

Original Research Article

Ultrastructure of Pollen Grains of the Genus *Ornithogalum* L. (Hyacinthaceae) in Jordan

Sawsan A.S. Oran* and O. Muna

Department of Biological Sciences, Faculty of Science, the University of Jordan, 11942, Amman-Jordan

*Corresponding author.

Abstract	Keywords
<p>The characteristics of the pollen grains of the species of <i>Ornithogalum</i> in Jordan have been examined in this current study, using light and scanning electron microscopy techniques. Pollen grains for 8 taxa of pollen grains of <i>Ornithogalum</i> have been studied. The morphological characteristics of <i>Ornithogalum</i> pollen as revealed by scanning electron (SEM) and light microscopy are bilaterally symmetrical, isopolar, monocolpate. The shape of pollen linear elliptic, elliptic ovoid, and oblong ovoid; the size P/E ranges 32-60 / 20-42 μm; sculpturing system of the type rugate, foveolate, psilate-slightly perforate to heterobrochate-perreticulate; the apertures shape varies from narrow linear monocolpate to wide elliptic monocolpate to wide linear oblong monocolpate. The morphological characteristics of pollen grains are found to be supportive taxonomical evidence for the discrimination and identification of the taxa of <i>Ornithogalum</i>.</p>	<p>Hyacinthaceae Micromorphology <i>Ornithogalum</i> Pollen grains Taxonomical evidence</p>

Introduction

The pollen micromorphology of 8 taxa of pollen grains of the genus *Ornithogalum* in Jordan has been investigated using light and scanning electron microscopy. The studied taxa were *Ornithogalum umbellatum*, *O. tenuifolium*, *O. trichophyllum*, *O. montanum*, *O. lanceolatum*, *O. narbonense* subsp. *brachystachys*, *O. neurostegium* subsp. *eigii* and *O. neurostegium* subsp. *neurostegium*.

The pollen grains of *Ornithogalum* was described by (Erdtman, 1952), he described the family Liliaceae as eurypalynous family and classified the pollen grains of *Ornithogalum* under the subfamily Scilloideae, which

means the pollen is 1-sulcate with long axis of 88 μm as in *Ornithogalum nutans*. The pollen grains of *Ornithogalum khuzestanicum* (Hyacinthaceae), a new species from Iran were studied (Heydarian et al., 2011). The characters of pollen are found of taxonomic value when studied with other affinities of *Ornithogalum*. The scanning electron microscopy study of the endemic species of *Ornithogalum chetikianum* and *O. demirizianum* in Turkey has been carried out by Yilmazcitak et al. (2015), the pollen grains of *O. chetikianum* are monosulcate, and the pollen grains of *O. demirizianum* are monosulcate and zonosulcate. The pollen grains of 13 species representing 6 segregate genera with in *Scilla s.l.* (Hyacinthaceae) were studied to evaluate the taxonomic value of pollen characters for generic

delimitation, the pollen grains of all examined species were found monosulcate, prolate, or sub-prolate and heteropolar; three types of sculpturing patterns were recognized: perforate-reticulate and perforate. This study shows that the exine of the pollen of *Scilla* is useful as a taxonomic character for the delimitation of the studied segregate genera (Ghavami et al., 2009). Another pollen study on the genus *Erythronium* (Liliaceae) is considered of systematic value (Masoumi, 2012).

Materials and methods

Pollen grains were examined using the light and scanning electron microscopy methods.

Light microscopy

Acetolysed pollen grains were used in this study using mature anthers. The size of pollen grain was measured by calculating the ratio of polar axis to equatorial axis P/E of at least 50 pollen grains for each particular taxon, and then examined using light microscope at 400 magnification. The aperture, shape, polarity, symmetry, and the sculpturing pattern were studied in the examined specimen as shown in Table 1.

