

# The analysis of grass pollen season in northern Poland in 2016

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**Abstract:** This paper presents the course of the pollen season of grass (*Poaceae*) in Szczecin, Drawsko Pomorskie, Bydgoszcz, Olsztyn, Piotrków Trybunalski, Warsaw and Białystok in 2016. Grass are typical wind-pollinated plants and the most important agent causing pollinosis in Europe. Many species of grasses growing in Poland have distribution ranges that extend far to the north, indicating their tolerance of severe arctic climate. 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 *Poaceae* started first in Warsaw, on the 10<sup>th</sup> of May (one week earlier than the other cities) lasted till the 8<sup>th</sup> of September. The differences of pollen seasons duration were slight. The highest, record airborne concentration of 458 pollen grains/m<sup>3</sup> was noted in Olsztyn on the 15<sup>th</sup> of June. The maximum values of seasonal pollen count occurred between of 4<sup>th</sup> June and 29<sup>th</sup> of June in all cities. The highest grass pollen allergen hazard occurred in 2016 in Warsaw, Drawsko Pomorskie and Olsztyn.

**Key words:** allergens, pollen count, grass (*Poaceae*), 2016

Grasses – *Poaceae* (R. Br.) Barnh – belong to one of the most abundant families in the world. From among more than 300 species of grasses known in Poland, there are 160 species permanently established in natural habitats. They include 130 species native to Poland and more than 30 alien species [1].

Grass pollen is the major cause of pollinosis in many parts of the world. The number and species of airborne pollen vary according to the time of day, seasonal and weather conditions, geographical location and proximity to pollen sources. The distance from grass pollen source is important especially for sufferers

of allergic diseases; for instance, measurement of rye pollen count carried out by Rapiejko et al. [2] on a field of blooming ray revealed a concentration of over 7,300 g/m<sup>3</sup> of air at 1.8 m above ground level and about 200 g/m<sup>3</sup> at 0.5 km away from the field borders. For persons with grass pollen allergy, this means a hazard of allergic symptoms.

Literature gives a few references to the number of pollen grains needed to provoke an allergic reaction in susceptible individuals. The grass pollen concentration at which clinical allergic symptoms can develop depends also on individual reactivity and show regional differentiations. In Poland, the people sensitive to

*Poaceae* pollen developed the first disease symptoms when exposed to more than 20 g/m<sup>3</sup>. Symptoms were noted in all the subjects sensitized to grass pollen at the concentration of approximately 50 g/m<sup>3</sup> of air. During exposure to the concentration of 65 pollen grains per 1 m<sup>3</sup> the symptoms were acute symptoms [2]. In Turku (Finland), a count of less than 30 g/m<sup>3</sup> was significantly correlated with respiratory tract symptoms at the start of the *Poaceae* pollen season [3]. In London (UK), the lowest concentration of grass pollen able to induce the appearance of hay fever symptoms was shown to be 10–50 g/m<sup>3</sup> [4]. In Croatia, the threshold value amounts to 30 /m<sup>3</sup> [5].

All grass pollen types show a very high degree of crossreactivity (the reaction between an antibody and an antigen that differs from the immunogen, mainly proteins). Grass pollen can also cross-react with food like beans, peas, cereals, peanut and fruit (melon, watermelon) as well as edible vegetables (carrot, celery) [6].

## Aim

The aim of this work was to analyse the grass pollen concentrations in the air of Szczecin, Warsaw, Drawsko Pomorskie, Bydgoszcz, Olsztyn, Piotrkow Trybunalski and Bialystok in 2016.

## Material and method

Measurements of airborne grass pollen were carried out in Szczecin, Warsaw, Drawsko Pomorskie, Bydgoszcz, Olsztyn, Piotrkow Trybunalski and Bialystok in the year 2016.

The pollen season was defined using the 98% method; the day on which the cumulative pollen count during the period 1 January – 30 June reached the value of  $\geq 1\%$  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  $\geq 99\%$  [7]. 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 grass family exceeding the threshold values at which the consecutive allergy symptoms develop were determined (tab. 1) [2].

## Results and discussion

As the family *Poaceae* is represented by many taxa, the pollen seasons were very long. In Szczecin the length of the *Poaceae* pollen season for example varied considerably from 112 days in 2008 and 2006 (113 days) to 148 days in 2004 [8]. In 2016, in all the measurement points studied, the grass pollen season started between 10<sup>th</sup> and 21<sup>st</sup> of June and lasted 105–119 days, to the first decade of September (fig. 1–4, tab. 1). In general the *Poaceae* pollen is present abundantly over most of the area of Poland from the half of May to the half of August [9]. In comparison to data from 2001–2005 [9] in northern Poland, in 2016 pollen concentration of grass pollen was one of the lowest in all analysed cities.

