

POLLEN FLORA OF PAKISTAN–LXVIII. ALLIACEAE

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Abstract

Pollen morphology 20 species of the family Alliaceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains are usually bilateral, heteropolar mostly boat shaped, sexine thicker than nexine. Tectal surface is mostly rugulate - foveolate or subsilate rarely reticulate. On the basis of apertural types 3 distinct pollen types are recognized, viz., *Allium fedtschenkoanum* -type, *Allium griffithianum*-type and *Allium roylei*-type.

Key words: *Allium*, *Allium fedtschenkoanum*, *Allium roylei*, Stenopalynous.

Introduction

Alliaceae is a small family, consisting of 30 genera and 720 species. Most species occur naturally in the northern hemisphere, with two centres of diversity, the main and large centre of diversity lies in the mountains of Southwest to Central Asia and a second but smaller centre lies in western North America (Mabberley, 2008). The family Alliaceae is represented in Pakistan by only one genus *Allium*, with 41 species (Nasir, 1975). Most of the workers placed Alliaceae under the family Liliaceae, because of the presence of superior ovary. However, the family Alliaceae was first recognized by Agardh (1858), Dahlgren *et al.* (1985) kept Alliaceae in the order Asparagales together with Hyacinthaceae, Amaryllidaceae and 28 other families. However, Alliaceae were separated from Amaryllidaceae by having steroidal saponins, superior ovary and absence of alkaloids. Takhtajan (1987, 1997) placed Alliaceae in the order Amaryllidales close to Hyacinthaceae mainly because of the umbellate inflorescence.

Plants are perennial bulbous herb, without rhizomes, leaves mostly radical, inflorescence cymose umbel, enclosed in a spathe when young. Tepals 6, in 2 whorls, stamens 6 free or connate, fruit capsule. The species of *Allium* are famous for their characteristically pungent odor and economically important plants. Best known species are *Allium cepa* (onion), *Allium sativum* (garlic), *Allium ascalonicum* (Shallot), *Allium porrum* (Leek) and *Allium schoenoprasum* (chive).

Pollen morphology of the family has been examined by Erdtman (1952), Wang (1960), Nair & Sharma (1965), Radulescu (1973), Kuprianova & Aliev (1979), Moore & Webb (1991), El-Sadek (1994), Kosenko & Kudryashova, (1995); Furness & Rudall (2001), Koc (2001). Zuraw (2007), Donmez & Isik (2008) and Li, *et al.* (2010). Ozler (2001) studied the pollen morphological structures of some *Asparagus* and *Allium* species from Turkey. Guler & Pehlivan (2006) studied pollen morphology of some *Allium* species belonging to *Allium* and *Codonoprasum* sections. Hosseinzadeh *et al.* (2009) and Neshati *et al.* (2009) studied pollen morphology of some species of *Allium* from Iran.

Ozhatay & Kocyigit, (2009) examined the pollen morphology of *Allium* species (Liliaceae) from Turkey. There are no reports on pollen morphology of the family Alliaceae from Pakistan. Present investigations are based on the pollen morphological studies of 20 species of the genus *Allium* by light and scanning electron microscope.

Materials and Methods

Polleniferous material was obtained from the specimens of Karachi University Herbarium (KUH), Centre for plant Conservation. In few cases fresh material was also collected from the field. The list of voucher specimens is deposited in KUH. The pollen grains were prepared for light (LM) 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 were 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 150 A°T he S.E.M examination was carried out on a Jeol microscope JSM-6820. The measurements are based on 15-20 readings from each specimen. Pollen diameter, polar axis (P), equatorial diameter (E), aperture size and exine thickness were measured (Tables 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 Alliaceae

Pollen grains usually bilateral, heteropolar. Shape mostly elliptic boat shape, monocolpate, sexine thicker than nexine. Tectal mostly rugulate-foveolate or subsilate rarely reticulate. On the basis of ornamentation pattern three distinct pollen types are recognized viz., *Allium fedtschenkoanum*-type, *Allium griffithianum*-type and *Allium roylei*-type.