Scanning electron microscopy

- Pollen grains were scattered on a clean stubs.
- The stubs were coated with thin layer of gold in a vacuum coating unit.
- The samples were examined using SEM-Zeiss, 100 Å, and by using Leica Cambridge scanning electron microscope Stereo Scan 360 Å. The characteristics of pollen grains as revealed by scanning electron microscope (SEM) were given.
- Micrographs for the pollen grains of different species of *Ornithogalum* at different magnification power were recorded (Figs. 1-3).

Results

The characters of the pollen grains of the taxa of the genus *Ornithogalum* as revealed by light and ESM microscopy are shown below in Table 1. The descriptive terminology of the pollen grains was used according to Moore and Webb (1978), Erdtman (1952), Radford et al. (1974), Oran (1996) and Oran (2015).

Table 1. Micro morphological characters of pollen grains for eight taxa of in Jordan *Ornithogalum*.

*Tax No.	Taxon name	Symmetry Polarity	Shape	Size µm#	Sculpturing system	Aperture shape	**Spec No.
1	<i>O. umbellatm</i>	Bilateral, isopolar	Linear-elliptic	60-67/ 27-42	Rugulate, foveolate-perforate	Linear monocolpate	13
2	<i>O. tenuifolium</i>	Bilateral, isopolar	Elliptic-ovoid	35-52/24-39	Rugulate, foveolate-perforate	Elliptic monocolpate	7
3	<i>O. trichophyllum</i>	Bilateral, isopolar	Oblong-ovoid	32-46/22-37	Psilate-slightly perforate	Linear oblong monocolpate	3
4	<i>O. montanum</i>	Bilateral, isopolar	Oblong-ovoid	36-50/20-35	Rugulate, foveolate-perforate	Linear oblong monocolpate	1
5	<i>O. lanceolatum</i>	Bilateral isopolar	Linear-elliptic	55-60/25-40	Heterobrochate, perreticulate	Linear monocolpate	18
6	<i>O. narbonense</i> subsp. <i>brachystachys</i>	Bilateral isopolar	Linear-elliptic	55-60/25-40	Rugulate, foveolate-perforate	Linear monocolpate	16
7	<i>O. neurostegium</i> subsp. <i>eigii</i>	Bilateral isopolar	Linear-elliptic	57-69/26-42	Rugulate, foveolate, perforate	Linear monocolpate	15
8	<i>O. neurostegium</i> subsp. <i>neurostegium</i>	Bilateral isopolar	Linear-elliptic	58-68/22-39	Rugulate, foveolate-perforate	Linear monocolpate	11

*Tax. = Taxon; **Spec. = Specimen; # µm = Micrometer;

Fig. 1: SEM micrographs of the pollen of *O. umbellatum* (A-pollen grain; B-exine ornamentation), *O. tenuifolium* (C-pollen grain; D-exine ornamentation) and *O. neurostegium* (E-pollen grain; F-exine ornamentation).

