Plane tree pollen season in Poland and Hungary in 2019 – why are the plane trees planted in cities so much?

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Abstract:
Allergic diseases are considered as important human health issues as they substantially restrict many allergic people. Trees such as the plane tree can pose a certain threat to allergy sufferers. Due to the frequent planting of these trees in large cities, their pollen can affect the increase in the frequency of local allergy symptoms. This study compares the plane tree pollen seasons in Poland, in Bialystok, Bydgoszcz, Warsaw, Zielona Gora, Piotrkow Trybunalski, Opole, Olsztyn, Szczecin and in Hungary, in Budapest, Debrecen, Gyor, Kaposvar, Kecskemet, Miskolc, Nyiregyhaza and Pecs in 2019. The investigations were carried out using the volumetric method (Hirst type pollen sampler). Seasonal Pollen Index (SPI) was estimated as the sum of daily average pollen concentrations in the given season. The season ranges from March to May, depending on the geographical latitude. Diagnosis of plane tree pollen allergy is made difficult due to some cross-reactivity with birch, but also alder, hazel, hornbeam, oak, beech, sweet chestnut, and to some extent with grass pollen. In 2019 the pollen season of Platanus started first in Hungary, in Pecs on the April 1st; in Poland the pollen season started in Szczecin and Zielona Gora on the April 4th. At the latest, a pollen season ended in Poland, in Warsaw and Bydgoszcz until May 11th–12th, similarly in Hungary – until May 11th in Budapest and Kaposvar. The differences of pollen seasons duration were very considerable, from 15 to 40 days. Also the differences of the highest airborne concentration especially between both countries were extremely considerable (2105 pollen grains/m^3 in Nyíregyháza and 3 pollen grains/m^3 in Białystok. The maximum values of seasonal pollen count in Polish cities occurred between April 24th and May 1st, and in Hungarian cities between April 9th and 16th. The highest plane tree pollen allergen hazard occurred in 2019 undoubtedly in Hungary: in Pecs, Kaposvar and Nyiregyhaza, and was ten times higher than in Poland. The highest variability in the analysed seasons was found in the peak value and annual total.

Key words: aeroallergens, pollen count, plane tree (*Platanus*), 2019, Poland, Hungary

Introduction

Platanus is a tree known throughout Europe, but it grows particularly well in its southwestern regions (Italy, France, Spain). In Poland, plane tree is growing mainly in the west of the country and the largest and oldest individuals live in Chojna (West Pomeranian)

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and Dobrzyce (Greater Poland) [1]. Hungarian plane trees are also famous in Europe. The international European Tree of the Year plebiscite is dominated by plane trees from Hungary. In Budapest, the huge plane tree is one of the most visited trees in the country, commemorated with countless photos of families resting in its shadow. The area around the tree was converted into a park in 1903. This park gained the title of the first Budapest decorative garden in the 90's [2].

The flowers of the plane tree are reduced and are borne in balls (globose heads). Male and female flowers are separate, but borne on the same plant (monoecious). Plane trees are wind-pollinated. Male flower-heads fall off after shedding their pollen [3].

The most often mentioned tree in Greek mythology is the plane tree. Its admiration reaches back to the Cretan and Phoenician cultures, and similarly to the old Hungarian tradition, in the ancient Rome plane tree seedlings used to be planted in honour of a newborn baby [1].

In moderate climate, pollen allergens of this tree are rarely the cause of allergic diseases, while in the eastern part of the Mediterranean they show medium and high allergenicity. Cross-reactions are mainly noted between plane tree and birch pollen allergens, as well as alder, hazel, hornbeam, oak, beech, chestnut and even although rarely, grass pollen [4, 5], and the cross-reactivity can enhance the allergy symptoms in persons allergic to the pollen of one of these taxa.

The symptoms of allergic disease are connected with the concentration of aeroallergen. The threshold value for clinical symptoms for plane tree pollen grains for the many of sensitized patients is visible during exposure to the concentration of 16 pollen grains in 1 m^3 of air, while the clinical symptoms for the most of sensitized patients are visible during exposure to the concentration of 91 pollen grains in 1 m^3 of air [6].

