The oak pollen concentration in the air of selected cities in Poland in 2018

Aneta Sulborska¹, Elżbieta Weryszko-Chmielewska¹, Krystyna Piotrowska-Weryszko¹, Agata Konarska¹, Beata Żuraw¹, Małgorzata Malkiewicz², Monika Ziemianin¹, Artur Górecki², Małgorzata Puc², Alina Stacewicz³, Grzegorz Siergiejko², Ewa M. Świebocka³, Agnieszka Lipiec¹, Adam Rapięjko⁴,⁵, Katarzyna Dąbrowska-Zapart⁴,⁵, Kazimiera Chlopek⁴,⁵, Andrzej Wieczorkiewicz⁴, Daniel Kotrych¹, Agnieszka Świdnicka-Siergiejko⁴, Dariusz Jurkiewicz¹, Piotr Rapięjko⁴,³

¹ Department of Botany, University of Life Sciences in Lublin, Poland
² Department of Palaeobotany, Institute of Geological Sciences, University of Wrocław
³ Department of Clinical and Environmental Allergology, Jagiellonian University, Medical College
⁴ Institute of Botany, Jagiellonian University
⁵ Department of Botany and Nature Conservation, Faculty of Biology, University of Szczecin, Poland
⁶ Pediatrics, Gastroenterology and Allergology Department, University Children Hospital, Medical University of Białystok, Poland
⁷ Department of Prevention of Environmental Hazards and Allergology, Medical University of Warsaw, Poland
⁸ Allergen Research Center, Poland
⁹ Oxford Archaeology Ltd., Oxford, England
¹⁰ Department of Paleontology and Stratigraphy, Faculty of Earth Sciences, University of Silesia
¹¹ Department of Orthopedics and Traumatology, Pomeranian Medical University of Szczecin, Poland
¹² Department of Gastroenterology and Internal Medicine, Medical University of Białystok
¹³ Department of Otolaryngology with Division of Cranio-Maxillo-Facial Surgery in Military Institute of Medicine, Warsaw, Poland

Abstract: This paper contains an analysis of oak pollen seasons in selected cities of Poland in 2018. Sampling sites were located in the following cities: Białystok, Bydgoszcz, Cracow, Drawsko Pomorskie, Lublin, Olsztyn, Opole, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, Wrocław and Zielona Gora.
The volumetric method was applied using the Burkard or Lanzoni trap. The pollen season was determined by the 98% method. The season started earliest in Sosnowiec (April 14th). The mean duration of the pollen season was 33 days. The highest pollen concentration (713 P/m³) was observed in Wrocław (April 19th). The peak values were recorded between April 19th and May 1st in the different cities.

Key words: aeroallergens, pollen concentration, oak (Quercus), 2018

The oak (Quercus) genus belongs to the family Fagaceae and it comprises about 600 species that are found almost exclusively in the Northern Hemisphere [1]. In Poland only 3 species grow in the wild: pedunculate oak (Quercus robur L.), sessile oak (Quercus petraea [Matt.] Liebl.), and pubescent oak (Quercus pubescens Willd.), as well as a hybrid of the former two species (Quercus × rosacea Bechst.) [1, 2]. Due to their longevity, up to 1000 years and more, Q. robur and Q. petrea often constitute the core of forest stands. Ornamental varieties of the above mentioned species, with various leaf forms and colors, are also used in park planting. The northern red oak (Qu. rubra L.) is the most frequently planted species of foreign origin (from Northern America); it grows faster than other oaks and is very resistant to frost
and air pollution [1]. In total, about 40 oak species are grown in Poland, among which the most important ones are mentioned above [2, 3].

Oak pollen grains are among 12 most allergenic pollen types [4]. Rapiejko [5] reports that for most sensitized patients, clinical symptoms are visible during exposure to a concentration of ca. 80 oak pollen grains in 1 m³ of air.

According to Burge [6], in the case of Quercus pollen grains the threshold value is a concentration of 16 pollen grains in 1 m³ of air, at which clinical symptoms occur in many sensitized patients exposed to this concentration, while for most sensitized patients clinical symptoms are visible during exposure to a concentration of 91 pollen grains in 1 m³ of air.

**Aim**

The aim of the study was to compare the oak pollen season in 13 monitoring sites in Poland: Bialystok, Bydgoszcz, Cracow, Drogows Pomorskie, Lublin, Olsztyn, Opole, Piotkow Trybunalski, Sosnowiec, Szczecin, Warsaw, Wroclaw and Zielona Gora.

**Material and method**

Measurement of the concentration of oak pollen grains in atmospheric air was performed by the volumetric method using Burkard or Lanzoni pollen samplers. 24-hour periods were analyzed in microscopic slides. The pollen season duration was determined by the 98% method. Pollen season start and end dates, pollen grains sum during the season expressed by the SPI (Seasonal Pollen Index), maximum pollen concentration, peak date and number of days with the oak pollen concentration exceeding the threshold value at which the consecutive allergy symptoms develop (according to Burge) [6] were determined.