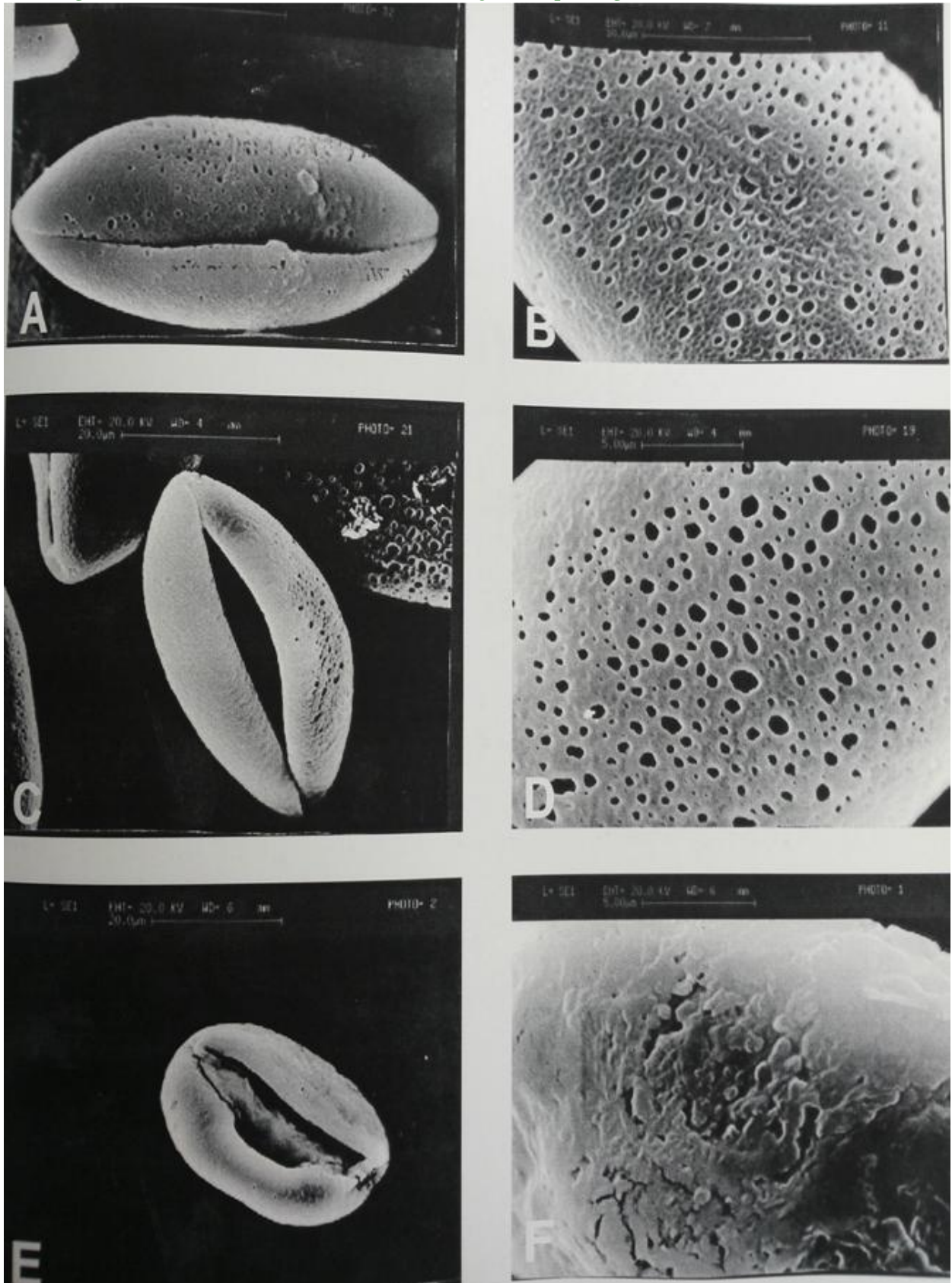


Fig. 2: SEM micrographs of the pollen of *O. montanum* (A-pollen grain; B-exine ornamentation), *O. lanceolatum* (C-pollen grain; D-exine ornamentation) and *O. narbonenses* subsp. *brachystachys* (E-pollen grain; F-exine ornamentation).

