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## **PALYNOLOGICAL STUDY OF *SCORZONERA DORIA* AND *HIERACIUM HOPPEANUM* (CICHORIEAE - ASTERACEAE) IN ALBANIA**

### **SUMMARY**

This paper presents the morphological features of the pollen grains of *Scorzonera doria* and *Hieracium hoppeanum* and the comparison of these features with other species of the genus *Scorzonera L.* and *Hieracium L.* The material for the study was taken from the National Herbarium in Tirana. Acetolysis and basic fuchsin methods were used to study the morphological features of *Scorzonera doria* and *Hieracium hoppeanum* pollen grains. The fixing of the pollen grains is made with glycerin gelatin. A light microscope was used to take photos and study the morphological features of the pollen grains. From the study of pollen grains of *Scorzonera doria* and *Hieracium hoppeanum*, results that they are tricolporate. The shape of pollen grains according to their outline is spheroidal and oblate-spheroidal. The exine appears thick, two-layered and its ornamentation is echinolophate.

### **INTRODUCTION**

*Scorzonera L.* and *Hieracium L.* are two genera of the tribe Cichorieae Lam. & DC., the first known and perhaps the most taxonomically studied tribe of the Asteraceae (Compositae) family (FUNK *et al.*, 2009). *Scorzonera L.* genus is represented by 180-190 species and is widespread in the mild and subtropical regions of Euroasia and North Africa (ZAIKA *et al.*, 2020). In Albania, *Scorzonera L.* genus is represented by 7 species, of which *Scorzonera doria* is an endemic-Balkan plant

(ANONYMOUS, 1988- 2000; QURESHI *et al.*, 2019) and is part of the Red List of Wild Flora of Albania (2013). Some species of *Scorzonera L.* genus are used as vegetables and as medicinal plants (QURESHI *et al.*, 2019).

*Hieracium L.* is a very diverse genus with about 500-10,000 species depending on the taxonomic concept. It consists of perennial herbaceous species distributed mainly in temperate areas of Europe, Asia and North America and in the mountains of Central and South America and some species have been introduced to Australia and New Zealand (FEHRER *et al.*, 2007). *Hieracium L.* genus is known for an extremely complex pattern of morphological variation and for a variety of reproductive strategies (such as sexuality and agamospermy). Its two subgenera, *Hieracium* subgenus and *Pilosella (Hill) S. F. Gray* subgenus are commonly distributed in Europe (ROTREKLOVÁ, 2008). These two subgenera are considered by many researchers as the most complicated taxonomic groups of vascular plants (SUDA *et al.*, 2007; GOÑALONS and SANZ, 2016). *Hieracium* subgenus is characterized by hybridization, apomixis and polyploidy. Apomixis is common in this genus, while sexual species are rare (GOÑALONS and SANZ, 2016). *Pilosella* subgenus is characterized by a mixture of sexually and facultatively apomictic taxa of the aposporous type (FEHRER *et al.*, 2007). In the Flora of Albania, *Hieracium* genus is represented by 39 species, including both *Hieracium* and *Pilosella* subgenera (ANONYMOUS, 1988- 2000).

As a result of the morphological diversity within *Scorzonera L.* and *Hieracium L.* genera, the number of studies in the palynological field has also increased for these two genera of the tribe Cichorieae Lam. & DC., family Asteraceae. The beginnings of studies of the pollen grains of *Scorzonera* species date back to 1935 with the work of Wodehouse (PINAR, 2016). Then these studies were followed by many other authors such as: ASKEROVA (1970; 1971; 1973); INCEOGLU and KARAMUSTAFA (1977); BLACKMORE (1982); NAIR and LAWRENCE (1985); MEO and KHAN (2004); OSMAN (2006); QURESHI *et al.*, (2008); TÜRKMEN *et al.*, (2010); BLACKMORE *et al.*, (2010); HAMZAOGLU *et al.*, (2010); COSKUNCELEBI *et al.*, (2012); KOYUNCU *et al.*, (2014); DAUTI (2016); PINAR *et al.*, (2016), presenting the changes both in the thickness of the exine of the pollen grains and in its ornamentation. The morphological features of the pollen grains for some *Hieracium* species have been made known and studied by DAUTI (2016); HALBRITTER (2016); HALBRITTER and SONNLEITNER (2016); ROTREKLOVÁ and KRAHULCOVÁ (2016); AUER (2020; 2021; 2022); HEIGL (2020; 2021).

