

Elm pollen concentrations in the atmospheric air of selected Polish cities in 2022

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Abstract:

The elm (*Ulmus* sp.) is one of the early spring flowering trees. The aim of the study was to compare the elm pollen season in selected Polish cities in 2022. The aeropalynological measurements were carried out with the volumetric method. The study was focused on determination of the total daily pollen grain concentrations during the season, the beginning and end of the pollen season (determined using the 95% method), the peak pollen concentrations, and the dates with maximum pollen concentrations. The earliest onset of the elm pollen season was noted in Sosnowiec (March 9th). In turn, the latest onset was recorded in Lublin (March 23th). The pollen season lasted from 18 days (in Cracow) to 37 days (in Sosnowiec). The highest total daily pollen grain concentrations and the highest maximum concentration were recorded in Cracow (1202 and 321 P/m³, respectively), whereas the lowest values of these parameters were noted in Białystok (72 and 9 P/m³, respectively). In most of the analyzed cities, the peak pollen concentration was recorded between March 25th and 29th.

Key words: elm (*Ulmus*), aeroallergens, pollen concentration, 2022

Introduction

The genus *Ulmus* belongs to the family *Ulmaceae*, typically occurring in the temperate zone. Six of the approximately 30–40 elm species growing worldwide have been identified in Europe. Three species

are part of the flora of Poland: the European white elm (*Ulmus laevis* Pall.), the Scots elm (*Ulmus glabra* Huds.), and the field elm (*Ulmus minor* Mill. Emden. Richens) [1]. The European white elm, which has the largest size and reaches up to 40 meters in height, is

the most common species in deciduous forests. In the past, elms were commonly grown as park and alley trees. After hazel and alder, elms are one of the earliest spring blooming trees [2, 3]. Their inconspicuous anemophilous flowers are usually gathered in bundles drooping down from thin pedicels. The Scots elm and the field elm most often flower in the second half of March. In the pollen calendar, the European white elm releases pollen approximately 2 weeks later. Sensitivity to elm pollen may trigger allergic reactions in February, March, and April. The main symptoms of allergy include runny nose, coughing, wheezing, watery eyes, headache, and sinus pain. Currently, the clinical importance of elm pollen in Poland is regarded as low [4], although elm is classified as an important plant allergen elsewhere in the world [5]. Nevertheless, elm pollen allergens are increasingly becoming a cause of allergic reactions also in Poland. In recent years, increased allergenicity of plant pollen has been observed, which may be associated with many factors, e.g. air pollution [6]. Air pollutants can enhance the allergenic properties of pollen, especially in urban areas. In addition, the urban microclimate and the presence of high buildings limit pollen transport and prolong the presence of airborne pollen grains, which may result in intensification of allergic reactions [4, 5]. However, elm pollen allergens and the elm pollen season in Poland have been poorly described in the literature to date.

Aim

The aim of the study was to compare the elm (*Ulmus* sp.) pollen season in the air of selected Polish cities in 2022.

Material and method

The elm pollen release was monitored in 13 Polish cities: Białystok, Bydgoszcz, Kielce, Cracow, Lublin, Olsztyn, Opole, Piotrków Trybunalski, Sosnowiec, Szczecin, Warsaw, Wrocław, and Zielona Góra. The concentration of pollen grains was recorded with the standardized volumetric method using Lanzoni and Burkard volumetric sampler. The content of pollen grains in the air was monitored in a 7-day cycle. The aerobiological analysis was performed in 24-h periods. The concentration of pollen grains was expressed in 1 m^3 of air (P/m^3). The length of the pollen season was determined using the 95% method, assuming that days with 2.5% and 97.5% of the recorded annual sum of pollen grains indicated the beginning and end of the

pollen season, respectively [7]. Additionally, the total daily pollen grain concentrations during the season (SPI) [8], the peak pollen concentrations, and the dates of maximum pollen concentrations were determined. The number of days with pollen grain concentrations $> 0 \text{ P}/\text{m}^3$ was also determined for the pollen seasons in each city.

