# Pollen Morphology of Caryophyllaceae Species From Iraq

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Abstract

In this study the pollen morphology of 8 species belonging to 4 genera of family Caryophyllaceae in Iraq: Holosteum glutrinsum F. et M. , H. umbellatum L., H. liniflorum Stev , Sagina apetala L., S. saginoides (L.) Karst., Tunica pachygona C.A.M., Telephium imperati L.and T. oligospermum Steud. et Boiss have been investigated by aid of light microscopy (LM) and scanning electron microscopy (SEM). In order to perform the pollen micro-morphology of Caryophyllaceae genera, and to find its significance in taxonomy of the group, qualitative and quantitative variables related to the shape, size, ornamentations and pores were studied. The shape is mostly spheroidal and rarely prolate, apertures are mostly polyporate and rarely tricolpate . Significate differences in grain size and pore number are also found in all species, the small grins are in Sagina L. and Telephium L. species, whereas the medium grains are Holosteum L. and Tunica (Hall) Scope species . Ornamentation varies from spinulose-perforate, Scabrate-porforate or punctuate-perforate.

Keywords: Caryophyllaceae, Pollen grain , Polyporate , SEM , Ornamentation

## 1- Introduction

The Caryophyllaceae is a large, cosmopolite family of 86 genera and about 2200 species of herbs and small shrubs (Bittrich, 1993; Heywood, 1998). The family Caryophyllaceae is important due to medicinal as well as ornamental properties (Arora and Panday, 1996), Caryophyllaceae family is represented by 24 genera and about 135 species in Iraq (Al-Musawi, 1987) . Caryophyllaceae was divided into 3 subfamilies; Alsinoideae, Paronychioideae, and Silenoideae (Tutin et al. , 1964 ;

Davis and Cullen, 1965; Zohary , 1966 ; McNeill , 1967 ; Gorshkova et al. ; 1970; Rendle, 1975). This arrangement of the family was changed by Bittrich (1993) and Ke (2001) as Alsinoideae , Paronychioideae, and Caryophylloideae .

Genus Telephium L. belongs to the family Caryophyllaceae, subfamily Paronychioideae (Tutin et al. , 1964 ), its represented by 2 species in Iraq : T.imperati L. and T.oligospermum Steud. et Boiss. (Al-Rawi, 1964). Genus Sagina L. and Holosteum L. belongs to the subfamily Alsinoideae (Tutin et al. , 1964 ), Sagina L. represented by 2 species: S.apetala L. and S.saginoides (L.)Karst. , while Holosteum L. represented by 3 species : H.glutinosum F. et M. , H.liniflorum Stev. and H.umberllaum in Iraq (Al-Rawi,1964) . Genus Tunica (Hall) Scope belongs to the subfamily Silenoideae (Gorshkova et al.; 1970) and its represented by one species in Iraq T.pachygona C.A.M. (Al-Rawi, 1964).

Pollen morphology of the family Caryophyllaceae has been examined by a number of workers such as Erdtman (1952) ; Nowicke (1975) ; Nowicke & Skvarla (1979) ; Erdtman (1986) ; Al-Elsawi (1989) ; Taia (1994) ; Yildiz (2001); Perveen & Qaiser (2006). Either in Iraq it has studied the pollen of some genus such as Gypsophila L. ( Al-Fahad,2005), Silene L. (Musa,2006) , Spergularia (Pers.) J. and Spergula L. (AL-Mowla ,2011) , Minuartia L. (Al-Taie , 2014).

In this study, to aim investigated for palynological information of 8 species belonging to 4 genera of Caryophyllaceae in Iraq which would be helpful to establish classification and phylogenetic relationship with Caryophyllaceae.

## 2- Materials and Methodes

In the present study, eight taxa of the Caryophyllaceaae have been investigated. Flowers of these species were collected from herbarium specimens deposited in National Herbarium of Iraq, Baghdad, Abo-Ghraib (BAG) , the list of specimens is shown in [Table-1].

The pollen grains were prepared for Light Microscope(LM) , using acetolysis method of AL-Mayah (1983) and the pollen grains were mounted in glycerin-jelly mixture and the general exomorphological features of the pollen were examined using Olympus microscope model SMZ 600 using image analysis software Dc- 2,. The measurements are based on 15-20 readings from each specimen. Pollen diameter, polar axis (P) and equatorial diameter (E), aperture size, pore and colpate diameter , number pores and colpate and exine thickness were measured (Tables 2).

