



The Palynomorphological Characteristics of *Amaryllidaceae* in Albania[#]

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Abstract: The article includes the palynomorphological study of the main members of family *Amaryllidaceae* in Albania. In this article submitted comparative features of the genus: *Acis*, *Leucojum*, *Narcissus*, *Sternbergia*. The material for the study was obtained in National Herbarium in Tirana. For the study of palynomorphological features are analyzed 31 pollen grains from each species. The treatment of material is made with acetolysis method and basic fuchsine. The fixing of pollen grains is made with glycerin gelatin. The study and photos of pollen grains are realized with light microscope with 1000x power. The pollen grains of plants above are oblate ellipsoid or oblate spheroidal, isopolare, monosulcate. The exine appears thick and has two-layers. The sculpture of exine is microreticulate, tectate- punctuate, foveolate. The palynomorphological study of these representatives is given for the first time in the literature of palynology.

Keywords: *Amaryllidaceae*, palynomorphological, pollen grains, monosulcate, exine, microreticulate

Introduction

Amaryllidaceae family is a perennial herbaceous family mostly bulbous and rare with rhizome. They are monocote plant of *Asparagales* order (APG II, 2003) . The family took its name from the noun *Amaryllis*. The leaves are usually linear, flowers are symmetrical and hermaphroditic and located like umbrella on the stalk. Petals and sepals are undifferentiated. This family was originally renamed in 1805 by Jean Henri Jaume Saint-Hilaire (Jaume Saint-Hilaire, 1805) and now contains about 1600 species, 75 genera, and 3 subfamilies: *Agapanthoideae*, *Allioideae*, *Amaryllidoideae* (Christenhusz & Byng, 2016).

The plants of *Amaryllidaceae* family are mainly on ground, rarely on water and are perennial except four species. Most genera are grown by bulb, only some genera like *Agapanthus*, *Clivia* and *Scadouxus* grown by rhizome. The leaves are simple, not fleshy and parallel placement. Form of the leaves can be straight, elongated, elliptical, lanceolate or fibrous. The flowers are hermaphroditic, rarely actinomorphic and zigomorphic. They have high economic value as ornamental plants, but some plants are even used as curative plants (Baytop & Mathew, 1984; Donmez & Isik, 2008).

This study is the continuation of a large number of studies in the field of palynology in our country (Kapidani, 1996; Pupuleku, 2001; Gjebrea, 2003; Kallajxhiu, 2011; Jance, 2014; Dauti, 2016).

Material and Methods

Material for the study was obtained from the National Herbarium, at University of Tirana. In cooperation with employees of herbar are found some flowers and stamens. They are placed in special envelopes and labeled. During data collection it is careful to maintain sterility of pollen species to study. In this study are taken 8 representatives from 4 genera of *Amaryllidaceae* Family. The genera of the family to take into study are: *Acis*, *Leucojum*, *Narcissus*, *Sternbergia*. To realize the study of morphological characteristics of pollen grains of plants taken in the study, we have used three processing methods:

- Acetolysis method of Erdtman (Erdtman, 1956).
- Simplified Acetolysis Method of Avetisjan (Avetisjan, 1950).
- Basic Fuchsine Method of Smoljaninova & Gollubkova,(1953).

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Two methods of acetolysis give very good results with respect to the elements sporoderme study, while basic fuchsin method gives very good results for the study of the shape, size and aperture, and in some cases even to the sculptural elements of exine.

After coloring, the materials were stuck with gelatin-glycerin, which was prepared according to the Kissler method (Avetisjan, 1950; Erdtman, 1956; Sllatkov, 1967; Kissler, 1935).

Prepared preparation after a few days was isolated with varnish or paraffin and after 2-3 days it became available for use and storage. With the above methods, we are prepared 3-6 microscope slides for each plant pollen grains. The terminology for determining of the pollen grains is based on that recommended previously (Erdtman 1952; Erdtman, 1957; Punt *et al.*, 1994; Kapidani 2005).

Results and Discussions

Genus: *Acis*

Acis ionica Barek, Kamari & Phitos (sin. *Leucojum valentinum* subsp. *Vlorense* Papparisto & Qosaj; *Leucojum ionicum* Kit Tan, Mullaj, Sfikas & Stride).