Results

In 2022, the earliest onset of the elm pollen season determined with the 95% method was recorded in Sosnowiec (March 9th). In most Polish cities, the pollen season began in the second decade of March, i.e. on March 14th (Kielce), March 15th (Opole, Warsaw, Wrocław, and Zielona Góra), March 16th (Białystok), March 18th (Szczecin), March 19th (Olsztyn), and March 20th (Bydgoszcz). The latest beginning of the pollen season was noted in Lublin (March 23th) as well as Cracow and Piotrków Trybunalski (March 21st). The average duration of the pollen season in the 13 analyzed Polish cities was 28 days. The longest pollen season was recorded in Sosnowiec (37 days) and Kielce (36 days), and the shortest duration of pollen release was noted in Cracow (18 days) (tab. 1; fig. 1–7).

The average value of the seasonal pollen sum (SPI) in the 13 analyzed Polish cities was 395. The lowest SPI value was noted in Szczecin (72) and Białystok (78), while the highest value was recorded in Cracow (1202) and Opole (827). The SPI values recorded in the other measurement stations were in the range of 152–581. The total daily pollen grain concentrations recorded in Warsaw (371) was the closest to the average values (tab. 1; fig. 1–7).

The highest maximum concentrations of pollen grains were observed in Cracow ($321 \text{ P}/\text{m}^3$), Opole ($121 \text{ P}/\text{m}^3$), and Wrocław ($112 \text{ P}/\text{m}^3$). The lowest peak concentrations were recorded in Białystok ($9 \text{ P}/\text{m}^3$) and Szczecin ($12 \text{ P}/\text{m}^3$). In the other cities, the values of the peak concentrations ranged from 23 to $73 \text{ P}/\text{m}^3$. The earliest peak pollen release date was recorded on March 20th in Białystok. In the other 12 cities, the peak concentration of pollen grains was noted between March 25th and 29th (tab. 1; fig. 1–7).

During the pollen season in the analyzed cities, the highest number of days with concentrations above $0 \text{ P}/\text{m}^3$ was recorded in Olsztyn and Piotrków Trybunalski (30), while the lowest number of days was noted in Cracow (18) and Szczecin (19).

Table 1. Characteristics of elm pollen season in 2022.

Site	Start/end of pollen season	Duration of pollen season (number of days)	Peak value (P/m ³)	Peak date	Number of days > 0 P/m ³	Seasonal pollen integral (SPI)
Bialystok	16.03/15.04	31	9	20.03	23	78
Bydgoszcz	20.03/16.04	28	23	29.03	28	249
Cracow	21.03/7.04	18	321	26.03	18	1202
Kielce	14.03/18.04	36	44	28.03	25	152
Lublin	23.03/16.04	25	33	29.03	22	177
Olsztyn	19.03/20.04	33	43	29.03	30	339
Opole	15.03/9.04	26	121	26.03	26	827
Piotrkow Trybunalski	21.03/19.04	30	54	28.03	30	302
Sosnowiec	9.03/14.04	37	49	27.03	25	268
Szczecin	18.03/11.04	25	12	26.03	19	72
Warsaw	15.03/12.04	29	48	27.03	29	371
Wroclaw	15.03/7.04	24	112	25.03	23	516
Zielona Gora	15.03/12.04	29	73	25.03	29	581

Figure 1. Elm pollen concentration in Wroclaw and Zielona Gora in 2022.

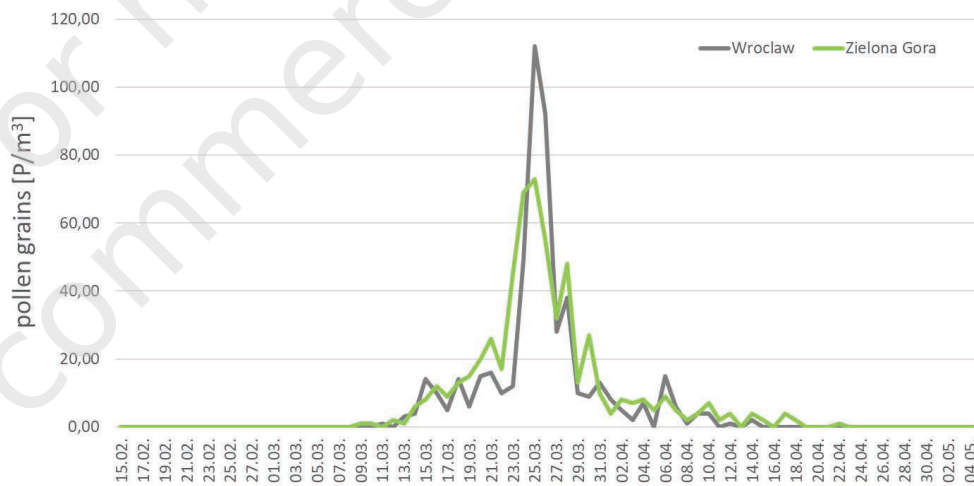


Figure 2. Elm pollen concentration in Warsaw and Sosnowiec in 2022.

