

Allergic risk zones of plane tree pollen (*Platanus* sp.) in Poznan

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Abstract

Introduction: *Platanus* is an ornamental tree commonly planted in the cities. In recent years the number of plane trees in Poznan has markedly increased. Because of the high allergenicity of plane tree pollen, the current tendency to plant a lot of young *Platanus* trees in Poznan seems to be disturbing.

Aim: The main aim of this study was to prepare a map presenting zones of the highest allergic risk of plane tree pollen in Poznan.

Material and methods: Daily average *Platanus* pollen counts (2005-2009) were collected in Poznan by two volumetric pollen traps located both in the city center and on the outskirts of Poznan. The field study of the distribution of *Platanus* trees in Poznan was conducted during three years (2008-2010).

Results: The *Platanus* pollen season usually starts at the end of April and lasts for about 3 weeks. The highest pollen level was observed in the city center between 14.00 and 16.00 h. Trace quantities of pollen were detected on the outskirts of Poznan. Over 50 *Platanus* populations with a number of trees > 20 have been found mainly in the city center. The total number of specimens exceeded 1500, including 448 mature regularly flowering trees.

Conclusions: Plane tree pollen exceeded the risk concentrations (> 50 P/m³) only for few days, however during the intensive pollen season the pollen level can easily reach very high values. On the outskirts of Poznan, the pollen level is too low to induce allergic reactions. In recent years, over 1000 of new *Platanus* trees have been planted. Presumably, along with maturation of these young specimens, the exposure to plane pollen in the city will also increase.

Key words: plane tree, allergens, allergic risk, green areas, Poznan.

Introduction

Platanus is a long-lived ornamental tree and, due to its tolerance to atmospheric pollution it is often planted in urban areas [1]. The London plane tree (*P. acerifolia*), a hybrid between *P. occidentalis* and *P. orientalis* [2], is especially resistant to frost and drought, and therefore it is frequently found in Polish cities [3]. Its time of flowering in Poznan occurs in spring [4]. Plane as an anemophilous tree produces large amounts of pollen in a short time [5].

Studies from Southern Europe, where *Platanus* is a widespread species, have shown that plane tree pollen is responsible for a high rate of allergic reactions, e.g. in Spain, positive skin prick tests were noted in 8-56% of examined patients depending on the region [2, 6-8]. The cross-reactivity between *Platanus* and other plant pollen

allergens, especially grass and mugwort, was frequently recorded [9, 10]. Moreover, the latest reports [9, 11, 12] show that people sensitized to plane tree pollen can have oral allergy symptoms after eating certain vegetables and fruit, e.g. lettuce, celery, peach, banana, apple or hazelnut.

In recent years the number of *Platanus* trees in Poznan has markedly increased. Many young plants were planted near the streets, in parks and new green areas. Presumably, along with maturation of these trees, the exposure to plane pollen in the city will also increase.

Aim

The main goal of this study was to define, based on aerobiological monitoring and field observations, the allergy risk zones of plane tree pollen in Poznan.

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Material and methods

Monitoring sites and *Platanus* pollen data

Daily average *Platanus* pollen counts (2005-2009) were collected in Poznan by two volumetric pollen traps of the Hirst design [13]. The first sampler was situated on the roof of a students' dormitory of the Poznan University of Medical Sciences at a height of 33 m. The station is sited in the city center at a distance of around 100 m from closest plane trees. The second trap was sited on the roof (height 22 m) of a building at the Adam Mickiewicz University Campus (Morasko) and located about 6.5 km from the nearest big cluster of plane trees (Figure 1). Pollen grains were counted along four horizontal transects, which were divided into 2 mm (1 h) intervals [14].

Pollen season analysis

The limits of the hazel pollen season were calculated by using the 95% [15] method, whereby the season starts when 2.5% of the total catch was achieved and ends when it is 97.5%. The intensity of the pollen season was defined as a sum of daily average *Platanus* counts pollen recorded in the season (Seasonal Pollen Index – SPI).

In order to prepare the diurnal curve of plant tree pollen, only days with concentrations above 10 grains/m³ were taken into account. Moreover, the number of days with > 50 grains/m³ during the pollen season was presented. This value is considered to be the threshold above which the first symptoms of allergy occur in people sensitized to plane tree pollen [10].

Distribution of plane trees in Poznan

The study of the distribution of *Platanus* trees in the Poznan area was conducted during three years (2008-2010). To evaluate the total number of plane trees in the city data obtained from several different sources were used:

- (i) lists of plane trees supplied by the Board of City Green Areas and Board of Town Roads of the City of Poznan,
- (ii) articles released on that subject [1],
- (iii) field studies.