Herbaceous and perennial plant. Geophytes. Bulb 20-35 x 15-25 mm, with a light brown membrane. Length of awns are 1.5-2 mm; anthers about 5-5.5 mm and yellow. They are found in limestone rocks near the seaside and at the south of the Vlora city, in Vlora-Jonufra roadway. Blooms in August-September. The number of chromosomes is $2n = 16$. Albanian endemic. Oleo-Ceratonion (Anonymous, 1988-2000).



Figure 1. *Acis ionica*

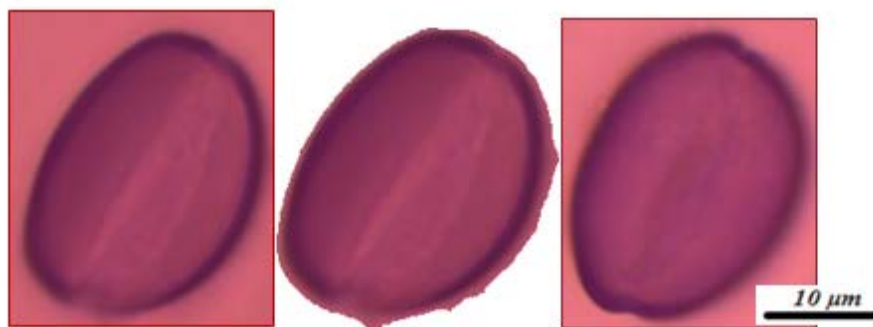


Figure 3.2. Pollen grains *Acis ionica* (1000X)

The pollen grains are monad. Their shape according to the outline varies from spheroidal to elliptic. The pollen grains are monosulcate. The sulci are long and go to the ends of the polar axis. They form light edges and are smooth. The ends of sulci give to the pollen grain a small depth and make them look as heteropolar.

Exine has two layers. Its layers are almost equal. Exine's sculpture is tectate perforate (Tectum or punctum- with holes less than 1 μm in diameter and the distance between holes is greater than their width. Exine's thickness is about 1 μm .

The length of pollen grains varies from 24- 27 (25) μm ; width 17 -20 (18) μm .

Genus: *Leucojum*

Leucojum aestivum L., Sp. Pl. 289 (1753).

Herbaceous and perennial plant. Geophytes. Plant summer. Bulb 25-40 mm in diameter, nearly spheroidal, with membrane-brown layer. It grows in wet meadows and marshlands. Blooms in April-May. Number of chromosomes $2n = 22$. European plants-Kaukaz. Poisonous plants and pharmaceuticals (Anonymous, 1988-2000).

The pollen grains are monad. The shape of the pollen grains according to the outline varies from spheroidal to elliptic. The pollen grains are monosulcate. The sulci are long and go to the ends of the polar axis. They form clear edges and light waves. The edges of sulcus give the impression that they are thicker than exine of pollen grains. The ends of sulcus give the outline of pollen grains, small depth and make them look as heteropolar.

Exine has two layers. Its layers are almost equal and the structure is microreticulate. The cells of reticulum have a diameter of less than 1 μm and the distance between the holes is greater than their width. Exine's thickness is about 1 μm .

The length of pollen grains varies from 36-42 (39) μm ; width 25 -30 (27) μm .

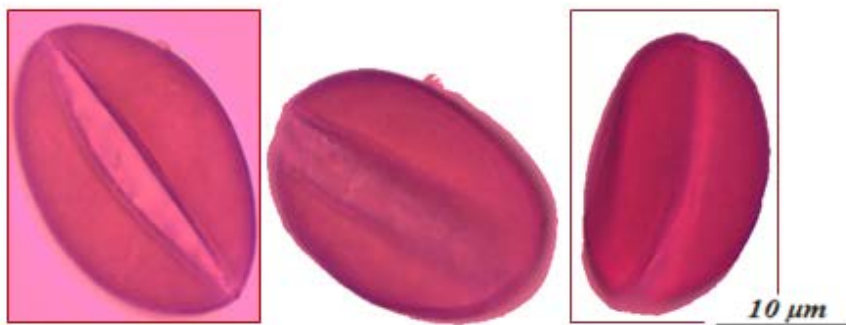


Figure 3. *Leucojum aestivum* L. **Figure 4.** Pollen grains *Leucojum aestivum* L (1000X). (www.pfaf.org)