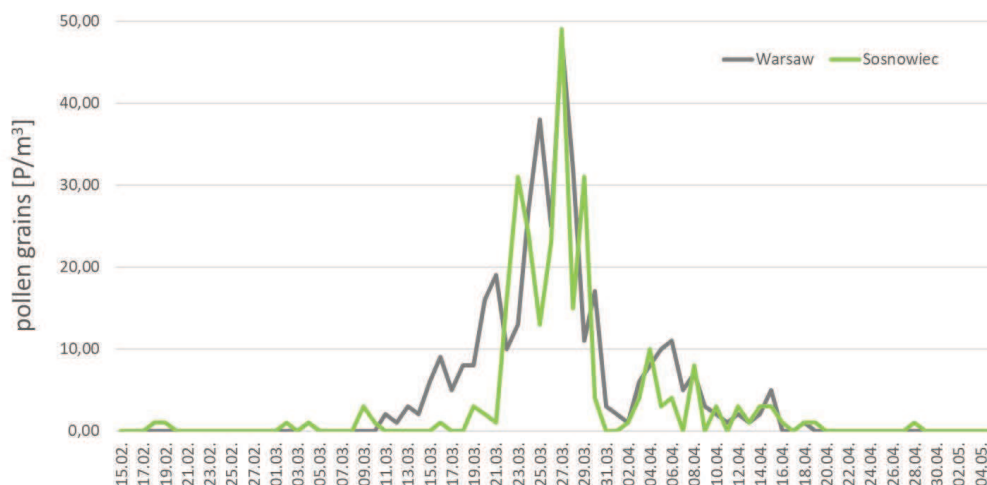


Figure 3. Elm pollen concentration in Opole and Cracow in 2022.

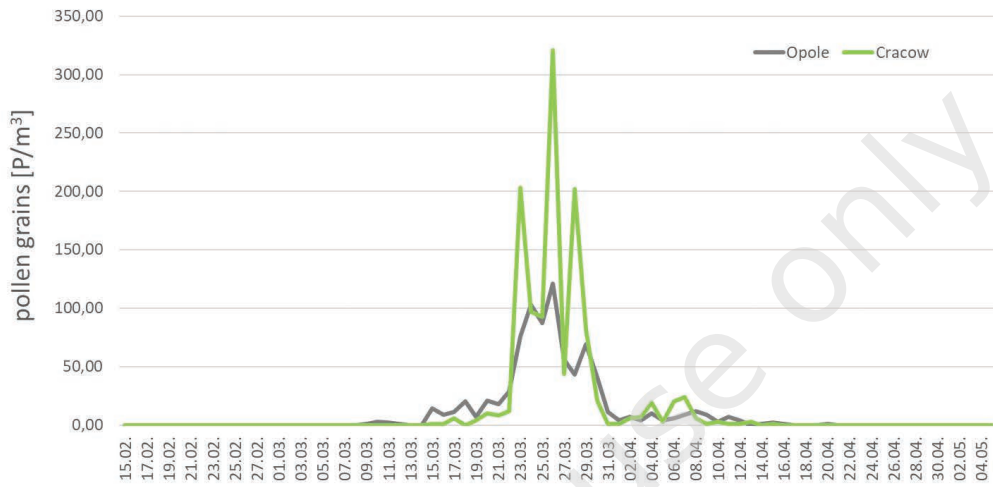


Figure 4. Elm pollen concentration in Kielce and Piotrkow Trybunalski in 2022.

