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POLLEN FEATURES OF HAZELNUT (*CORYLUS AVELLANA* L.) FROM DIFFERENT HABITATS

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Abstract. The aim of this work was to study general morphological characteristics of pollen grains of *Corylus avellana* L. Seven samples of pollen were investigated. Samples were collected from different habitats in Ukraine – from botanical gardens (Kyiv, Kamianets-Podilskyi) and natural habitats (Kyiv region, Kamianets-Podilskyi, and Sumy region). We studied such morphological traits of pollen grains as length of polar and equatorial axes, diameter of pores, and shape of the pollen grain (elongation index). Analysis of morphological characters of pollen was carried out using electron microscope. Comparison of data was performed with the data of the base polleninfo.org. During research the differences in these parameters were marked. Pollen grains of *C. avellana* are generally isopolar, from suboblate to oblate or oblate-spheroidal, and contain 3 pores. The article contains an attempt to explain the size variations noted for the pollen collected from different habitats.

Key words: *Corylus avellana*, pollen, polar axis, equatorial axis, shape of pollen

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Introduction

Corylus avellana L. is one of the earliest pollen allergen in Europe, and represents the Betulaceae family. Pollen allergy (pollinosis) is a common disease realized through hypersensitivity reaction of the respiratory tract and eye's conjunctivae to pollen grains. Pollen grains are composed of proteins, specific allergens that can cause allergic diseases in humans and animals. Hazelnut pollen has been detected in aerobiological studies in Zagreb, Croatia; Lublin, Poland; Skein, Norway; Crete and Thessaloniki, Greece. Moreover, there is commercial cultivation of C. avellana in USA (Oregon), Turkey, Spain, Italy, and Iran (Peltre *et al.* 1988).

The pollen of *C. avellana* provides allergic reaction already at the concentrations of 20-30 grains per m^3 per 24 h. Values greater than 80 grains per m^3 per 24 h produce allergic symptomatology in 90% of patients (Vik *et al.* 1991). These studies swowed that *C. avellana* pollen allergy may result in aggravation of winter respiratory symptoms. Diagnostic of polynosis in Kyiv (Ukraine) was revealed the hypersensitivity to pollen grains of *C. avellana* in 57.1% of patients (Vityk 2008).

In conditions of environmental pollution, pollen adsorbs and accumulates xenobiotics that in hundreds of times increase the immunogenicity, and promote changes in the structure of allergens (Peltre *et al.* 1988, 1990; Urbanekr 1993). One of the main reasons for increasing of allergic diseases is the deterioration of environmental conditions.

The aim of this work was to define such morphological features of pollen grains in *C. avellana* as: length of polar and equatorial axes, form of the pollen grains, and diameter of pore.

Material and methods

We used seven samples of *C. avellana* pollen grains, collected during the flowering period from N.N. Grishko National Botanical Garden in Kyiv (NBG), A.V. Fomin Botanical Garden in Kyiv (BGF), and Botanical Garden in Kamianets-Podilskyi (BG), Mariinsky Park

in Kyiv; as well as from such natural habitats as outskirts of the village Mikulichi (Kyiv region), the outskirts of Kamianets-Podilskyi (near cement plant), the outskirts of village Ternovka (Sumy region). Pollen grains were studied at the Institute of Biodiversity and Biological Safety of Slovak Agricultural University in Nitra using an electron microscope Carl Zeiss LS 15. The samples of pollen grains were applied to double-tape, fastened to metal object's tables with a diameter of 10 mm. Measurement of morphometric parameters were performed on 80 pollen grains from each genotype using the program AxioVision Rel. 4.8.2.0. The characterization of pollen grains was calculated by taking the following parameters: the polar axis (P – line connecting the proximal and distal pole), the equatorial axis (E – a line perpendicular to the polar axis and located in the equatorial plane), and the diameter of the pores (this is a round aperture in which the ratio of length to width is less than two). For describing the morphological features of pollen grains we used standard terminology (Kremp 1967; Meyer-Melykyan 1987; Punt *et al.* 2007). The form of pollen grains (elongation factor) was installed by the ratio of the polar axis to the value of the equatorial diameter (P/E). For the analysis of the forms of pollen grains the classifier "The forms of pollen grains" (Meyer-Melykyan *et al.* 1999), and for analysis of sizes – classifier by Tokarev (2002) were applied. The types of textures were described by the methodology of Bucher *et al.* (2004). The comparison of received results was conducted applying Student *t*-test and *F*-test (Fisher's exact test), accordingly to the standard procedure.