Genus: *Narcissus*

***Narcissus serotinus* L., Sp. Pl. 290 (1753).**

Herbaceous and perennial plant. Bulb 15-25 x 12-20 mm. The filament of stamen is shorter or few longer than the anthers. It grows in dry limestone hillsides etc. Blooms in September-November. Chromosome number of $2n=10, 20, 30$. Steno-Mediterranean (Anonymous, 1988-2000).

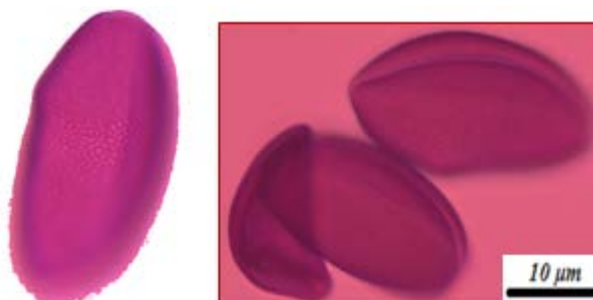


Figure 5. *Narcissus serotinus* L. **Figure 6.** Pollen grains of *Narcissus serotinus* L (1000X).

The pollen grains are monad. Their shape according to the outline is elliptical to elongate elliptical. The pollen grains are monosulcate. The sulci are long and go to the ends of the polar axis. They form clear edges and light waves. The edges of sulcus give the impression that they are thicker than exine of pollen grains. The ends of sulcus give the outline of pollen grains, small depth and make them look as heteropolar. Exine has two layers. Its layers are almost equal and it has microreticulate sculptures. The cells of reticulum have a diameter of less than 1 μm and the distance between the holes is greater than their width. Exine's thickness is about 1 μm .

The length of the pollen grains varies from 39- 44 (42) μm , width 25 -28 (26) μm .

***Narcissus tazetta* L., Sp. Pl. 290 (1753).**

Herbaceous and perennial plant. Geophytes. Bulb up to 50-35 mm. It grows in rocky places, in cultivated lands, and cultivated as ornamental plant. Blooms in February-May. Mediterranean (Anonymous, 1988-2000).



Figure 3.7. *Narcissus tazetta* L. **Figure 3.8.** Pollen grains of *Narcissus tazetta* L. (1000X). (en.wikipedia.org)

The pollen grains are monad. Their shape according to the outline is elliptical to elongated elliptical. The pollen grains are monosulcate. The sulci are long and go to the ends of the polar axis. They form clear edges and light waves. The edges of sulcus give the impression that they are thicker than exine of pollen grains. The ends of sulcus give the outline of pollen grains, small depth and make them look as heteropolar.

Exine has two layers. Its layers are almost equal and it has microreticulate sculptures. The cells of reticulum have a diameter of less than 1 μm and the distance between the holes is greater than their width. Exine's thickness is about 1 μm .

The length of the pollen grains varies from 42- 45 (43) μm , width 22-24 (23) μm .

***Narcissus poeticus* L., Sp. Pl. 289 (1753).**

Perennial herbaceous plant. Geophytes. Bulb up to 17-40 x 12-35 mm. It grows in humid mountain meadows. Blooms in April-May. Chromosome number $2x=14$. European-South Orofite. Medicine plant; in folk medicine used against bronchitis, asthma, etc (Anonymous, 1988-2000).

The pollen grains are monad. Their shape according to the outline is elliptical to elongated elliptical. The pollen grains are monosulcate. The sulci are long and go to the ends of the polar axis. They form clear edges and light waves. The edges of sulcus give the impression that they are thicker than exine of pollen grains contours. The ends of sulcus give the outline of pollen grains, small depth and make them look as heteropolar.



Figure 9. *Narcissus poeticus* L. (en.wikipedia.org) **Figure 10.** Pollen grains *Narcissus poeticus* L. (1000X).