Preparing pollen for scanning electronic microscope (SEM):

The pollen grains were stabilized on aluminum stocks using double sided cello tape and coated with a thin layer of gold using coating equipment. Then the specimens

were observed under S.E.M. Ziess / Supra 55Vp (Germany) at University of Basra/ Pharmacy collage

Table 1- The list of the species used for pollen micro-morphological study and their localities

| N. | Taxa | Localities | Herbarium number |
|---|---|---|---|
| 1 | Holosteum glutrinsum F. et M. | Amadia | 1269 |
| 2 | Holosteum umbellatum L. | Shargate | 1042 |
| 3 | Holosteum liniflorum Stev | DSD/40 km SE ZUBAIR | 16900 |
| 4 | Sagina apetala L. | Suleimaniya liwa/Qarachita | 7710 |
| 5 | Sagina saginoides (L.) Karst. | Erbil liwa/Ser Kurawa | 9723 |
| 6 | Tunica pachygona C.A.M. | 10km W.of Tawela | 22127 |
| 7 | Telephium imperati L. | MJS/Jabal sinjar | 52567 |
| 8 | Telephium oligospermum Steud. et Boiss | MRO/15km NE of Rania lower slope of Qandil range | 24244 |

3- Results

Quantitative and qualitative characters are presented in Tables 2 (terminology according to Erdtman (1952).

Pollen grains are usually radially symmetrical , apolar , Porate rarely 3-colpate spheroidal or rarely prolate, Sexine thicker than nexine. Tectum Punctuate- perforate , Scabrate-perforate and spinulate-perforate.

Key to the pollen genus

1- Pollen grains colpate ……..
Telephium

1- Pollen grains porate ……..…… …….
2

2- pollen small size ……..
Sagina

2-pollen medium size……..……3

3-Dimeter pore > 4 µm……..……
Tunica

3- Dimeter pore < 4 µm ……...……...…….……..……..……
Holosteum

1- Telephium L.

Pollen grains prolate shape , tri-colpate , pollen dimeter (14-18.9) µm , small size . P/E ratio: (90-97) , length colpate dimeter (11.5-15.75) µm , width colpate dimeter (2.8-3.55) µm , exine thickness(1.05-1.40) µm , intine thickness (0.49-0.70) µm .

Species 1 : Telephium imperati L.. (Table .2 , Fig.2:C1-C3, Fig4:F1-F2 )

Pollen class: Tricolpate

P/E ratio%: ٩٧

Shape: Prolate

Ornamentation: Punctuate- perforate

Measurements: Size: Polar axis (14-17.5) 15.12 µm and Equatorial axis (14.5-17.25)15.55 µm , colpate Length (11.5-11.95)11.75 µm , Width (2.8-3.00)2.88 µm in diameter. Exine thickness (1.33-1.40)1.37 µm , intine thickness (0.56-0.7)0.64 µm

Species 2 : Telephium oligospermum (Table .2 , Fig.2:D1-D3, Fig4:G1-G2 )

Pollen class: Tricolpate

P/E ratio%: 90

Shape: Prolate

Ornamentation: Punctuate- perforate

Measurements: Size: Polar axia (14-16.8) 14.7 µm and Equatorial axix (14.7-18.9)16.27 µm , colpate Length (12.5-15.75)12.00 µm , Width (3-3.55)3.11 µm in diameter. Exine thickness (1.05-1.40)1.37 µm , intine thickness (0.49-0.63)0.54 µm

2- Sagina L.

Pollen grains spherical shape , polyporate , pollen dimeter (18.2-21) µm , small size . P/E ratio : 100 , length pores dimeter (1.75-2.8) µm, width pores dimeter (1.75-2.45 ) µm, exine thickness(0.7-2.10) µm , intine thickness (0.56-0.7) µm .