Results and discussion

Pollen grains of *C. avellana* (18×26 μm) are tripolar with deep oncusis (lenticular spherical structures, which are unstable to acetolysis and placed at apertures) in each pore (Hyde & Adams 1958; Hofman & Michalik 1998). They are characterized as angle-apertures (Erdtman 1952): equatorial apertures and apertures which are located in every corner of the pollen grain. According to previous studies of pollen grains in hazelnut (Dyakowska 1959), the average weight of pollen grains is 9.45 ng (1 ng = 10^{-9} g), and the average diameter is 24.20 μm, the rate of fall in still air is 2.90 cm/sec.

Pollen grains of *C. avellana* are smooth, 3-pored, grain with a sub-triangular polar view and sub-oblate equatorial view (Godwin 1975). The surface sculpturing is with tiny scabrae on the ridges (Moore *et al.* 1991), but usually appears smooth after preparation (Fig. 1).

Accordingly to polleninfo.org database (Pollenatlas 2013), pollen grains of *C. avellana* are characterized by following features. Shape: round, triangular in polar view, oval in equatorial view; size: polar axis 27.3 (25-31) μm, equatorial axis 28.9 (26-31) μm; appertures: tripolar pollen grains, pores are 2-3 μm in diameter; pollen shell: thin, rough exine, thin intina with a very large bulge regions (lenticular structures); additional attributes: granular cytoplasm.

The results of conducted measurements of *C. avellana* pollen grains are represented in Tab. 1:

1) the coefficient of variation of the polar axis of the greatest significance is 7.52% (BG, Kamianets-Podilskyi), and the lowest value – 3.91% (BGF, Kyiv);

2) the coefficient of variation of the equatorial diameter of the greatest significance is 8.07% (outskirts of the v. Mikulichi, Kyiv region), and the lowest – 5.2% (BGF, Kyiv);

3) the coefficient of variation of the form of pollen grain has the greatest value 10.45% (outskirts of the v. Mikulichi, Kyiv region), and the lowest – 6.94% (BGF, Kyiv);

4) the coefficient of variation of the diameter of the pores of the greatest significance is 19.82% (Mariinsky Park, Kyiv), and the lowest – 13.97% (outskirts of the v. Mikulichi, Kyiv region).

Average values for the length of the polar axis remained from 24.92 to 27.93 μm and equatorial diameter – from 25.47 to 28.75 μm. Value of the form of pollen grains ranged from 0.91 to 0.98.