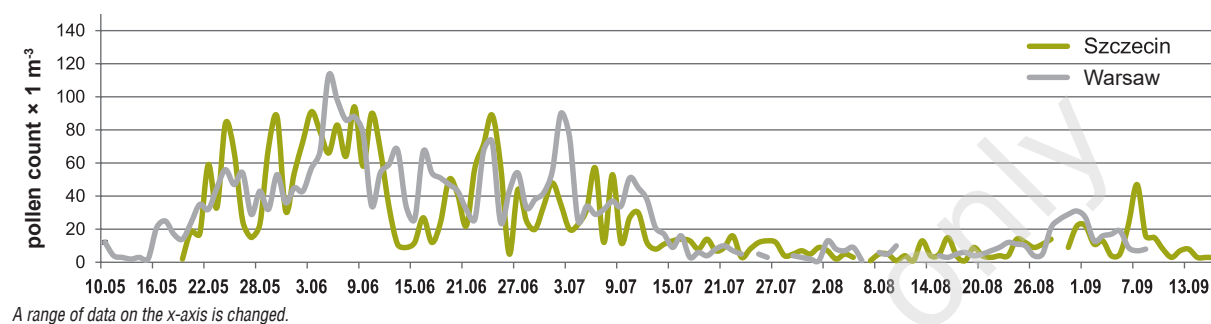
In 2001–2005 in our country the maximum daily concentration was observed between 3<sup>rd</sup> of June and 12<sup>th</sup> of July [9]. In 2016 in most cities of central and northern Poland the dates of maximum concentrations were noted between 4<sup>th</sup> and 15<sup>th</sup> of June (tab. 1, fig. 1–4). In Portugal the maximum airborne concentration of *Poaceae* pollen usually occurs in July [10]. Garcia-Mozo et al. [11] reported that in southern Spain, the peak date was recorded around mid-May; this is the period of the highest risk of the appearance of pollinosis symptoms in persons with hypersensitivity of the grass pollen allergens. In this study the highest daily pollen count was noted in 2016 in Olsztyn (458 g/m<sup>3</sup>) (tab. 1) and the highest annual sum of grass pol-

**Table 1.** Characteristics of grass pollen season in 2016.

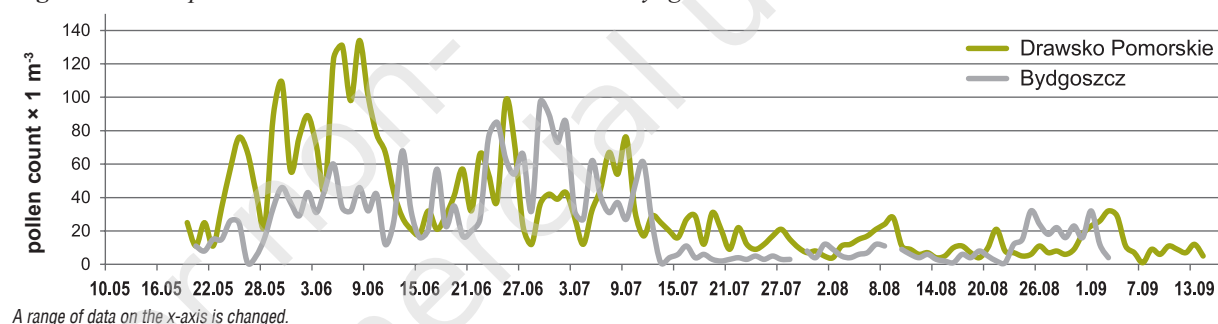
Features of pollen season	Szczecin	Warsaw	Drawsko Pomorskie	Bydgoszcz	Olsztyn	Piotrkow Trybunalski	Bialystok
Duration of pollen season (number of days)	19.05–16.09 (119)	10.05–8.09 (115)	19.05–14.09 (119)	20.05–3.09 (105)	17.05–5.09 (112)	21.05–7.09 (109)	15.05–9.09 (117)
Seasonal Pollen Index SPI (total)	2992	3334	3791	2577	3739	3133	2711
Peak value and peak date	94 (8.06)	113 (5.06)	134 (8.06)	97 (29.06)	458 (15.06)	135 (7.06)	146 (4.06)
Days $\geq 20$ g/m <sup>3</sup> [2]*	48	62	60	48	57	53	45
Days $\geq 50$ g/m <sup>3</sup> [2]**	20	22	24	14	28	18	18

\* first symptoms of allergy; \*\* symptoms present in all examined patients.