Table 1. General pollen characters found in pollen type *Allium griffithianum*

Species	Length in μm	Breadth in μm	Colpus in μm	Exine Thickness in μm
<i>Allium barszczewksii</i> Lipsky	25(21.04±0.81) 38.75	17.5(34.5±1.40) 22.5	30(30.5±0.49) 32.5	0.5(1.37±0.21) 2
<i>Allium consanguineum</i> Kunth	25(17.46±0.42) 30	13.75(26.25±0.46) 20	22.5(26.53±0.65) 30	1.25(1.61±0.15) 2.25
<i>Allium farctum</i> Wendelbo	29.9	18.6	20.4	5.15
<i>Allium gilli</i> Wendelbo	25.75	19.57	18.01	2.44
<i>Allium griffithianum</i> Boiss.	12.5(14.4±32) 15	18.75(21.77±0.41) 23.75	15(19.20±0.33) 20	0.25(0.78±0.14) 1.25
<i>Allium jacquemontii</i> Kunth	15(16.5±0.55) 18.75	22.5(17.66±0.38) 27.5	17.5(22.2±0.86) 25	0.25(0.75±0.14) 1.25
<i>Allium lamondiae</i> Wendelbo	17.6(19.06±0.37) 20	25(25.16±0.48) 27.5	17.5(25.15±0.12) 25	0.25(0.78±0.14) 1.25
<i>Allium porrum</i> L.	20(29.27±1.02) 25	30(32.36±0.64) 35.1	27.5(30.15±0.69) 32.5	0.25(0.47±0.07) 1.0
<i>Allium tripterum</i> E. Nasir	23.4	39.2	34.43	2.71
<i>Allium filifolium</i> Regel	21.2	29.0	26.00	1.71
<i>Allium sativum</i> L.	23.2	25.0	23.21	1.20
<i>Allium oreoprasum</i> Schrenk	29.21	30.21	28.11	2.12

Table 2. General pollen characters found in pollen type-*Allium roylei*.

Name of species	Length in μm	Breadth in μm	Colpus in μm	Exine Thickness
<i>Allium schoenoprasum</i> L.	16.25(16.52±0.35) 20	25(26.87±0.42) 28.15	22.5(23.16±0.68) 25	0.5(0.92±1.0) 1.25
<i>Allium tuberosum</i> Rottl. ex Spreng.	18.75(23.48±1.86) 27.5	27.5(35.56±2.75) 40	25(28.75±2.16) 32.5	0.25(0.31±0.06) 0.5
<i>Allium humile</i> Kunth	25(26.87±0.62) 20	16(17.18±0.07) 16	0.22	01.25
<i>Allium semonovii</i> Regel	15(16.25±0.62) 20	22.5(34.95±0.90) 29.5	15(21.5±1.69)	25
<i>Allium roylei</i> Stearn	36.05	20.6	25.75	2.06
<i>Allium rosenbachianum</i> Regel	21.63	16.18	19.57	2.06
<i>Allium umbilicatum</i> Boiss.	30.0	20.1		
<i>Allium victoralis</i> L.	30.9	20.6	19.57	3.09

Key to the pollen types

- 1.+ Pollen reticulate *Allium fedtschenkoanum* -type
 - Tectum not as above 2
 2.+ 2.+ Tectum subsilate *Allium roylei*
 - Tectum rugulate-foveolate or densely regulate *Allium griffithianum*

Pollen type: *Allium fedtschenkoanum*- type (Fig.1A &B).**Pollen class:** Monocolpate**Shape:** Oblate**Apertures:** Colpus long narrow with acute ends**Exine:** Sexine thicker than nexine.**Ornamentation:** Reticulate**Measurements:** Size: P = (17.5-18.5) \pm 2.13 (-20.10) μm , and breadth (25.6) 26.45 \pm 0.9 (27.521) μm , colpi (20.95-) 22.5 \pm 1.23 (25.00) μm in long Exine 0.5 (0.98 \pm 0.15) 0.81 μm thick, sexine thicker than nexine. Tectum reticulate.**Species included:** *Allium fedtschenkoanum* Regel

