Analysis of Corylus pollen season in Poland in 2020

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Abstract:

In Poland hazel is one of the earliest flowering plants and in phenology it belongs to indicator plants that mark the beginning of early spring. Hazel pollen grains contain allergens that are a cause of pollen allergy during the early spring period. The aim of the present study was to compare *Corylus* pollen seasons in 2020 in the following 11 cities located in different regions of Poland: Szczecin, Bydgoszcz, Zielona Gora, Wroclaw, Opole, Sosnowiec, Piotrkow Trybunalski, Warsaw, Lublin, Olsztyn, and Bialystok. This research was conducted using the volumetric method and Burkard or Lanzoni pollen samplers. Pollen season duration was determined by the 95% method. This study analyzed the specific parameters of the pollen season (start, end, peak value, peak date, annual total) and also determined the number of days with a concentration exceeding the threshold values at which the first allergy symptoms in people sensitized to hazel pollen and symptoms in all allergic patients occur, respectively. The hazel pollen season in 2020 began relatively early, between January 11th and February 2nd. The season start was recorded earliest in Opole and latest in Olsztyn and Bialystok. The study found that the pollen season started earlier in the western part of Poland than in the eastern regions. The highest maximum *Corylus* pollen concentration was recorded in Lublin (388 P/m^3), whereas the lowest one in Bydgoszcz (48 P/m^3). The maximum daily concentration of *Corylus* pollen grains was recorded in different periods in the individual cities, while the peak concentration values occurred between January 31th and March 4th. The highest risk of allergy in people sensitive to the pollen of this taxon was found in Lublin since the most days with a pollen concentration exceeding the threshold value were observed in this city. Lublin was found to have the highest annual total values and they were 1.6–5.6 times higher than in the other cities. The highest annual pollen sums and peak values as well as the highest number of days with a concentration exceeding the threshold value had also been recorded in Lublin previously.

Key words: aeroallergens, pollen concentration, risk of allergy, hazel, 2020

Introduction

The pollen of hazel (*Corylus*) is one of the more important sources of allergens in Europe. In Poland 11% of people have been found to be sensitized to the pollen of this taxon [1]. A significant number of patients exhibiting symptoms of allergy to *Corylus* pollen

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has been recorded in Switzerland [2], Hungary [3], and Turkey [4].

Corylus belongs to the family *Betulaceae*. Alder (*Alnus sp.*), birch (*Betula sp.*), and hornbeam (*Carpinus sp.*) are classified in the same family. Because the pollen of the above-mentioned genera contains allergens showing homology, their simultaneous presence in the air can lead to cross reactions in allergic people [5].

The genus *Corylus* includes shrubs, e.g. common hazel (*Corylus avellana*), and trees such as Turkish hazel (*Corylus colurna*). The abundance of common hazel pollen can be evidenced by an impressive number of pollen grains (over 8 mln) released by one inflorescence called catkin [6]. During the growing season, hazel sheds pollen earliest of all anemophilous trees and in phenology the beginning of flowering of *Corylus avellana* is considered to be the beginning of early spring.

The onset and characteristics of the *Corylus* pollen season greatly depend on weather conditions before and during flowering. Due to the above, large differences are observed in pollen release dates for this taxon [7]. In an earlier study, it was shown that in Poland in the 1950's the beginning of flowering of *Corylus* female flowers occurred in March [8]. In recent years, on the other hand, the beginning of hazel flowering most frequently took place much earlier, already at the end of January [9, 10]. *Corylus* pollen production, release, and dispersal are significantly affected by meteorological factors, among them temperature, precipitation, humidity, sunlight hours, and wind speed [7, 11].

Many studies have demonstrated that climate warming has an impact on plant flowering times and pollen abundance [12, 13]. Earlier flowering of plants [11] as well as shortened and more intense pollen seasons are recorded [14].

Aim

The aim of the study was to compare the hazel pollen concentration in the air of selected cities in Poland in 2020.