Aim

The aim of the study was to compare the plane pollen concentrations in the air of Poland, in Bialystok, Bydgoszcz, Zielona Gora, Piotrkow Trybunalski, Opole, Olsztyn, Szczecin and Warsaw an also in the air of Hungary, in Budapest, Debrecen, Gyor, Kaposvar, Kecskemet, Miskolc, Nyiregyhaza and Pecs in 2019 as well as to indicate the highest risk of pollen allergens in individual cities.

Material and method

Measurements of aeroplankton were carried out in the selected cities of Poland and Hungary in 2019. Measurements were performed by the volumetric method. The used devices, which are recommended by the IAA (International Association for Aerobiology), take air samples (Burkard and Lanzoni as the Hirst type pollen sampler) in volumes corresponding to average human respiratory parameters [7].

The duration of the pollen season was determined by the 98% method [8], assuming that the onset and end of the season were days with recorded 1% and 99% of the annual total of pollen grains, respectively. The total pollen count over this period was expressed by the SPI (Seasonal Pollen Index).

Based on literature data, the number of days was determined in which concentrations of pollen of the *Platanus* genus exceed the threshold values of consecutive allergy symptoms' development (tab. 1, 2) [6].

Results and discussion

Green planning in the cities focusses on specific site requirements such as temperature tolerance or aesthetics as crucial criteria in the choice of plants. The allergenicity of plants, however, is often neglected.

Table 1. *Characteristics of plane tree pollen season in Poland in 2019.*

Features of pollen season/city (number of residents in the thousands)	Bialystok 297,3	Bydgoszcz 352,3	Warsaw 1764,6	Zielona Gora 139,1	Olsztyn 607,5	Opole 128,2	Szczecin 403,8	Piotrkow Trybunalski 72,2
Duration of pollen season (number of days)	**25 IV**–9 V (15)	**6 IV**–11 V (36)	**12 IV**–12 V (31)	**5 IV**–9 V (35)	**18 IV**– 9 V (22)	**12 IV**–9 V (28)	**5 IV**–9 V (35)	**8 IV**–7 V (30)
Seasonal Pollen Index SPI (total)	15	154	182	363	41	250	646	97
Peak value and peak date	3 (29 IV)	14 (27 IV)	21 (27 IV)	59 (25 IV)	4 (1 V)	45 (28 IV)	102 (25 IV)	11 (24 IV)
Days ≥ 14 g/m^3 [6]*	0	1	4	8	0	6	11	0
Days ≥ 91 g/m^3 [6]**	0	0	0	0	0	0	2	0

** Symptoms present in many patients; ** symptoms present in most patients.*

Table 2. *Characteristics of plane tree pollen season in Hungary in 2019.*

Features of pollen season/city (number of residents in the thousands)	Budapest 1794,7	Debrecen 208,2	Gyor 131,3	Kaposvar 68,0	Kecskemét 113,3	Miskolc 160,0	Nyíregyháza 117,8	Pecs 147,7
Duration of pollen season (number of days)	**2 IV**–11 V (40)	**5 IV**–1 V (27)	**4 IV**–2 V (29)	**3 IV**–11 V (39)	**3 IV**–1 V (29)	**14 IV**–29 IV (16)	**7 IV**–4 V (25)	**1 IV**–28 IV (28)
Seasonal Pollen Index SPI (total)	4341	2231	2153	10 457	2401	372	11 321	10 372
Peak value and peak date	504 (10 IV)	650 (9 IV)	419 (9 IV)	1838 (10 IV)	512 (10 IV)	80 (16 IV)	2105 (10 IV)	1428 (9 IV)
Days ≥ 14 g/m³ [6]*	26	18	24	29	24	9	26	27
Days ≥ 91 g/m³ [6]**	17	7	6	21	7	0	19	23