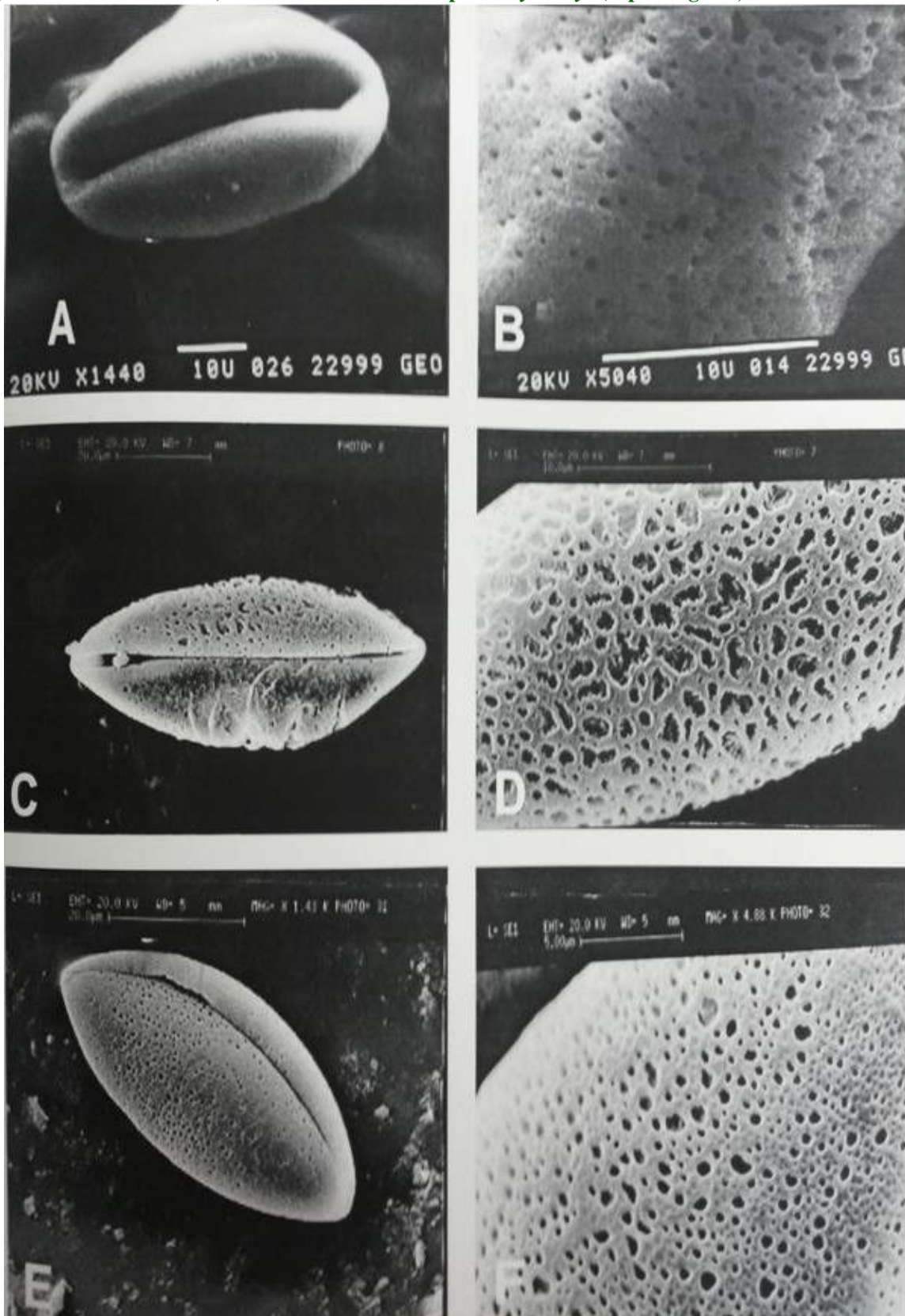