Species 1 : Sagina apetala (Table .2 , Fig.2:A1-A2,Fig.3:C1-C2)

Pollen class: polyporate

P/E ratio%: 100

Shape: Spherical

Ornamentation: spinulose - perforate

Measurements: Size: Pollen dimension (19.6-21) 20.44 µm, pore Length (1.75-2.31)2.26 µm , Width (1.75-2.27)2.21 µm in diameter. Exine thickness (0.88-2.10)1.34 µm , intine thickness (0.56-0.7)0.63 µm

Species 2 : Sagina saginoides (Table .2 , Fig.2:B1-B2, Fig.4:D1-D2)

Pollen class: polyporate

P/E ratio%: 100

Shape: Spherical

Ornamentation: Spinulose - perforate

Measurements: Size: Pollen dimension (18.2-20.3) 19.07 µm, pore Length (2.1-2.8)2.27 µm , width (2.1-2.45)2.32 µm in diameter. Exine thickness (0.7-1.75)1.48 µm , intine thickness (0.58-0.63)0.59 µm

3- Tunica (Hall) Scope

Tunica pachygona (Table .2 , Fig.1:D1-D3, Fig.4:E1-E2)

Pollen grains spherical shape , polyporate , pollen dimension (26.25-27.3)26.95 µm , medium size . P/E ratio : 100 , length pores dimeter (4.2-4.9) µm, width pores dimeter (4.1-5 ) µm, exine thickness(1.4-1.75) µm , intine thickness (0.49-0.63) µm .

4- Holosteum L.

Pollen grains Spherical shape , Polyporate , pollen dimeter (24.5-30.8) µm , medium size . P/E ratio : 100 , length pores dimeter (2.11-3.5) µm, width pores dimeter (2.01-3.5 ) µm, exine thickness(0.7-1.45) µm , intine thickness (0.28-0.79) µm .

Species 1 : Holosteum glutrinsum (Table .2 , Fig.1:A1-A2 )

Pollen class: polyporate

P/E ratio%: 100

Shape: Spherical

Ornamentation: Scabrate- perforate

Measurements: Size: Pollen dimension (25.75-27.05) 26.11 µm , pore Length (2.11-3)2.75 µm , Width (2.01-3.11)2.50 µm in diameter. Exine thickness (1-1.45)1.23 µm , intine thickness (0.29-0.79)0.59 µm

Species 2 : Holosteum umbellatum (Table .2 , Fig.1:B1-B2,Fig.3:A1-A2)

Pollen class: polyporate

P/E ratio%: 100

Shape: Spherical

Ornamentation: Scabrate - perforate

Measurements: Size: Pollen dimension (24.5-25.9) 25.34 µm , pore Length (2.8-3.5)3.15 µm , Width (2.5-3.5)3.33 µm in diameter. Exine thickness (1.22-1.4)1.33 µm , intine thickness (0.49-0.77)0.53 µm.

Species 3 : Holosteum liniflorum (Table .2 , Fig.1:D1-D2, Fig.3:B1-B2)

Pollen class: polyporate

P/E ratio%: 100

Shape: Spherical

Ornamentation: Scabrate - perforate

Measurements: Size: Pollen dimension (28-30.8) 29.4 µm , pore Length (2.8-3.5)3.26 µm , Width (2.8-3.5)3.29 µm in diameter. Exine thickness (0.7-1.05)0.87 µm , intine thickness (0.28-0.49)0.36 µm .

Table2. General pollen characters of species Caryophyllaceae family in Iraq (values in µm).

| N | Taxa | Pollen shape | Number of pores or colpate | Polar axis | Equatorial diameter | Pollen dimension | P/E ratio % | Size of pollen | Pore or colpate diameter | | Exine thickness | Intine thickness | Ornamentation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Length | width | | | |
| ١ | Holosteum glutrinsum | Spherical | (14-16) | - | - | (25-27.05) 26.11 | 100 | M | (2.11-3) 2.75 | (2.01-3.11) 2.50 | (1-1.45) 1.23 | (0.29-0.79) 0.59 | Scabrate-perforate |
| ٢ | Holosteum umbellatum | Spherical | (12-16) | - | - | (24.5-25.9) 25.34 | 100 | M | (2.8-3.5) 3.15 | (2.8-3.5) 3.33 | (1.22-1.4) 1.33 | (0.49-0.77) 0.53 | Scabrate - perforate |
| ٣ | Holosteum liniflorum | Spherical | (10-12) | - | - | (28-30.8) 29.4 | 100 | M | (2.8-3.5) 3.26 | (2.8-3.5) 3.29 | (0.7-1.05) 0.87 | (0.28-0.49) 0.36 | Scabrate - perforate |
| ٤ | Sagina apetala | Spherical | (12-14) | - | - | (19-21) | 100 | S | (1.75-2.31) | (1.75-2.27) | (0.88-2.10) | (0.56-0.7) | spinulose - perforate |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 20.44 | | | 2.26 | 2.21 | 1.34 | 0.63 | |
| ٥ | Sagina saginoides | Spherical | (20-22) | - | - | (18.2-20.3) 19.07 | 100 | S | (2.1-2.8) 2.27 | (2.1-2.45) 2.٣١ | (0.7-1.75) 1.48 | (0.58-0.63) 0.59 | spinulose - perforate |
| ٦ | Tunica pachygona | Spherical | (8-12) | - | - | (26.25-27.3) 26.95 | 100 | M | (4.2-4.9) 4.63 | (4.1-5) 4.36 | (1.4-1.75) 1.57 | (0.49-0.63) 0.55 | Spinuale-perforate |
| ٧ | Telephium imperati | Prolate | Tricolpate | (14-17.5) 15.12 | (14.5-17.25) 15.55 | - | 97 | S | (11.5-11.95) 11.75 | (2.8-3.00) 2.88 | (1.33-1.40) 1.37 | (0.56-0.7) 0.64 | Punctuate-perforate |
| ٨ | Telephium oligospermum | Prolate | Tricolpate | (14-16.8) 14.7 | (14.7-18.9) 16.27 | - | 90 | S | (12.5-15.75) 12.00 | (3-3.55) 3.11 | (1.05-1.40) 1.13 | (0.49-0.63) 0.54 | Punctuate-perforate |