In this paper, the palynomorphological study of *Scorzonera doria (Scorzonera L.)* and *Hieracium hoppeanum (Hieracium L. subgenus Pilosella)* species will be presented for the first time in the Albanian palynological literature. Also in this paper will be presented the comparison of the palynomorphological features of *Scorzonera doria* with the palynomorphological features of *S. mollis* and *S. purpurea* (DAUTI, 2016) as well as the comparison of the palynomorphological features of *Hieracium hoppeanum* with those of *Hieracium praealtum*

(subgenus *Pilosella*) and *Hieracium waldsteinii* Tausch (subgenus *Hieracium*) (DAUTI, 2016). These data will help to further complete the palynological studies for the Asteraceae family in the Flora of Albania, carried out by Albanian researchers.

## MATERIAL AND METHODS

The study material was taken from the National Herbarium, at the Museum of Natural Sciences, FNS, University of Tirana. Pollen was shaken from the flowers of the herbaceous plant into envelopes. The name of the plant and the details of the herbarium label are written on the envelope. To study the morphological characteristics of the pollen grains of *Scorzonera doria* and *Hieracium hoppeanum* plants we used acetolysis method of Erdtman (1956) and basic fuchsin method of SMOLJANINOVA and GOLLUBKOVA (1953). These methods of chemical processing of pollen grains samples are the most common in the preparation of the microscopic slides to be examined with a light microscope.

The preparation of permanent microscopic slides with pollen grains previously cleared by following one of the above methods was done with gelatin-glycerin, prepared according to Kissler method (SLLATKOV, 1967). Then the microscope slide were labeled, where the pollen grain sample data were listed. The palynological features of pollen grains were studied by the Digital Microscope/Camera Software, Motic Images Plus 2.0 ML, B1Series. The microscopic photos of pollen grains of the plants studied, are presented in polar and equatorial view with magnification 1000X, and are taken by Anxhela Dauti. The preparation of microscope slides and their study was carried out at the University 'A. Xhuvani', Elbasan.

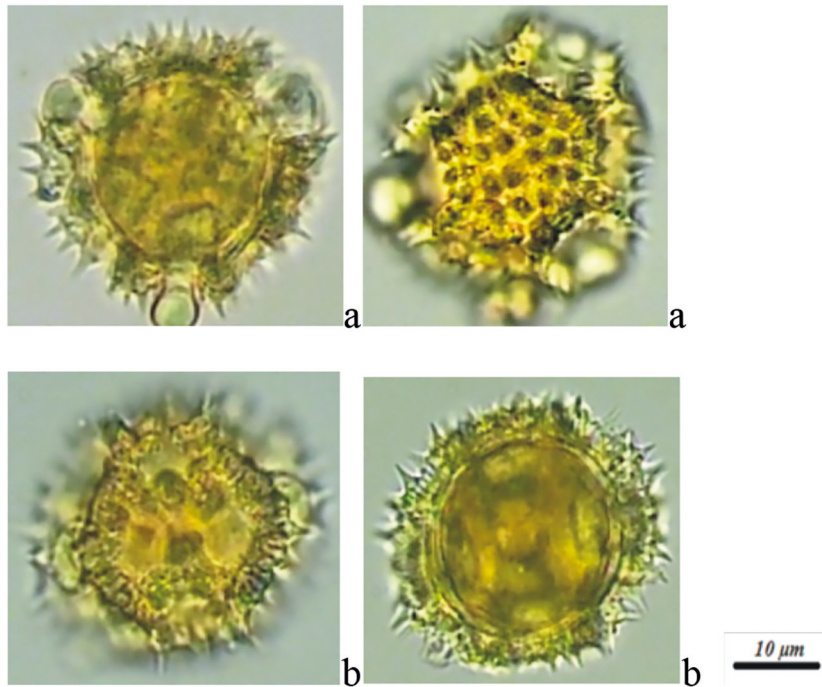
The terminology used in describing the characteristics of pollen grains is based on the one recommended by STIX (1960), ERDTMAN (1969), MOORE *et al.*, (1991), PUNT *et al.*, (1994), KAPIDANI (2005), PUNT *et al.*, (2007).

## RESULTS AND DISCUSSION

Genus: *Scorzonera L.*

*Scorzonera doria* Degen et Bald., Öster. Bot. Zeitschr. 46:417 (1896).

