Record values of ragweed pollen count in Poland in 2024

Małgorzata Puc[1, 2], Karina Szczypiór-Piasecka[3], Krystyna Piotrowska-Weryszko[4], Agnieszka Lipiec[5], Joanna Rapiejko[6, 7], Szymon Tomczyk[8], Grzegorz Siergiejko[9]

[1] Institute of Marine & Environmental Sciences, University of Szczecin, Poland
[2] Molecular Biology and Biotechnology Centre, Institute of Biology, University of Szczecin, Poland
[3] Department of Musculoskeletal System Rehabilitation, Pomeranian Medical University, Szczecin, Poland
[4] Department of Botany and Plant Physiology, Subdepartment of Aerobiology, University of Life Sciences in Lublin, Poland
[5] Department of Prevention of Environmental Hazards, Allergology and Immunology, Medical University of Warsaw, Poland
[6] Medical University of Warsaw, Poland
[7] Allergen Research Center, Warsaw, Poland
[8] University of Wroclaw, Faculty of Earth and Environmental Sciences, Wroclaw, Poland
[9] Pediatrics, Gastroenterology and Allergology Department, University Children Hospital, Medical University of Bialystok, Poland

Abstract:

This paper presents the course of the pollen season of ragweed (*Ambrosia*) in selected cities of Poland (Lublin, Warsaw, Szczecin, Zielona Gora, Wroclaw and Bialystok) in 2024. The ragweed pollen grains are known as very potent aeroallergens, often noted to enter into cross reactions. This pollen is a common cause of pollinosis in North America. In Europe ragweed is an introduced species in the middle of an ongoing invasion event and, therefore, represents a case of a human population being exposed to increasing concentrations of this allergen.

Measurements were performed by the volumetric method (Burkard and Lanzoni pollen samplers). Pollen season was defined as the period in which 98% of the annual total catch occurred. Seasonal Pollen Index (SPI) was estimated as the annual sum of daily average pollen concentrations. The pollen season of *Ambrosia* in 2024 started first in Wroclaw, on the 12th of August, then in Lublin and Warsaw, on the 15th and 16th of August (about 1–2 weeks earlier than in the other cities). This pollen season lasted between the 22nd of September and the 27th of September. The differences of pollen seasons durations were clear (from 27 to 44 days). The highest airborne concentration of 174 pollen grains/m^3 was noted in Lublin on the 4th of September. The maximum values of seasonal pollen count occurred between 4th and 17th of September, only in Wrocław 28th of August. The highest ragweed pollen allergen hazard occurred in 2024 in Warsaw and lasted 23 days and in Lublin – 22 days and was high. So far, in various years in Poland, this threat lasted less than 10 days.

Key words: allergens, pollen count, risk of allergy, ragweed, *Ambrosia*, 2024

Ragweed is a native annual plant found throughout North America on roadsides, fields and cultivated ground. It has become invasive in much of the world including Central and South America, Europe, Asia, Australia, and Africa. Ragweed is a major cause of hay fever in the late summer and fall. It is also a prolific producer of seeds that provide food for birds and small mammals. The plant was widely used by Native Americans as an herbal medicine, both externally and internally. Today, the pollen is harvested commercially for use in pharmaceuticals designed to treat hay fever.

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Ambrosia L. was first identified in the wild in Europe in the mid-19th century. For many years ragweed appeared in Europe in the hitherto unknown localities, and the number of people allergic to the allergens of this plant has been gradually increasing [1, 2]. In Europe the occurrence of ragweed pollen is not uniform, it has been abundantly noted in Hungary, Ukraine and in North Italy, less frequent in France, in the Balkan Peninsula, in Switzerland, Austria, Slovakia, Czech Republic and also in Germany and United Kingdom [2–5].

The genus *Ambrosia* contains about 42 species of which only 5 have been noted in Europe. The best known and most widespread is common ragweed (*A. artemisiifolia* L.), an invasive plant that has been introduced into many parts of the world, including many countries in Europe. Three other species are also invasive plants giant ragweed (*A. trifida* L.), western ragweed (*A. psilostachya* DC.) and lacy ragweed (*A. tenuifolia* Spreng.) Among *Ambrosia* genus only *A. maritima* L. is native [6].