The values between arches represent the mean and the values out the arches represent the minimum and maximum values.

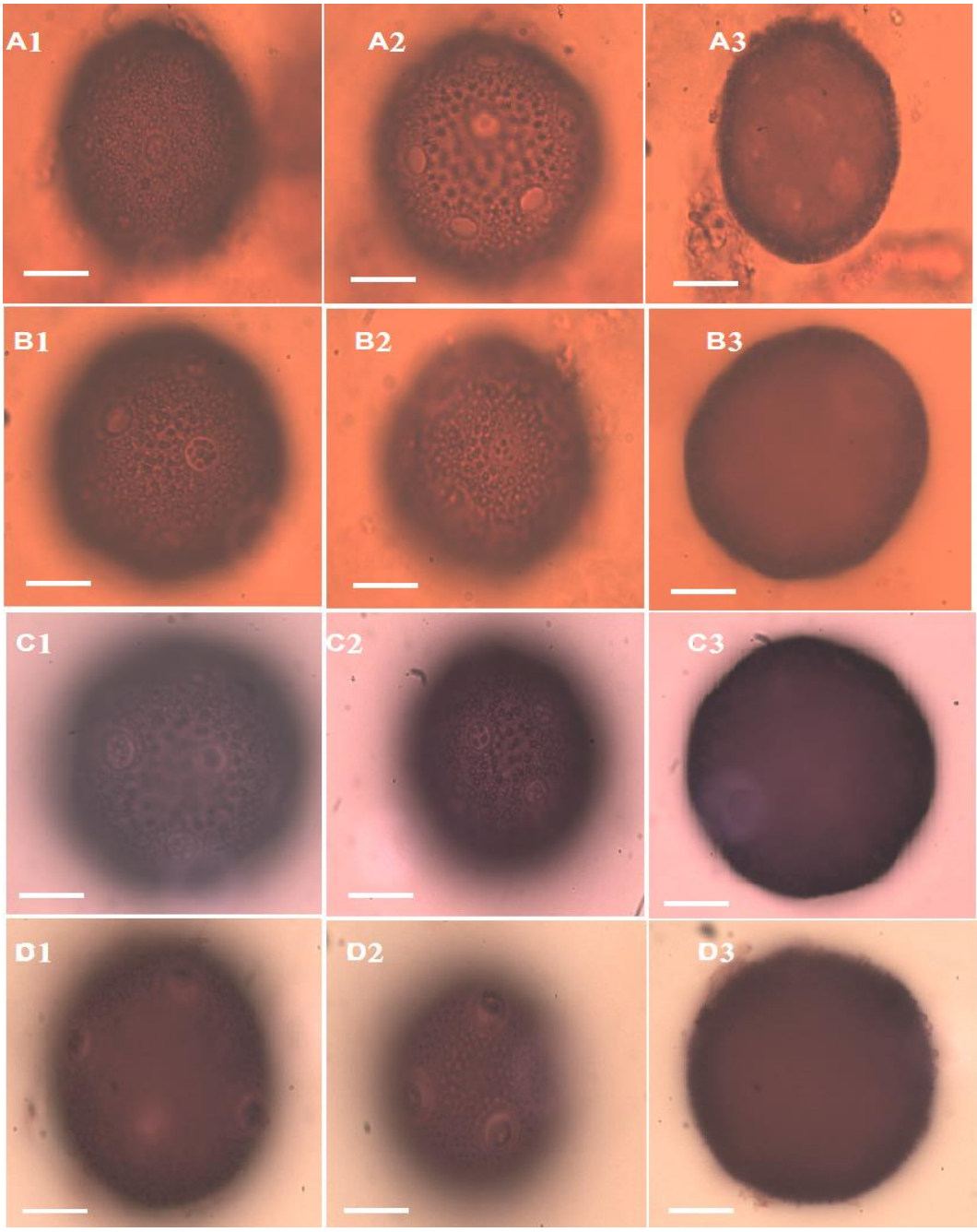


Figure 1. LM photos of pollen grains of Species : A1-A3: Holosteum glutrinsum ; B1-B3: Holosteum umbellatum ; C1-C3: Holosteum liniflorum ; D1-D3: Tunica pachygona
(Scales =10 µm)