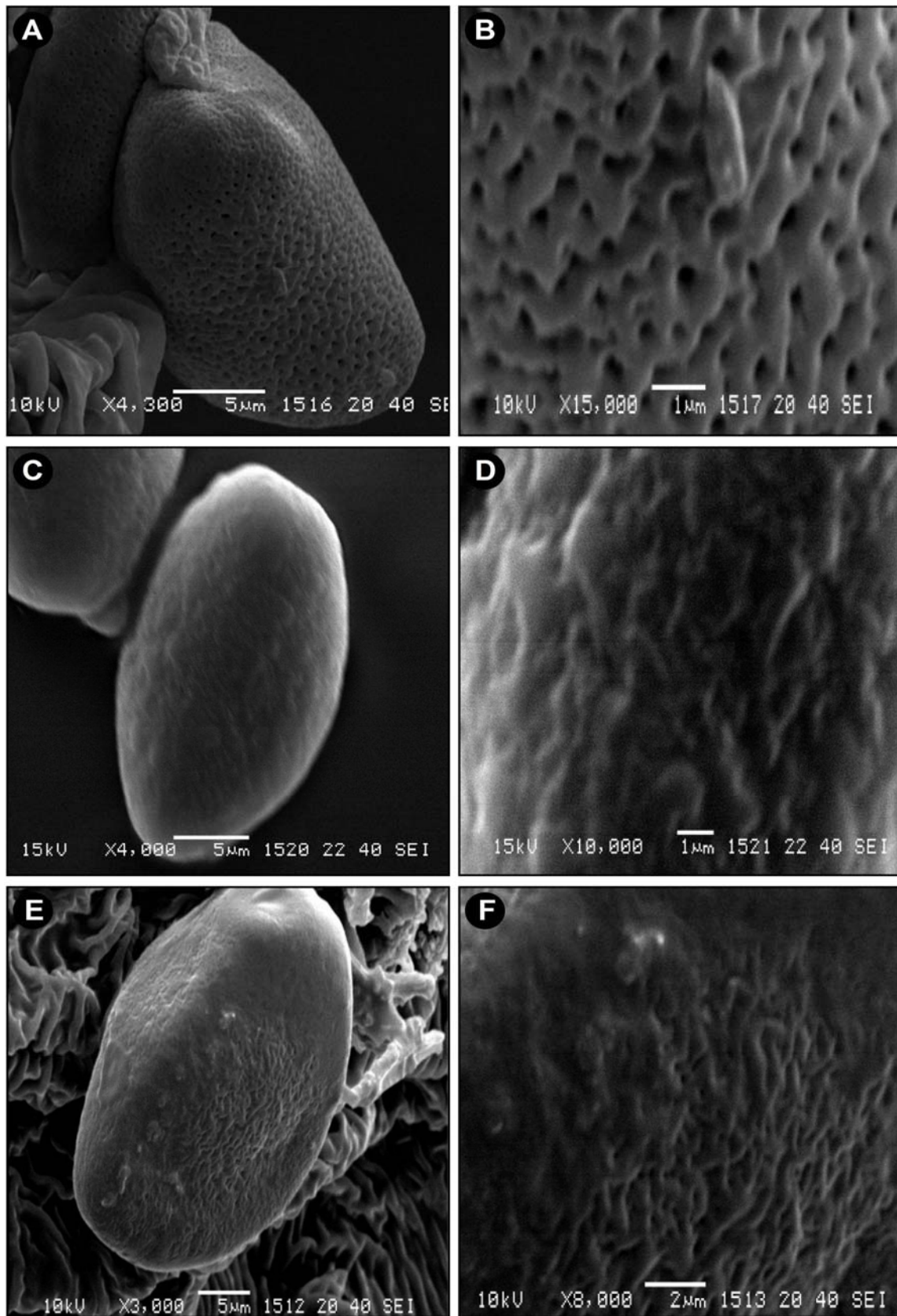


Fig. 1. Scanning electron micrographs. *Allium fedschenkoanum*: A, equatorial view; B, exine pattern. *Allium griffithianum*: C, equatorial view; D, exine pattern. *Allium barszczewksii*: E, equatorial view; F, exine pattern.