**Results and discussion**

In 2018 the oak pollen season started in the studied cities between April 12th and April 21st, earliest in Sosnowiec (tab. 1). In 6 cities, the onset of the season occurred 6–16 days later than in 2017, while in 5 cities at dates similar to those in the previous year [7]. The average duration of the oak pollen season at the investigated monitoring sites was 33 days in 2018 (tab. 1), while in 2017 it was 44 days [7]. In 2018 the end of the oak pollen season occurred between May 13th and May 26th. The highest seasonal pollen count (SPI) for oak was recorded in Lublin, followed by Wroclaw (tab. 1). The next values of this parameter, very similar, were observed in Warsaw and Piotkow Trybunalski, followed by Opole, Zielona Gora and Olsztyn. The least oak pollen was observed in Bialystok (tab. 1). The average SPI in 2018 was 1816 pollen grains, whereas in 2017 it was 1363 [7].

The pattern of oak pollen seasons in the individual cities is illustrated by curves characterized by the presence of several peaks, which indicates that flowering and pollen shed of different oak taxa occurred at different times (figs 1–6). Because flowering of the most frequently found oak species in Poland, the pendulate oak, occurs about 2 weeks earlier than that of the sessile oak [3, 8], in the graphs this corresponds to the first peak, which is most often higher than the next peaks (figs 2, 3, 5, 6). The multiple peak curves

### Table 1. Characteristics of oak pollen season in 2018.

| Features of pollen season | Bialystok | Bydgoszcz | Cracow | Drogows Pomorskie | Lublin | Olsztyn | Opole | Piotkow Trybunalski | Sosnowiec | Szczecin | Warsaw | Wroclaw | Zielona Gora |
|---------------------------|-----------|-----------|--------|-------------------|--------|--------|-------|-------------------|-----------|---------|--------|---------|-------------|
| Duration of pollen season (number of days) | 14.04–22.05 (39) | 16.04–16.05 (31) | 18.04–14.05 (27) | 19.04–22.05 (34) | 20.04–17.05 (28) | 17.04–18.05 (32) | 16.04–26.05 (41) | 19.04–19.05 (31) | 12.04–20.05 (39) | 17.04–18.05 (32) | 21.04–19.05 (29) | 15.04–13.05 (29) | 15.04–19.05 (35) |
| Seasonal Pollen Index | 285 | 1674 | 1794 | 1673 | 4488 | 2137 | 2181 | 2865 | 930 | 1359 | 2728 | 3808 | 2120 |
| Peak value and peak date | 44 (1.05) | 275 (30.04) | 396 (21.04) | 243 (30.04) | 581 (22.04) | 275 (25.04) | 354 (21.04) | 287 (29.04) | 207 (21.04) | 197 (29.04) | 378 (25.04) | 713 (25.04) |
| Days ≥ 16 Pm** | 4 (4) | 7 (7) | 10 (10) | 13 (13) | 10 (9) | 8 (8) | 6 (6) | 12 (12) | 14 (14) | 8 (8) | 12 (12) | 10 (10) |
| Days ≥ 91 Pm*** | 0 (0) | 7 (7) | 6 (6) | 6 (6) | 14 (14) | 9 (9) | 8 (8) | 14 (14) | 3 (3) | 5 (5) | 12 (12) | 9 (9) | 8 (8) |

* Symptoms present in many patients.
** Symptoms present in most patients.
Figure 1. Oak pollen count in Białystok and Szczecin in 2018.

Figure 2. Oak pollen count in Bydgoszcz and Drawsko Pomorskie in 2018.

Figure 3. Oak pollen count in Cracow and Lublin in 2018.
Figure 4. Oak pollen count in Olsztyn and Piotrkow Trybunalski in 2018.

Figure 5. Oak pollen count in Sosnowiec, Opole and Wroclaw in 2018.

Figure 6. Oak pollen count in Warsaw and Zielona Gora in 2018.
illustrating the pattern of oak pollen seasons in some cities (Lublin, Szczecin, Warsaw) confirm the occurrence of several oak species in urban green spaces and at the outskirts of the cities, as reported by Puc et al. [7] for Szczecin, as well as by Adamiec and Trzaskowska [9] for Lublin.

The highest daily pollen count of Quercus was recorded in 2018 on April 19th in Wroclaw, followed by Lublin on April 22nd, while the lowest value of this trait was found in Bialystok on May 1st (tab. 1).

The highest Quercus pollen risk (above 91 P/m³/24 h) occurred in Lublin and Piotrkow Trybunalski (14 days) as well as in Warsaw (12 days). In the other cities this value was 0–9 days (tab. 1). For most of the cities these are higher values than those recorded in 2017 [7].

Conclusions
1. In 2018 the oak pollen season started in the second 10 days of April in most of the cities. The pollen season duration at the investigated monitoring sites was 27–41 days (on average 33 days).
2. In 2018 the average seasonal oak pollen count (SPI) for the investigated monitoring sites was 1816 pollen grains and was higher than the average in 2017. The highest SPI and peak value were found in Lublin and Wroclaw.
3. The highest oak pollen allergen risk occurred in Lublin, Piotrkow Trybunalski and Warsaw.

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The authors declare that they have no competing interests.
Ethics:
The contents presented in this paper are compatible with the rules the Declaration of Helsinki, EU directives and standardized requirements for medical journals.

Corresponding author:
Aneta Sulborska, PhD
Department of Botany, Faculty of Horticulture and Landscape Architecture, University of Life Sciences in Lublin
20-950 Lublin, Akademicka 15 street
e-mail: aneta.sulborska@up.lublin.pl