and *Viburnum grandiflorum*-type.

Key to the pollen types

- 1 + Pollen grains colporate 2
 - Pollen colpate 5
- 2 + Tectum reticulate or rugulate-reticulate 3
 - Tectum sub-psilate or spinulose 4
- 3 + Tectum reticulate *Viburnum grandiflorum*-type
 - Tectum rugulate-reticulate *Lonicera quinquelocularis*-type
- 4 + Tectum spinulose *Lonicera webbiana*-type
 - Tectum sub-psilate *Abelia triflora*-type
- 5 + Tectum spinulose *Lonicera obovata*-type
 - Tectum sub-psilate *Lonicera myrtillus*-type

Pollen type: *Abelia triflora*-type (Fig.1 A-C).

Pollen class: Tricolporate

P/E ratio: 110

Shape: Prolate-spheroidal

Apertures: Colpus long sunken with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Sub-psilate

Measurements: Size: Polar axis P=35 (48.75±1.2) 62.5, and equatorial diameter E=40 (28±2.1) 57.5µm colpi 11.61 (23±1.4)-35µm long. Exine 1.5-3.0µm thick, sexine as thick as nexine. Tectum sub-psilate-punctate

Species included: *Abelia triflora* R.Br.

Table 1. General characters of pollen grains found in the pollen type-*Lonicera obovata*.

Name of taxa	Shape	Polar axis (P) in μm	Equatorial diameter (E) μm	Colpus length in μm	Exine thickness in μm	Tectum
<i>Leycesteria formosa</i> Wall.	Ob-Sp	50.0 (52.75 \pm 1.05)	52.50 (55.50 \pm 1.2)	20.1 (23.75 \pm 0.67)	2.10 (2.45 \pm 0.07)	Spinulose, surface psilate
<i>Lonicera asperifolia</i> (Decne.) Hook f. & Thoms.	Ob-Sp	42.50 (53.02 \pm 1.59)	59.02 \pm 1.20	10.50 (16.28 \pm 1.0)	2.50 (3.10 \pm 0.16)	Spinulose
<i>Lonicera hispida</i> Pall. ex Willd.	Sub-Oblate	47.50 (53.12 \pm 2.07)	56.25 (60.93 \pm 1.86)	12.50 (12.81 \pm 0.31)	2.50 (2.87 \pm 0.16)	Spinulose, interspersal surface subsilate
<i>Lonicera korolkovii</i> Stapf.	Ob-Sp	47.50 (54.21 \pm 1.51)	53.70 (60.31 \pm 1.26)	20.10 (23.12 \pm 1.23)	2.25 (2.53 \pm 0.08)	Spinulose, subsilate between spine
<i>Lonicera obovata</i> Royle ex Hook.f. & Thoms.	Ob-Sp	38.75 (39.59 \pm 0.41)	c. 42.50	12.50 (13.76 \pm 0.72)	2.25 (2.33 \pm 0.08)	Spinulose, interspersal surface subsilate
<i>L. cancasica</i> Pallas subsp. <i>govaniata</i> Wall. ex DC. Hara	Ob-Sp	50.10 (53.57 \pm 0.92)	52.50 (57.50 \pm 1.09)	16.25 (19.10 \pm 0.80)	1.75 (2.28 \pm 0.09)	Spinulose, punctate
<i>L. microphylla</i> Wild. ex Roem & Schultes	Ob-Sp	57.50 (53.91 \pm 0.34)	57.50 (60.72 \pm 0.47)	22.50	2.50	Spinulose, subsilate
<i>L. heterophylla</i> Decne.	Ob-Sp	43.75 (60.96 \pm 0.67)	45.0 (49.87 \pm 0.93)	12.50 (15.12 \pm 0.39)	2.0 (2.35 \pm 0.05)	Spinulose, subsilate
<i>L. griffithii</i> Hook f. & Thoms.	Ob-Sp	58.75 (60.96 \pm 0.55)	58.75 (63.48 \pm 0.83)	17.50 (23.26 \pm 0.86)	3.10 (3.75 \pm 0.11)	Spinose, subsilate in between
<i>L. semenovii</i> Regel.	Ob-Sp	50.0 (53.92 \pm 1.60)	55.0 (58.70 \pm 1.03)	15.50 (17.03 \pm 0.31)	2.50 (3.28 \pm 3.50)	Spinulose
<i>L. vaccinioides</i> Rehder.	Ob-Sp	47.50 (50.60 \pm 1.30)	47.50 (52.08 \pm 0.75)	12.50 (13.50 \pm 0.50)	2.50 (2.58 \pm 0.06)	Spinulose

Table 2. General characters of pollen grains found in pollen type-*Viburnum cotinifolium*.

