Allergenic Ambrosia pollen grains in the air of some Polish cities in 2019

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Abstract:

Ambrosia is regarded as the most dangerous allergy-related plant posing a considerable threat to human health with its highly allergenic pollen. In Europe, there are 4 *Ambrosia* species originating from North America; they most often colonize ruderal habitats and agricultural fields. The aim of the study was to compare *Ambrosia* pollen seasons in 9 cities located in different parts of Poland in 2019. Aerobiological tests were conducted in Bialystok, Bydgoszcz, Lublin, Olsztyn, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, and Wroclaw. The investigations were carried out with the volumetric method using Burkard or Lanzoni pollen samplers. The 98% method was used to determine the duration of the pollen season. The earliest onset of the pollen season was recorded in Szczecin (August 7th) and Sosnowiec (August 9th), whereas the latest beginning was noted in Wroclaw (August 22nd) and Bydgoszcz (August 21st). The longest pollen season was recorded in Sosnowiec (52 days) as well as Lublin and Szczecin (50 days), while the shortest pollen season was noted in Wroclaw (10 days). The highest mean daily concentrations of *Ambrosia* pollen grains were recorded in Sosnowiec (104 P/m^3) and Wroclaw (77 P/m^3), whereas the lowest value was obtained in Szczecin (18 P/m^3). Peak days were noted mostly during the last 10 days of August. The highest value of *Ambrosia* annual pollen sum was reported from Sosnowiec (326) and Lublin (310), while the lowest sum was noted in Szczecin (69). The multimodal course of the graph presenting the pollen seasons in the analysed cities and literature data indicate that the pollen originated not only from local sources but also from long-distance transport. The highest risk of *Ambrosia* pollen-induced allergy in sensitive subjects was demonstrated in Lublin, Piotrkow Trybunalski and Warsaw. The concentration of *Ambrosia* pollen in the air of the analysed Polish cities was substantially lower than the values indicated by measurement stations located in other parts of Europe.

Key words: aeroallergens, pollen concentration, risk of allergy, *Ambrosia* 2019

Ambrosia pollen grains are extremely allergenic; hence, ragweed jest regarded as the most dangerous allergy-related plant [1]. *Ambrosia* pollen is one of the most allergenic pollen types in Europe [2]. 4 species naturalised in Europe but originating from North America, i.e. *Ambrosia artemisiifolia*, *A. coronopifolia*, *A. trifida* and *A. elatior*, are the sources of *Ambrosia* pollen [3, 4]. These plants most frequently grow in ruderal and riparian habitats and often colonise agricultural fields [5]. As shown by

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data collected by the European Allergenic Network, the mean pollen index for ragweed calculated based on data from 368 measurement stations is 697, with a maximum value of 14 590. The ragweed most often occurs in Central and Eastern Europe [4].

In Poland, for many years, the highest concentrations of ragweed pollen have been recorded in Lublin, with the maximum pollen index from 13 years reaching 1200 and the mean value of this index of 388 [6]. In turn, the maximum values of the *Ambrosia* pollen index recorded in multiyear studies (10–13 years) in other cities were lower, i.e. 399, 425, 460, and 474 in Wroclaw, Lodz, Cracow, and Sosnowiec, respectively [7–10].

In Poland, *Ambrosia* pollen constitutes a small proportion of the airborne pollen spectrum. It was found that, on average, the pollen of this taxon accounted for 3% in Lodz [8] and 0.65% in Lublin [11]. A greater share of ragweed pollen in the aeroplankton was demonstrated in Ukraine (Vinitsa), where 8-year investigations showed that *Ambrosia* pollen constituted 2–23% of the pollen spectrum with a mean of 6.6% [12].

A measure of the strong allergenic effect of *Ambrosia* pollen on the organism of sensitive individuals is the occurrence of the first symptoms of allergy already in the presence of 1–3 pollen grains in 1 m^3 of air within 24 hours [13, 14]. Other authors have reported that allergic reaction may occur at a concentration of 12–13 pollen grains/m^3 of air/day [15, 16], or 20 pollen grains/m^3 of air/day [17].

