

Pollen Morphology of Caryophyllaceae in Jordan

by

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ABSTRACT

The pollen-grains morphology of 32 species of *Caryophyllaceae* belonging to the 18 genera: *Arenaria*, *Bolanthus*, *Cerastium*, *Dianthus*, *Gymnocarpus*, *Gypsophila*, *Holosteum*, *Minuartia*, *Paronychia*, *Polycarpaea*, *Pteranthus*, *Robbairia*, *Sclerocephalus*, *Silene*, *Spergula*, *Spergularia*, *Stellaria* and *Vaccaria* have been studied by the aid of light and scanning electron microscopy SEM. The pollen were all monads, radially symmetrical, apolar or isopolar. The shape is mostly spheroidal and rarely prolate or polyhedral with hexagonal to octagonal outline. The pollen size ranges between 15-40.0 μm . Apertures are mostly polyaperturate and rarely tricolpate, or polyaperturate. *Spergularia marina* showed polymorphic grains with apertures vary from hexaperturate, polyaperturate or spiral. Exine sculpturing varies from scabrate, scabrate spinulose, scabrate papillate or scabrate foveolate.

INTRODUCTION

Pollen grains of some families of the flowering plants in Jordan have been already studied such as *Umbelliferae* (AL-EISAWI 1977), *Zygophyllaceae* (LAHHAM & AL-EISAWI 1986), *Ranunculaceae* (AL EISAWI 1986) and *Cruciferae* (LAHHAM & AL-EISAWI 1987).

The family *Caryophyllaceae* is one of the well represented families in Jordan comprising 28 genera and 92 species (AL-EISAWI 1982). It includes annuals or perennial herbs with swollen nodes and opposite or whorled leaves.

Taxa of *Caryophyllaceae* are distributed in the four major phytogeographical regions Mediterranean, Irano-Turanian, Saharo-Arabian, and Sudanian (Tropical penetration) region (ZOHARY 1973; AL-EISAWI 1985). *Cerastium dichotomum*,

Vaccaria pyramidata, *Silene aegyptiaca* and *Silene conoidea* are typical species occurring in the Mediterranean region. *Gypsophila arabica*, *G. pilosa* and *Bufonia ephedrina* are typical Irano-Turanian elements. *Pteranthus dichotomous*, *Spergularia diandra*, *S. media* are typical desert (Saharo-Arabian) plants. While *Robbairia delileana* and *Sclerocephalus arabicus* are Sudanian (Tropical penetration) elements.

Up to our knowledge no previous work has been made on the pollen of *Caryophyllaceae* in our area.

The most relevant previous works are those of VISHNU-MITTRE & GUPTA (1964), ERDTMAN (1972), NOWICKE (1975) and GHAZANFER (1984).

VISHNU-MITTRE & GUPTA (1964) described the characters of 72 species (15 genera) of *Caryophyllaceae* in India. He classified them into 13 types and stated that the palynology of *Caryophyllaceae* support its relation with other families in *Centrospermae*.

ERDTMAN (1972) examined 100 species from 50 genera of *Caryophyllaceae* and described the pollen grains as colpate (3-colpate), rugate or forate (exceptionally porate or rugate), varying in size (longest axis from 10-60 μ m).

NOWICKE (1975) in a comprehensive work on the order *Centrospermae* studied the pollen grains of 90 species from 16 families by light and scanning electron microscopy. Three basic pollen types were found: 3-colpate, pantoporate and pantocolpate. All with spinulose and tubuliferous/punctate ectexine.

GHAZANFER (1984) studied the pollen morphology of the genus *Silene* sect. *Siphonomorpha* and *Auriculata*. She found that the species belonging to the section *Siphonomorpha* show only punctate tubuliferous/spinulose ectexine while species belonging to section *Auriculatae* show punctate, reticulate and semireticulate tubuliferous/or spinulose ectexine.

In this work 18 genera and 32 species were studied using light and scanning electron microscopy (SEM). The shape, size, apertures, sculpturing and exine characteristics were recorded as given in the results.

MATERIALS and METHODS

Pollen grains were taken from well identified herbarium specimens deposited at the Herbarium, Department of Biological Sciences, Faculty of Science, University of Jordan, Amman, Jordan (AMM). For light microscopy the pollen grains were prepared using acetolysis method of KUMMEL & RAUP (1965). For scanning electron microscopy (SEM) pollen were mounted unacetolysed onto clean stubs. A solution of double sided sellotape dissolved in chloroform was used as an adhesive. The pollen then were sputter-coated with platinum and examined in JEOL 35 SEM. The SEM was carried out at MAX PLANK Institut, München, W.-Germany.