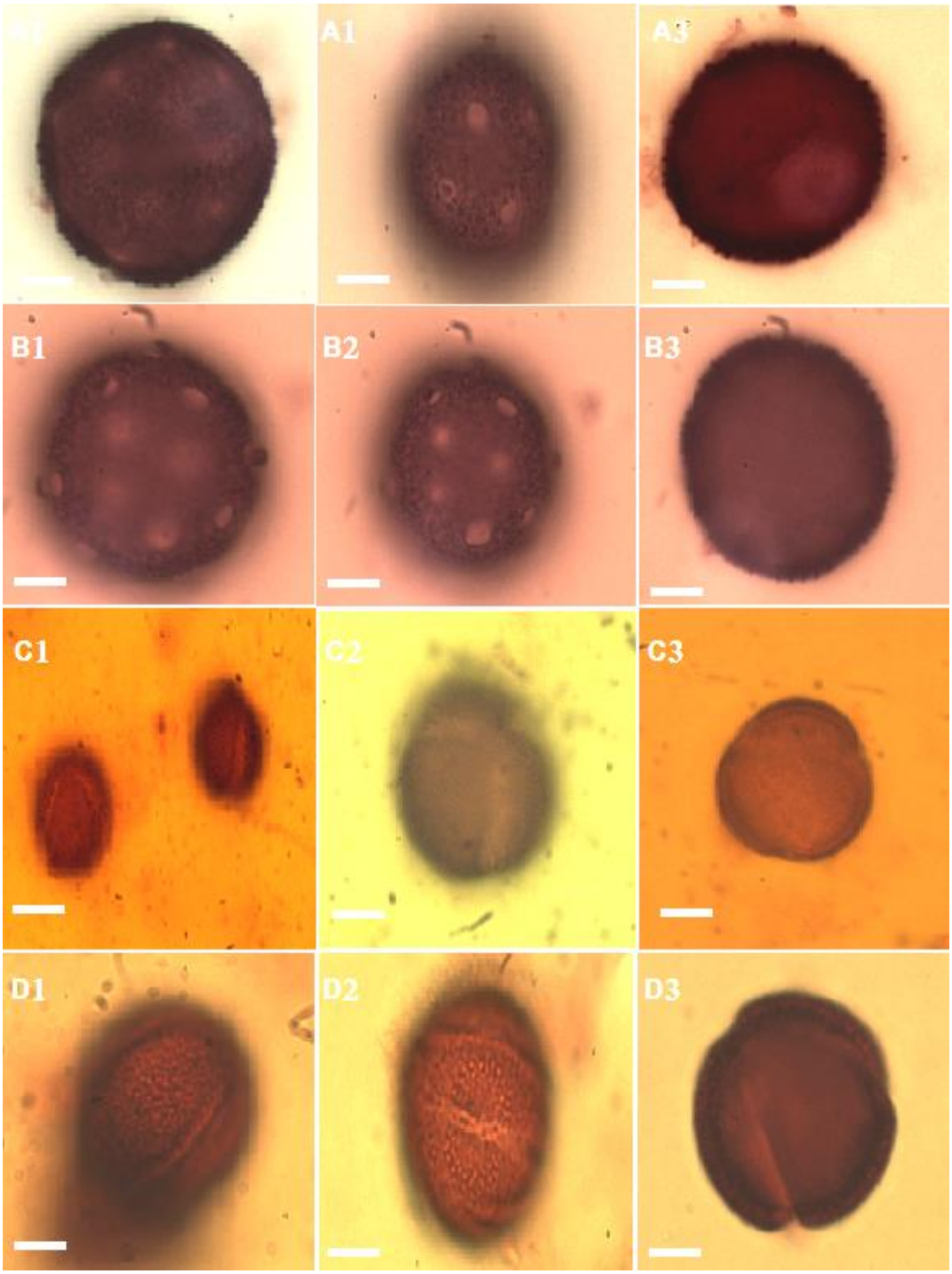


Figure 2. LM photos of pollen grains of Species : A1-A3: Sagina apetala ; B1-B3: Sagina saginoides ; C1-C3: Telephium imperati ; D1-D3: Telephium oligospermum

