



Seed micromorphology of *Ornithogalum refractum* and *Ornithogalum fimbriatum* (Hyacinthaceae) from Turkey

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Abstract

In this study contributions on taxonomy of *Ornithogalum* taxa in recent years were given. The micromorphological characters of seed surfaces of *Ornithogalum fimbriatum* Willd. and *Ornithogalum refractum* Kit et Schlecht. were scanned by scanning electron microscope and were given for the first time. The outer periclinal walls were flat with smooth surface and there were intense fibrous pattern in *Ornithogalum fimbriatum* and *Ornithogalum refractum*. The cells of testa were mostly rectangular shape in *Ornithogalum refractum* while square or weakly curved similar to square shape in *Ornithogalum fimbriatum*.

Key words: morphology, *Ornithogalum*, seed, SEM, Turkey

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Türkiye’de *Ornithogalum refractum* ve *Ornithogalum fimbriatum* (Hyacinthaceae)’un tohum mikromorfolojisi

Özet

Bu çalışmada, son yıllardaki *Ornithogalum* taksonlarının taksonomisi üzerinde katkılar verilmiştir. *Ornithogalum fimbriatum* Willd. ve *Ornithogalum refractum* Kit et Schlecht.’in tohum yüzeylerinin mikromorfolojik karakterleri scanning elektron mikroskobu ile taranmıştır ve ilk defa verilmiştir. *Ornithogalum fimbriatum* ve *Ornithogalum refractum* testa hücrelerin dış yan çeperleri düz ve düz yüzeyli ve yoğun fibrilli yapılara sahiptir. Testa hücreleri çoğunlukla *Ornithogalum refractum*’da dikdörtgenimsi şekilli iken, *Ornithogalum fimbriatum*. ‘da ise kare şekilli veya hafifçe kıvrımlı kareye benzer şekillidir.

Anahtar kelimeler: morfoloji, *Ornithogalum*, SEM, Türkiye, tohum

1. Introduction

Hyacinthaceae family comprises of about 41–70 genera and 770–1000 species (Stevens, 2001). Hyacinthaceae include bulbous plants which are mainly distributed through Europe, Africa and south-west Asia, with a single small genus in South America (APG II, 2003). The taxonomic arrangement within subfamily Ornithogaloideae (Hyacinthaceae) has been a matter of controversy in recent decades, several new taxonomic treatments have been proposed, based exclusively on plastid DNA sequences, and these have resulted in classifications which are to a great extent contradictory. Some authors have recognized only a single genus *Ornithogalum* for the whole subfamily, including 250–300 species of variable morphology, whereas others have recognized many genera (Martínez-Azorin et al., 2011). Ornithogaloideae are distributed through Europe, south-west Asia and Africa and include about 280 species (Speta, 1998a). The definition of genera and the assignment of species to genera within this subfamily have troubled taxonomists since Linnaeus (Stedje, 2001a, b) and there has been a great controversy concerning generic treatments. Speta (1998a) in a study of Ornithogaloideae recognized 13 genera: *Stellarioides* Medik., *Coilonox* Raf., *Albuca* L., *Pseudogaltonia* Kuntze, *Dipcadi* Medik., *Galtonia* Decne., *Zahariadia* Speta, *Melomphis* Raf., *Cathissa* Salisb., *Eliokarmos* Raf., *Loncomelos* Raf., *Honorius* Gray and *Ornithogalum* L. In the study of Martínez-Azorin et al. (2011) on the basis of the phylogenetic analyses, 19 monophyletic genera were accepted within Ornithogaloideae: *Albuca* L.,