Material and method

Measurements of airborne hazel pollen concentration were carried out in Szczecin, Bydgoszcz, Zielona Gora, Wroclaw, Opole, Sosnowiec, Piotrkow Trybunalski, Warsaw, Lublin, Olsztyn, and Bialystok in 2020. Aeroplankton samples were collected using the volumetric method and Burkard or Lanzoni pollen samplers. Microscopic observations were performed on preparations obtained in a 7-day cycle with assessment of 24-hour periods. Pollen concentrations were expressed as the number of pollen grains in 1 m^3 of air per day (P/m^3). The duration of the hazel pollen seasons was determined by the 95% method. The start and end of the season were defined as the date when 2.5% and 97.5% of the seasonal cumulative pollen count was trapped, respectively. The study compares the start and end dates of the pollen season, maximum concentrations, annual total and the number of days with a pollen concentration of 35 P/m^3 and 80 P/m^3. The first allergy symptoms in subjects sensitized to hazel pollen and symptoms in all allergic patients occur at these threshold values [15].

Results

In Poland in 2020 the start of the hazel pollen season occurred between January 11th and February 2nd (tab. 1). The earliest start of the season was recorded in Opole, whereas the latest one in Olsztyn and Bialystok. In the cities located in the western part of Poland (Szczecin, Zielona Gora, Wroclaw), the pollen season began in the middle of January. The pollen season ended in the first week of March (between March 3rd and 7th) in most of the cities, but in Sosnowiec and Lublin it lasted until March 14th, whereas in Bydgoszcz and Olsztyn until March 22th and March 23th, respectively. Multiple peaks can be noted in the daily airborne pollen concentrations. High pollen concentrations occurred several times during the pollen season and they were separated by days on which the pollen concentrations were at a low level. The periods of high pollen concentration were similar in most of the cities and they occurred at the turn of January and February, in the middle of February, and at the beginning of March (fig. 1–6). The maximum hazel pollen concentrations were recorded in the individual cities on different dates, between January 31th and March 4th (tab. 1). The seasonal peak values ranged 48 P/m^3 – 388 P/m^3. The highest pollen concentration was recorded in Lublin, while the lowest one in Bydgoszcz. In the other cities, the peak value was from 98 P/m^3 to 178 P/m^3. The most days with a concentration exceeding the threshold value of 35 P/m^3 were observed in Lublin and Warsaw (13 days), followed by Zielona Gora (11 days) and Piotrkow Trybunalski (10 days). The fewest days with the above-mentioned pollen concentration were recorded in Olsztyn (1 day) and in Szczecin, Bydgoszcz, and Bialystok (2 days). The number of days with a pollen

Table 1. *Characteristics of Corylus pollen season in 2020.*

Site	Pollen season period by the 95% method	Peak value [P/m³]	Peak date	Days number with concentration above threshold		Annual pollen sum
				35 P/m³	80 P/m³	
Szczecin	15.01–07.03	124	31.01	2	1	542
Bydgoszcz	1.02–22.03	48	4.03	2	0	459
Zielona Gora	15.01–7.03	98	31.01	11	3	1168
Wroclaw	15.01–2.03	154	16.02	6	3	677
Opole	11.01–7.03	132	1.02	7	3	917
Sosnowiec	31.01–14.03	178	16.02	5	1	1030
Piotrkow Trybunalski	20.01–7.03	146	16.02	10	3	1124
Warsaw	16.01–5.03	133	16.02	13	3	1260
Lublin	1.02–14.03	388	17.02	13	7	2080
Olsztyn	2.02–23.03	99	4.03	1	1	395
Bialystok	2.02–6.03	122	4.03	2	1	371

concentration of more than 80 P/m³ was highest in Lublin (7 days), whereas in Bydgoszcz no such days were recorded. 1 or 3 days on which the pollen concentration exceeded the threshold value of more than 80 P/m³ were observed in the other cities. The highest annual total value (2080 pollen grains) was recorded in Lublin and it was 1.6–5.6 times higher than in the other cities. In 2020 the fewest hazel pollen grains were recorded in Bialystok (371).

Discussion

In 2020 the hazel pollen content in the air of Lublin much exceeded the annual pollen sums and maximum daily pollen concentrations of this taxon found in the other 10 cities of Poland. The annual *Corylus* pollen sum in Lublin was 40% higher than the total annual pollen count recorded in Warsaw, where the value of this parameter ranked second among the cities in which the study was carried out in the year in question. It is worth noting that in a long-term study the *Corylus* pollen concentrations were also much higher in Lublin than in other cities of Poland [16].