Name of taxa	Shape	Polar axis (P) in μm	Equatorial diameter (E) μm	Colpus length in μm	Exine thickness in μm
<i>Viburnum cotinifolium</i> D.Don.	Sub-Pr	27.50 (30.50 \pm 0.40)	27.50 (29.34 \pm 0.45)	15.50 (17.50 \pm 0.30)	3.0 (4.50 \pm 0.196)
<i>V. mullaha</i> Buch.-Ham. ex Don.	Sub-Pr	20.11 (23.35 \pm 0.18)	18.10 (18.12 \pm 0.21)	13.75 (15.85 \pm 0.274)	2.25 (2.44 \pm 0.02)
<i>V. grandiflorum</i> Wall. ex DC.	Sub-Pr	25.0 (27.10 \pm 0.33)	18.75 (23.30 \pm 0.33)	18.75 (22.06 \pm 0.44)	2.25 (2.40 \pm 0.02)

Abbreviation: Ob-Sp= Oblate-Spheroidal, Sub-Pr= Sub-Prolate, Pr-Sp= Prolate-Spheroidal

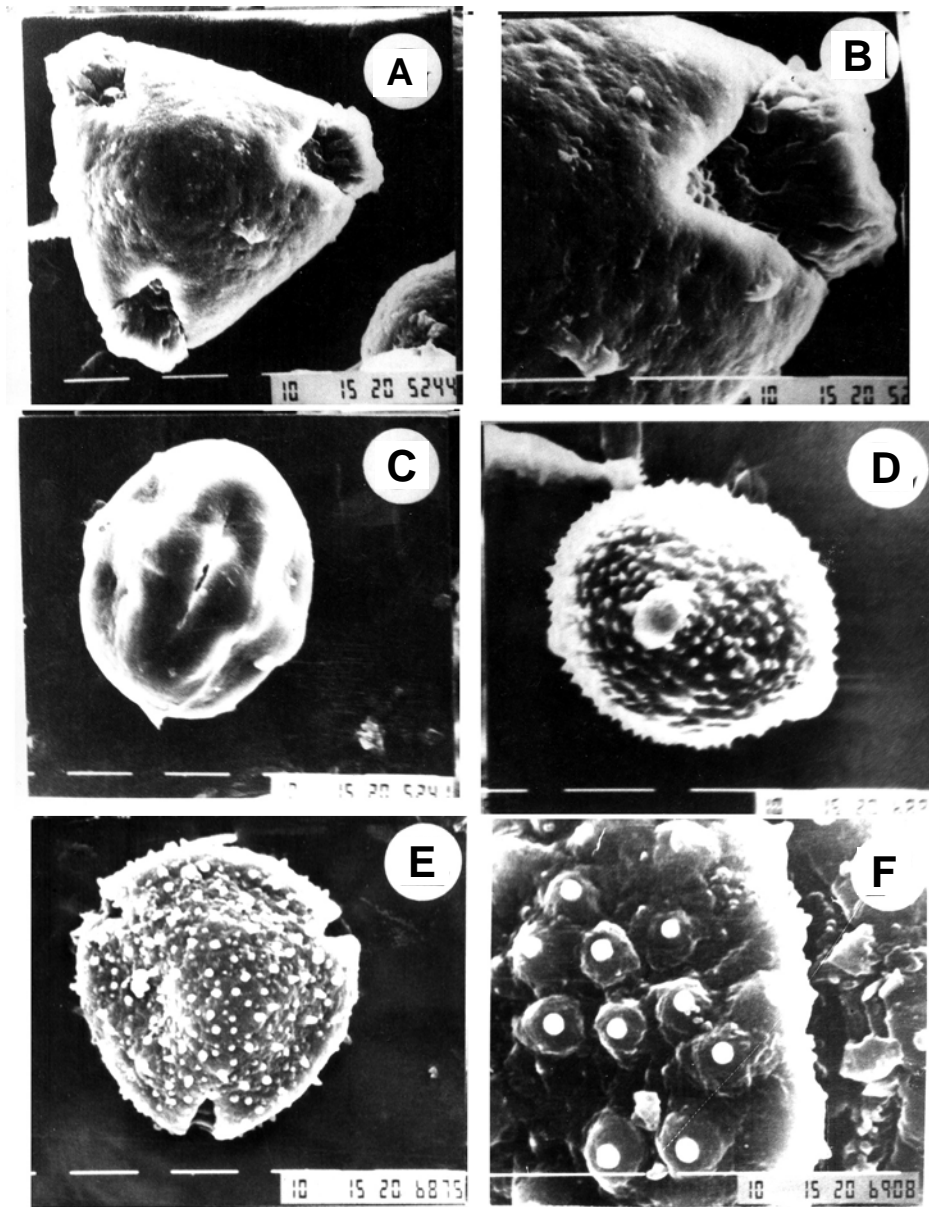


Fig. 1. Scanning electron micrographs of pollen grains. *Abelia trifolora*: A, Polar view, B, Exine pattern, C, Equatorial view. *Loniceria obovata*: D, Equatorial view; E, Polar view, F, Exine pattern. Scale bar=10 μ m.

Pollen type: *Loniceria myrtilus*-type

Pollen class: Tricolpate

P/E ratio: 93.0

Shape: Oblate-spheroidal

Apertures: Colpus short sunken with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Sub-psilate.

Measurements: Size: Polar axis $P=35.75 (37.75\pm 1.2)$ 40.25 and equatorial diameter $E=40 (42.22\pm 2.1)$ 45.5 μm colpi 11.61 (14.87 ± 1.4)-17.25 μm long. Exine 2.5-3.75 μm thick, sexine thicker than nexine. Tectum sub-psilate-punctate

Species included: *Lonicera myrtilloides* Hook.f. & Thoms.