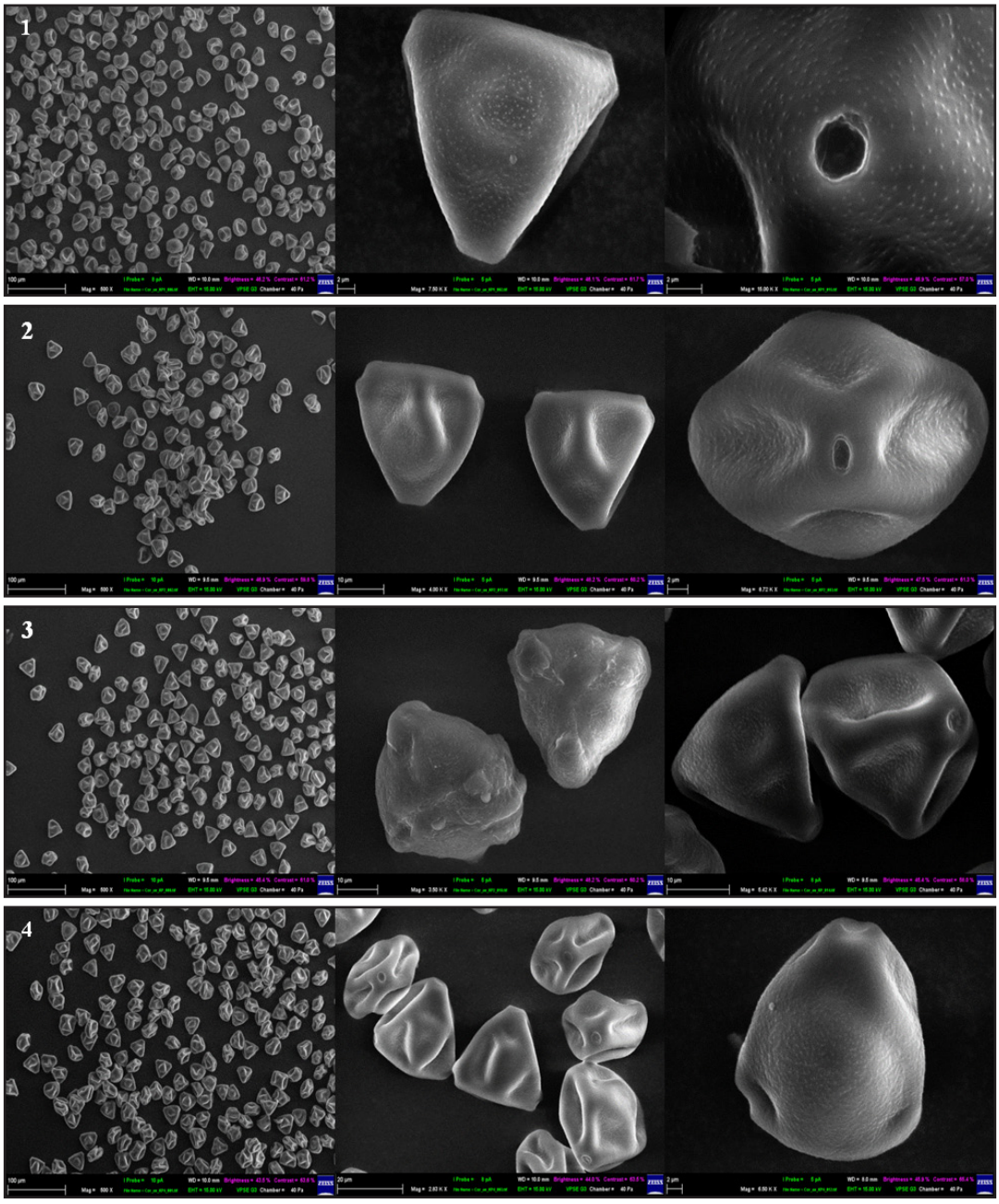

Fig. 1. Pollen grains of *Corylus avellana* collected from different habitats: **1** – NBG (Kyiv); **2** – BGF (Kyiv); **3** – Maryinsky Park (Kyiv); **4** – BG (Kamianets-Podilskyi); **5** – outskirts of Kamianets-Podilskyi; **6** – outskirts of v. Ternovka (Sumy region); **7** – outskirts of the v. Mikulichi (Kyiv region) (Photos by Ostrovsky, 2013). Continuation see next page.

The correlation coefficient of pollen grains *C. avellana* varies from +1 to –1, as shown on Fig. 2. Positive correlation is inherent in such samples of pollen as: 1 – NBS (Kyiv); 3 – Mariinsky park (Kyiv); 6 – outskirts of v. Ternovka (the largest coefficient is 0.17); 7 – outskirts of v. Mikulichi (the lowest value is 0.004). A negative correlation was noted in the