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Avonsera (Speta) J.C. Manning & Goldblatt, *Battandiera* Maire, *Cathissa* (Salisb.) Baker, *Coilonox* Raf., *Dipcadi* Medik., *Eliokarmos* Raf., *Elsiea* F.M. Leight, *Ethesia* Raf., *Galtonia* Decne., *Honorius* Gray, *Loncomelos* Raf., *Melomphis* Raf., *Neopaterosonia* Schönland, *Nicipe* Raf., *Ornithogalum* L., *Pseudogaltonia* Kuntze, *Stellarioides* Medik. and *Trimelopter* Raf. The most informative phylogenetically characters correspond namely to the colour and presence of a band on tepals, capsule shape, seed morphology and seed disposition in the capsule locules (Martínez-Azorin et al., 2011). The genus, *Ornithogalum* was widely grown in Africa, Mediterranean, Europa and Asia naturally and contains nearly 150 species all of the world (Petanidou & Vujic, 2007). Fourty four species has been represented in Turkey and 17 species of them are endemic (Cullen, 1984; Ekim, Koyuncu, Vural, Duman, Aytac & Adigüzel, 2000; Düşen & Deniz, 2005; Uysal, Ertuğrul & Dural, 2005). *Ornithogalum* species is an impressive ornamental plant due to its attractive white flowers and used as medicinal plants (Asimgil, 2003). They have commercial importance in the cut flower industry. *O. pyrenaicum* L. or *Loncomelos pyrenaicus* (L.) L.D. Hrouda ex J. Holub, *O. narbonense* L. or *Loncomelos narbonense* (L.) Raf. and *O. sigmoideum* Freyn & Sint. have potentially an economic importance since it is consumed as vegetable in Turkey (Baytop, 1997).

Anatolia is an important distribution area for *Ornithogalum* in Asia. These plants are also distributed in the Balkan Peninsula (Zahariadi, 1980). According to the Flora of Greece and Balkans (Polunin, 1987) there are about 26 often similar-looking species in the Balkans area, 6 of which are endemic plants.

Since the first revision of *Ornithogalum* for the Flora of Turkey, 31 taxa have been added to the known species and the number of species increased to 55 in Turkey, together with recent additions (Cullen, 1984; Davis et al., 1988a; Speta, 2000a, 2000b; Özhatay, 2000; Düşen & Sümbül, 2002, 2003; Düşen & Deniz, 2005; Uysal et al., 2005; Özhatay & Kültür, 2006; Dalgıç et al., 2006; Varol, 2008; Bağcı et al., 2009; Yıldırım, 2009; Koca & Yıldırım, 2010; Ozhatay et al., 2011; Bağcı et al., 2011; Mutlu & Karakuş, 2012). The genus is represented in European Turkey by 14 species (Cullen, 1984; Davis et al., 1988a; Dalgıç, 1990; Dalgıç et al., 2009).

Many taxonomic surveys showed the importance of micro- and macro morphological studies of seeds in plant systematics (Duran et al., 2010). Morphology of seeds is rather diverse in Hyacinthaceae. Seed characteristics have been shown to be useful for subfamilial delimitation (Speta, 1998b) and generic grouping (Jessop, 1975). According to Speta (1998b) seeds in subfamily Ornithogaloideae are flattened and angled. Seed micromorphology of some species of the genus *Ornithogalum* from East Africa was described (Stedje & Nordal, 1984). In addition to this, micromorphological characters of the seeds of *O. oligophyllum* E. D. Clarke, *O. wiademannii* Boiss., *O. sigmoideum* Freyn & Sint., *O. orthophyllum* Ten. and *O. armeniacum* Baker were determined (Coşkunçelebi et al., 2000). Recently, seed morphology of *O. boucheanum* Asch., *O. nutans* L., *O. pyrenaicum* L. or (*L. pyrenaicus*), and *O. umbellatum* L. or *O. narbonense* L. or (*L. narbonense*) were observed using stereoscope and scanning electron microscope (Bednorz & Czarna, 2008). Micromorphology of seeds of *Ornithogalum* (Hyacinthaceae) in North Africa were examined by SEM (Moret et al., 2008). However, there is no study on *O. fimbriatum* Willd. and *O. refractum* Kit. ex Schlecht about their seed morphology examined by SEM. This paper aims to investigate the micromorphological characters of the seeds belonging *O. fimbriatum* and *O. refractum*, distributed in European Turkey.

2. Materials and methods

All examinations were carried out on fully developed dry seeds. *O. fimbriatum* was collected from Kırklareli while *O. refractum* was collected from Edirne in European Turkey. Twenty seeds of each species were mounted on aluminum stubs with “Leit-Tabs” and coated with gold in an Agar sputter coater. Electron micrographs were obtained with a LEO 435 VP scanning electron microscope at an accelerating voltage of 15 kV. The terminology describing the seed surface followed mainly Barthlott (Barthlott, 1981; 1984). Seed surfaces were photographed at 150× or 82× magnification for general view of seeds, 500× magnification to see seed surfaces with morphological details.