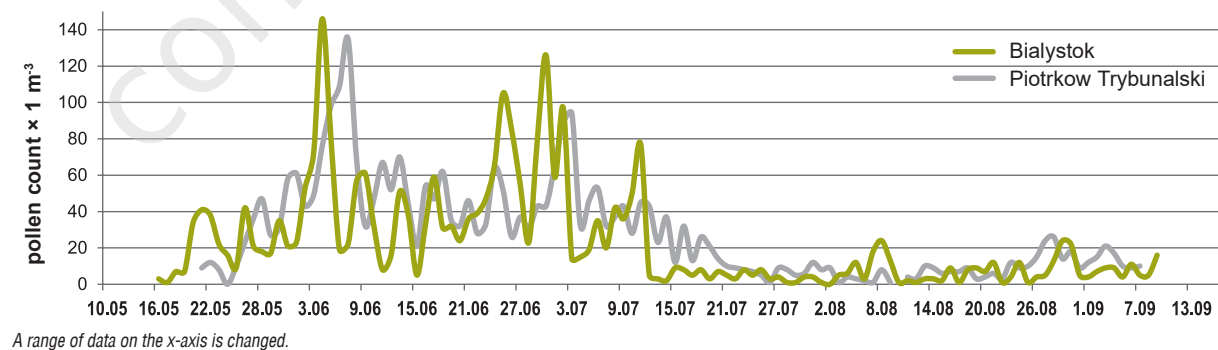
**Figure 1.** Grass pollen count in Szczecin and Warsaw in 2016.



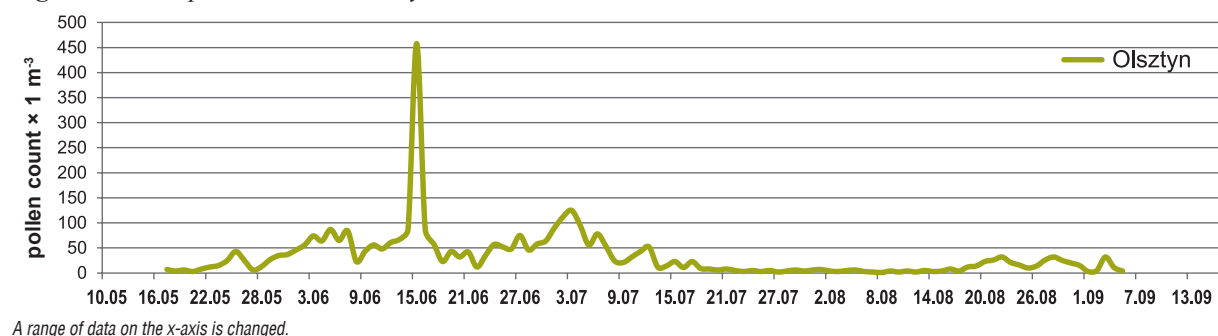
**Figure 2.** Grass pollen count in Drawsko Pomorskie and Bydgoszcz in 2016.



**Figure 3.** Grass pollen count in Białystok and Piotrków Trybunalski in 2016.



**Figure 4.** Grass pollen count in Olsztyn in 2016.



len grains (SPI) was observed in Drawsko Pomorskie and in Olsztyn (above 3700).

The period, in which the grass pollen count exceeded the threshold value of 20 g/m<sup>3</sup> causing the first symptoms, lasted in northern Poland from 45 to 62 days. The highest pollen concentration causing severe clinical symptoms (above 50 g/m<sup>3</sup>) was noted in Olsztyn (28 days), in Drawsko Pomorskie (24 days) and in Warsaw (22 days) (tab. 1). In Zagreb, Croatia, a high variability was observed in the number of weeks when grass pollen concentration exceeded the threshold value of 30 g/m<sup>3</sup>, i.e. 1–5 weeks in the years 2002–2005 [5].

## Conclusions

Grass pollen season in most cities was more than 110 days long and was characterized by quite low total annual pollen (maximum to 3791 g/m<sup>3</sup>).

The start of grass pollen season in 2016 occurred in the half of June; in Warsaw as early as 10<sup>th</sup> of June and lasted to the beginning of September.

The highest grass pollen allergen hazard occurred in 2016 in Olsztyn, Drawsko Pomorskie and Warsaw. The period with pollen counts exceeding the threshold value ( $\geq 20$  g/m<sup>3</sup>) lasted as long as 57 and 62 days. The lowest risk of allergy symptoms to grass pollen was observed in Szczecin, Białystok and Bydgoszcz 45–48 days of exceeded threshold count.

The updating of pollen calendars and accurate pollen announcements are important for efficient prophylaxis of pollen allergies.

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### Authors' contributions:

Puc M: 50%; Kotrych D: 10%; Rapiejko P: 10%; Lipiec A: 10%; and other Authors: 4% each.

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The authors declare that they have no competing interests.

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### Ethics:

The contents presented in this paper are compatible with the rules the Declaration of Helsinki, EU directives and standardized requirements for medical journals.

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