** Symptoms present in many patients; ** symptoms present in most patients.*

Figure 1. *Plane tree pollen count in Bialystok and Bydgoszcz in 2019.*

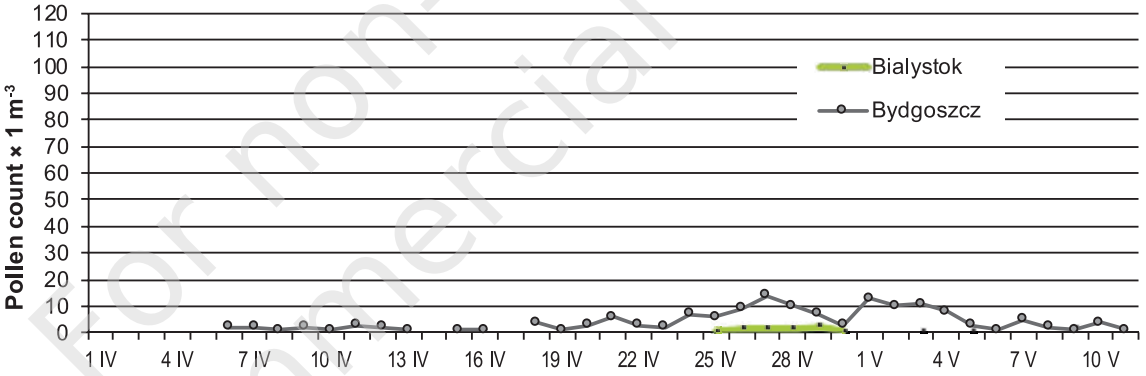


Figure 2. *Plane tree pollen count in Warsaw and Zielona Gora in 2019.*

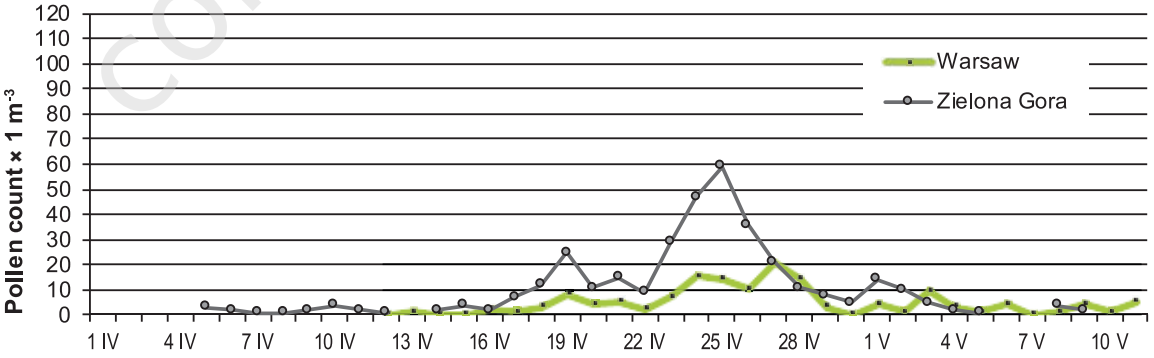


Figure 3. *Plane tree pollen count in Olsztyn and Opole in 2019.*

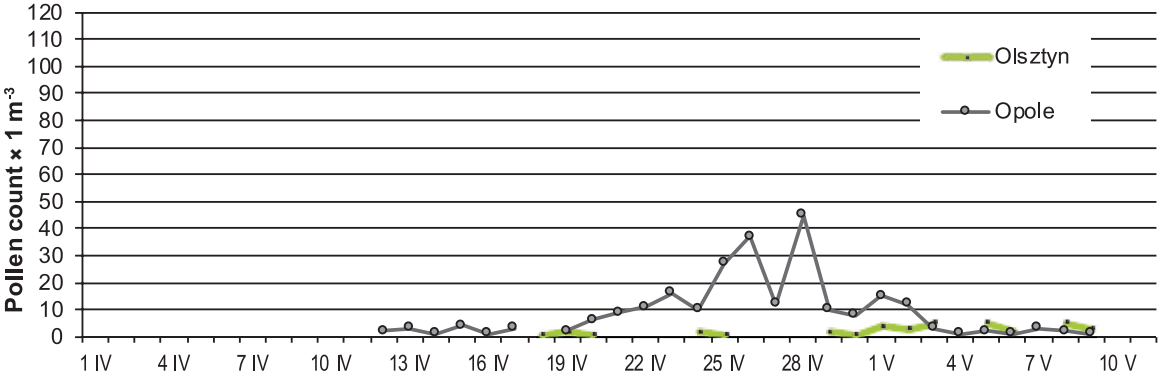


Figure 4. *Plane tree pollen count in Szczecin and Piotrkow Trybunalski in 2019.*