Pollen type: *Lonicera quinquelocularis*-type

Pollen class: Tricolporate

P/E ratio: 93.0

Shape: Oblate-spheroidal

Apertures: Colpus short sunken with acute ends.

Exine: Sexine slightly thinner than nexine.

Ornamentation: Rugulate-reticulate.

Measurements: Size: Polar axis $P=53.75 (48.75\pm 1.2)$ 61.25 and equatorial diameter $E=55 (60.22\pm 2.1)$ 65.5 μm colpi 17.61 (23 ± 1.4)-31.25 μm long. Exine 2.5-3.75 μm thick, sexine as thick as nexine. Tectum rugulate-reticulate

Species included: *Lonicera quinquelocularis* Hardwicke

Pollen type: *Lonicera obovata*-type (Fig. 1D-F)

Pollen class: Tricolpate

P/E ratio: 88-97

Shape: Oblate-spheroidal rarely sub-oblate

Apertures: Colpus small sunken with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Spinulose sub-psilate in between.

Measurements: Size: Polar length=(38.5-) 51.75 ± 0.78 (-65.5) μm and equatorial breadth (45.1) 57.5 ± 0.82 (70) μm , colpi (12.5-) 20.11 ± 0.42 (27.5) μm in diameter. Exine 1.75-4.25 μm thick, sexine thicker than nexine. Tectum spinulose, sub-psilate in between.

Species included: *Leycesteria formosa* Wall., *Lonicera asperfolia* (Dcne.) Hook.f.Thomos, *L. hispida* Pall. ex Wall., *L. korolkovii* Stapf., *L. obovata* Royle ex Hook.f., *L. caucasica* Pallas, *L. microphylla* Wall ex Roem. & Schultes, *L.heterophylla* Decne, *L. griffithii* Hook.f.& Thoms., *L.semenovii* Regel and *L. vaccinoides* Rehder.