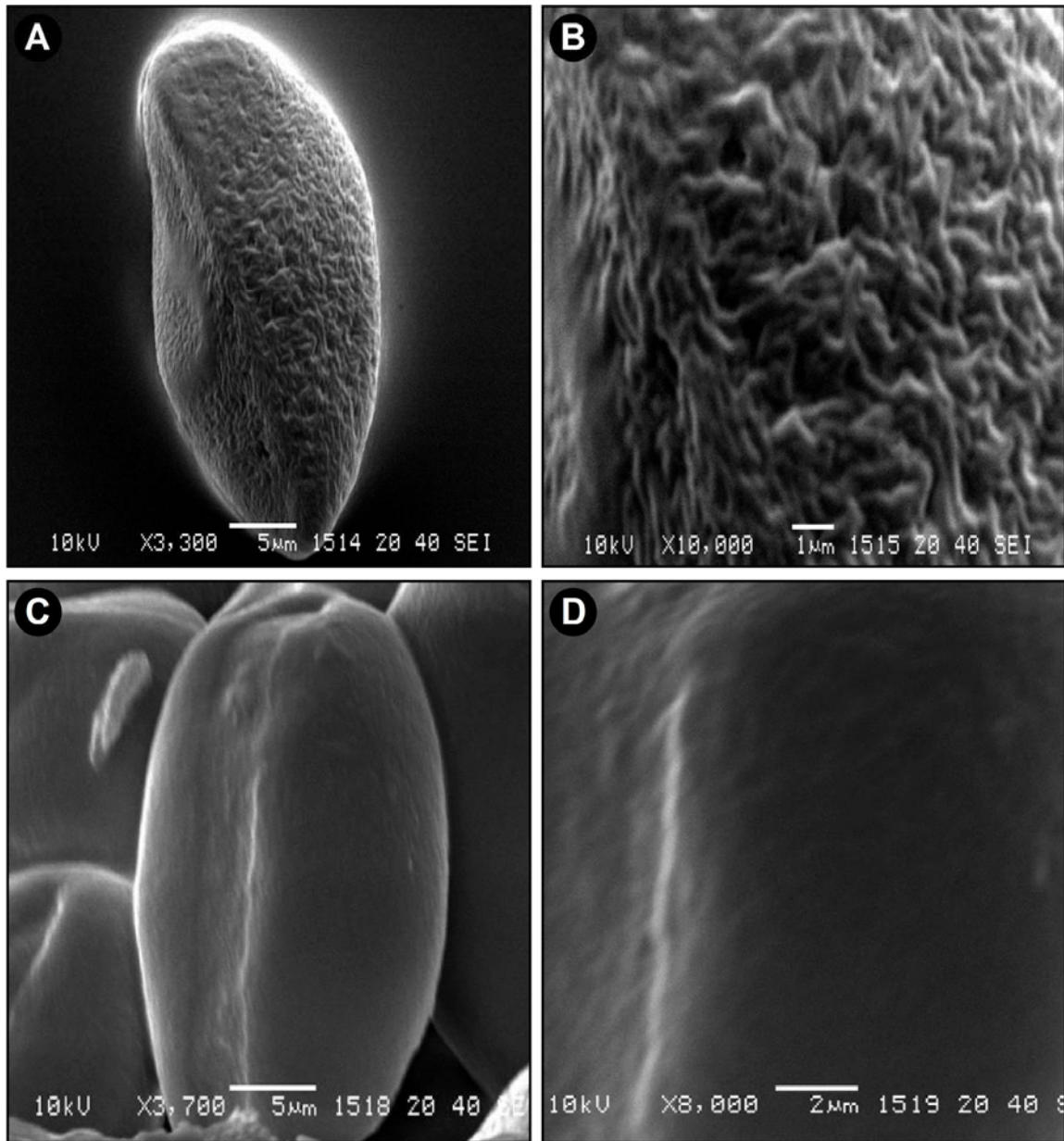


Fig. 2. Scanning electron micrographs. *Allium farctum*: A, equatorial view; B, exine pattern. *Allium filifolium*: C, equatorial view; D, exine pattern.

Pollen type: *Allium griffithianum* -type (Fig.1C-F; Fig.2A &B)

Pollen class: Monocolpate

Shape: oblate

Apertures: Colpus long narrow with acute ends

Exine: Sexine thicker than nexine.

Ornamentation: Rugulate-foveolate

Measurements: Size: Length = (15.00-) 34.51 ± 0.31 (-39.00) μm and breadth (13.75) 32.51 ± 0.27 (39.00) μm , colpi 15-34 μm long. Exine 0.50 (1.06 ± 0.48) 2.21 μm thick, sexine thicker than nexine. Tectum rugulate-foveolate.

Species included: *Allium consanguineum* Ved, and *Allium griffithianum* Boiss., *Allium barszczewksii* Lipsky, *Allium lamondiae* Wendelbo, *Allium porrum* L., *Allium*

jacquemonti Regel, *Allium farctum* Wendelbo, *Allium oreoprasum* Schrenk, *Allium sativum* Allium tripterum E.Nasir, *Allium filifolium* Regel, *Allium gillii* Wendelbo.

Pollen type: *Allium roylei*-type (Fig. 2C &D).

Pollen class: Monocolpate

Shape: Oblate

Apertures: Colpus long narrow with acute ends

Exine: Sexine thicker than nexine.