LIST OF TAXA STUDIED

- Arenaria leptoclados* (Reichenb.) Guss.
Bolanthus filicaulis (Boiss.) Barkoudah
Cerastium dichotomum L.
- *glomeratum* Thuill.
Dianthus tripunctatus Sibth. & Sm.
Gymnocarpus decandrum Forrskal
Gypsophila arabica Barkoudah
- *pilosa* Hudson
- *viscosa* Murr.
Herniaria hirsuta L.
Holosteum glutinosum (Bieb.) Fischer & C. A. Meyer
- *umbellatum* L.
Minuartia formosa (Fenzl) Mattf.
- *hybrida* (Vill.) Schischkin
- *picta* (Sibth. & Sm.) Bornm.
Paronychia arabica (L.) DC.
- *argentea* Lam.
- *sinaica* Fresen.
Polycarpaea repens (Forsskal) Ascherson & Schweinf.
Pteranthus dichotomus Forsskal
Robbairia delileana Milne-Redhead
Sclerocephalus arabicus Boiss.
Silene aegyptiaca (L.) L. fil.
- *apetala* Willd.
- *arenosa* C. Koch
- *colorata* Poiret
- *damascena* Boiss. & Gaill.
Spergula fallax (Lowe) Krause
Spergularia diandra (Guss.) Heldr. & Sart.
- *marina* (L.) Griseb.
Stellaria media (L.) Vill.
- *pallida* (Dumort.) Piré
Vaccaria pyramidata Medikus

RESULTS

Arenaria leptoclados (Reichenb.) Guss. (Plate 6, G)
Pollen apolar, radially symmetrical and spheroidal. Diameter 25,0 μ m. The wall 3 μ m in thickness, crassisexinous, columellae simple. Polypantoporate. The diameter of pores 3 μ m, annulate and punctate. Sculpturing scabrate.

Bolanthus filicaulis (Boiss.) Barkoudah (Plate 4, E)
Pollen apolar, radially symmetrical and spheroidal. Diameter 25.0 μ m. The wall 2 μ m in thickness, crassisexinous. Polypantoporate. The diameter of pores 2,5 μ m, raised and papillate. Sculpturing scabrate.

***Cerastium dichotomum* L. (Plate 3, A & B)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 35,6 μm . The wall 2 μm in thickness. Polyantoporate. The diameter of pores 4 μm , annulate, raised, and papillate. Sculpturing scabrate and perforate.

***Cerastium glomeratum* Thuill.**

Pollen apolar, radially symmetrical and spheroidal. Diameter 32,5 μm . The wall 2 μm in thickness, crassisexinous. Polyantoporate. the diameter of pores 4 μm , annulate. Sculpturing scabrate.

***Dianthus tripunctatus* Sibth. & Sm. (Plate 6, C & D)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 40,0 μm . The wall 4 μm in thickness, crassisexinous (sexine to nexine 3:1), columellae thick. Polyantoporate. The diameter of pores 5 μm , annulate. Sculpturing reticulolumellate.

***Gymnocarpos decandrum* Forssak (Plate 5, E & F)**

Pollen apolar, radially symmetrical, spheroidal to polyhedral with hexagonal outline. Diameter 19,9 μm . The wall 2 μm in thickness. Polyantoporate. The diameter of pores 5 μm , raised to flat. Sculpturing psilate to sparsely and minutely scabrate.

***Gypsophila arabica* Barkoudah (Plate 2, A)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 33,9 μm . The wall 2 μm in thickness, crassisexinous. Polyantoporate. The diameter of pores 5 μm , annulate, raised, papillate, and each pore is situated on a flattened side. Sculpturing scabrate to perforate.

***Gypsophila pilosa* Hudson (Plate 2, C)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 30,0 μm . The wall 2 μm in thickness, crassisexinous. Polyantoporate. The diameter of pores 5 μm , annulate with star-like corrugations. Sculpturing tectate, and sparsely scabrate.

