Hazel pollen in the air of selected Polish cities in 2022

Joanna Rapiejko[1], Małgorzata Malkiewicz[2], Małgorzata Puc[3], Agata Konarska[4], Monika Ziemianin[5], Joanna Ślusarczyk[6], Dariusz Jurkiewicz[7], Grzegorz Siergiejko[8], Kazimiera Chłopek[9], Agnieszka Lipiec[10]

[1] Allergen Research Center, Warsaw, Poland
[2] Laboratory of Paleobotany, Department of Stratigraphical Geology, Institute of Geological Sciences, University of Wroclaw, Poland
[3] Institute of Marine & Environmental Sciences, University of Szczecin, Poland
[4] Department of Botany and Plant Physiology, University of Life Sciences in Lublin, Lublin, Poland
[5] Department of Clinical and Environmental Allergology, Medical College, Jagiellonian University, Cracow, Poland
[6] Department of Environmental Biology, Institute of Biology, Jan Kochanowski University in Kielce, Poland
[7] Department of Otolaryngology with Division of Cranio-Maxillo-Facial Surgery in Military Institute of Medicine, Warsaw, Poland
[8] Pediatrics, Gastroenterology and Allergology Department, University Children Hospital, Medical University of Bialystok, Poland
[9] Faculty of Natural Sciences, Institute of Earth Sciences, University of Silesia in Katowice, Poland
[10] Department of the Prevention of Environmental Hazards, Allergology and Immunology, Medical University of Warsaw, Poland

Abstract:
Hazel is an important source of tree pollen allergens, which are responsible for inhalant allergy symptoms in early spring. The aim of the study was to compare *Corylus* pollen season in 2022 in 12 cities located in different regions of Poland: Bialystok, Bydgoszcz, Cracow, Kielce, Lublin, Olsztyn, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, Wroclaw and Zielona Gora. The measurements were conducted using a Burkard-type volumetric sampler, operating in continuous volumetric mode. The following parameters were analyzed: pollen season duration, peak value and peak date, seasonal pollen integral and number of days with concentration exceeding the threshold values triggering allergy symptoms in sensitized individuals. The hazel pollen season in 2022 began in January and the first decade of February. The earliest it began in the western regions, and the latest in eastern Poland. In most cities, maximum daily pollen concentrations were registered between February 5th and 24th. The 2022 hazel pollen season, compared to the 2021 season, was characterized by higher maximum daily pollen concentrations, higher seasonal pollen integrals (SPI) and higher number of days exceeding the threshold value for triggering allergy symptoms in most of the analyzed cities. The highest peak was recorded in Lublin (290 grains/m^3) and the highest annual sum (SPI) in Cracow (2071). In 2022 the highest risk of allergy symptoms to hazel pollen allergens in sensitized individuals was found in Lublin, Cracow, Kielce and Sosnowiec.

Key words: aeroallergens, pollen concentration, hazel (*Corylus*), 2022

Introduction

The *Betulaceae* family includes the genera *Alnus* Mill. (alder), *Betula* L. (birch), *Corylus* L. (hazel), *Carpinus* L (hornbeam), and *Ostrya* Scop. (hop hornbeam). The genus *Corylus* L. is represented by shrubs, such as common hazel (*Corylus avellana* L.), and trees, such as Turkish hazel (*Corylus colurna* L.) [1, 2].

Hazel is widespread in Poland, with the highest concentration of its cultivation in the central-south-eastern macro-region [3]. During the growing season, hazel releases pollen the earliest of all allergenic

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plants. Phenologically, the flowering of *C. avellana* L. is considered the beginning of early spring. The occurrence of hazel pollen in the air is significantly influenced by meteorological factors [4, 5].

Due to the hazel pollen season falling within the "infection season" (January–March), symptoms of sensitization to hazel pollen allergens sometimes need to be differentiated from symptoms of upper respiratory tract infection [6].