Ornamentation: Subsilate

Measurements: Size: P = (15.5) 25.79 ± 2.1 (-36.05) μm , and breadth (16.00) 36.00 ± 0.9 (40.0) μm , colpi (15.12-) 27.50 ± 1.23 (25.26) μm in long Exine 0.51 (2.04 ± 0.15) 3.09 μm thick, sexine thicker than nexine. Tectum subsilate

Species included: *Allium schoenoprasum* L., *Allium semonovii* Regel *Allium tuberosum* Rottl. ex Spreng, *Allium humile* Kunth., *Allium rosenbachianum* Regle, *Allium umbilicatum* Boiss. And *Allium victorialis*

Discussion

The family Alliaceae is more or less stenopalynous taxon. Pollen grains are generally monocolpate, bilateral, boat shaped with subsilate or rugulate-foveolate rarely reticulate tectum. Most striking variation is found within exine pattern. Most frequent tectum is rugulate-foveolate. However, subsilate exine ornamentation is also found in considerable number of taxa viz., *Allium schoenoprasum* L., *Allium semonovii* Regel *Allium tuberosum* Rottl. ex Spreng, *Allium humile* Kunth., *Allium rosenbachianum* Regle, *Allium umbilicatum* Boiss., *Allium victorialis* L. whereas reticulate exine ornamentation is rare and found only in one species i.e., *Allium fedtschenkoanum*. On the basis of exine pattern three pollen types are recognized viz., *Allium fedtschenkoanum* – type, *Allium griffithianum*-type and *Allium roylei*-type. Schulze (1980) examined pollen morphology of eight genera of family Alliaceae and reported sulcate and reticulate pollen. Furthermore, he was of the opinion the genus *Allium* was homogeneous in both aperture type and exine ornamentation.

Present pollen data is based on 20 species of the genus *Allium* representing seven subgenera and 13 sections viz., Subgenus *Allium* (*Allium sativum* section *Allium*, *Allium umbilicatum* Section *Avulsea*, *Allium gilli* Section *Scordium*, *Allium lamondiae* Section *Scordium*, *Allium jacquemontii* Section *Caerulea*, *Allium porrum* Section *Allium*, *Allium griffithianum* Section *Avulsea*), Subgenus *Anguinum* (*Allium victorialis* Section *Anguinum*), Subgenus *Butomissa* (*Allium tuberosum* Section *Butomissa*), Subgenus *Cepa* (*Allium farctum* Section *Cepa*, *Allium Cepa* Section *Cepa*, *Allium humile* Section *Cepa*, *Allium fedtschenkoanum* Section *Annuloprason*, *Allium schoenoprasum* Section *Schoenoprasum*, *Allium semonovii* Section *Annuloprason*), Subgenus *Molium* (*Allium barszczewskii* Section *Allium*, *Allium triperum* Section *Molium*), Subgenus *Melanocrommyum* (*Allium rosenbachianum* Section *Megaloprason*), Subgenus *Polyprason*, (*Allium consanguineum* Section *Oreiprason*, *Allium roylei* Section *Oreiprason*).

The pollen types do not correspond with the sectional classification of the genus *Allium* (Friesen *et al.*, 2006; Li *et al.*, 2010). In all the pollen type's taxa of different sections are found for e.g., pollen type: *Allium griffithianum* have species of seven different sections viz., *Allium*, *Scordium* *Caerulea*, *Avulsea* *Cepa*, *Molium* and *Oreiprason*. Similarly, nine species of pollen type *Allium roylei* are distributed into eight different sections such as, Section *Avulsea* (*Allium umbilicatum*), Section *Anguinum* (*Allium victorialis*), Section *Butomissa* (*Allium tuberosum*), Section *Cepa* (*Allium Cepa*, *Allium humile*) Section *Schoenoprasum* (*Allium schoenoprasum*), Section *Annuloprason* (*Allium semonovii*) Section *Megaloprason* (*Allium rosenbachianum*) Section *Oreiprason* (*Allium roylei*). However, Güler & Pehlivan (2006) studied

palynological characters of two sections of *Allium* viz., *Codonoprasum* and *Allium*, and they reported that aperture type and the presence of an operculum, could be of taxonomic value at the sectional level. However, present pollen data do not support Güler & Pehlivan findings, because three species studied from the section *Allium* are non operculate. Neshati *et al.* (2009) examined pollen morphology of 30 *Allium* species representing 15 sections and reported that the long sulcus continuing to the proximal side and ending before the proximal pole to be apparently a synapomorphy of sect. *Allium*. Ozhatay & Kocyigit (2009) suggested that there is several pollen characters of taxonomic significance in the genus *Allium*. The main palynological differences have been found at the section level they studied 23 species of *Allium* from Turkey, distributed in six sections. However, the present pollen data is more or less correlates with the sub generic classification of the genus *Allium*. For instance, in pollen type *Allium griffithianum*, species of subgenus *Allium* is present. Similarly, in subgenus *Cepa* species of pollen type *Allium roylei* are commonly found. However, remaining subgenera are represented by one or two species (see to the Pollen types).

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