***Gypsophila viscosa* Murr. (Plate 2, E)**

Pollen apolar, radially symmetrical spheroidal to polyhedral with hexagonal outline. Diameter 30,0 μm . Polyantoporate. The diameter of pores 4,5 μm , with a star-like corrugation. Sculpturing sparsely scabrate to perforate.

***Holosteum glutinosum* (Bieb.) Fischer & C. A. Meyer (Plate 3, C)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 32,1 μm . The wall 3 μm in thickness, tectate. Polyantoporate. The diameter of pores 3 μm , annulate, raised and papillate. Sculpturing sparsely scabrate and perforate.

***Holosteum umbellatum* L. (Plate 3, D)**

Pollen apolar, radially symmetrical and spheroidal to polyhedral. Diameter 24,6 μm . The wall 3 μm in thickness. Polyantoporate. The diameter of pores 4 μm , annulate, castillate, papillate and slightly sunken. Sculpturing scabrate and perforate around the apertures.

***Minuartia formasa* (Fenzl) Mattf. (Plate 2, B)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 25,0 μm . The wall 3 μm in thickness, crassisexinous, tectate, columella simple. Polyantoporate. The diameter of pores 5 μm , annulate, aperculate, raised, castellate to scabrate. Sculpturing scabrate.

***Minuartia hybrida* (Vill.) Schischkin (Plate 2, F)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 25,0 μm . The wall 2 μm in thickness, crassisexinous, columella simple. Polyantoporate. The diameter of pores 5 μm , annulate, papillate, sunken. Sculpturing scabrate to perforate.

***Minuartia picta* (Sibth. & Sm.) Bornm. (Plate 2, D)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 26,0 μm . The wall 2 μm in thickness, crassisexinous, tectate, columella simple. Polyantoporate. The diameter of pores 4 μm , circular, raised, and papillate. Sculpturing scabrate.

***Paronychia arabica* (L.) DC. (Plate 1, A)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 17,5 μm . The wall 1,5 μm in thickness, crassisexinous, baculate, tegillate. Polyantoporate. The diameter of pores 4 μm , raised to flattened, and papillate. Sculpturing scabrate to rugate.

***Paronychia argentea* Lam. (Plate 1, B)**

Pollen apolar, radially symmetrical spheroidal to polyhedral. Diameter 17,5 μm . Polyantoporate. Pores papillate to rugate and corrugate. Sculpturing psilate-scabrate.

***Paronychia sinaica* Fresen. (Plate 1, C)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 24,0 μm . The wall 1,5 μm in thickness. Pores indistinct. Sculpturing sparsely scabrate.

***Polycarpaea repens* (Forsskal) Asch. & Schw. (Plate 1, E)**

Pollen isopolar, radially symmetrical. Polar diameter 12,5 μm . Equatorial diameter 17,5 μm , P/E = 0,7. The wall 1,5 μm in thickness, tectate, prolate. Tricolporate, apertures long and flat. Sculpturing scabrate.

Pteranthus dichotomus Forsskal (Plate 1, D)

Pollen apolar, radially symmetrical and spheroidal. Diameter 25,0 μ m. The wall 2 μ m in thickness, crassisexinous. Polyantoporate. Pores annulate, papillate, and operculate. Sculpturing scabrate to rugate or spinulose.

Robbairia delileana Milne-Redhead (Plate 1, F)

Pollen apolar, radially symmetrical and prolate. Polar diameter 17,5 μ m, equatorial diameter 12,5 μ m, P/E = 0,7. The wall 1,5 μ m in thickness, finely vacuolate, tectate, prolate. Tricolporate. Apertures long and open. Sculpturing minutely scabrate.

Sclerocephalus arabicus Boiss. (Plate 6, H)

Pollen apolar, radially symmetrical, spheroidal to polyhedral with hexagonal outline. Diameter 17,5 μ m. The wall 3 μ m in thickness, crassisexinous, tectate. Polyantoporate. The diameter of pores 2 μ m, annulate. Grains with hexagonal pattern of ridges. Sculpturing scabrate.

Silene aegyptiaca (L.) L. fil. (Plate 4, A)

Pollen apolar, radially symmetrical and spheroidal. Diameter 30,0 μ m. The wall 3 μ m in thickness, crassisexinous. Polyantoporate. Diameter of pores 5 μ m, annulate, castellate and echinate. Sculpturing scabrate.