(Scales =10 µm)

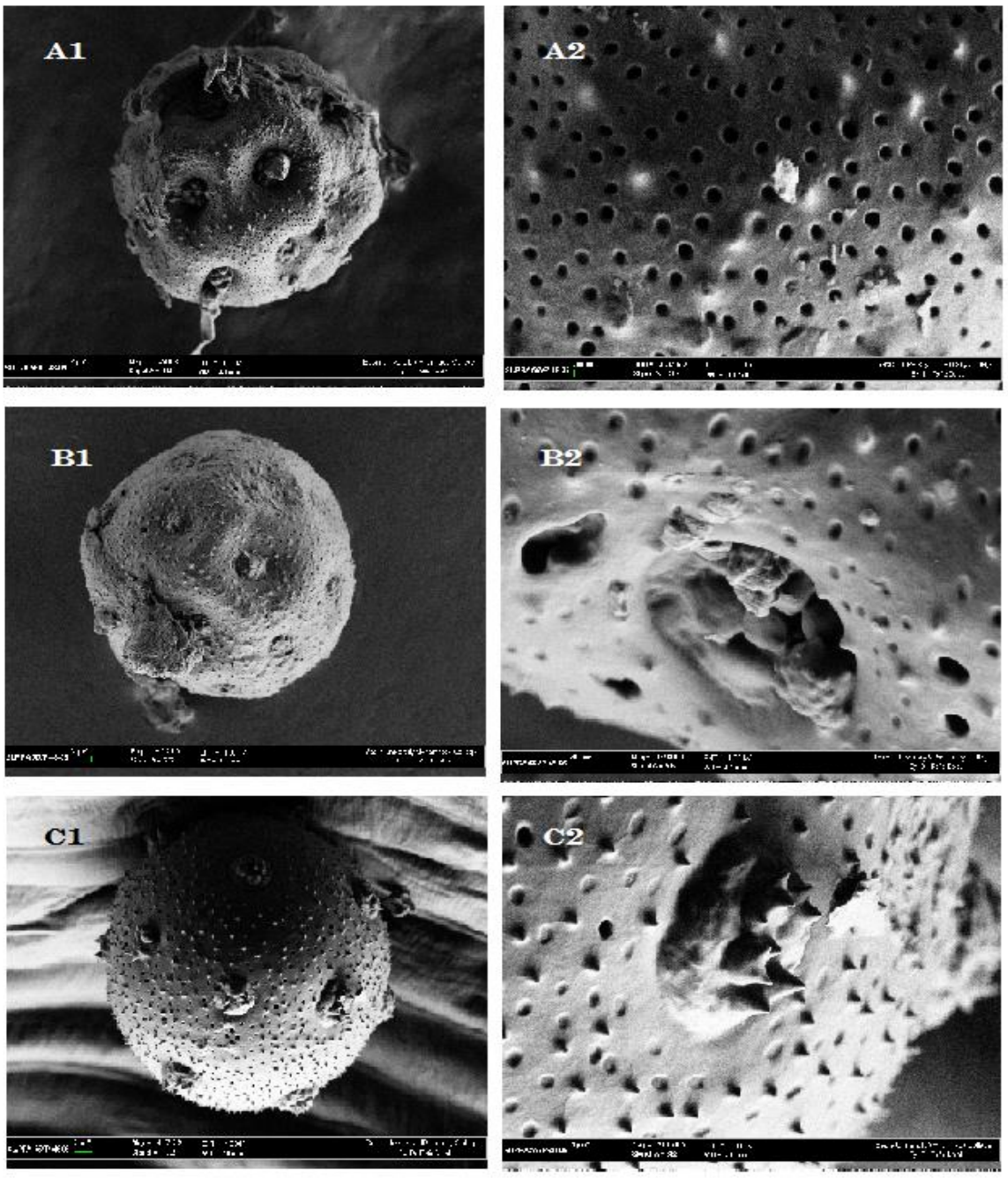


Figure 3. S.E.M. photos of pollen grains of Species:A1-A2 Holosteum liniflorum; B1-B2 Holosteum umbellatum; C1-C2 Sagina apetala