Previous studies have shown development of allergy to *Ambrosia* pollen allergens in 11% of patients in Poland [18]. As reported by Rodinkova [12], *Ambrosia* pollen grains are more allergenic for children than for the adult population in Ukraine.

Ambrosia pollen grains are classified as small (~20 µm); hence, they can be transported by air over long distances [19]. Many studies indicate a long-distance transport of *Ambrosia* pollen in Europe, e.g. from France to Switzerland [20], from France, Italy, and Croatia to Hungary [21], from Pannonian Plain to Poland [22–25], from Ukraine to Poland [26], and from Central and South Europe to the United Kingdom and the Netherlands [27].

Aim

The aim of this research was to compare *Ambrosia* pollen concentrations recorded in 2019 in the air of nine cities in Poland: Bialystok, Bydgoszcz, Lublin, Olsztyn, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, and Wroclaw.

Material and method

Airborne *Ambrosia* pollen was recorded with the standard volumetric method using Burkard or Lanzoni pollen traps manufactured based on the Hirst-type sampler [28]. The pollen traps were placed on the roofs of the buildings in the analysed cities and operated on a continuous basis. Daily mean pollen concentrations were expressed as the number of pollen grains per cubic meter of air (P/m^3). The duration of the pollen season was determined with the 98% method. The pollen season patterns were represented in graphs. The analyses included the onset and length of the pollen season, the maximum concentration, the date of peak days, and the annual pollen sum.

The threshold values of 5 P/m^3 and 20 P/m^3 served for determination of the degree of allergy risk during the *Ambrosia* pollen season according to literature data [17, 29].

Results

In 2019, the earliest onset of the *Ambrosia* pollen season was recorded in Szczecin (August 7th) followed by Sosnowiec (August 9th) as well as Lublin and Piotrkow Trybunalski (August 12th). The latest beginning of the pollen season of this taxon was noted in Wroclaw (August 22nd) and Bydgoszcz (August 21st) (tab. 1).

An extremely short *Ambrosia* pollen season was recorded in Wroclaw (10 days). In turn, the pollen season persisted for 30–39 days in Piotrkow Trybunalski, Bydgoszcz, Olsztyn, and Bialystok and 45–52 days in Warsaw, Lublin, Szczecin, and Sosnowiec. As demonstrated by a majority of the measurement stations, the end of the pollen season of this taxon was noted in the last 10 days of September.

The maximum daily concentration of *Ambrosia* pollen grains was recorded between August 27th and September 1st in seven of the measurement stations (tab. 1). The peak day was noted on September 9th only in Bialystok and Olsztyn.

The graphic representations of the pollen seasons in all cities in 2019 showed the presence of several peaks (figs 1–5). Such multimodal graphs may indicate that the pollen originates from long-distance transport.

The highest peak values were recorded in Sosnowiec, Wroclaw, Bialystok, and Lublin, i.e. 104, 77, 59, and 59 pollen grains in 1 m^3, whereas the lowest value of this parameter was noted in Szczecin (18 P/m^3).

In 2019, the highest annual sum of *Ambrosia* pollen was recorded in Sosnowiec (326) and Lublin

Table 1. *Characteristics of ragweed pollen season in 2019.*

Features of pollen season	Bialystok	Bydgoszcz	Lublin	Olsztyn	Piotrkow Trybunalski	Sosnowiec	Szczecin	Warsaw	Wroclaw
Duration of pollen season (number of days)	19.08–26.09 (39)	21.08–25.09 (36)	12.08–30.09 (50)	19.08–24.09 (37)	12.08–10.09 (30)	9.08–29.09 (52)	7.08–25.09 (50)	18.08–1.10 (45)	22.08–31.08 (10)
Annual pollen sum	**128**	**174**	**310**	**104**	**273**	**326**	**69**	**224**	**150**
Peak value and peak date	59	29	59	24	43	104	18	37	77
	9.09	30.08	29.08	9.09	31.08	28.08	1.09	29.08	27.08
Days ≥ 5 P/m³	6	9	14	5	12	8	4	12	4
Days ≥ 20 P/m³	2	3	6	1	4	5	0	4	2