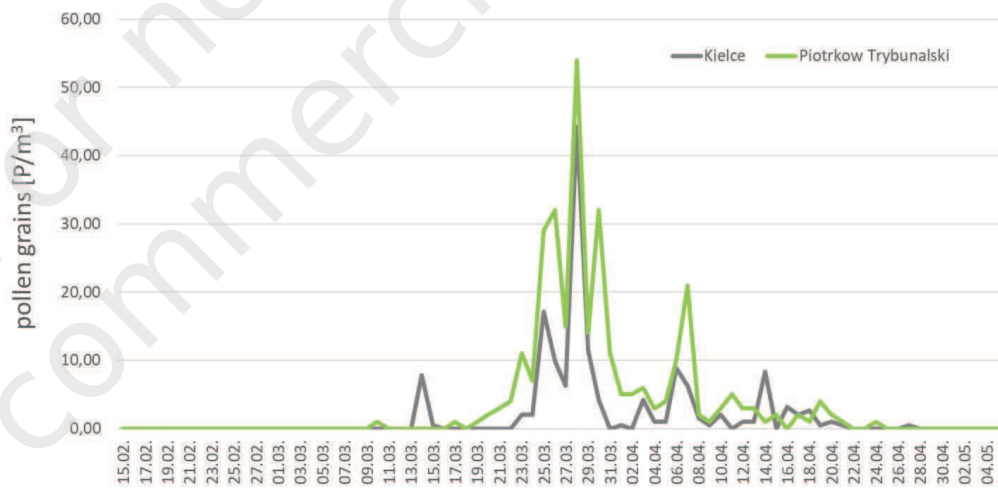


Figure 5. Elm pollen concentration in Olsztyn and Bydgoszcz in 2022.

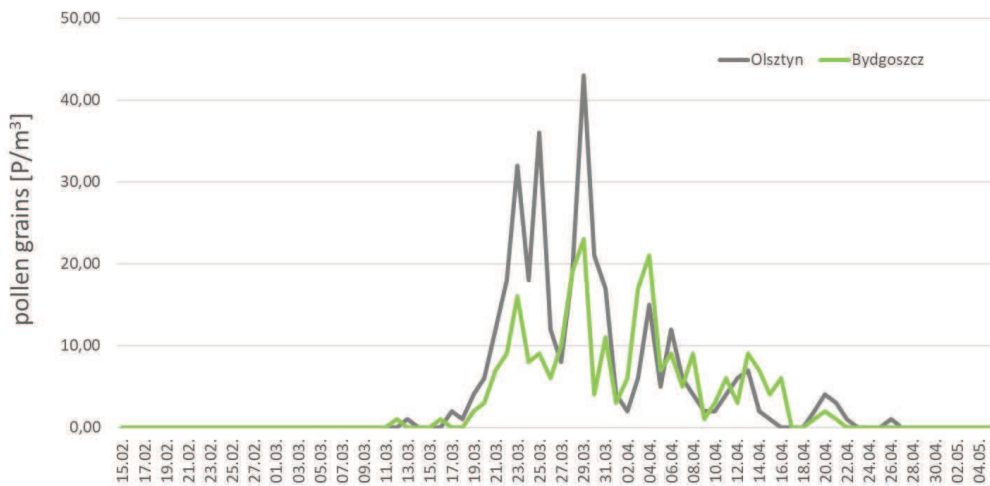


Figure 6. Elm pollen concentration in Lublin and Szczecin in 2022.

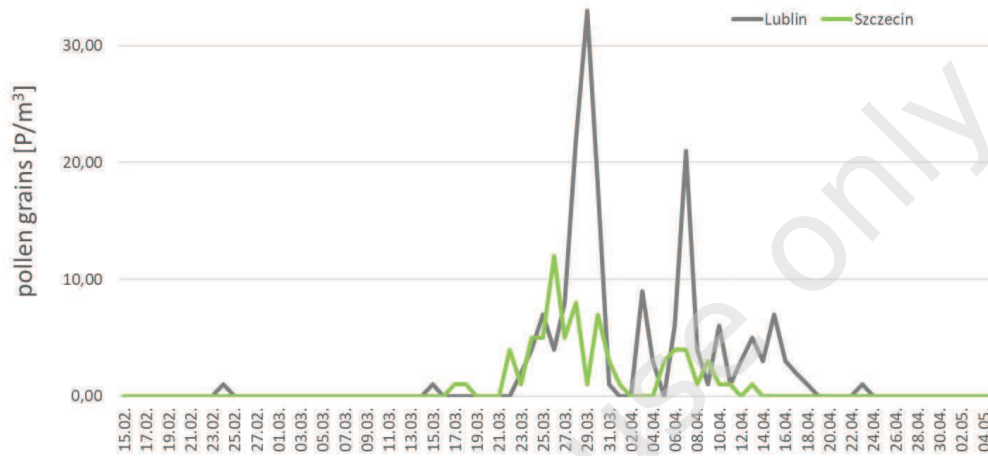
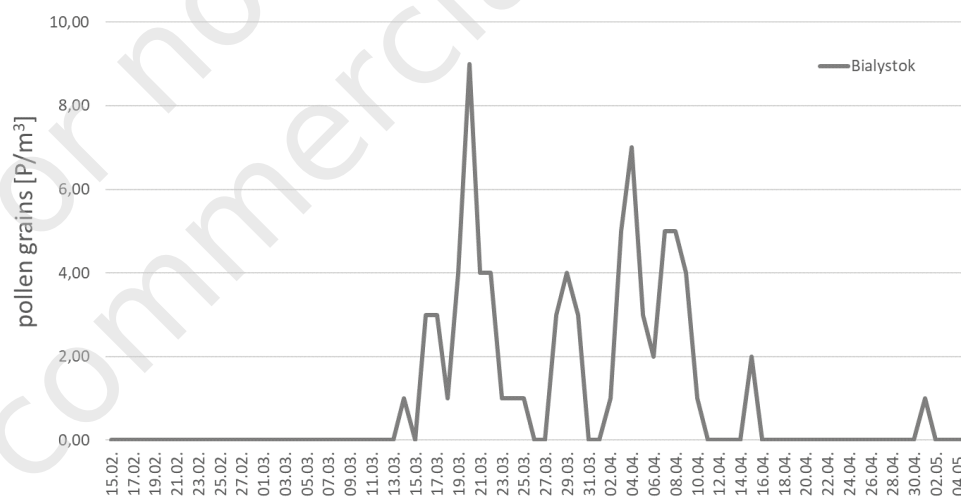