Field observations were conducted in order to verify the presence of plane trees in the areas mentioned in documents referred to (i) and, (ii) and to find new (recently planted) specimens of *Platanus* tree in Poznan.

Results

Variations in *Platanus* pollen seasons in Poznan during 2005-2009 (Eskulap monitoring station)

The *Platanus* pollen season in Poznan starts at the turn of April and May and ends usually in the third decade of May. The earliest onset of the pollen season was noticed in 2007 (April 23) and the latest – in 2006 (May 6). The plane tree pollen season usually lasted for about three weeks, but high concentrations of *Platanus* pollen (> 50 P/m³) were only recorded for short periods (Table 1). However, during the most intensive pollen seasons, very high daily pollen concentrations (> 150 P/m³) were recorded in the air. Strong day-to-day variation in the pollen level was noticed in Poznan. The highest concentrations of pollen were recorded within only few days since the pollen

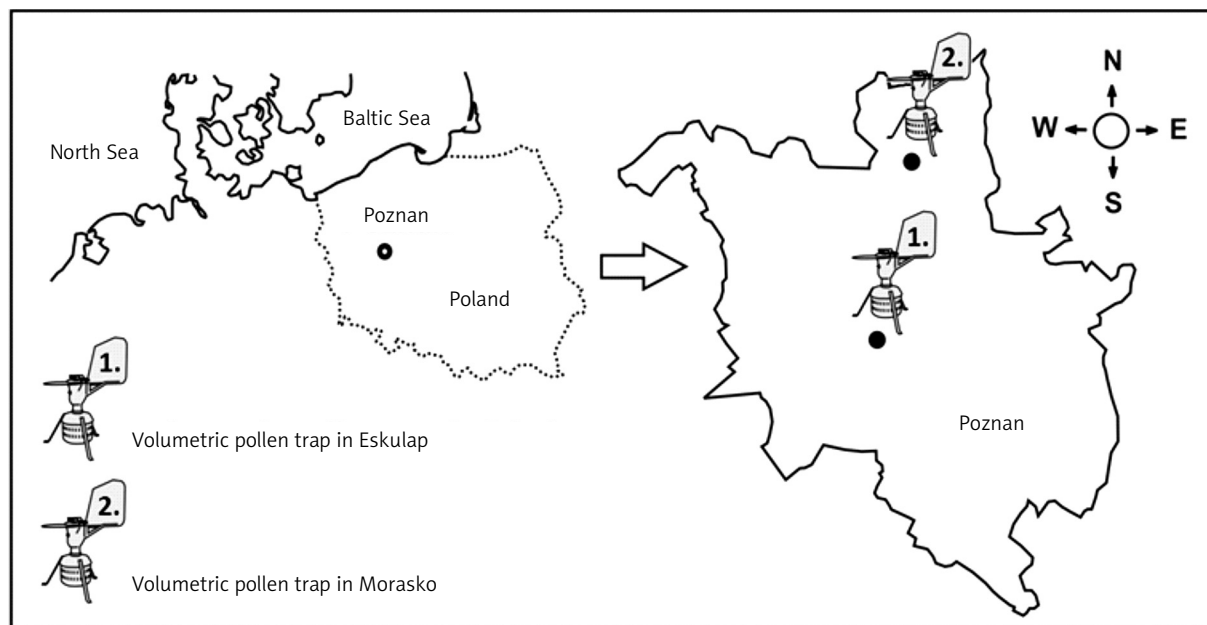


Figure 1. Localization of volumetric pollen traps in Poznan

Table 1. Main characteristics of *Platanus* pollen seasons in the city centre of Poznan during 2005-2009

Year	SPI	Duration	Start	End	Number of days > 50 P/m ³	Max. daily concentration [P/m ³]	Max. bihourly concentration [P/m ³]
2005	153	47	122	168	0	27	133
2006	547	15	126	140	4	176	535
2007	468	13	113	125	1	316	784
2008	361	15	124	138	2	150	535
2009	250	29	115	143	0	40	90
Mean	356	24	120	143	1	142	416

season start (Figure 2). The most intensive pollen season was recorded in 2006 (SPI = 547 P/m³) and the lowest seasonal sum of pollen was observed in 2005 (SPI = 153 P/m³).

Diurnal pattern of plane tree pollen

Platanus pollen concentrations start increasing during morning hours (8.00-10.00). The highest level of pollen was usually observed between 14.00 and 16.00 (Figure 3) when the average bihourly pollen concentrations reached almost 100 P/m³. During the most intensive pollen season, the maximum bihourly pollen level exceeded 750 P/m³. At night and in the early morning, pollen concentrations were very low.