The highest level of allergy to ragweed pollen is recorded in Hungary, where 58–60% of those tested were found to be sensitised to ragweed. However, high rates of sensitisation were also detected in Denmark (almost 20%), the Netherlands (15%) and Germany (14%). Interestingly, almost a quarter of those found to be ragweed sensitised also had symptoms of asthma [7]. *Ambrosia* pollen cross react with almost all other composites, especially with *Artemisia* pollen (mugwort). The majority of patients allergic to ragweed are also allergic to the pollen of mugwort, grass and the allergens of apple and celery [8]. The threat related to the allergens of *Ambrosia* pollen is enhanced by the fact that the concentration of these taxa pollen (as well as the pollen of other herbs) just above the ground level is a few times higher than at a height of 15–25 m [9].

Aim

The aim of this work was to analyse the ragweed pollen concentrations in the air of Lublin, Warsaw, Szczecin, Zielona Gora, Wroclaw and Bialystok in 2024 and assess the level of exposure of cities inhabitants to the allergenic ragweed pollen.

Material and method

Measurements of airborne *Ambrosia* pollen were carried out in Lublin, Warsaw, Szczecin, Zielona Gora, Wroclaw and Bialystok in the year 2024.

The pollen season was defined using the 98% method; the day on which the cumulative pollen count during the period 1st January–30th June reached the value of ≥1% was determined to be the start date of the pollen season, and the end of the season was the day when the cumulative pollen count was ≥99% [10]. The total pollen count over this period was expressed by the symbol SPI (*Seasonal Pollen Index*).

On the basis of literature data, the number of days with concentrations of the pollen of the ragweed exceeding the threshold values at which the consecutive allergy symptoms develop were determined (tab. 1)

On the basis of literature data the number of days at which the pollen concentrations of the taxa studied exceeded the threshold values at which allergy symptoms develop, was determined. Laaidi and Laaidi [11] reported a threshold value for *Ambrosia* pollen of 13 g/m^3 in Burgundy, France.

Results and discussion

Comparison of the dynamics of ragweed pollen seasons in 2024 in the analyzed cities shows similarities regarding the dates of pollen concentration peaks. The first distinct peak was recorded on September 28th–29th, the second peak as a seasonal maximum on September 2nd–11th and the third peak on September 17th. Such similarity of seasonal dynamics at different measurement points may indicate that this ragweed pollen comes from source areas in eastern and southern Europe (where ragweed is common, often as a native species). This pollen migration is possible due to carrying *Ambrosia* pollen grains by long-distance transport with atmospheric air masses [11, 12]. Bilińska et al. [13] showed that on days with maximum ragweed pollen concentrations recorded in Poland, air masses always come from the eastern part of the Pannonian Plain or eastern Ukraine. Moreover, outside the main areas where ragweed occurs, high pollen concentrations of this plant in Poland are recorded episodically.

In 2024, in all the measurement points studied, the ragweed pollen season started between 12th and 29th of August and lasted 27–44 days, almost to the end of September (fig. 1–3, tab. 1). In comparison to data from 2001–2005 and 2016, 2018–2019 [14–19], in 2024 pollen concentration of *Ambrosia* pollen was one of the highest in all analyzed cities, especially in Lublin and Warsaw.

Also in studies conducted in the years 2001–2005, in Poland the maximum daily concentration was observed within 3 weeks: between the end of August

Table 1. *Characteristics of ragweed pollen season – comparison of data from 2024 with data from the years**: 2024, 2016 [16, 17], 2018 [18] and 2019 [19].*