Together with birch and alder pollen, hazel is an important source of tree pollen allergens in the temperate climate zone of the Northern Hemisphere [7]. In the European GA2LEN study, conducted in several European countries, people with suspected inhalant allergy were examined [8, 9]. The percentage of patients sensitized to hazel (with positive skin prick test) ranged from 7.4% in Portugal and 11.9% in France to 35.9% in Germany and 49.4% in Denmark [8]. In Poland, the percentage was 22.3%, analogous to the European average of 22.8% [8]. The prevalence of clinically relevant sensitization to hazel in people with inhalant allergy ranged from 3.2% in Portugal and 7.4% in France to 32.4% in Germany and 37.8% in Denmark [9]. In Poland, the percentage was 13.3%, while the European average was 17.1% [9].

The marker for sensitization to hazel is *Cor a* 1, a major allergen to which nearly 100% of people allergic to hazel react. It belongs to the *PR-10* (*Bet v* 1-like) family of proteins. This family is responsible for the symptoms of allergy to tree pollen of the order *Fagales* Engl. [10]. Cross-reactions within the *Fagales* are observed, including birch, alder, hazel, oak and beech. *Cor a* 1 homologs are also found in fruits, vegetables and hazelnuts [11]. *Cor a* 2, belonging to the minor allergens of hazel, represents the profilin group. Profilins are considered panallergens and show very high cross-reactivity within the world of plants and foods of plant origin [10]. In people who are sensitized to *Cor a* 1 and *Cor a* 2, the cross-reactivity mechanism results in allergic symptoms (e.g. oral allergy syndrome) after eating fruits (melon, kiwi, peach, watermelon, orange, banana, strawberry, pineapple, apple, pear, cherry and lemon), vegetables (tomato, celery, soybean, pea, pepper and carrot) or nuts and grains (hazelnuts, walnuts, almonds, sunflower, pumpkin and sesame); including tree pollen-hazelnut syndrome [10, 11].

Aim

The aim of the study was to compare the hazel pollen season in 2022 in 12 cities located in different regions of Poland.

Material and method

Natural bioaerosol measurement stations were located in Bialystok, Bydgoszcz, Cracow, Kielce, Lublin, Olsztyn, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, Wroclaw and Zielona Gora. The measurements were conducted during the 2022 pollen season. Pollen data were recorded, according to international standards, using a Burkard-type volumetric sampler, operating in continuous volumetric mode [12, 13]. Concentrations were recorded in 7-day cycles and microscopic analysis was performed for each 24-hour period.

The duration of the hazel pollen season was determined by the 98% method, assuming that the beginning and end of the season were days with recorded 1% and 99% of the annual total of pollen catch, respectively [14]. Other features of the season that have been determined are: the sum of the daily average pollen concentrations for the season expressed by the seasonal pollen integral (SPI) [15] and maximum daily pollen concentration for the seasons as well as the date of occurrence of the maximum. The number of days with *Corylus* pollen concentrations exceeding threshold values for the development of symptoms in allergic individuals was determined according to the available literature [16] (tab. 1).

Results

In 2022, the start of the hazel pollen season was recorded earliest in the western regions of Poland; in Zielona Gora (January 13th) and Szczecin (January 14th), and the latest in Bialystok (February 8th), Cracow (February 9th) and Lublin (February 10th). In most cities, the hazel pollen season ended in the 3rd decade of March, while in Bydgoszcz, Warsaw, Piotrkow Trybunalski and Lublin in the first days of April. The average duration of the season in the 12 measurement sites was 58 days, with the shortest in Cracow and Piotrkow Trybunalski, and the longest in Kielce and Zielona Gora (tab. 1) (fig. 1–6).