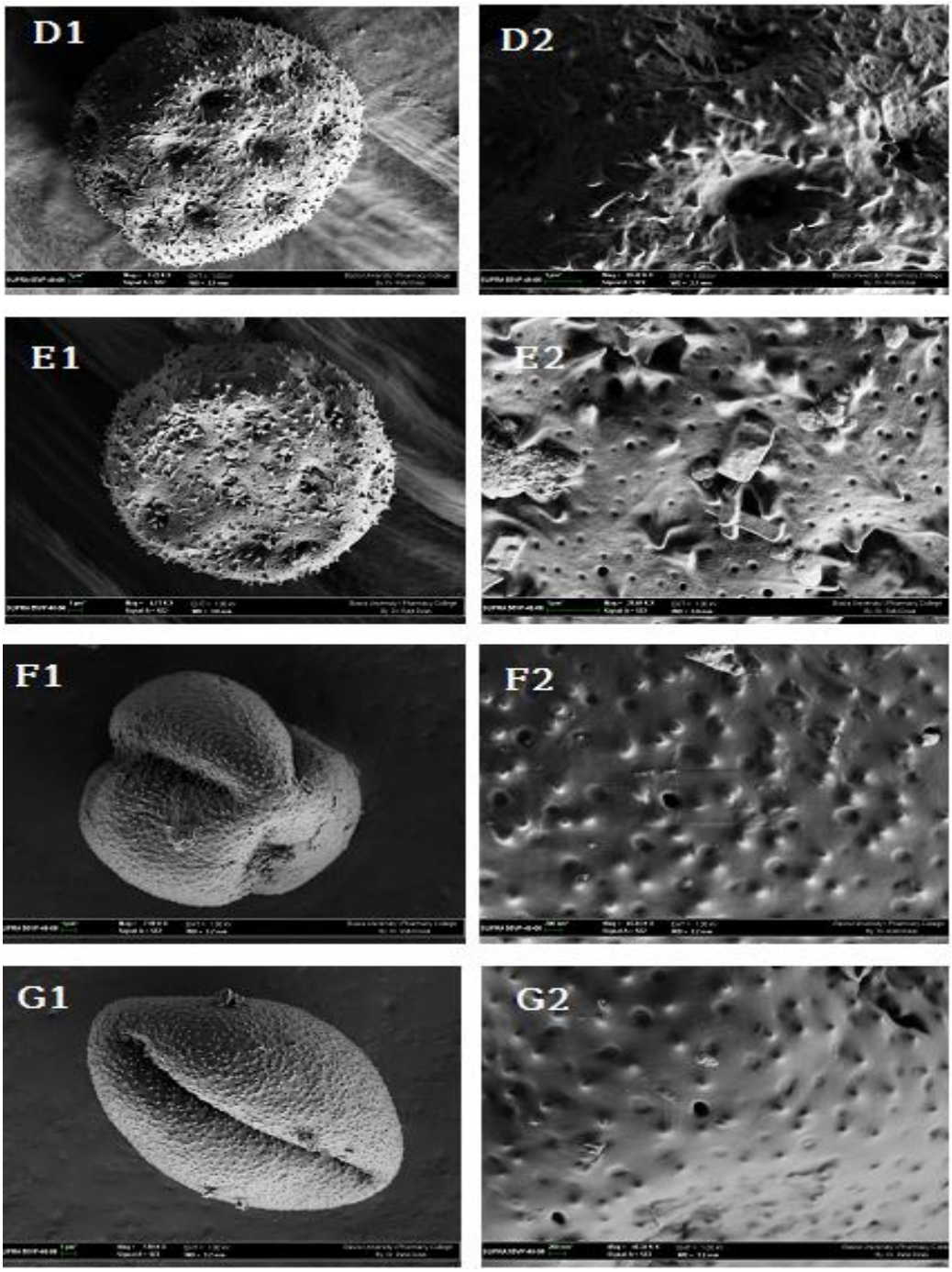


Figure 4. S.E.M. photos of pollen grains of Species:D1-D2 Sagina saginoides; E1-E2 Tunica pachygona;
F1-F2 Telephium imperati; G1-G2 Telephium oligospermum.