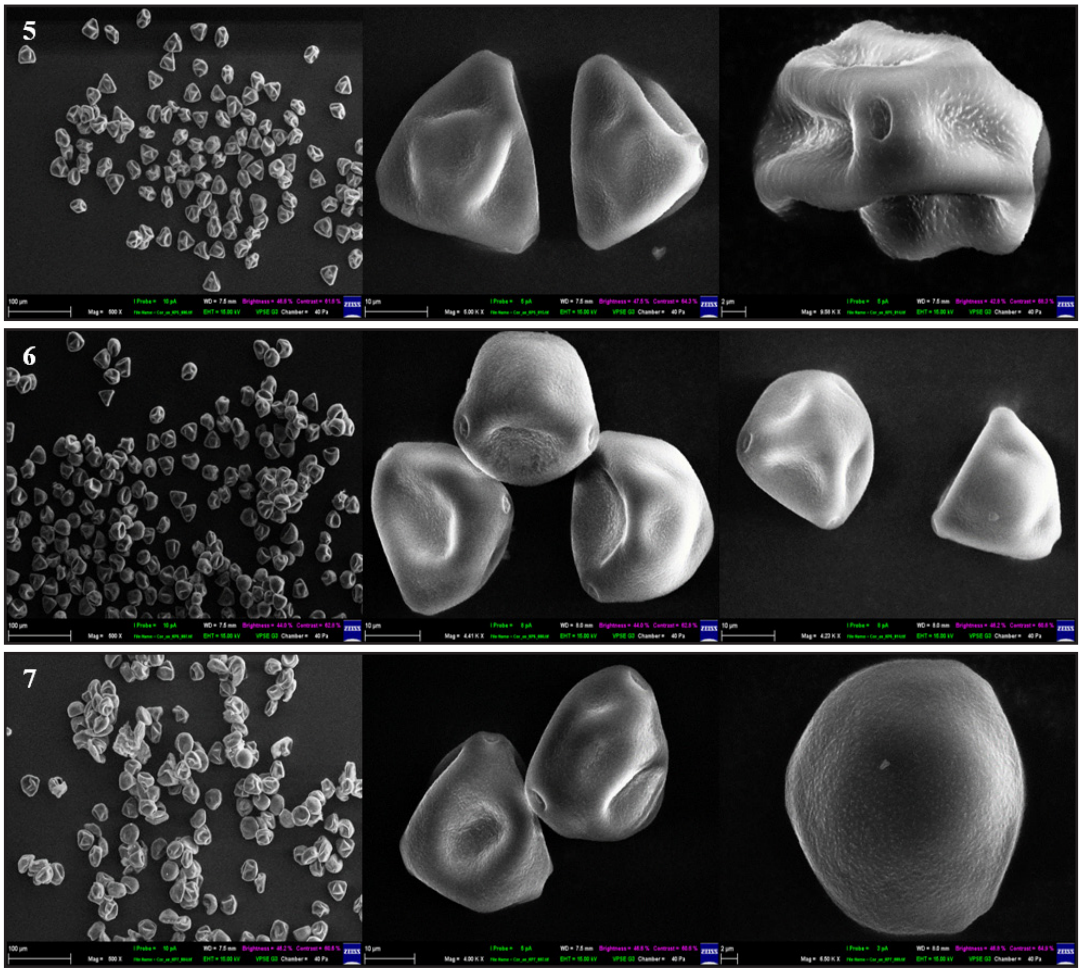

Fig. 1. Continued.

following pollen samples: 2 – BSF, Kyiv (the largest value is –0.09); 4 – Botanical Gardens of Kamianets-Podilskyi (the lowest value is –0.04); 5 – outskirts of v. Ternovka.

Conclusions

Studies have focused on the morphological features of pollen grains of *C. avellana*, namely on the diameter of polar and equatorial axes, the shape of the pollen grain, and the pore diameter. Statistical differences were found in the measurement of the polar axis of the pollen grains (optimal values correspond to a sample from v. Mikulichi, and the least – to the sample from NBG), equatorial diameter (values correspond to the normal in samples from BS Kamianets-Podilskyi and v. Mikulichi, and are minimal – in sample from v. Ternovka), the form of pollen grain (it excesses of normal value in the samples from v. Ternoka and v. Mikulichi). The diameter of the pores is in the normal range in all of the samples. Pollen grains of *C. avellana* have the following morphological features: the state of aggregation – monads, the form – from oblate-spheroidal to spheroidal, and the symmetry – radial symmetrical isopolar, the shape of the equatorial projection – rounded and flattened-round, the size – small and medium, on the position – rounded-triangular, the apertures – contains of 3 pores, the sculpture – pitted. Average values for the length of the polar axis remained within 24.92-27.93 μm, and equatorial diameter was

Table 1. Measurements of morphological traits of *Corylus avellana* pollen grains: **min** – minimum value; **max** – maximum value; **x** – arithmetic mean; **S** – standard error; **CV%** – variation coefficient; **Polleninfo** – results from the database (Pollenatlas 2013).