Comparison of aerobiological data from two monitoring stations in Poznan (Eskulap vs. Morasko)

The annual sums of plane tree pollen at the Morasko station (about 6.5 km from the city center) were ten to twenty times lower than in Eskulap (Figure 4) and never exceeded 50 P/m³. Usually, only few pollen grains were recorded daily at this site. Obtained data suggest that plane tree pollen falls down at a short distance from its source, i.e. tree, and is not transported for long distances.

The plane tree distribution in Poznan

Over 50 *Platanus* populations with more than 20 trees have been found in Poznan. The total number of speci-

mens exceeded 1500, including 448 mature regularly flowering trees. The distribution of *Platanus* within the city is irregular. There is a high concentration of stands in the city center but very often these are single trees or groups of only few specimens. Plane avenues are characteristic of Poznan. Thickly planted sections of Przybyszewskiego Street (81 trees), Rolna Street (55 trees), 27 Grudnia Street (22 trees) and Niepodległości Avenue (42 trees) stand out from them. Plane trees also grow in parks and at

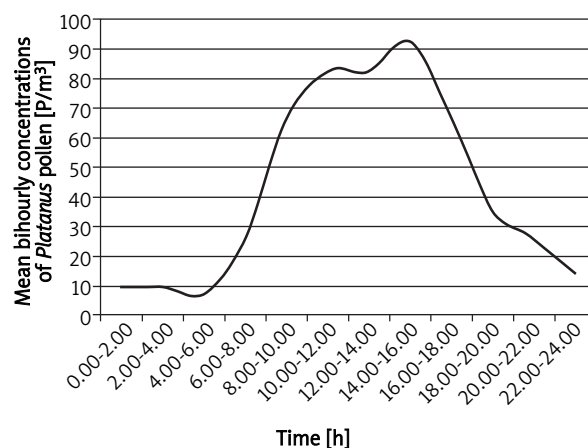


Figure 3. Daily pattern of *Platanus* pollen concentrations in the centre of Poznan