The highest daily pollen concentrations during the season were recorded in Lublin (290 grains/m^3), Cracow (281 grains/m^3), Sosnowiec (279 grains/m^3), Kielce (241 grains/m^3) and Wroclaw (231 grains/m^3), and the lowest maxima, at about 4 times lower levels, in Bydgoszcz (55 grains/m^3), Szczecin (63 grains/m^3) and Bialystok (73 grains/m^3) (tab. 1). At most measurement sites the maximum daily concentrations were recorded between February 5th and 24th, although in Bialystok and Kielce the peak value was recorded between March 14th and 16th. The highest annual pollen sums

Table 1. *Characteristics of hazel pollen season in 2022.*

Feature of pollen season	Bialystok	Bydgoszcz	Cracow	Kielce	Lublin	Olsztyn	Piotrkow Trybunalski	Sosnowiec	Szczecin	Warsaw	Wroclaw	Zielona Gora
Duration of pollen season	7.02–31.03	30.01–8.04	9.02–24.03	25.01–26.03	10.02–4.04	3.02–31.03	26.01–7.04	5.02–29.03	14.01–21.03	29.01–4.04	n.d.–22.03	13.01–28.03
Seasonal pollen integral (SPI)	472	1062	2071	2062	1799	1038	1490	2038	328	1386	1248	1558
Peak value and peak date	73 (16.03)	55 (16.02)	281 (10.02)	241 (14.03)	290 (24.02)	67 (16.02)	190 (17.02)	276 (12.02)	63 (5.02)	112 (18.02)	231 (9.02)	94 (10.02)
Days ≥ 35 pollen/m³ [16]	1	7	17	15	17	10	12	13	2	12	11	15
Days ≥ 80 pollen/m³ [16]	0	0	9	7	4	0	4	8	0	1	2	3