Silene apetala Willd. (Plate 4, B)

Pollen apolar, radially symmetrical and spheroidal. Diameter 30,0 μ m. The wall 3 μ m in thickness, crassisexinous. Polyantoporate. Diameter of pores 5 μ m, annulate, rugate. Sculpturing roughly scabrate.

Silene arenosa C. Koch (Plate 4, C)

Pollen apolar, radially symmetrical and spheroidal. Diameter 37,5 μ m. The wall 3 μ m in thickness, crassisexinous. Polyantoporate. Diameter of pores 5 μ m, raised, castellate and papillate. Sculpturing foveolate, and scabrate to papillate.

Silene colorata Poiret (Plate 4, D)

Pollen apolar, radially symmetrical and spheroidal. Diameter 32,0 μ m. The wall 3 μ m in thickness, crassisexinous, tectate, columella simple, and pilate. Polyantoporate. Diameter of pores 3 μ m, annulate, papillate to spinulose. Sculpturing roughly rugate to scabrate.

Silene damascena Boiss. & Gaill. (Plate 6, A & B)

Pollen apolar, radially symmetrical and spheroidal. Diameter 26,2 μ m. The wall 3 μ m in thickness, tectate, columella branched. Polyantoporate. Diameter of pores 5 μ m, annulate and punctate. Sculpturing foveolate and scabrate.

***Spergula fallax* (Lowe) Krause (Plate 5, F)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 22,0 μm . Polypantoporate. Diameter of pores 4 μm , annulate, raised, papillate and castellate. Sculpturing scabrate.

***Spergularia diandra* (Guss.) Heldr. & Sart. (Plate 5, D)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 15,0 μm . The wall 1 μm in thickness. Polypantocolpate. Colpi flat. Sculpturing scabrate and perforate.

***Spergularia marina* (L.) Griseb. (Plate 5, A, B, C & E)**

Pollen apolar, radially symmetrical and spheroidal. Diameter 18,0 μm . The wall 1 μm in thickness. Apertures hexacolpate, polypantocolpate, or spiral. Colpi open, roughly scabrate to papillate. Sculpturing scabrate.

***Stellaria media* (L.) Vill. (Plate 3, F)**

Pollen apolar, radially symmetrical, spheroidal to polyhedral with hexagonal outline. Diameter 20,2 μm . The diameter of pores 5 μm , completely sunken, papillate, and polypantoporate. Sculpturing spinulose to papillate and sparsely perforate around apertures.

***Stellaria pallida* (Dumort.) Pire (Plate 3, E)**

Pollen apolar, radially symmetrical, polyhedral to spheroidal. Diameter 19,0 μm . Polypantoporate. The diameter of pores 3 μm , castellate to papillate, sunken. Sculpturing papillate to spinulose.

***Vaccaria pyramidata* Medikus (Plate 4, F)**

Pollen apolar, radially symmetrical, and spheroidal. Diameter 38,6 μm . The wall 3 μm in thickness, crassisexinuous and tectate. Polypantoporate. The diameter of pores 5 μm , annulate, raised and castellate to scabrate. Sculpturing scabrate.

DISCUSSION

From the description of the studied species pollen-grains as presented in the results and the plates 1-6, the morphological characteristics can be summarized as follows:

1. The shape of the majority of the species is spheroidal and rarely prolate as it is in *Robbairia delileana* (Plate 1, F). The spheroidal shape sometimes becomes polyhedral with an outline of hexagonal to octagonal as it is in *Gypsophila viscosa*: (Plate 2, E), *Paronychia argentea* (Plate 1, A) and *Stellaria media* (Plate 3, F).

2. The size of pollen-grains ranged between 15,0 um in *Spergularia diandra* and 40 um in *Dianthus tripunctatus*. In the majority of the species the pollen size ranges between 25-30 um.
3. The apertures of pollen-grains are dominated by the polyaperturate type with exception of tricolporate type in *Robbairia delileana* and *Polycarpaea repens*. A polymorphic type ranges between hexapantocolpate to polyaperturate and spiral was found to occur in one species only which is *Spergularia marina* (Plate 5, A, B, C & D).
The size of the pores in the polyaperturate ranges between 2-5 um in diameter. Also pores can be raised or sunken, annulate or not and sometimes surrounded by star-like corrugations as it is in *Gypsophila pilosa* and *Gypsophila viscosa*.
4. Sculpturing in most of the species is scabrate but sometimes varies from minutely to roughly scabrate or scabrate papillate to scabrate spinulose, or rarely foveolate as it is in *Silene arenosa*.