However, the annual pollen sum shown in Lublin in 2020 reached a record value compared to the study results found in this city in the previous years. The *Corylus* pollen seasonal curves for the years 2020 and 2019 as well as the average pollen season determined based on the last 10 years are presented for comparison. Clear differences can be seen in the pattern of the seasons and they indicate a much higher *Corylus* pollen production over the last two years than in the previous years (fig. 6). It can be presumed that the recorded changes are a result of a temperature increase that has occurred in Lublin during the last decades [13, 17]. In 2020 the maximum *Corylus* pollen concentrations occurred at the studied sampling sites on different dates, between January 31th and March 4th. A great variation in the dates corresponding to the highest pollen concentrations was also found in 2018, though the most intense pollen release occurred a month later (March 3rd – April 4th) [18].

In 2020 the onset of the hazel pollen season took place relatively early at all the sampling sites in Poland, as it occurred between January 11th and February 2nd. The start of this taxon's pollen season was recorded much later in 2019 (February 5th – February 18th) [19] and in 2018 (January 25th – March 3rd) [18]. We found that in the three above-mentioned years of the study the season started earliest in the western part of Poland and latest in the eastern regions of the country.

Lublin was shown to exhibit the greatest risk of allergy to *Corylus* pollen, which is associated with the highest pollen concentration and the highest number of days on which the pollen concentration exceeded the threshold values. In the season studied, there was also a significant risk to allergy sufferers in Warsaw, Zielona Gora, and Piotrkow Trybunalski. Lublin and Piotrkow Trybunalski also belonged to the cities that exhibited the highest risk of allergy to this taxon's pollen in the two previous years [18, 19].