Features of pollen season	Lublin	Warsaw	Szczecin	Zielona Gora	Wroclaw	Bialystok
Duration of pollen season **in 2024**	15 VIII– 27 IX	16 VIII–26 IX	24 VIII–22 IX	21 VIII–23 IX	12 VIII–23 IX	29 VIII–24 IX
Length of the season: number of days						
in 2024	**44**	**42**	**30**	**34**	**43**	**27**
in 2016	**54**	**54**	**35**	**56**	**23**	**28**
in 2018	**67**	**69**	**79**	**79**	**51**	**46**
in 2019	**50**	**45**	**50**	**-**	**10**	**39**
Seasonal Pollen Index SPI (*annual total*)						
in 2024	**1507**	**888**	**421**	**181**	**193**	**468**
in 2016	**85**	**174**	**36**	**371**	**195**	**86**
in 2018	**474**	**341**	**34**	**555**	**19**	**391**
in 2019	**310**	**224**	**69**	**-**	**150**	**128**
Peak value and peak date						
in 2024	**174 (4 IX)**	**122 (6 IX)**	**79 (6 IX)**	**28 (17 IX)**	**44 (28 VIII)**	**66 (16 IX)**
in 2016	**25 (29 VIII)**	**38 (29 VIII)**	**7 (9 IX)**	**71 (27 VIII)**	**69 (27 VIII)**	**47 (29 VIII)**
in 2018	**99 (7 IX)**	**56 (7 IX)**	**10 (30 VIII)**	**58 (8 IX)**	**12 (18 IX)**	**129 (7 IX)**
in 2019	**59 (29 VIII)**	**37 (29 VIII)**	**18 (1 IX)**	**-**	**77 (27 VIII)**	**59 (9 IX)**
Number of days ≥13 g/m^3 [11]*						
in 2024	**22**	**23**	**10**	**4**	**4**	**11**
in 2016	**3**	**5**	**0**	**5**	**4**	**1**
Number of days ≥20 g/m^3 [18, 19]*						
in 2018	**7**	**4**	**0**	**5**	**0**	**4**
in 2019	**6**	**4**	**0**	**-**	**2**	**2**

* first symptoms of allergy; **- articles published in „Alergoprofil" were selected for comparison; "-" – lack of data.

and mid-September [15]. In 2024 in most cities of central and northern Poland the dates of maximum concentrations were noted within 13 days: between 4th and 17th of September, only in Wroclaw much earlier, on August 28. The highest, record annual sum of *Ambrosia* pollen grains (SPI) was observed in Lublin (1507) and in Warsaw (888). In the years 2016–2019 [16–19] these values ranged between 19–555 (tab. 1, fig. 1–3).

Owing to the huge production of the *Ambrosia* pollen (one specimen produces 0.5 mln grains in a pollen season), it can be present in concentrations much higher than the threshold value (≥13 g/m^3) for 25–30 days in the critical period in Burgundy (France) [11]. According to some authors the threshold value is the pollen count at which 60–80% of people allergic to *Ambrosia* pollen reveal acute symptoms of pollinosis [5, 11]. Additionally, the allergens of ragweed pollen exhibit increased allergenicity after exposure to NO_2, especially in highly urbanized areas [20]. In Szczecin in the years 2016–2019 only very short periods (0–7 days) were noted with the concentration of pollen grains higher than the threshold value [16–19]. In 2024 in Lublin and Warsaw period with pollen counts exceeding the value ≥13 g/m^3 lasted 22–23 days (tab. 1).

One answer to the question about the cause of very high ragweed pollen concentrations in the air in 2024 may be changing climate, in particular an increase in air temperature, which generates increased