Key to the species and species groups

- 1 + Pollen grains sub-oblate *Lonicera hispida*
 - Pollen grains oblate-spheroidal *Lonicera asperfolia*
 (*Leycesteria formosa* Wall., *Lonicera asperfolia* (Dcne.) Hook.f.Thomos, *L. korolkovii* stapf., *L.obovata* Royle ex Hook.f., *L. caucasica* Pallas, *L. microphylla* Wall ex Roem & Schultes , *L.heterophylla* Decne, *L. griffithi* Hook.f.& Thoms., *L.semenovii* Regel and *L. vaccinoides* Rehder.

Pollen type: *Lonicera webbiana*-type (Fig. 2A-C)

Pollen class: Tricolporate

P/E ratio: 0.87

Shape: Sub-oblate

Apertures: Colpus small sunken with acute ends.

Exine: Sexine slightly thicker than nexine.

Ornamentation: Spinulose evenly distributed.

Measurements: Size: Polar length=(56.5-) 62.32±0.78 (-66.5) µm and equatorial breadth (66.1) 71.5±0.82 (75) µm, colpi (25.2-) 29.11±0.42 (35.5) µm in diameter. Exine 3.0-4.75µm thick, sexine slightly thicker than nexine. Tectum Spinulose.

Species included: *Lonicera webbiana* Wall. ex DC.

Pollen type: *Viburnum cotinifolium*-type (Fig.2 D-F).

Pollen class: Tricolporate

P/E ratio: 103-1.28

Shape: Sub-prolate rarely prolate-spheroidal

Apertures: Colpus small sunken with acute ends.

Exine: Sexine thicker than nexine.

Ornamentation: Coarsely reticulate.

Measurements: Size: Polar length=(20.5-) 25.75±0.78 (-30.1) µm and equatorial breadth (18.1) 24.1±0.82 (30) µm, colpi (13.5-) 20.11±0.42 (25.5) µm in diameter. Exine 2.75-7.25 µm thick, sexine thicker than nexine. Tectum coarsely reticulate.

Species included: *Viburnum cotinifolium* D.Don, *V. grandiflorum* Wall. ex DC. and *V. mullaha* Buch.-Ham. ex D. Don.

Key to the species

- 1 + Pollen grains prolate-spheroidal *Viburnum cotinifolium*
 - Pollen grains sub-prolate 2
- 2 + Polar length of pollen grains 20-23 µm *V. mullaha*
 - Polar length of pollen grains 25-30 µm *V. grandiflorum*

Discussion

Caprifoliaceae is a more or less eurapalynous family. Significant variation in exine pattern and apertural types has been observed. All the species have aperturate pollen. Oblate-spheroidal are more frequent. However, prolate-spheroidal and sub-oblate pollen are also found in *Abelia triflora* and *Lonicera hispida* respectively. Two types of apertures i.e., colpate (short) and colporate are found. Tectum varies from sub-pilate to spinulose, interspinal surface have different type of ornamentation such as psilate, punctuate-rugulate, sub-psilate to punctuate. Two genera i.e., *Lonicera* and *Viburnum* are clearly separated on the basis of tectum. *Viburnum* has coarsely reticulate tectum on the other hand most of the *Lonicera* species have spinulose pollen. On the basis of tectum and exine pattern family has been divided into six pollen types viz., *Abelia triflora*-type, *Lonicera obovata*-type, *Lonicera myrtillus*-type, *Lonicera quinquelocularis*-type, *Lonicera webbiana*-type and *Viburnum grandiflorum*-type. However, Punt (1976) divided the family Caprifoliaceae into 10 distinct pollen types viz., *Lonicera alpigena*-type, *Lonicera caprifolium*-type, *Lonicera coerulea*-type, *Lonicera periclymenum*-type, *Lonicera xylosteum*-type, *Sambucus ebulus*-type, *Sambucus nigra*-type, *Viburnum lantana*-type, *Viburnum opulus*-type and *Viburnum tinus*-type.