Figure 1. *Corylus pollen concentration in Szczecin and Sosnowiec in 2020.*

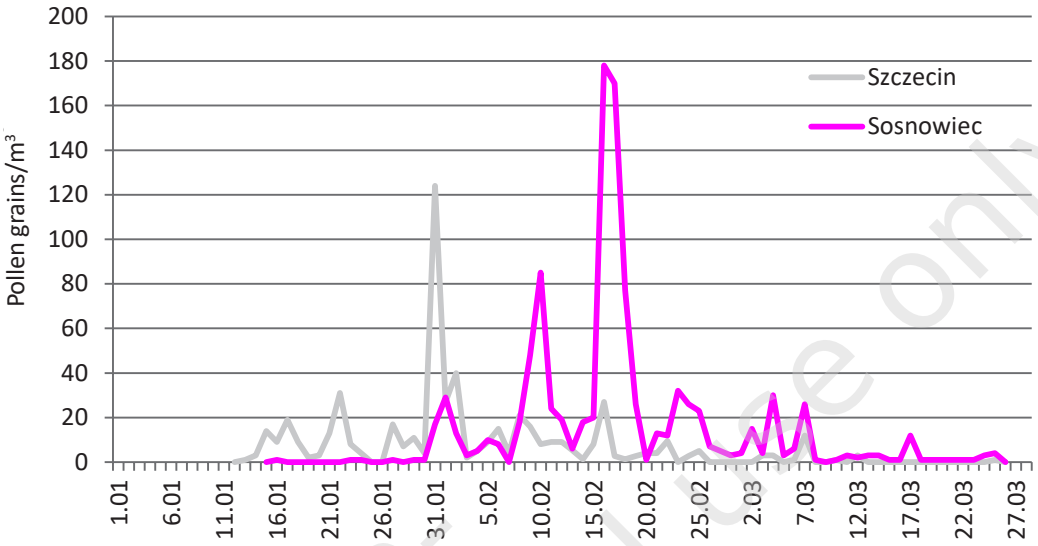


Figure 2. *Corylus pollen concentration in Zielona Gora and Opole in 2020.*

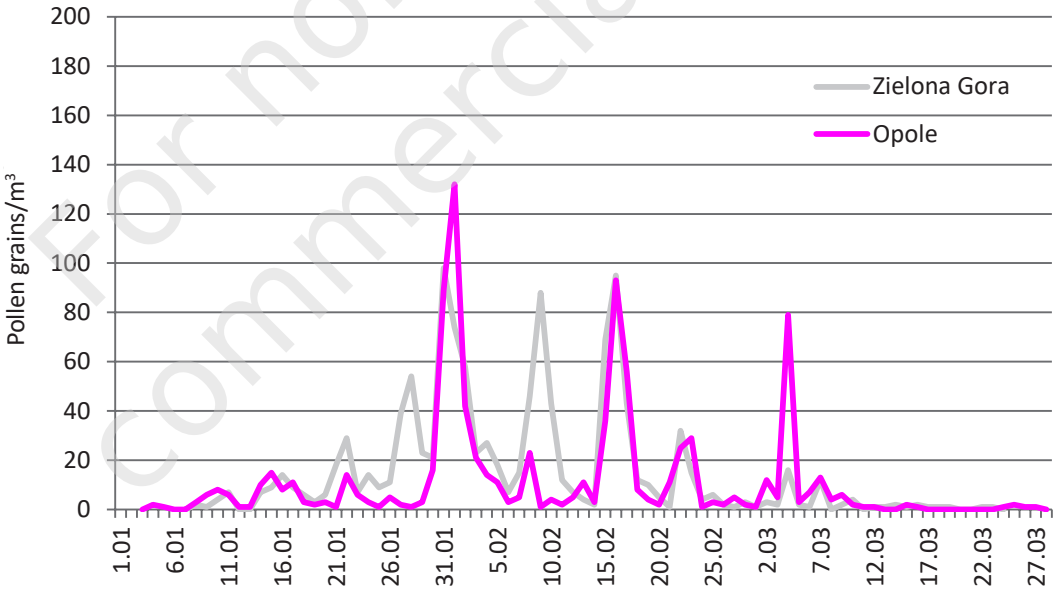


Figure 3. *Corylus pollen concentration in Warsaw and Piotrkow Trybunalski in 2020.*