Figure 1. *Ragweed pollen count in Lublin and Warsaw in 2024.*

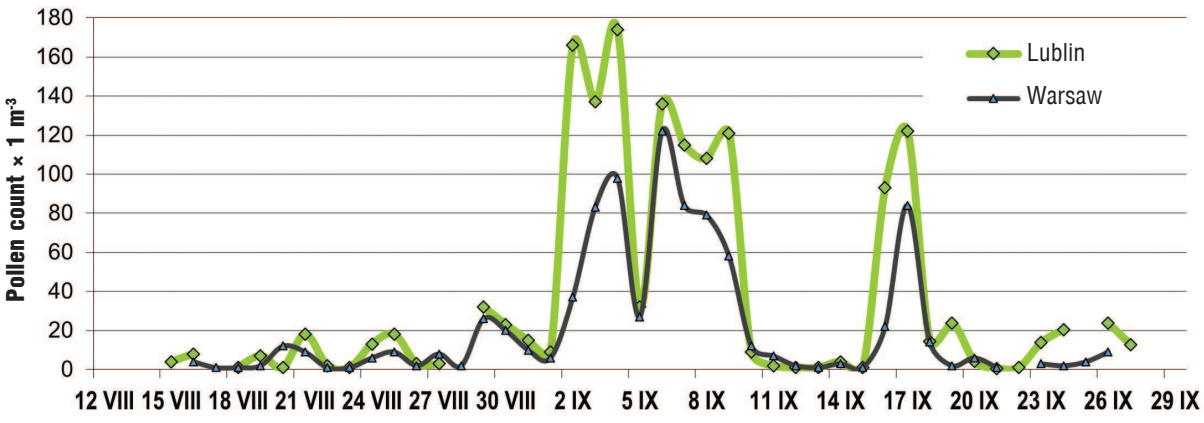


Figure 2. *Ragweed pollen count in Szczecin and Zielona Gora in 2024.*

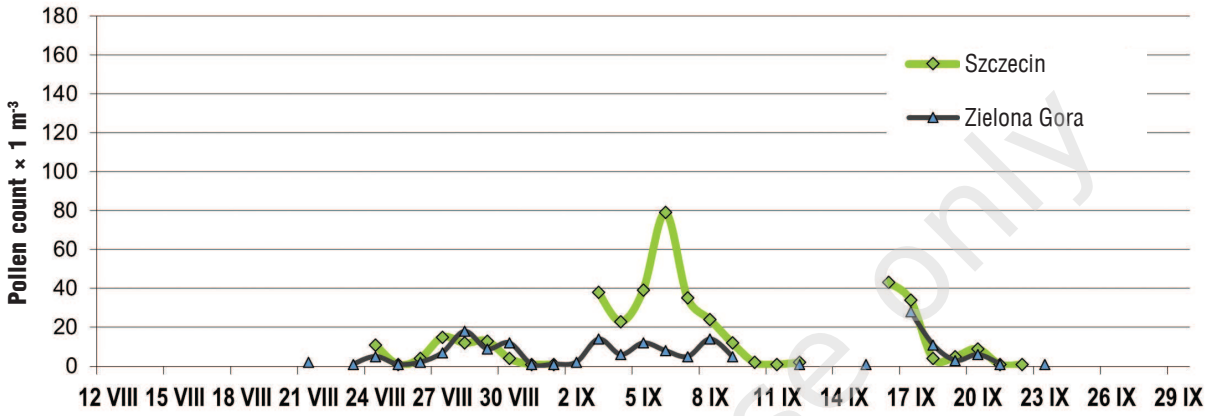
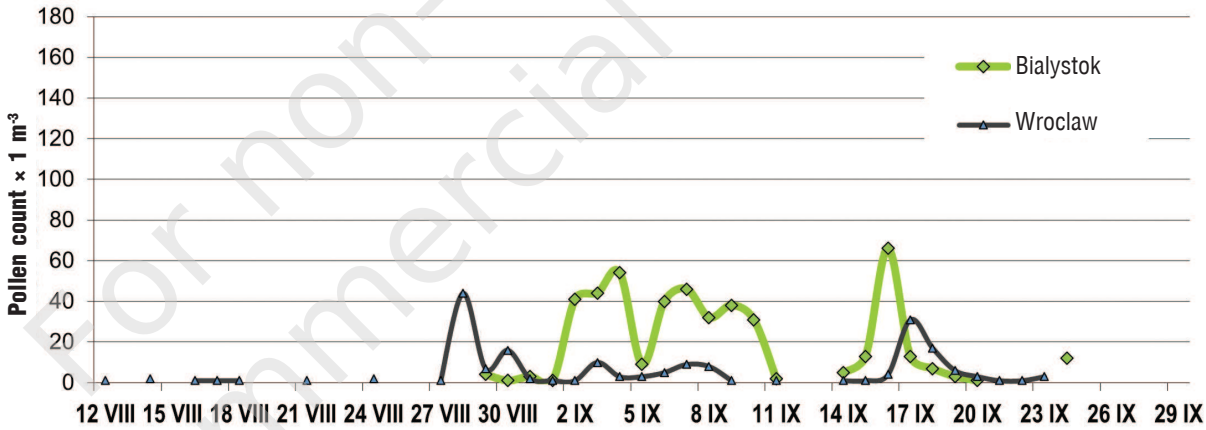