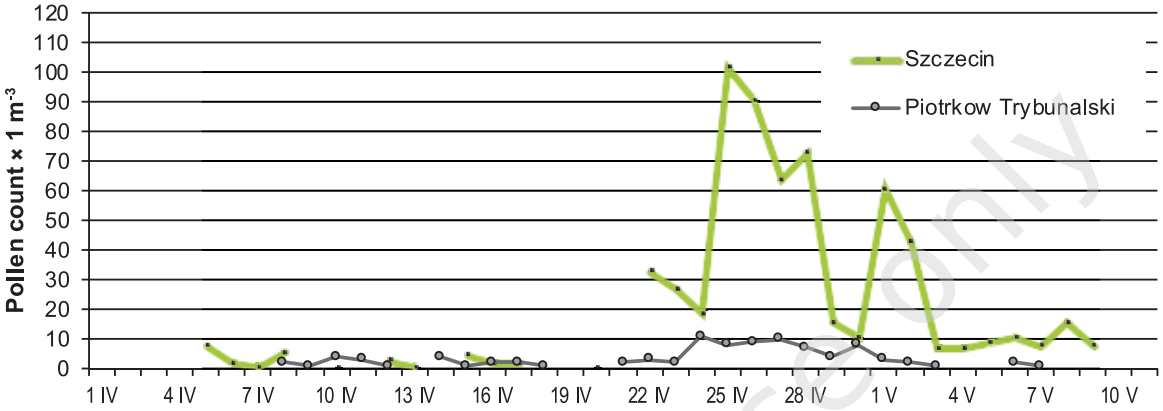


Figure 5. *Plane tree pollen count in Budapest and Debrecen in 2019.*

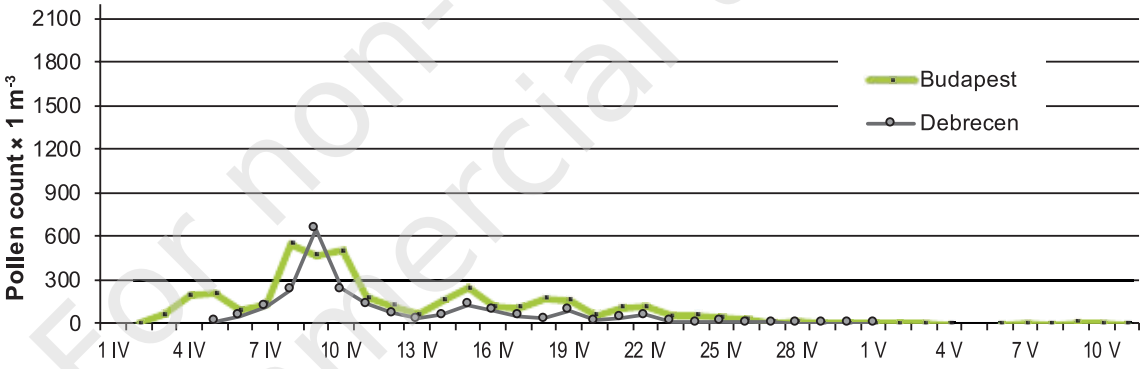


Figure 6. *Plane tree pollen count in Gyor and Kaposvar in 2019.*