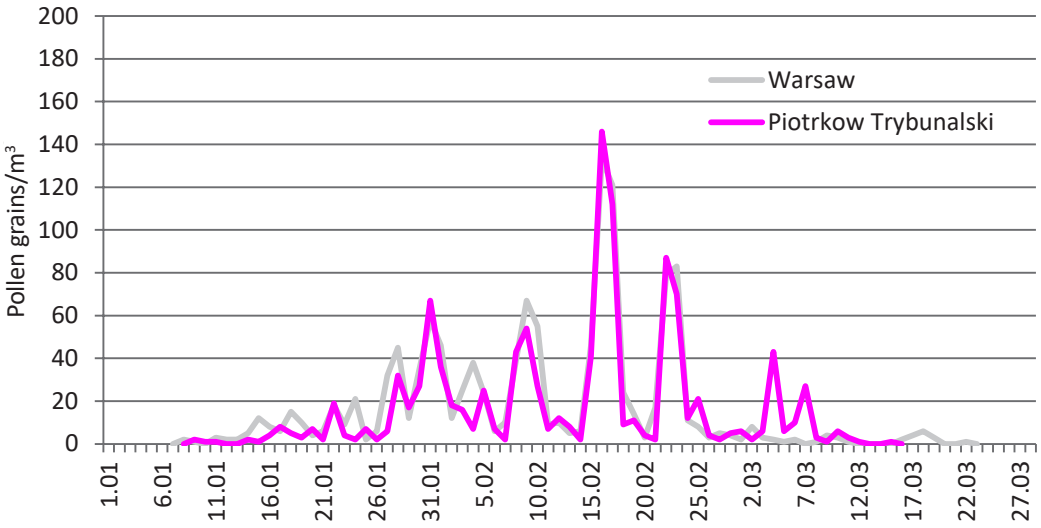


Figure 4. *Corylus pollen concentration in Bydgoszcz and Wroclaw in 2020.*

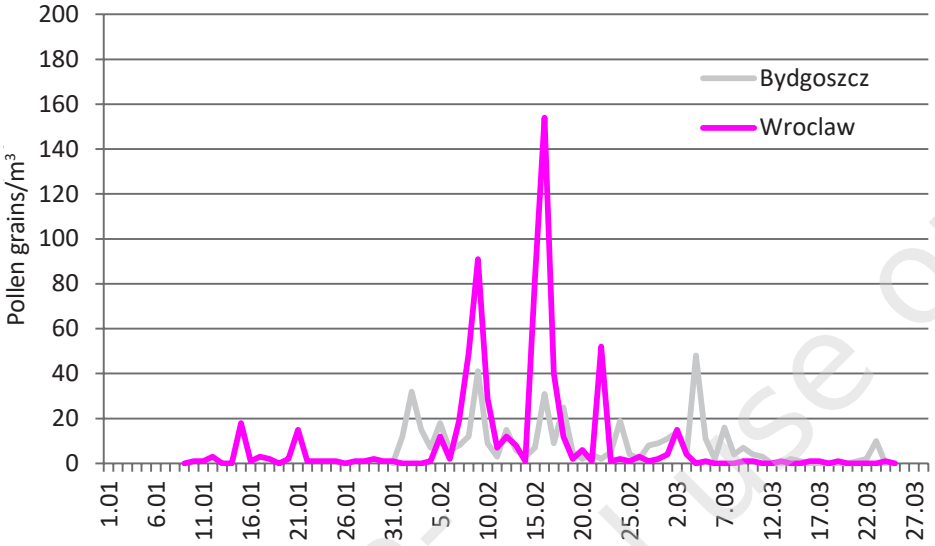


Figure 5. *Corylus pollen concentration in Bialystok and Olsztyn in 2020.*

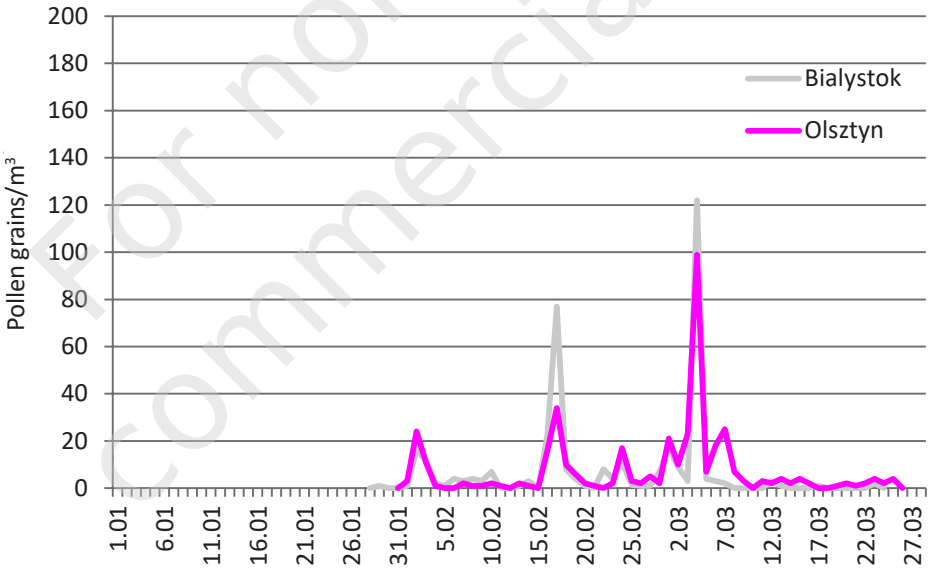
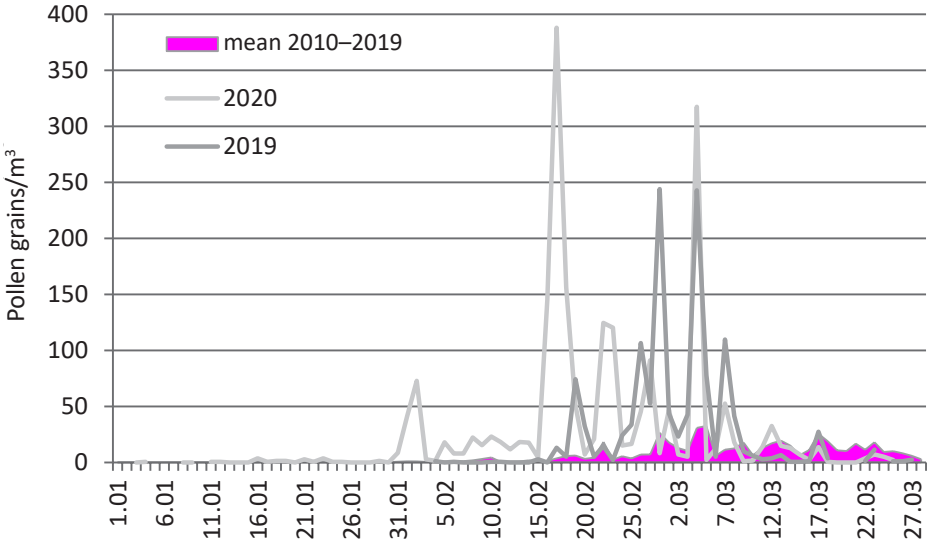


Figure 6. *Corylus pollen concentration in Lublin in 2019–2020, mean from 2010–2019. Note: scale is different than in other figures.*



Conclusions

In 2020 the hazel pollen season started earliest in the western part of Poland (in the second 10 days of January) and latest in eastern Poland (at the beginning of February).