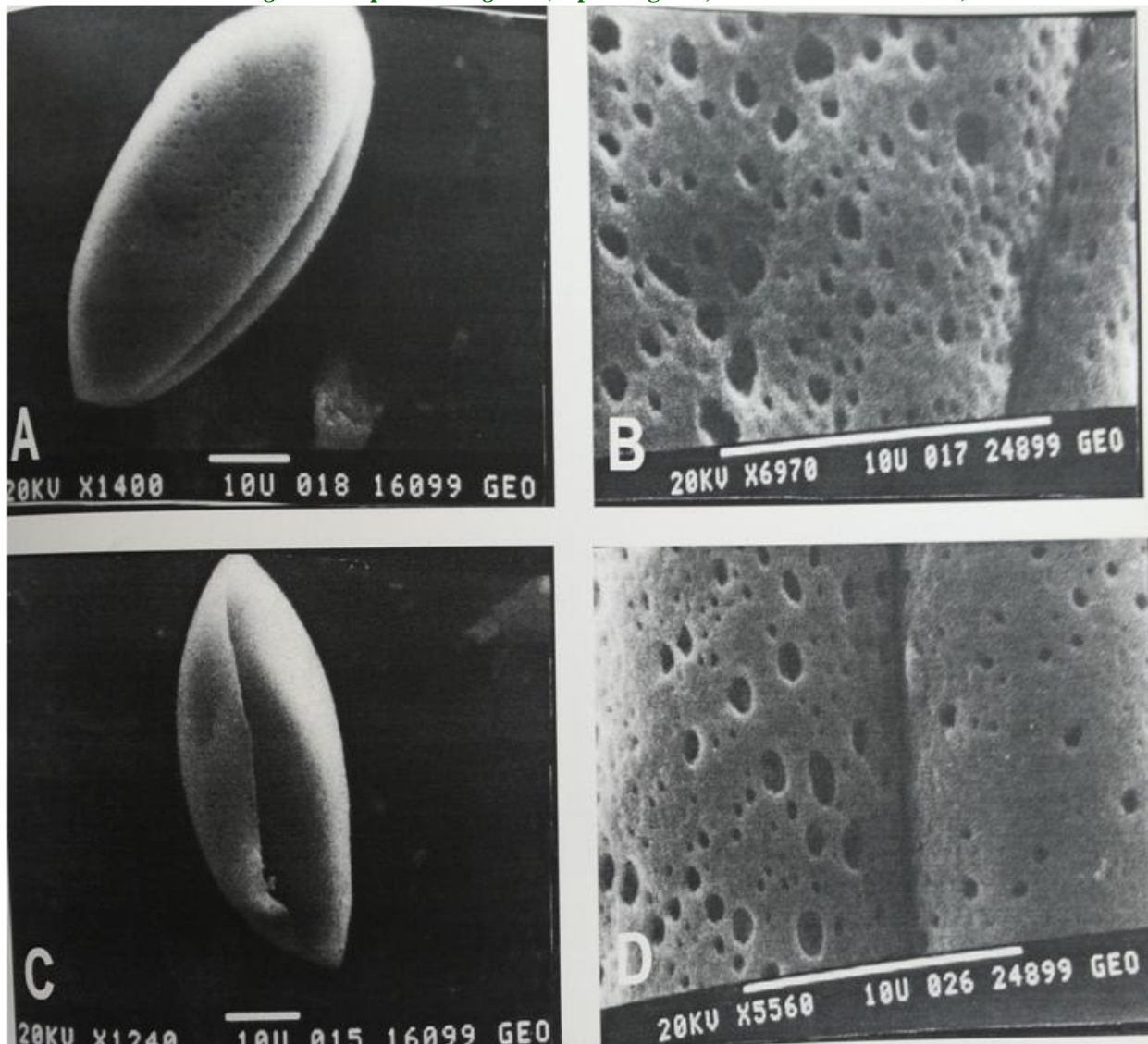