Figure 1. *Hazel pollen concentration in Bialystok and Bydgoszcz in 2022.*

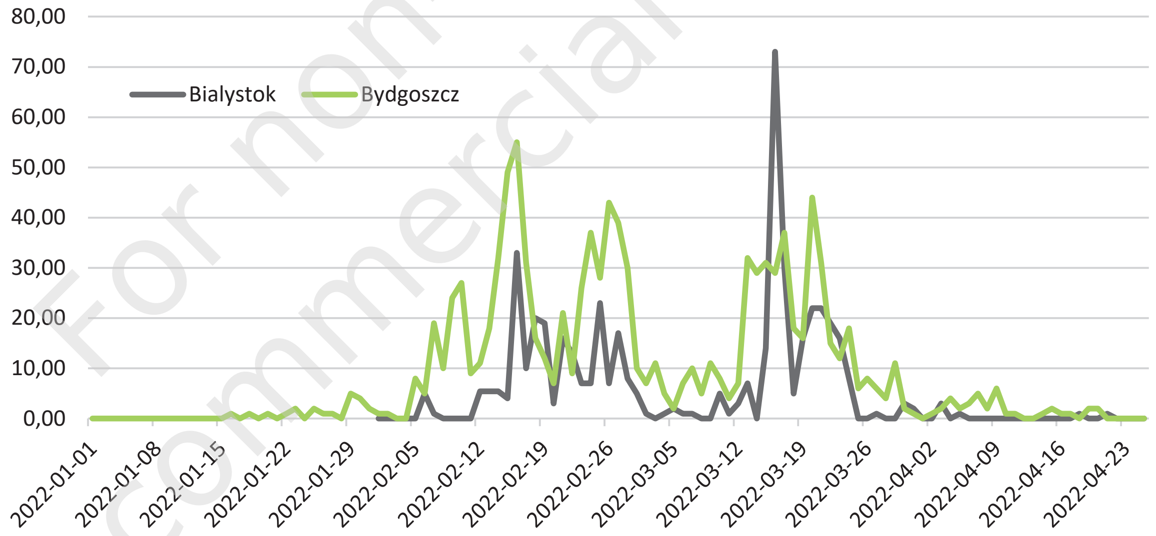


Figure 2. *Hazel pollen concentration in Cracow and Sosnowiec in 2022.*

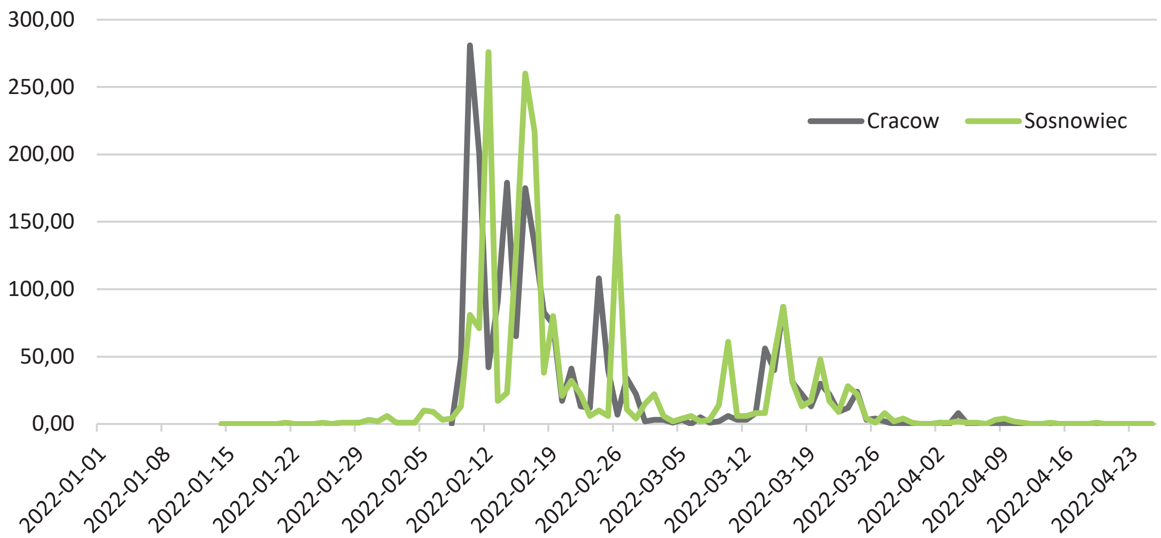


Figure 3. *Hazel pollen concentration in Lublin and Olsztyn in 2022.*

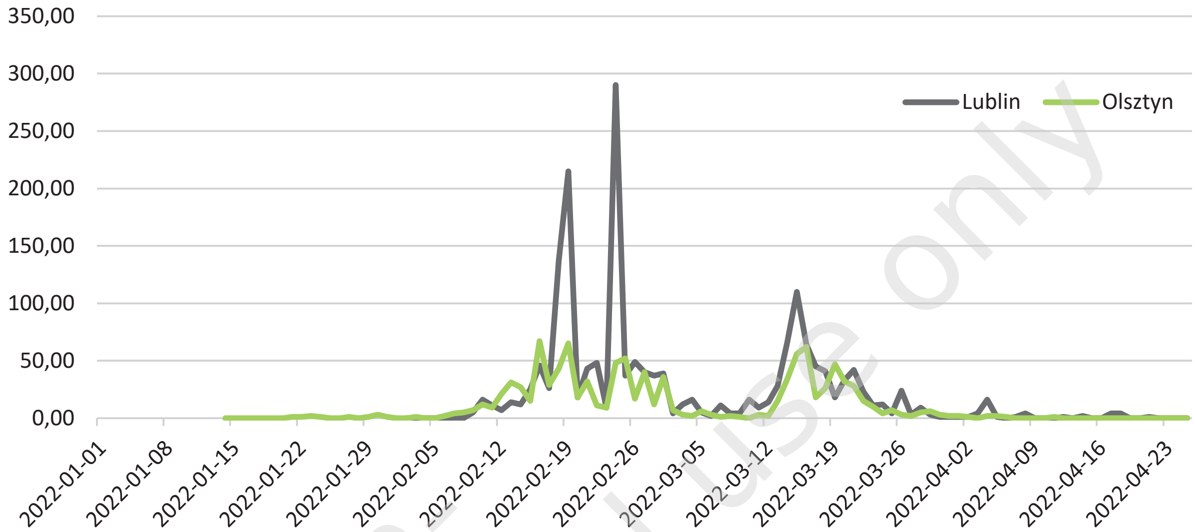


Figure 4. *Hazel pollen concentration in Piotrkow Trybunalski and Szczecin in 2022.*