The exine has two layers. Its layers are almost equal and it has microreticulate sculptures. The cells of the reticulum are about 1- 1.5 μm in diameter and the distance between the holes is smaller than their width. Exine's thickness is about 1.5 μm .

The length of the pollen grains varies from 42- 48 (46) μm ; width 22-25 (24) μm .

***Narcissus pseudonarcissus* L., Sp. Pl. 289 (1753).**

Perennial herbaceous plant. Geophytes. 20-50 mm bulb. Cultivated as ornamental plant in gardens and naturalized meadows. Blooms in March-May. The number of chromosomes $2n=14$. Western European (Anonymous, 1988-2000).



Figure 3.11. *Narcissus pseudonarcissus* L. **Figure 3.12.** Pollen grains *Narcissus pseudonarcissus* L. (1000X) (www.pinterest.com)

The pollen grains are monad. Their shape according to the outline is elliptical to elongated elliptical. The pollen grains are monosulcate. The sulci are long and go to the ends of the polar axis. They form clear edges and light waves. The edges of sulcus give the impression that they are thicker than exine of pollen grains. The ends of sulcus give the outline of pollen grains, small depth and make them look as heteropolar.

The exine has two layers. Its layers are almost equal. The structure of exine is microreticulate. The cells of the reticulum have a diameter of about 1- 1.5 μm and the distance between the holes is smaller than their width. Exine's thickness is about 1.5 μm .

The length of the pollen grains varies from 57- 60 (59) μm ; width 27-30 (29) μm .

Genus: *Sternbergia*

Sternbergia colchiciflora Waldst et Kit., Pl. Rar. Hung. 2: 172 (1803-1804).

Perennial plant. Geophytes. 1-2 cm in diameter bulb, dry rocky places in the higher mountain areas.

September- October period. Chromosome $2n = 20, 26$. Located in Southwest South-Western Asia (Anonymous, 1988-2000).

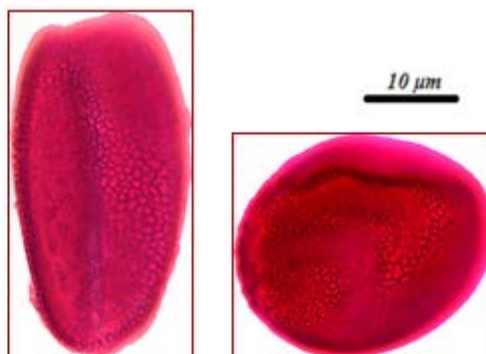


Figure 3.13. *Sternbergia colchiciflora* L. (1000X).

Figure 3.14. Pollen grains *Sternbergia colchiciflora*

The pollen grains are monad. Their shape according to the outline is elliptical to elongated elliptical. The pollen grains are monosulcate. The sulci are long and go to the ends of the polar axis. They form clear edges and light waves. The ends of sulcus give the outline of pollen grains, small depth and make them look as heteropolar.

The exine has two layers. Its layers are almost equal. The structure of exine is microreticulate. The cells of the reticulum have a diameter of about 2 μm and the distance between the holes is smaller than their width. Exine's thickness is about 1.5 μm -2.

The length of the pollen grains varies from 60- 63 (62) μm ; width 29-31 (30) μm .

***Sternbergia lutea* (L.) Ker-Gawler. Ex Sprengel, Syst. Veg. 2: 57 (1825).**

Perennial herbaceous plant. S. yellow. Geophytes. 1-2 cm in diameter bulb. It grows in dry places and shrubs. Blooms in September-November. Number of chromosomes: $2n=22$. Located in the Mediterranean and mountainous areas (Anonymous, 1988-2000).

The pollen grains are monad. Their shape according to the outline is elliptical to elongated elliptical. The pollen grains are monosulcate. The sulci are long and go to the ends of the polar axis. They form clear edges and light waves. The ends of sulcus give the outline of pollen grains, small depth and make them look as heteropolar.



Figure 3.15. *Sternbergia lutea*(L.)

Figure 3.16. Pollen grains *Sternbergia lutea* (L.) (1000X).