Figure 1. *Ragweed pollen count in Bialystok and Olsztyn in 2019.*

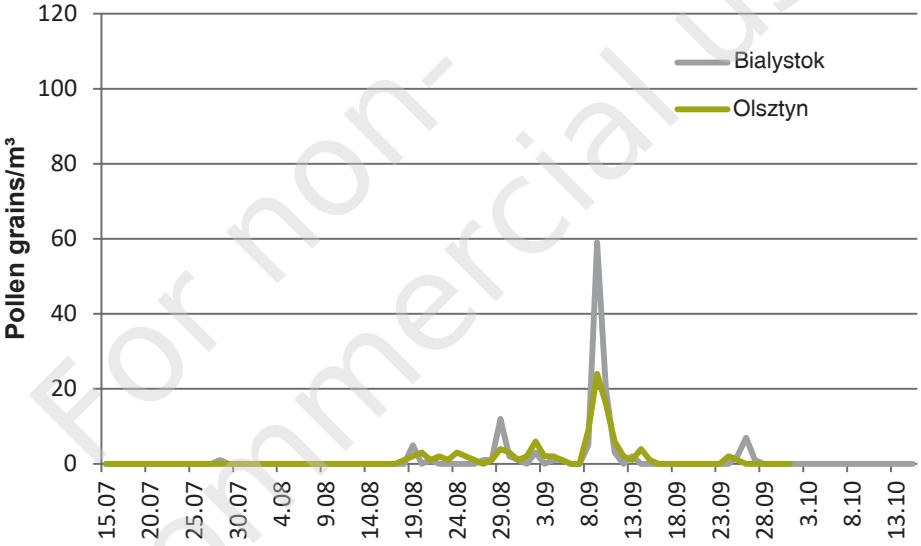


Figure 2. *Ragweed pollen count in Bydgoszcz and Szczecin in 2019.*

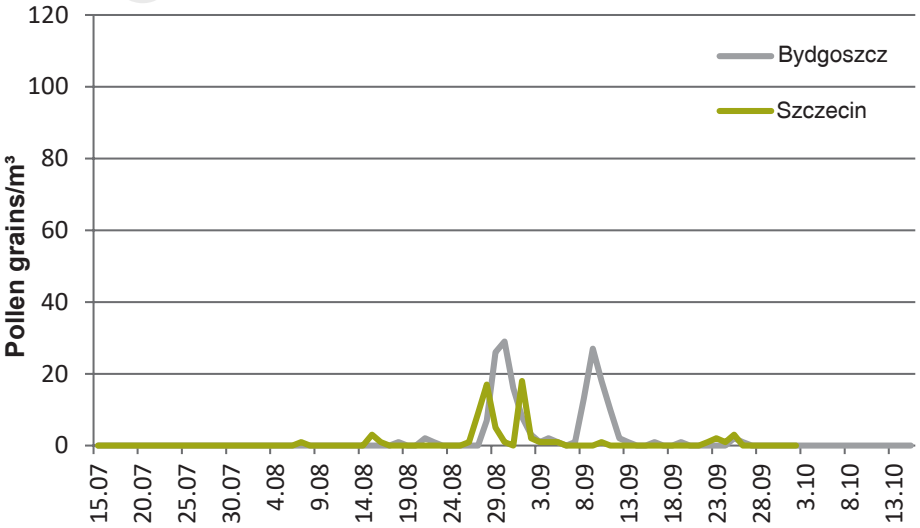