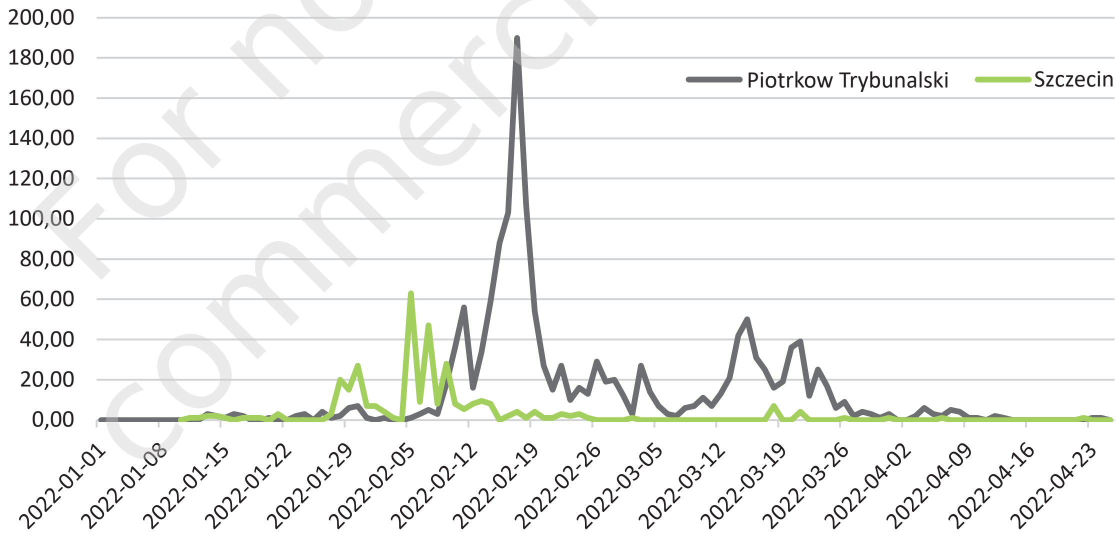


Figure 5. *Hazel pollen concentration in Warsaw and Wroclaw in 2022.*

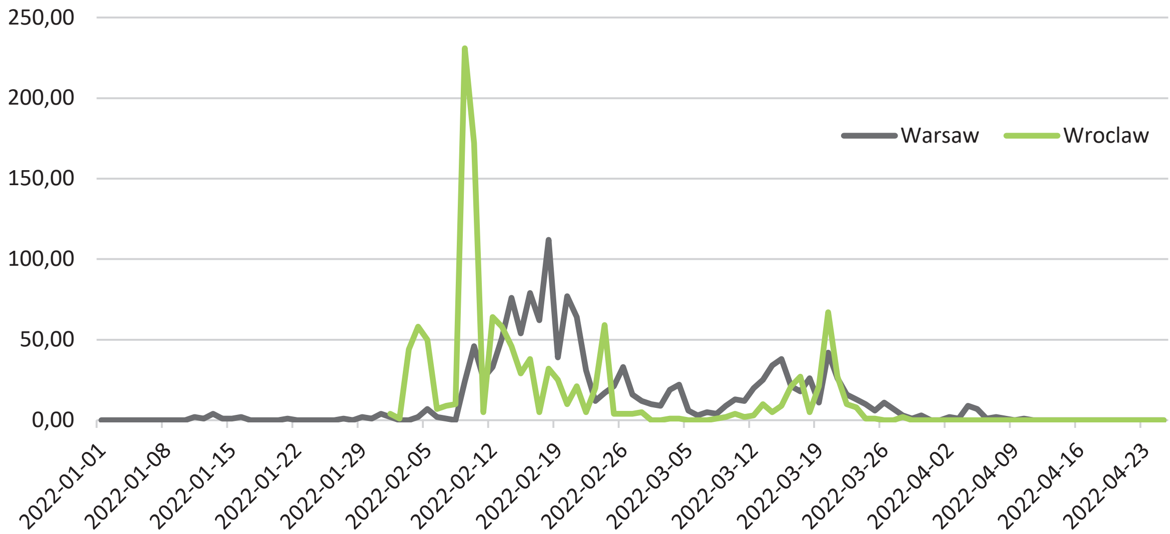
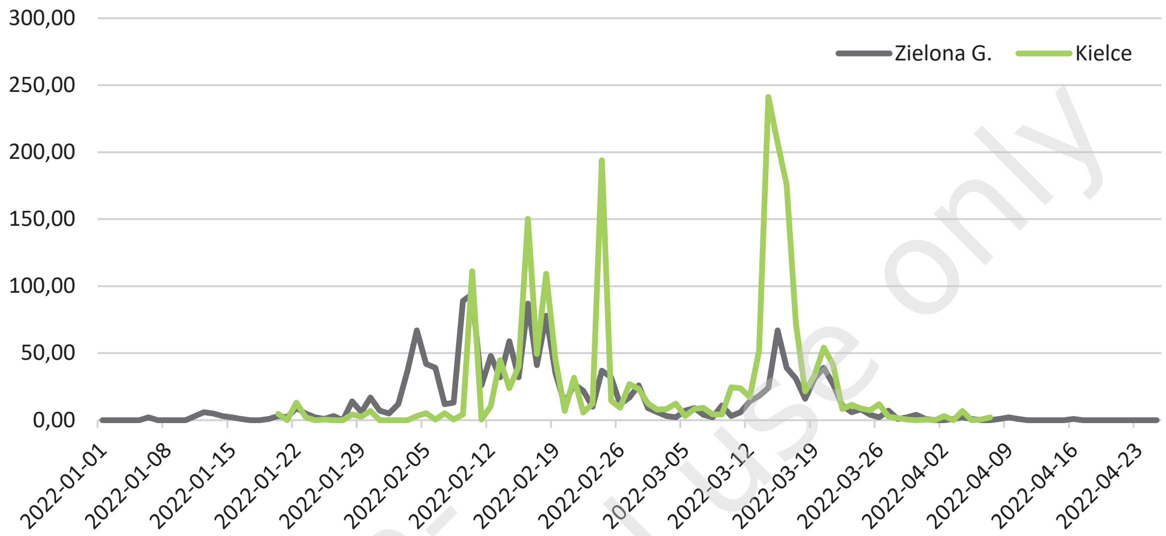


Figure 6. *Hazel pollen concentration in Zielona Gora and Kielce in 2022.*



(SPI), at 2038–2071, characterized Sosnowiec, Kielce and Cracow. The lowest values of seasonal pollen integral (SPI), at 328–427, were recorded in Szczecin and Bialystok respectively (tab. 1). The average SPI for hazel pollen season was 1379.

The number of days with pollen concentrations exceeding the threshold value at which allergy symptoms in sensitized individuals occur (35 grains/m^3) did not exceed a dozen days, and the highest, amounting to 15–17 days, was registered in Kielce, Zielona Gora, Lublin and Cracow. The highest number of days with very high concentrations (at least 80 grains/m^3) was recorded in Kielce, Sosnowiec and Cracow and amounted to 7, 8 and 9 days, respectively. The smallest number of days with hazel pollen concentrations generating allergy symptoms in sensitized individuals was recorded in Szczecin and Bialystok (tab. 1, fig. 1–6).