The exine has two layers. Its layers are almost equal. The sculpture of exine is reticulate. The reticulate cells are clear, multiangular and with size about 2 μm . The distance between holes is smaller than their width. Exine's thickness is about 1.5-2 μm .

The length of the pollen grains varies from 63- 67 (65) μm ; width 34-36 (35) μm .

Palynomorphological features of representatives of *Acis*, *Leucojum*, *Narcissus*, *Sternbergia* are expressed in Table 2.

Table 2. Palynomorphological features compared with species of these genera that are taken to study.

Nr	Species	The shape of pollen grains	Number of sulci	Sculptures	The thickness of exine (μm)	The length of pollen grains (μm)	The width of pollen grains (μm)
1	<i>Acis ionica</i>	Spheroidal - elliptical	Monosulcate	Foveolate or tectate perforate <1 μm	~1	24-27(25)	17-20(18)
2	<i>Leucojum aestivum</i>	Spheroidal - elliptical	Monosulcate	Microreticulate <1 μm	~ 1	36-42(39)	25-30(27)
3	<i>Narcissus serotinus</i>	Elliptical - elongated elliptical	Monosulcate	Microreticulate 1 μm	~ ~ 1	39-44(42)	25-28(26)
4	<i>Narcissus tazzeza</i>	Elliptical - elongated elliptical	Monosulcate	Microreticulate 1 μm	~ ~ 1	42-45(43)	22-24(23)
5	<i>Narcissus poeticus</i>	Elliptical - elongated elliptical	Monosulcate	Microreticulate 1- 1.5 μm	~ ~ 1.5	42-48(46)	22-25(24)
6	<i>Narcissus pseudonarcissus</i>	Elliptical - elongated elliptical	Monosulcate	Microreticulate 1 μm	~ ~ 1.5	57- 60 (59)	27-30 (29)
7	<i>Sternbergia colchiciflora</i>	Elliptical - elongated elliptical	Monosulcate	Reticulate μm	~ 2 ~ 1.5 -2	60-63(62)	29-31(30)
8	<i>Sternbergia lutea</i>	Elliptical - elongated elliptical	Monosulcate	Reticulate many angles about 2 μm	~ 1.5 -2	63-67(65)	34-36(35)

In Table 2, all representatives of the Amaryllidaceae family retrieved for the study are named monosulcate because they have only one sulcus.

The shape of pollen grains generally varies from elliptical to elongated elliptical.

The sculptures of exine in these species generally varies from foveolate or tectate perforate to microreticulate and reticulate.

Interesting is the fact that in the species that are studied we can find a correlation between the size of the reticulate cells and the size of the pollen grains.

From the data in Table 2 we conclude that the average pollen with longitudinal axis 25-43 μm , have microreticulate structure in which reticulate cells do not pass 1 μm and thickness of exine is about 1 μm .

For those pollen that have longitudinal axis within the ranges from 46-65 μm , the size of the reticulate cells has increased by 1.5 - 2 μm . Likewise also it's noted the biggest thickness of exine which varies from 1.5 - 2 μm .

By comparing the palynological features of representatives in this study we noted that these features are stable, so these features have only some small fluctuations. The study of palynomorphological features of Amaryllidaceae family that are studied with 1000X magnification optical microscope, allows us to get more information on the characteristics regarding these plants.

Conclusions

1. From the analysis of palynological features of representatives of Amaryllidaceae family we concluded that they are monosulcate, where pollen grain's shape varies from elliptical to elongated elliptical.
2. The sculpture in these species, generally varies from foveolate or tectate perforate to microreticulate and reticulate.
3. The average pollen grains with longitudinal axis of 25-43 μm , the size of the reticulate cells does not exceed 1 μm and the thickness of exine is about 1 μm .
4. For those pollen which longitudinal axis varies from 46-65 μm , the size of the reticulate cells varies

from 1.5 - 2 μm , while the thickness of exine varies from 1.5 - 2 μm .

5. By comparing the palynological features of representatives that are taken for this study we concluded that these features within a genus are stable, so these features have only some small fluctuations.
6. The data about *Acis ionica* are given for the first time in the world palynological literature.

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