Figure 3. *Ragweed pollen count in Sosnowiec and Wroclaw in 2019.*

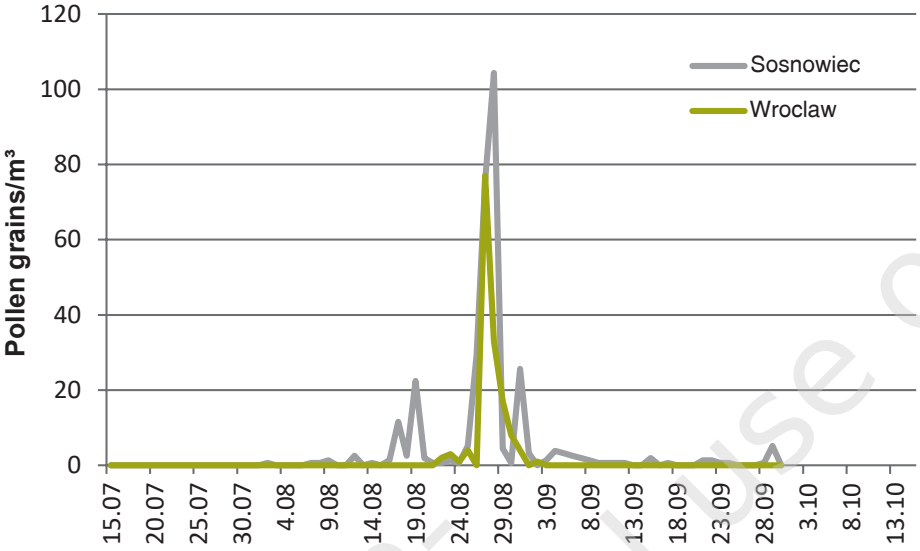


Figure 4. *Ragweed pollen count in Piotrkow Trybunalski and Warsaw in 2019.*

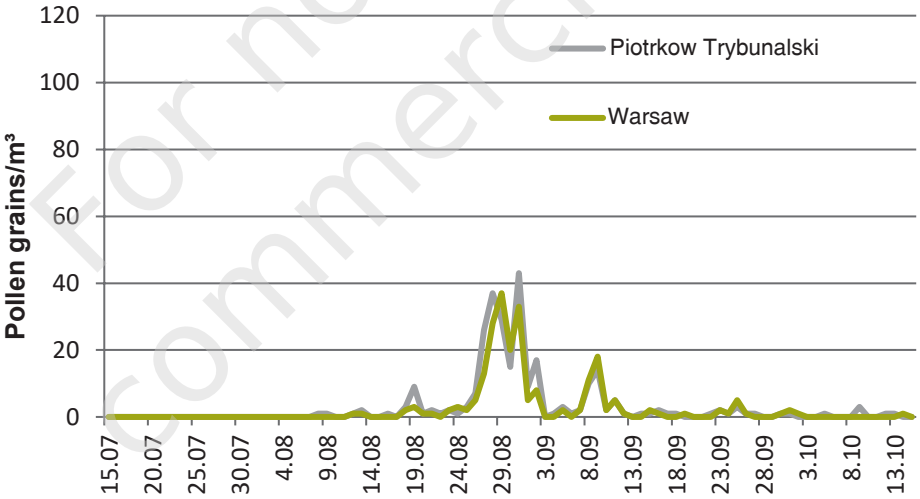
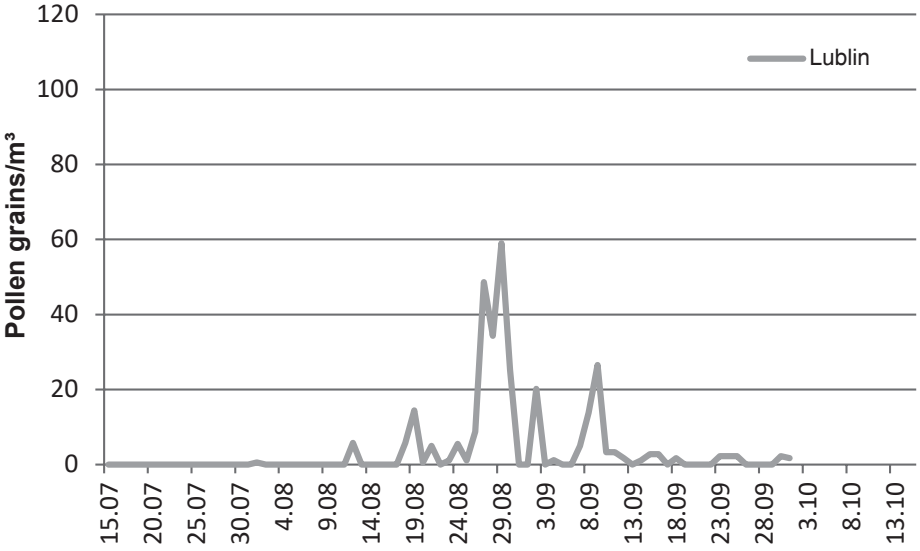