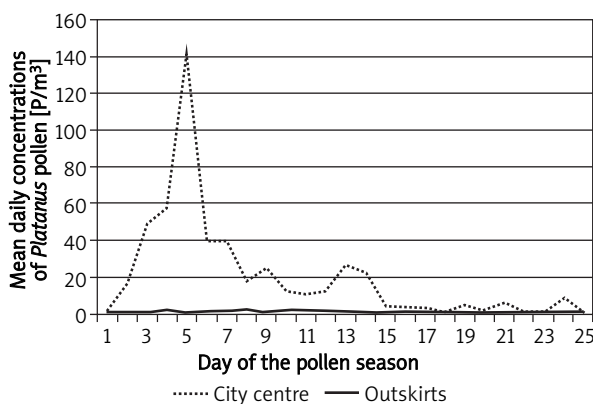


Figure 2. Seasonal pollen patterns in two sites in Poznan

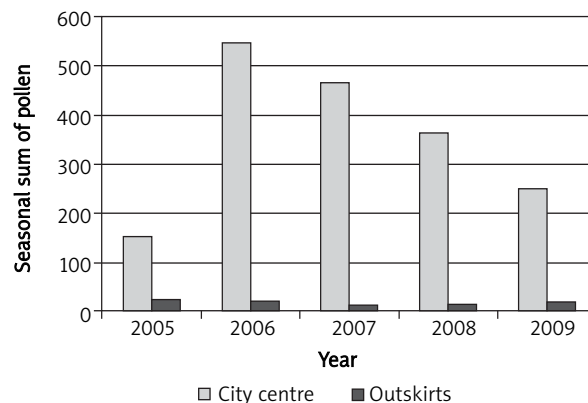


Figure 4. Comparison of *Platanus* SPI in two sites in Poznan in 2005-2009

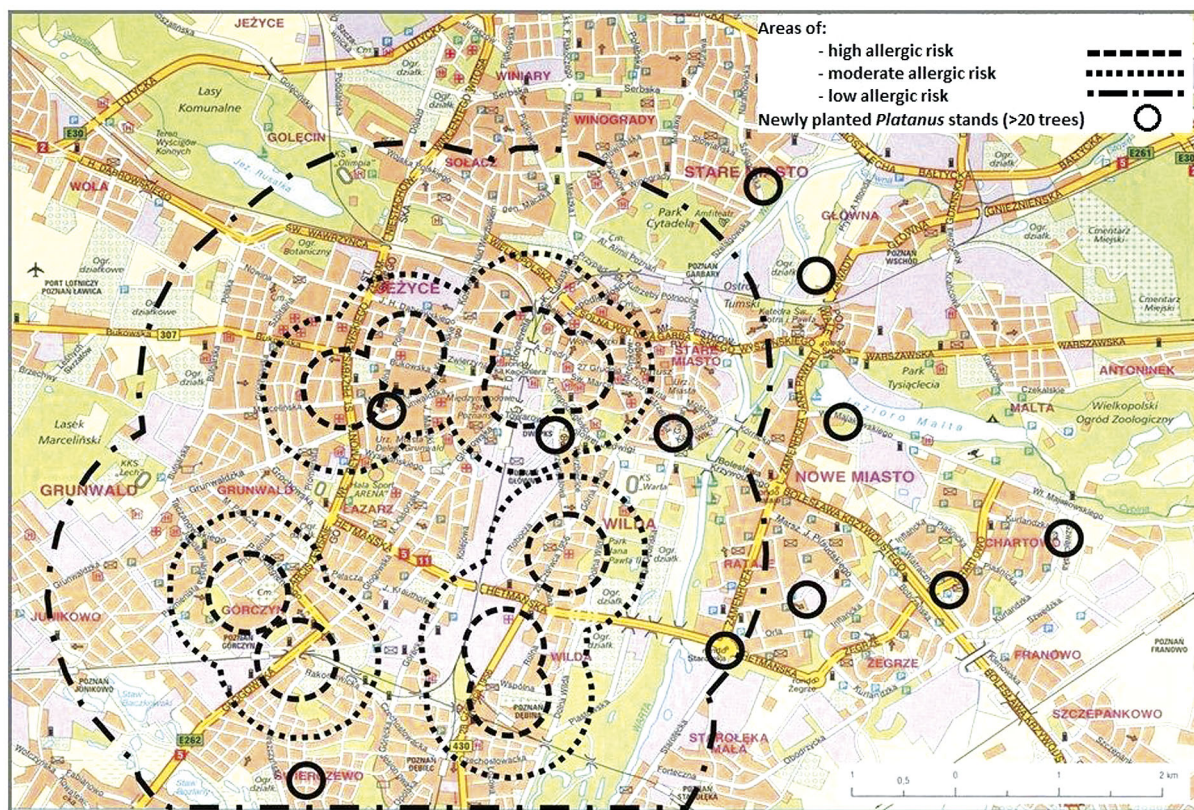


Figure 5. The allergic risk zones of *Platanus* pollen in Poznan

cemeteries, where they form large clusters, e.g. Mickiewicz Park (22 specimens), Górczyński Park on Albańska Street (43 specimens), Park of the Orthopedic Hospital on 28 Czerwca Street (41 specimens), cemetery on Bluszczo-wa Street (43 specimens), Górczyński Cemetery on Ściegiennego Street (33 specimens). In recent years, numerous young trees have been planted in the strict city center (surroundings of the Bus Station – new Matyi Street – 48 specimens) as well as in other parts of Poznan (Bohaterów Westerplatte Street – 109 specimens, Starołęka Roundabout – over 100 specimens, surroundings of the Malta Lake – about 90 specimens, Rataje Park – 80 specimens). Furthermore, Hlonda Street (so-called Nowe Zawady) has been also planted with a great number of plane trees (155 specimens).

Discussion

Analysis of the plane tree pollen seasons in Poznan (2005-2009) has shown that the highest level of pollen was recorded usually within just few days from the start of the season. During this period, pollen concentrations can reach very high values (> 150 grains/m³) and therefore can induce allergic reactions. High concentrations of pollen grains are however limited to a small area around the sources, i.e. trees.

Comparative results of the pollen seasons from two stations in Poznan (the city center and the outskirts) showed that *Platanus* pollen is not transported over long distances. The analysis of diurnal pattern provided similar information as no distinct increase in pollen concentrations was noticed in the evening. These results suggest that most of the plane tree pollen grains fall down on the ground within few hours after the liberation from anthers. These data confirm previous observations [16] that indicated that the highest *Platanus* pollen concentrations occur within just 400 m from the tree. Another 400 m further from the tree, it rapidly decreases.

The above-mentioned information together with field studies conducted in 2008-2010 has been used to create the map of the highest allergy risk zones of plane tree pollen in Poznan (Figure 5). Areas with predicted high, moderate and low pollen concentrations are shown schematically on the enclosed map. It is important to notice that areas defined, their shape, size and distribution can change to some extent, depending on the wind strength and direction in the respective season. Areas where in the recent few years numerous young plane trees have been planted (stands with more than 20 specimens) were marked with an additional continuous line (circle).

Because of the high allergenicity of plane tree pollen, the current tendency to plant a lot of young *Platanus* trees

in many new areas in Poznan seems to be disturbing. In recent years over 1000 of new specimens have been planted, what tripled the number of these trees in the city. It should be assumed that this situation, along with the trees' maturation, will lead to a noticeable increase in plane tree pollen concentrations in the air of Poznan in the nearest future. This will probably influence prevalence of allergic reactions among individuals sensitized to *Platanus* pollen.

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