4- Discussion:

The results of the current study have shown that the shape of pollen grains for the genus under study was various between spherical or prolate as shown in table 2. The pollen grains apertures recorded three types included polyporate and colpate, this agreed with Erdtman (1971) who mentioned that four types of pollen grains in family caryophyllaceae involved the two types porate and coplate. Our study also agreed with Al-Elsawi (1989),Taia (1994) and Perveen and Qaiser (2006).

In respect to the size of pollen grains the species can be divided into two categories , small varied between (10-25) μm in the genus Sagina and Telephium that belong to the subfamily Alsinoideae and Paronychioideae respectively. The second group of pollen was medium-sized, (25-35) μm which included genus Holosteum that belong to the subfamily Alsinoideae and genus Tunica which belong to subfamily Silenoideae.

The results illustrated that exine sculpture was of the scabrate -perforate type in genus Holosteum while in Sagina apetala was spinulose-perforate whereas Sagina saginoides was Spinulate – microperforate, Tunica pachygona was Spinulate-perforate, genus Telephium was granulate. Operculum surface was granules in genus Holosteum and composed of simple spines in Sagina apetala. Pores were sunken in H. liniflorum; H. umbellatum, S. saginoides and Tunica pachygona but swollen in the other species Sagina apetala. This result agreed with Al-Elsawi (1989) which described the ornamentation of genus Holosteum as scabrate –perforate

Some of Holosteum species from Jordan were palynologically investigated by Al-Elsawi (1989), our results agreed with it, which described the ornamentation of genus as scabrate -perforate. While Perveen and Qaiser (2006) described the ornamentation of genus as spinulate-punctate and Taia (1994) described it as reticulate. Perveen and Qaiser (2006) investigated pollen morphology of Telephium species grown in Pakistan and they described it as Punctuate for species Telephium imperati , while Taia (1994) in Egypt described

it as Granulate for species Telephium spherospherum. there are no reported data about pollen morphology of other Tunica species.

Considering these statements we reach a conclusion that pollen micro-morphological studies have had considerable role in distinguishing some related taxa at the species rank and it is clear that with this study pollen ornamentation, pore numbers, pore diameter, operculum ornamentation of pollen grains are helpful characters in determining Caryophyllaceae genus.

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# مظهرية حبوب اللقاح لأنواع العائلة القرنفلية Caryophyllaceae في العراق

صادق صبيح كريم الطائي [١] علا محمد نور الموسوي [٢]
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**الخلاصة**

ثم في هذا البحث دراسة مظهرية حبوب اللقاح لثمان انواع تعود الى اربع اجناس من العائلة القرنفلية في العراق وهي Holosteum glutrinsum F. et M و H. umbellatum L. و H. liniflorum Stev و Sagina apetala L و S. saginoides (L.) Karst و Tunica pachygona C.A.M. و Telephium imperati L و T. oligospermum Steud. et Boiss باستخدام المجهر الضوئي Light Microscopy (LM) والمجهر الالكتروني الماسح Scanning Electron Microscopy (SEM) . اعتمدت الدراسة على الصفات الكمية والنوعية لحبوب اللقاح لغرض تقسيم وتصنيف الانواع ، حيث اعتمد على شكل حبوب اللقاح و حجمها والثقوب والزخارف على سطحها ، من حيث الشكل فقد كانت اغلب حبوب اللقاح ذات شكل كروية Spherical ونادرا Prolate ، واغلبها متعددة ثقوب Polyporate ونادرا ثلاثية الاخاديد Tricolpate ، اختلفت حبوب اللقاح من احجامها وعدد الثقوب في الانواع المدورسة فقد كانت حبوب اللقاح صغيرة الحجم في انواع الجنس Sagina L. و Telephium L. ، بينما كانت حبوب اللقاح متوسطة الحجم في انواع الجنس Holosteum L. و Tunica (Hall) Scope ، اما الزخارف فقد كانت ذات شكل Spinulose-perforate او Scabrate-porforate او Punctuate-perforate في الانواع تحت الدراسة.