Finally, the results obtained from this study of pollen-grains of *Caryophyllaceae* in Jordan were found to be similar to those found in *Centrospermae* families. It also agrees with what was previously mentioned by ERDTMAN (1972), NOWICKE (1975).

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REFERENCES

- AL-EISAWI, D.M., 1977: Pollen Morphology of Umbelliferae. Jordan, Ph. D. Reading University, Reading, U.K.
- 1982: List of Jordan Vascular Plants. - Mitt. Bot. Staatssamml. München 18: 79-182.
- 1985: Vegetation in Jordan. In: HADIDI, A., Studies in the History and Archaeology of Jordan. Vol. II, pp. 45-57. Department of Antiquities, Amman. Hashemite Kingdom of Jordan..
- 1986: Pollen Morphology of Ranunculaceae in Jordan. - Pollen et Spores, 28: 311-328.

- ERDTMAN, G., Pollen Morphology and Plant Taxonomy, Agiosperms, 2nd ed. New York, pp. 372-374.
- GHAZANFER, S.A., 1984: Pollen Morphology of the Genus *Silene* L. (Caryophyllaceae), Sections Siphonomorpha Otth and Auriculatae (Boiss.) Schischk. - New Phytol. 98: 683-690.
- KUMMEL, B. & RAUP, D., 1965: Handbook of paleontological techniques. W.H. Freeman, San Francisco.
- LAHHAM, J. & AL-EISAWI, D.M., 1986: Pollen Morphology of Jordanian Zygophyllaceae. - Candollea 41(2): 325-328.
- , - 1987: Pollen Morphology of Jordanian Cruciferae. - Mitt. Bot. Staatssamml. München 23: 355-375.
- NOWICKE, J.W., 1975: Pollen Morphology in the Order Centrospermae. - Grana 15: 51-77.
- VISHNU-MITTRE & GUPTA, H.P., 1964: Studies of Indian Pollen Grains. III. Caryophyllaceae. - Pollen et Spores 6(1): 99-111.
- ZOHARY, M., 1973: Geobotanical Foundation of the Middle East. Amsterdam: Swets and Zeitlinger.

PLATE 1

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|--------------------------------|-----------------------------------|
| A. <i>Paronychia arabica</i> ; | B. <i>Paronychia argentea</i> ; |
| C. <i>Paronychia sinaica</i> ; | D. <i>Pteranthus dichotomus</i> ; |
| E. <i>Polycarpaea repens</i> ; | F. <i>Robbairia delileana</i> ; |

PLATE 2

- | | |
|--------------------------------|-------------------------------|
| A. <i>Gypsophila arabica</i> ; | B. <i>Minuartia formosa</i> ; |
| C. <i>Gypsophila pilosa</i> ; | D. <i>Minuartia picta</i> ; |
| E. <i>Gypsophila viscosa</i> ; | F. <i>Minuartia hybrida</i> ; |

PLATE 3

- | | |
|----------------------------------|----------------------------------|
| A. <i>Cerastium dichotomum</i> ; | B. <i>Cerastium dichotomum</i> ; |
| C. <i>Holosteum glutinosum</i> ; | D. <i>Holosteum umbellatum</i> ; |
| E. <i>Stellaria pallida</i> ; | F. <i>Stellaria media</i> ; |

PLATE 4

- A. *Silene aegyptiaca*; B. *Silene apetala*;
C. *Silene arenosa*; D. *Silene colorata*;
E. *Bolanthus filicaulis*; F. *Vaccaria pyramidata*;

PLATE 5

- A. *Spergularia marina*: micrograph showing hexacolpate pollen.
B. *Spergularia marina*: micrograph showing the three types of apertures in one group; hexacolpate, polypantocolpate, and spiral from two views.
C. *Spergularia marina*: micrograph showing spiral type of colpi.
D. *Spergularia diandra*
E. *Spergularia marina*: micrograph showing polypantocolpate.
F. *Spergularia fallax*

PLATE 6

- A. *Silene damascena* X1000
B. *Silene damascena* X1000
C. *Dianthus tripunctatus* X1000
D. *Dianthus tripunctatus* X1000
E. *Gymnocarpos decandrum* X1000
F. *Gymnocarpos decandrum* X1000
G. *Arenaria leptoclados* X1000
H. *Sclerocephalus arabicus* X1000