Figure 7. Elm pollen concentration in Białystok in 2022.



Discussion

The elm pollen season in 2022 in the analyzed regions of Poland was dynamic and variable. In most of the cities, the pollen season lasted from mid-March to mid-April. Each measurement station revealed several peaks, which may be associated with e.g. the weather conditions, which have an impact on the intensity of pollen release. The course of the elm pollen season in Wrocław and Zielona Góra exhibited the greatest similarity. A considerable similarity was also revealed between Kielce and Piotrków Trybunalski and between Olsztyn and Bydgoszcz.

The values of the maximum elm pollen concentrations differed between the analyzed cities. The highest peak concentration of pollen grains and the highest total daily concentrations were found in the

air of Cracow although the elm pollen season was the shortest in this city. The longest pollen season was recorded in Sosnowiec. It was characterized by a relatively low peak concentration value (49 P/m³), which was almost 1.5-fold lower than the average value calculated for the 13 measurement stations (72 P/m³) and over 6-fold lower than the value recorded in Cracow. The lowest peak pollen concentrations were recorded in Białystok. They were 8-fold lower than the average values.

The highest daily sums of elm pollen grains were recorded in cities located in the southern (Cracow), south-western (Opole, Wrocław), and western (Zielona Góra) parts of Poland. In Białystok and Cracow, the highest elm pollen concentration was observed shortly after the onset of the pollen season,

i.e. on day 4 and 5, respectively. In contrast, the peak elm pollen concentration in Sosnowiec was recorded no sooner than on day 18 after the beginning of the season.

In six cities, i.e. Bydgoszcz, Cracow, Opole, Piotrkow Trybunalski, Warsaw, and Zielona Gora, there were no days with the value of 0 P/m³ during the elm pollen season, which indicates a more compact character of the pollen release.

Plant pollen is currently a serious health problem, as it affects the comfort and quality of life of allergic subjects. The growing problem of the development of allergic diseases caused by pollinosis can be observed both in Poland and across Europe. The content of airborne pollen grains exhibits large seasonal and diurnal variations. The release of pollen grains from anthers depends on many factors. Changes in the content of pollen grains in the air are also determined by local habitat conditions and topography [4, 9].

Conclusion

In 2022, the elm (*Ulmus* sp.) pollen season in most of the analyzed Polish cities began in the second decade of March and ended in the second decade of April.

The shortest elm pollen season was recorded in Cracow and Szczecin and the longest season was noted in Sosnowiec and Kielce.

In most of the analyzed cities, the maximum pollen concentrations were recorded between March 25th and 29th.

The highest maximum daily concentration of pollen grains was recorded in Cracow, and the lowest values of the parameter were noted in Bialystok.

The highest total daily pollen concentrations (SPI) were recorded in Cracow and Opole and the lowest values were noted in Bialystok and Szczecin.

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