Place of sampling	min	max	x	S	CV%	Polleninfo
Polar axis, μm (P)						
NBG (Kyiv)	21.55	28.26	24.92	1.51	6.07	27.30 (25-31)
BGF (Kyiv)	24.12	30.12	26.50	1.03	3.91	
Mariinsky Park (Kyiv)	21.42	29.00	25.06	1.53	6.11	
BG (Kamianets-Podolskyi)	17.57	30.43	26.21	1.97	7.52	
Outskirts of Kamianets-Podilskyi	22.40	28.97	25.78	1.32	5.15	
Outskirts of v. Ternovka	20.68	28.54	25.12	1.68	6.71	
Outskirts of v. Mykulichi	23.83	31.27	27.93	1.59	5.69	
Equatorial axis, μm (E)						
NBG (Kyiv)	22.42	32.10	26.72	1.72	6.45	28.90 (26-31)
BGF (Kyiv)	24.04	30.44	27.92	1.45	5.20	
Mariinsky Park (Kyiv)	23.48	29.96	27.07	1.42	5.24	
BG (Kamianets-Podolskyi)	25.69	32.44	28.75	1.67	5.83	
Outskirts of Kamianets-Podilskyi	22.94	31.54	27.70	1.81	6.54	
Outskirts of v. Ternovka	22.13	28.47	25.47	1.59	6.24	
Outskirts of v. Mykulichi	21.36	33.54	28.42	2.29	8.07	
Shape of the pollen grain (P/E)						
NBG (Kyiv)	0.76	1.31	0.93	0.07	7.86	0.94
BGF (Kyiv)	0.79	1.41	0.95	0.06	6.94	
Mariinsky Park (Kyiv)	0.76	1.11	0.92	0.07	7.94	
BG (Kamianets-Podolskyi)	0.58	1.13	0.91	0.08	9.70	
Outskirts of Kamianets-Podilskyi	0.74	1.15	0.93	0.08	8.73	
Outskirts of v. Ternovka	0.76	1.19	0.98	0.08	8.33	
Outskirts of v. Mykulichi	0.81	1.40	0.98	0.10	10.45	
Diameter of pore, μm						
NBG (Kyiv)	1.68	3.35	2.57	0.37	14.37	2.00-3.00
BGF (Kyiv)	1.68	3.40	2.57	0.37	14.34	
Mariinsky Park (Kyiv)	1.68	3.40	2.46	0.48	19.82	
BG (Kamianets-Podolskyi)	1.68	3.75	2.70	0.41	15.40	
Outskirts of Kamianets-Podilskyi	1.68	3.40	2.59	0.41	15.86	
Outskirts of v. Ternovka	1.68	3.54	2.50	0.42	16.75	
Outskirts of v. Mykulichi	1.68	3.40	2.57	0.36	13.97	

from 25.47 to 28.75 μm. Value of the form of pollen grains ranged from 0.91 to 0.98, which characterizes the pollen grains of *C. avellana* (by elongation index) like from oblate-spheroidal to spheroidal.

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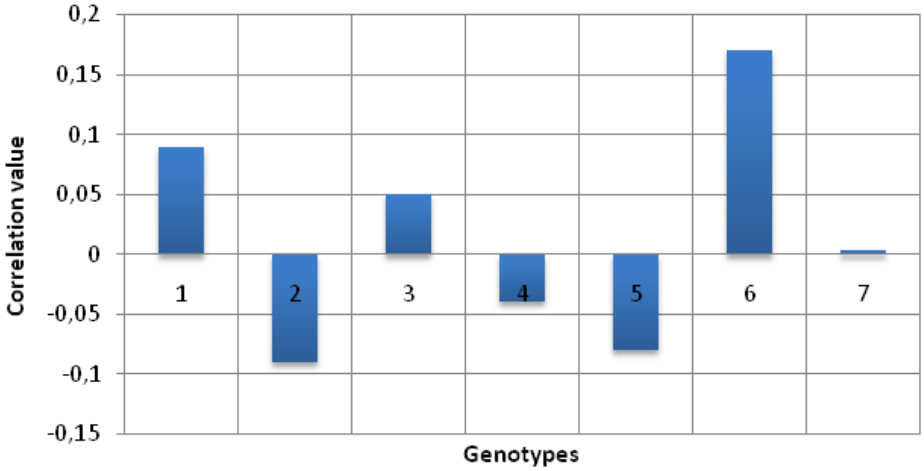

Fig. 2. The correlation coefficient of morphometric characteristics of pollen grains of *Corylus avellana*.

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