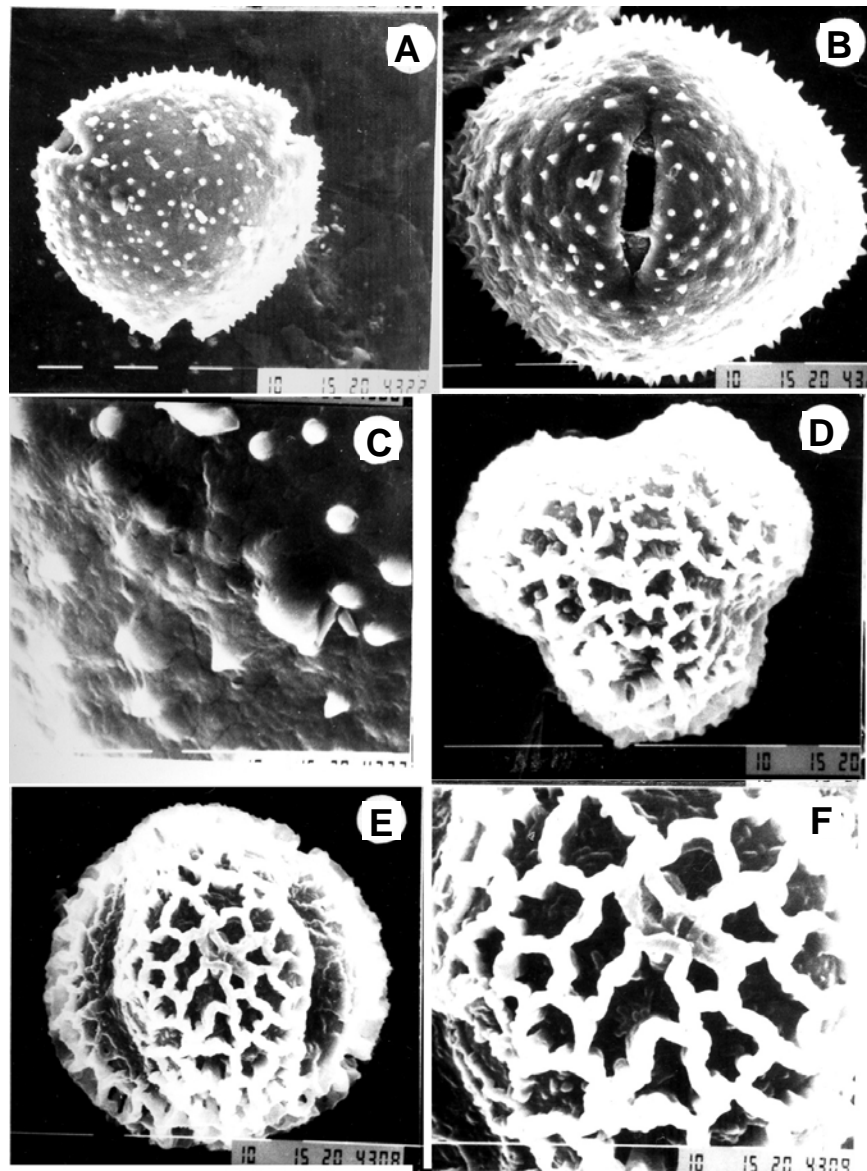


Fig. 2. Scanning electron micrographs of pollen grains. *Lonicera webbiana*: A, Polar view; B, Equatorial view, C, Exine pattern. *Viburnum cotinifolium*: D, Polar view, E, Equatorial view; F, Exine pattern

Scale bar=10 μ m.

Takhtajan (1980), Cronquist (1981), Throne (1983) and Dahlgren (1989) kept the family under the order Dipsacales near Valerianaceae and Dipsacaceae. The phylogenetic analyses of the order Dipsacales by Olmstead *et al.*, (2000); Bell *et al.*, (2001); Bremer *et al.* (2001) and Zhang *et al.*, (2003) suggested that the family Caprifoliaceae sens. str. are

paraphyletic in origin and genera of Caprifoliaceae do not form a monophyletic group. They split into Adoxaceae (include *Viburnum*, *Sambucus*, and Adoxina, which contains *Adoxa* and its relatives) from Caprifoliaceae.

The family Caprifoliaceae includes tribes like Diervilleae, Caprifolieae, Linnaeae, and three families viz., Morinaceae, Valerianaceae and Dipsacaceae. (Donoghue *et al.*, (2001). Present pollen data also support the paraphyletic nature of the family Caprifoliaceae. Within the single family almost all type of tectal surface are found (see key to the pollen types). However, Caprifoliaceous pollen shows the close relationship to the Valerianaceae and Dipsacaceae within these families pantocolpate pollen are found with spinulose tectum (Qaiser & Perveen 1997).

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