3. Results

In this study, the micromorphological characters of the seed outer surface of two *Ornithogalum* species collected from European Turkey were examined by SEM. The micromorphological features of the seeds as seen in figures (Figs. 1, 2) including micrographs provided an additional source of characters for the separation of the examined species. Seed coats of *O. fimbriatum* and *O. refractum* showed net-like cell arrangement and alveolate primary sculpture. The cells of testa were nearly isodiametric, tetragonal pentagonal or hexagonal, 200 µm in diameter in *O. refractum* and 50-100 µm in *O. fimbriatum* (Figs. 1, 2). The anticlinal walls were strongly curved and raised distinctly in *O. fimbriatum* and *O. refractum* (Figs. 1, 2). The outer periclinal walls were flat with smooth surface and there were intense fibrous pattern in *O. fimbriatum* and in *O. refractum* (Figs. 1, 2).

4. Conclusions

According to the investigations of Martínez-Azorin et al. (2010a, 2010b, 2011) that made for phlogenetics of Ornithogaloideae there were *Loncomelos*, *Melomphis*, *Ornithogalum* and *Honorius* clades. *O. narbonense* L. was

represented as *Loncomelos narbonense* (L.) Speta and *O. pyrenaicum* L. was represented as *Loncomelos pyrenaicus* (L.) L.D. Hrouda ex Holub in the study (Martínez-Azorin et al., 2011).

As in previously described species of *Ornithogalum*, distinctions in seed surface features were observed. Micromorphological characters of the seeds belonging *O. sigmoideum* and *O. armeniacum* were nearly similar to each other. However, distinct differences were found among the *O. pyrenicum* (*L. pyrenaicus*), *O. narbonense* (*L. narbonense*) and the other examined seed surfaces (Stedje & Nordal, 1984; Coşkunçelebi et al., 2000; Bednorz & Czarna, 2008). In present study seed surfaces of *O. fimbriatum* and *O. refractum* were similar to *O. sigmoideum* and *O. armeniacum*. Mutlu and Karakuş (2012) determined that *O. malatyanum* was closely allied to *O. pyrenaicum* subsp. *sphaerocarpum* and *O. narbonense* (*L. narbonense*) especially because of its cylindrical inflorescence and flowers numbering more than 15 (Cullen, 1984). Seed surfaces of *O. pyrenaicum* (*L. pyrenaicus*) and *O. narbonense* (*L. narbonense*) were distinctly different from the seed morphology of *O. fimbriatum*, *O. refractum*, *O. sigmoideum*, *O. armeniacum*. The reason of this could be because of belonging different subgenera. These variations could be used as a taxonomic criterion at specific level for this genus.

In recent years, there were lots of taxonomic studies (Martinez-Azorin et al., 2010a, b; 2011; Manning et al., 2004, 2009). One of them was about contributions on taxonomy of *Ornithogalum* taxa in recent years. There were 19 different genus branched from one genus *Ornithogalum* according to Martinez-Azorin et al. (2011). Also, the micromorphological characters of seed surfaces were important to determine the species of *Ornithogalum* L. genus. The present data represent the analysis of the seed coat morphology of *O. fimbriatum* and *O. refractum* grown in European Turkey.

Acknowledgements

We would like to thank G. Dalgıç for her help to collect *Ornithogalum* specimens and also thank the members of Sabancı University for their valuable helpness for SEM studies.

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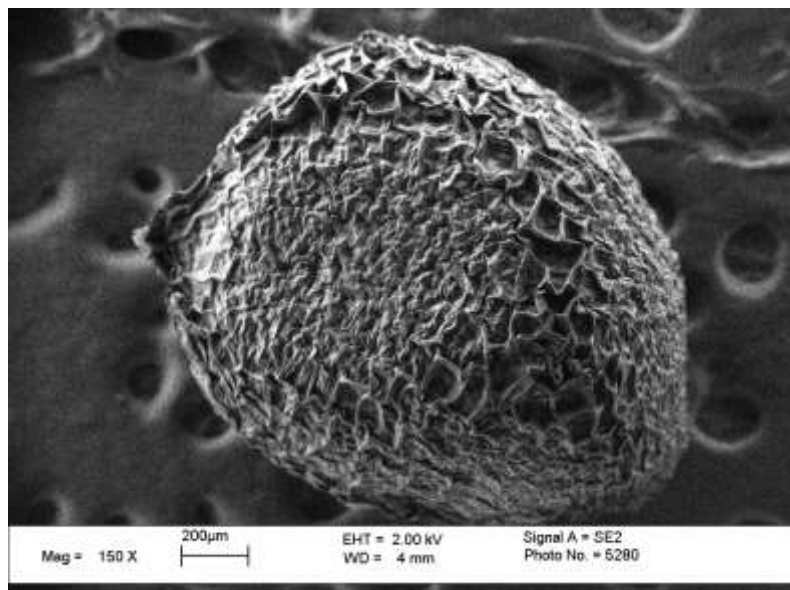