Fig. 3: SEM micrographs of the pollen of *O. neurostegium* subsp. *eigii* (A-pollen grain; B-exine ornamentation) and *O. neurostegium* subsp. *neurostegium* (C-pollen grain; D-exine ornamentation).



Key for the pollen grains of *Ornithogalum* taxa recorded in Jordan

- 1. Pollen grain ovate-linear elliptic in outer shape
 - 2. Pollen grain ovate-elliptic, polar axis larger than $\leq 55 \mu\text{m}$*O. tenuifolium*
 - 2. Pollen grain linear elliptic, polar axis $\geq 55 \mu\text{m}$
 - 3. Sculpture surface heterobrochate, perreticulate.....*O. lanceolatam*
 - 3. Sculpture surface regulate foveolate-perforate
 - 4. Sculpture surface regulate-foveolate, with large lumen size
 - 5. Muri with dense perforation at colpus membrane*O. neurostegia* subsp. *eigii*
 - 5. Muri with less perforation at the colpus membrane.....*O. neurostegia* subsp. *neurostegia*
 - 4. Sculpture surface regulate –perforate, with small lumen size
 - 6. Polar axis of pollen grain $\geq 60 \mu\text{m}$ *O. umbellatum*
 - 6. Polar axis of pollen grain $\leq 60 \mu\text{m}$ *O. narborensis* subsp. *brachystachys*
- 1. Pollen grain oblong-ovoid in outer shape
 - 7. Sculpture surface psilate, slightly perforate..... *O. trichphyllum*
 - 7. Sculpture surface regulate-foveolate, perforate.... *O. montanum*

Discussion

The results of this study of the pollen grains of the 8 taxa of the genus *Ornithogalum* in Jordan, using light and scanning electron microscopy, showed variation in pollen shape, sculpturing pattern of the exine and the shape of the aperture among the taxa under investigation that can be used as a valid taxonomic evidence to distinguish between the different *Ornithogalum* taxa recorded in Jordan.

Moreover the palynological characters were useful in constructing the key for the different studied taxa. It is concluded from this study that the palynological evidence is a supportive tool for the characterization and discrimination of the different pollen grains belong to different taxa of the genus *Ornithogalum* based on the morphological variations of the pollen grains of each taxon, and thus supporting the morphological characteristics for the delimitation and characterization of the taxa under investigation.

Acknowledgement

The author, Dr. Sawsan A.S. Oran is grateful to the University of Jordan for the financial support during my sabbatical year 2014-2015, and for the Missouri Botanical Garden, St. Louis, USA, for the offered technical facilities. Also, the author acknowledges the kind invitation of the Department of Biological Sciences at Washington University in St. Louis/ Missouri, USA.

References

- Erdtman, G., 1952. Pollen Morphology and Taxonomy of Angiosperms. Alm-quistand, Wikesel, Stockholm. pp.11-24.
- Ghavami, E., Jamzad, Z., Tavasoli, A., 2009. Evaluation of pollen morphology as a taxonomic character for generic delimitation in *Scilla*. (Hyacinthaceae). Nordic J. Bot. 27(6), 510-515.
- Heydarian, F., Nejadstari, T., Mamadi, S.M.M., Assadi, M., 2011. *Ornithogalum khuzestanicum* (Hyacinthaceae), a new species from Iran. Iran. J. Bot. 18(1), 47-54.
- Masoumi, S.M., 2012. Pollen morphology of *Erythronium* (Liliaceae) and its systematic relationships. J. Basic Appl. Sci. Res. 2(2), 1833-1838.
- Moore, P.D., Webb, J.A. 1978. An Illustrated Guide to Pollen Analysis. Hodder and Stoughton, London. pp. 31-77.
- Oran, S.A., 1996. Ultrastructure of pollen grains of the genus *Salvia* (Labiatae) in Jordan and the neighboring countries. Nat. Engg. Sci. 24(3), 629-641.
- Oran, S.A., 2015. Ultrastructure of pollen grains of the genus *Phlomis* L. (Lamiaceae) in Jordan. Int. J. Curr. Res. Biosci. Plant Biol. 2(7), 83-87.
- Radford, A.E., Dickison, V.C., Massey, H.R., Bell, C.R., 1974. Vascular Plant Systematics. Herrer and Row Publisher, New York. pp.211-221.
- Yilmazcitak, B., Dural, H., Buyukkartal, H. N., Pinar, N. M., 2015. Morphological, anatomical, palynological, and micromorphological characters of 2 endemic species of *Ornithogalum* (*O. chetikianum* and *O. demirizianum*) in Turkey. Turk. J. Bot. 139, 48-59.