Hemicryptophytes. Herbaceous and perennial plant. Stems 10 - 45 cm. It grows in dry rocky places. It blooms in June – August (DEMIRI, 1983; ANONYMOUS, 1988-2000; VANGJELLI, 2018). It is part of the Red List of the Wild Flora of Albania (2013). Endemic - Balkan.



**Fig. 1-** Pollen grains *Scorzonera doria*; **a.** polar view; **b.** equatorial view (1000X).

The pollen grains are tricolporate. Polar axis varies from 38-42 (40)  $\mu\text{m}$ . The equatorial diameter varies from 38-42 (40)  $\mu\text{m}$ . The shape of pollen grains by outline is spheroidal ( $P/E = 0.95-1.05$ ). Exine is thick and two-layered. The sculpture of exine is echinolophate accompanied by a perforate structure in the base of the spines. The spines are thin, long and acuminate. The length of the spine is 3  $\mu\text{m}$ , while its width at the base varies from 1-2  $\mu\text{m}$ . The thickness of exine without spines varies from 4-5  $\mu\text{m}$ . Ectexine is much thicker than endexine. Ectexine varies from 3-4  $\mu\text{m}$ , while endexine is 1  $\mu\text{m}$ . The colpi are not clearly distinguishable. Mesocolpium varies from 19-22 (20)  $\mu\text{m}$  (Fig. 1).

Genus ***Hieracium* L.** Subgenus *Pilosella* (Hill) S. F. Gray.

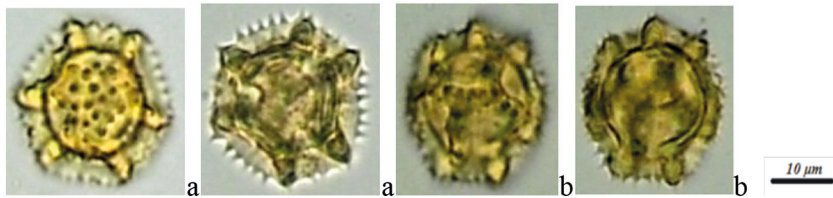
*Hieracium hoppeanum* Schultes, Österreichs. Fl. Ed. 2,2:428 (1814)

(=*Pilosella hoppeana* (Schult.) F.W.Schultz & Sch.Bip;

<http://www.theplantlist.org/tpl/record/gcc-104901>).

Hemicryptophytes. Herbaceous and perennial plant. It grows in subalpine and alpine pastures. It blooms in June – August (Demiri, 1983; Anonymous, 1988-2000; Vangjeli, 2018).

The pollen grains are tricolporate. The polar axis of pollen grains varies from 24-25  $\mu\text{m}$  (24.8  $\mu\text{m}$ ). Their equatorial diameter varies from 25-26  $\mu\text{m}$  (25.4  $\mu\text{m}$ ). In polar and equatorial view they have spheroidal shape. The shape of pollen grains by outline is oblate spheroidal ( $P/E = 0.96-1.00$ ). Exine is with echinate sculpture of echinolophate type (fenestrate).



**Fig. 2-** Pollen grains *Hieracium hoppeanum*; **a.** polar view; **b.** equatorial view (1000X).

The spines of the ridge are small and sharp. The length of the spine varies from 2-2.5  $\mu\text{m}$ , its width at the base is 1  $\mu\text{m}$ . The thickness of the exine without spines is 3  $\mu\text{m}$ . The ectexine is slightly thicker than endexine. Ectexine is 2  $\mu\text{m}$ , while endexine is 1  $\mu\text{m}$ . Mesocolpium of pollen grains varies from 10-11  $\mu\text{m}$ . The pore appears with circular outline. Its diameter varies from 4-5  $\mu\text{m}$  (Fig. 2).

**Tab. 1-** Comparative table of morphological features of *Scorzonera* pollen grains

Palynomorphological features	<i>Scorzonera doria</i>	<i>Scorzonera mollis</i>	<i>Scorzonera purpurea</i>
Polar axis (P) ( $\mu\text{m}$ )	38-42 (40)	44-49 (45.9)	45 - 48 (46.1)
Equatorial diameter (E) ( $\mu\text{m}$ )	38-42 (40)	44-49 (46.5)	45-48 (45.9)
Thickness of exine without spines ( $\mu\text{m}$ )	4 - 5	5 - 6	4 - 5
Length of spine ( $\mu\text{m}$ )	3	3 - 4	2 - 3
Width of spine ( $\mu\text{m}$ )	1 - 2	1.5 - 2	1 - 2
Mesocolpium ( $\mu\text{m}$ )	19 - 22 (20)	24 - 28 (25.1)	23 - 26 (24.7)
The shape of pollen grains (P/E)	spheroidal	spheroidal	spheroidal
Sculpture of exine	echinolophate-perforate	echinolophate-perforate	echinolophate-perforate
Aperture type	tricolporate	tricolporate	tricolporate