Discussion

In 2022, the start of the hazel pollen season occurred, as in years 2014–2020, in January and the first half of February [17–24]. In 2021, when prolonged period of low temperatures contributed to a delay in hazel flowering, it occurred between February 20th and March 1st [25]. This difference shows that the start of the hazel pollen season is variable and dependents on weather conditions, as has been shown in literature [4, 5]. In 2022, similarly to 2020, the hazel pollen season began earliest in western Poland and latest in eastern regions [24]. However, in 2021 this pattern was observed only partially [25].

As in previous years, in 2022 the maximum daily pollen concentration values varied considerably between cities [14–24], however, for majority of the assessed cities the values were higher than in the 2021 season. For example, in Bialystok this year's maximum daily pollen concentration was 2.7 times higher than in 2021, in Lublin and Cracow about 2 times higher [25]. However, in 2022 the maximum daily pollen concentrations in Bialystok and Lublin were lower than in 2020 season [24]. As in previous years, with the exception of 2021, the city with the highest maximum daily concentration was Lublin [23–25]. The number of days with pollen concentrations above the threshold value (35 grains/m^3) was also among the highest in Lublin, as in previous years. This is influenced by the large area of hazel planting in Lublin region, which accounts for 42.4% of the total acreage of its cultivation in Poland [3].

In most of the analyzed cities the number of days exceeding the threshold value for triggering allergy symptoms in sensitized individuals was higher than in 2021; the highest for Lublin (as mentioned above), Cracow and Kielce [25].

Only in Cracow the peak date of daily pollen concentration was recorded very soon after the start of the pollen season (1 day), similar to the 2021 season [25]. In other cities in 2022 the peak value was recorded at a greater time interval from the date of the start of the season, in most of the analyzed cities in the second decade of February. The seasonal peaks were recorded latest in Bialystok, while the earliest in Szczecin, similar to the 2018–2021 season [22–25].

The average value for seasonal pollen integral (SPI) for the cities assessed in 2022 turned out to be

2 times higher than in 2021; including Cracow 3.5 times higher, Sosnowiec 2.2 times higher, Lublin and Wroclaw 1.8 times higher [25].

Conclusions

In 2022, in the analyzed cities of Poland, the hazel pollen season began in January and the first decade of February. The earliest it began in the western regions of Poland (in mid-January), and the latest in eastern Poland (in the first decade of February).

In most cities, maximum daily pollen concentrations were recorded between February 5th and 24th.

The 2022 hazel pollen season, compared to the 2021 season, was characterized by higher maximum daily pollen concentrations, higher seasonal pollen integrals (SPI) and higher number of days exceeding the threshold value for triggering allergy symptoms in most of the analyzed cities.

In 2022 pollen season the highest risk of allergy symptoms to hazel pollen allergens in sensitized individuals was found in Lublin, Cracow, Kielce and Sosnowiec.

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ORCID
J. Rapiejko – ID – http://orcid.org/0000-0001-9832-0413
M. Puc – ID – http://orcid.org/0000-0001-6734-9352
M. Malkiewicz – ID – http://orcid.org/0000-0001-6768-7968
M. Ziemianin – ID – http://orcid.org/0000-0003-4568-8710
J. Ślusarczyk – ID – http://orcid.org/0000-0001-8022-3244
A. Konarska – ID – http://orcid.org/0000-0003-2174-7608
G. Siergiejko – ID – http://orcid.org/0000-0003-4084-8332
D. Jurkiewicz – ID – http://orcid.org/0000-0003-3729-2679
A. Lipiec – ID – http://orcid.org/0000-0003-3037-2326

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Corresponding author:
Agnieszka Lipiec, MD, PhD, D.H.Sc.
Department of Prevention of Environmental Hazards,
Allergology and Immunology,
Medical University of Warsaw
02-091 Warszawa, ul. Banacha 1a
e-mail: alipiec@wum.edu.pl