Figure 1. *Ornithogalum fimbriatum* - a

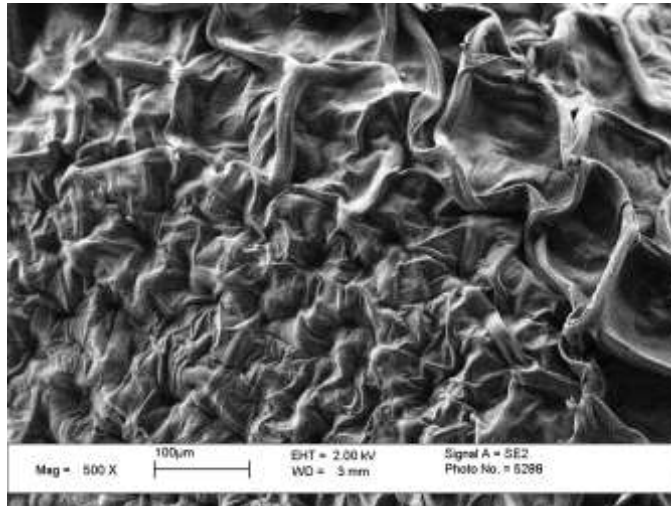


Figure 1. *Ornithogalum fimbriatum* – b

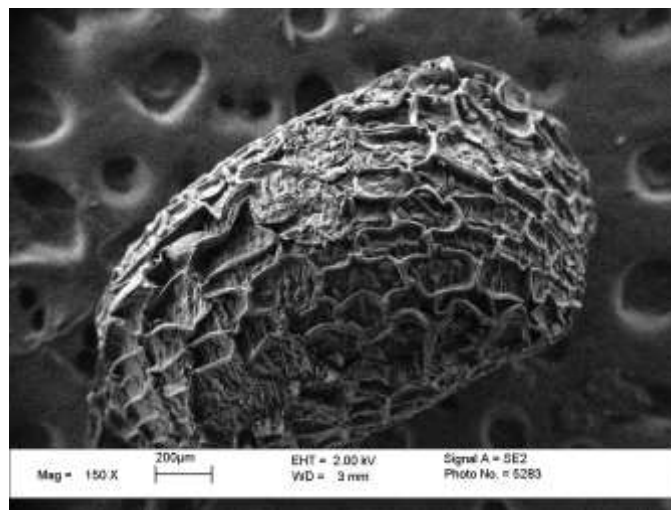


Figure 2. *Ornithogalum refractum* - a

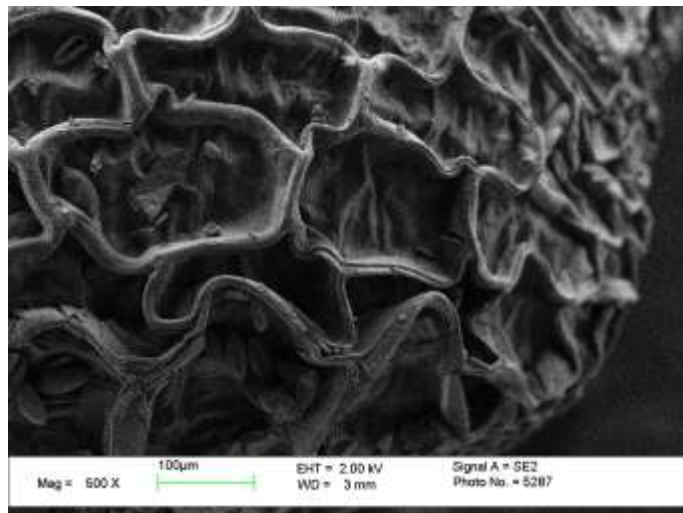


Figure 2. *Ornithogalum refractum* – b

(Received for publication 03 December 2013; The date of publication 15 August 2014)