The highest annual pollen sum and peak value were found in Lublin, similarly to the previous years.

The highest risk of allergy to *Corylus* pollen was found in Lublin, Warsaw, Zielona Gora, and Piotrkow Trybunalski.

References

1. *Majkowska-Wojciechowska B. Pyłek roślin i alergeny sezonowe w Polsce. Alergia Astma Immunologia. 2016; 21(1): 5-15.*
2. *Frei T, Torricelli R, Peeters AG et al. The relationship between airborne pollen distribution and the frequency of specific pollen sensitization at two climatically different locations in Switzerland. Aerobiologia. 1995; 11: 269-73.*
3. *Kadocsa E, Juhasz M. Study of airborne composition and allergen spectrum of hay fever patients in South Hungary (1990-1999). Aerobiologia. 2002; 18: 203-9.*
4. *Erkara IP, Cingi C, Ayranci U et al. Skin trick test reactivity in allergic rhinitis patients to airborne pollens. Environ Monit Assess. 2009; 151: 401-12.*
5. *Hauser M, Roulias A, Ferreira F et al. Panallergens and their impact on the allergic patient. Allergy Asthma Clin Immun. 2010; 6(1): 1.*
6. *Piotrowska K. Ecological features of flowers and the amount of pollen released in Corylus avellana (L.) and Alnus glutinosa (L.) Gaertn. Acta Agrobotanica. 2008; 61(1): 33-9.*
7. *Puc M. The effect of meteorological conditions on hazel and alder pollen concentration in the air of Szczecin. Acta Agrobotanica. 2007; 60(2): 65-70.*
8. *Sokołowska J. Przewodnik Fenologiczny. Wydawnictwo Komunikacji i Łączności, Warszawa 1980.*
9. *Myszkowska D, Jenner B, Puc M et al. Spatial variations in dynamics of Alnus and Corylus pollen seasons in Poland. Aerobiologia. 2010; 26: 209-21.*
10. *Piotrowska-Weryszko K, Weryszko-Chmielewska E. Charakterystyka sezonów pyłkowych leszczyny i olszy w Lublinie w 2014 r. Alergoprofil. 2014; 10(2): 21-3.*
11. *Rodriguez-Rajo FJ, Dopazo A, Jato V. Environmental factors affecting the start of pollen season and concentrations of airborne Alnus pollen in two localities in Galicia (NW Spain). Ann Agric Environ Med. 2004; 11: 35-44.*
12. *Ariano R, Canonica GW, Passalacqua G. Possible role of climate changes in variations in pollen seasons and allergic sensitizations during 27 years. Ann Allergy Asthma Immunol. 2010; 104(3): 215-22.*
13. *Weryszko-Chmielewska E, Piotrowska-Weryszko K, Dąbrowska A. Response of Tilia sp. L. to climate warming in urban conditions – phenological and aerobiological studies. Urban For Urban Gree. 2019; 43: 126369.*
14. *Skjøth CA, Bilińska D, Werner M et al. Footprint areas of pollen from alder (Alnus) and birch (Betula) in the UK (Worcester) and Poland (Wrocław) during 2005–2014. Acta Agrobotanica. 2015; 68(4): 315-24.*
15. *Rapiejko P, Lipiec A, Wojdas A et al. Threshold pollen concentration necessary to evoke allergic symptoms. Int Rev Allergol Clin. 2004; 10(3): 91-3.*
16. *Weryszko-Chmielewska E (ed). Pyłek roślin w aeroplanktonie różnych regionów Polski. Wydawnictwo Akademii Medycznej w Lublinie, Lublin 2006.*
17. *Piotrowska K, Kaszewski BM. The influence of meteorological conditions on the start of the hazel (Corylus L.) pollen season in Lublin, 2001-2009. Acta Agrobotanica. 2009; 62(2): 59-66.*
18. *Piotrowska-Weryszko K, Konarska A, Kaszewski BM et al. Analysis of Corylus pollen seasons in selected cities of Poland in 2018. Alergoprofil. 2018; 1(14): 21-6.*
19. *Piotrowska-Weryszko K, Konarska A, Puc M et al. Corylus pollen season in Poland in 2019. Alergoprofil. 2019; 15(1): 16-21.*

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