In the Tab. 1 are shown the characteristics of the pollen grains of *Scorzonera doria* and two other *Scorzonera* species taken from the Albanian palynological literature (Dauti, 2016). Based on the data in Tab. 1, we notice that there are similari-

ties between *Scorzonera* species but also differences in the palynomorphological features obtained in the study. Regarding the shape of the pollen grains according to the contour, the sculpture of the exine, the type of aperture and the width of the spines at the base, we notice that they are similar in *Scorzonera* species. Differences between *Scorzonera* species can be seen in the size of the pollen grains, which is larger in the *S. mollis* and *S. purpurea* species. Other changes can also be observed in features such as: the thickness of exine, the length of spine and the size of mesocolpium, which result larger in pollen grains of *S. mollis*.

**Tab. 2-** Comparative table of morphological features of *Hieracium* pollen grains

Palynomorphological features	<i>Hieracium hoppeanum</i> (subgenus <i>Pilosella</i> )	<i>Hieracium praealtum</i> (subgenus <i>Pilosella</i> )	<i>Hieracium waldsteinii</i> (subgenus <i>Hieracium</i> )
Polar axis (P) (µm)	24-25 (24.8)	26-31 (28)	27-34 (29.5)
Equatorial diameter (E) (µm)	25-26 (25.4)	26-30 (28.5)	29-34 (30.5)
Thickness of exine without spines (µm)	3	3 - 4	2.6 – 3.5 (3)
Length of spines (µm)	2 - 2.5	2	2 - 3
Width of spines (µm)	1 - 1.5	0.5 - 1	1.3 - 2
Diameter of pores (µm)	4 - 5	5 - 6	5.5
Mesocolpium (µm)	10 - 11	13 - 15 (14)	14 - 18.5
The shape of pollen grains (P/E)	oblate spheroidal	oblate spheroidal to spheroidal	oblate spheroidal to spheroidal
Sculpture of exine	echinolophate	echinolophate	echinolophate
Aperture type	tricolporate	tricolporate	tricolporate

The palynomorphological features of *Hieracium hoppeanum* that are being studied and those of the two other *Hieracium* species taken from the Albanian palynological literature (DAUTI, 2016) are reflected in Tab. 2. From the data of this table, we notice that features such as: the shape of the pollen grain according to the outline, the type of aperture and the sculpture of exine are similar in *Hieracium L.* species. The palynomorphological features such as: the thickness of exine, the length of spines, the width of spines and the diameter of the pore result in very small differences between *Hieracium L.* species. Regarding the characteristics, the size of the pollen grain and mesocolpium are different between *Hieracium L.* species. The size of pollen grain and mesocolpium are larger in *Hieracium waldsteinii* species.

Comparing the two genera *Scorzonera L.* and *Hieracium L.* from the palynomorphological data presented in Tabs. 1 and 2, it turns out that there are obvious differences between them. The size of pollen grain, the thickness of exine and the mesocolpium are larger in *Scorzonera* species. Regarding the feature of the spine length, it turns out that there are no big differences between the two genera. However, at slightly higher values, this palynomorphological feature results in *Scorzonera* species. Differences between the genera *Scorzonera L.* and *Hieracium L.* are also seen in the sculpture of exine. In *Scorzonera* species, the sculpture of exine is echinolophate and perforate, while in *Hieracium* species, the sculpture of exine is only echinolophate.

## CONCLUSIONS

The palynomorphological data of *Scorzonera doria* and *Hieracium hoppeanum* species with the light microscope show obvious differences, not only within the genera *Scorzonera L.* and *Hieracium L.* respectively, but also between the two genera. The size of pollen grain, the thickness of exine, the length of spine and the size of mesocolpium result as distinctive features within *Scorzonera L.* genus. The size of pollen grain and mesocolpium are smaller in *Scorzonera doria*. In *Hieracium L.* genus, the size of pollen grain and mesocolpium are the distinguishing features between the species, which are smaller in *Hieracium hoppeanum* species. Between *Scorzonera L.* and *Hieracium L.* genera there are also morphological features of the pollen grains, which make these genera distinct from each other within the tribe Cichorieae Lam. & DC.

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