Figure 3. *Ragweed pollen count in Wroclaw and Bialystok in 2024.*



pollen productivity in many plants, including ragweed. The changing climate could also promote the spread of the highly allergenic plant throughout Europe [21]. We have data from meteorological observations to confirm these phenomena: in 2024, the summer, lasting from June to August, was – globally – the warmest in the history of instrumental measurements. The average near-surface air temperature for the summer season was 0.69°C higher than the average for 1991–2020, thus breaking the record from the previous year (0.66°C). Thermal conditions in Poland were in line with the global trend. The strong upward trend in air temperature in Poland, which has been occurring for a number of years, continued in the summer of 2024. The average area air temperature in the summer of 2024 in Poland was 19.6°C and was 1.6°C higher than the multi-year average for this season (climatological normal period 1991–2020). The warmest was in Warsaw and Rzeszow (21.1°C), Tarnow (21.0°C) and Wroclaw (20.9°C) [22].

Conclusions

The similarity of the dynamics of ragweed pollen seasons in different Polish cities indicates the origin of the pollen from the source areas of southern and eastern Europe.

The differences between daily pollen concentration of ragweed in the cities of Poland are mainly caused by the long-distance transport and probably these differences are also a result of the expansiveness of the taxon, populating new areas.

The start of ragweed pollen season in 2024 occurred mostly in the second half of August; however in Wrocław as early as 12th of August. The end of ragweed pollen season lasted to 22nd–27th of September.

Ambrosia pollen season in 2024, in most cities was between 27 and 44 days long and was characterized by very high total annual pollen (maximum up to 1507 g/m^3 in Lublin). In other analysed years, the highest annual total pollen sum was 555 g/m^3 in Zielona Gora.

The start of ragweed pollen season in 2024 occurred mostly in the second half of August; however in

Olsztyn as early as 7th of August. The end of ragweed pollen season lasted to the half of October.

Ambrosia pollen season in most cities was between 28 and 69 days long and was characterized by very low total annual pollen (maximum up to 174 g/m^3 in Warsaw).

The highest ragweed pollen allergen hazard occurred in 2024 in Warsaw and Lublin. The period with pollen counts exceeding the threshold value (≥13 g/m^3) lasted as long as 23 and 22 days. In other analyzed years, from 0 to 7 days with exceeded threshold values were recorded.

The knowledge of the potentially allergenic pollen count and the updating of pollen calendars are important for efficient prophylaxis of inhalant allergies.

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ORCID
Małgorzata Puc – ID – http://orcid.org/0000-0001-6734-9352
Karina Szczypiór-Piasecka – ID – http://orcid.org/0000-0002-9562-9201
Krystyna Piotrowska-Weryszko – ID – http://orcid.org/0000-0003-3827-3218
Agnieszka Lipiec – ID – http://orcid.org/0000-0003-3037-2326
Joanna Rapiejko – ID – http://orcid.org/0000-0001-9832-0413
Szymon Tomczyk – ID - https://orcid.org/0009-0007-8930-907X
Grzegorz Siergiejko – ID – http://orcid.org/0000-0003-4084-8332

Author's contributions:
Puc M.: A-F, Szczypiór-Piasecka K.: A, C-F and other Authors: A-C, E-F.
A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F- Final approval of the article.
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Corresponding author:
Małgorzata Puc, Assoc. Prof.
Institute of Marine & Environmental Sciences,
University of Szczecin
71-412 Szczecin, ul. Felczaka 3c
e-mail: malgorzata.puc@usz.edu.pl