Figure 5. *Ragweed pollen count in Lublin in 2019.*



(310) and the lowest value was noted in Szczecin (69). The mean value of this parameter for the 9 analysed cities in this year was 195.

The greatest risk of allergy related to the largest number of days with the exceeded threshold value of 5 P/m^3 was noted in Lublin (14 days), Piotrkow Trybunalski (12 days), and Warsaw (12 days). In turn, the highest frequency of concentrations exceeding 20 P/m^3 was recorded in Lublin (6 days), Sosnowiec (5 days), Piotrkow Trybunalski (4 days), and Warsaw (4 days) (tab. 1).

Discussion

In 2019, the *Ambrosia* pollen seasons in the analysed cities started between August 7th and August 22nd. This was similar to the dates recorded in 2016 for many cities in Poland [30, 31] and differed from the results from 2018, in which the first *Ambrosia* pollen grains were recorded already on July 26th [32].

The results of the annual *Ambrosia* pollen sum obtained in 2019 indicate a large spatial variation in the concentration of the pollen of this taxon in Poland (69–326). This parameter differed significantly between the measurement stations in 2018 [32] and in 2016 [30, 31].

Multiyear research conducted in Lublin showed substantially higher concentrations of *Ambrosia* pollen than the values recorded in other Polish cities [6, 7, 10]. The annual sum of *Ambrosia* pollen (83) reported in Lublin in 2016 was the lowest of the values recorded in 6 cities, with a several-fold higher value noted in Zielona Gora (371). Similarly, higher abundance of *Ambrosia* pollen was recorded in Opole and Zielona Gora than in Lublin in 2018 [32]. The investigations conducted in 2019 showed the highest annual pollen sums in Sosnowiec (326) followed by Lublin (310).

The concentrations of *Ambrosia* pollen were not high in 2019. The mean annual sum of *Ambrosia* pollen recorded in the 9 measurement stations in the study year was substantially lower (195) than the mean calculated for many cities in 2016 (295) [30, 31] and the mean noted in 2018 (291) [32].

As demonstrated in the present study, the *Ambrosia* pollen concentrations recorded in Poland are considerably lower than in many other European countries. This is reflected in the high mean pollen index (697) calculated for 368 measurement stations in Europe [4], which substantially exceeds the values reported by aerobiological stations in Poland.

Ambrosia pollen recorded in Poland is not only released by plants growing in the country, but also originates primarily from distant transport. As demonstrated by Stępalska et al. [33], the high *Ambrosia* pollen concentrations in the southeastern part of Poland are associated with the pollen transport with air mass inflow from the east-south and south-west and with local sources.

The presence of airborne *Ambrosia* pollen in the first half of August, which was noted in 2019 in Sosnowiec, Szczecin, Lublin and Piotrkow Trybunalski, intensified the human health risk due to the co-occurrence of the *Artemisia* pollen season. This is also highlighted by authors of previous papers on the pollen of both these taxa [33].

Conclusions

1. In 2019, the *Ambrosia* pollen season in most of the Polish cities analysed in the study began in the first or second 10 day period in August, i.e. ca. 10 days later than in 2018.
2. The pollen season of the investigated taxon was substantially shorter in 2019 than in 2018.
3. The maximum ragweed pollen concentration in 2019 was most frequently recorded at the end of August or in the first 10 days of September.
4. The highest risk of *Ambrosia* pollen-induced allergy in patients was noted in Lublin, Piotrkow Trybunalski and Warsaw.

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