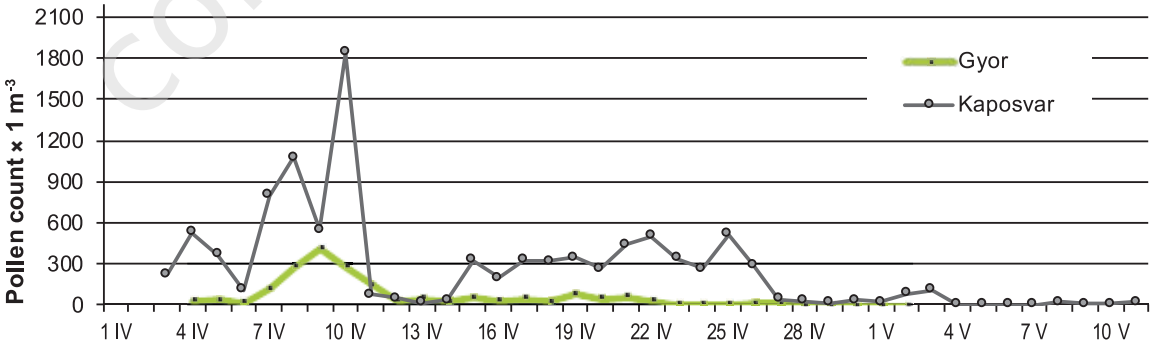


Figure 7. *Plane tree pollen count in Kecskemét and Miskolc in 2019.*

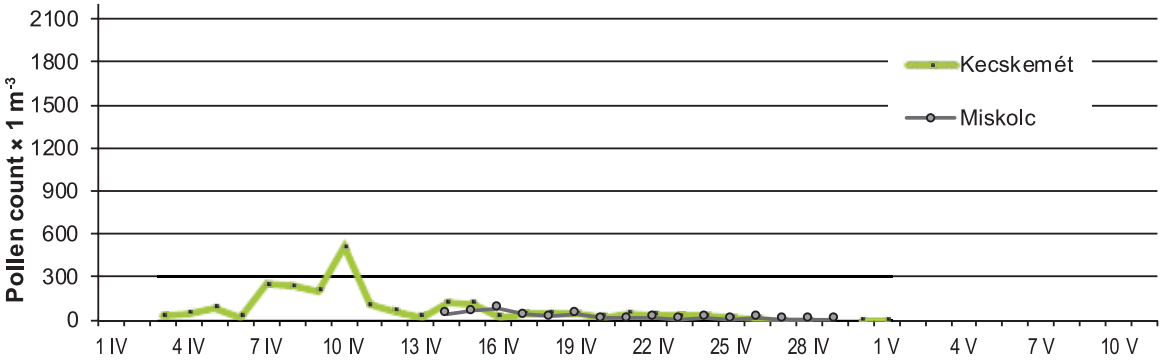
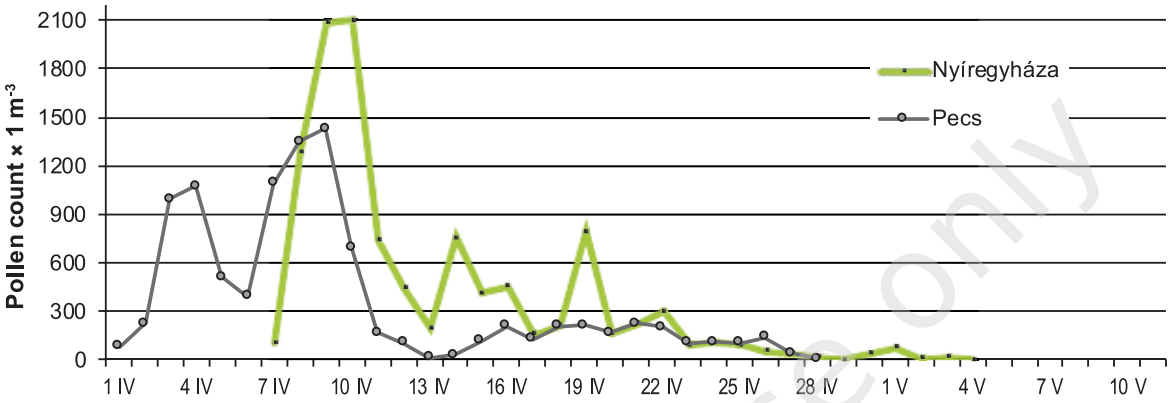


Figure 8. *Plane tree pollen count in Nyíregyháza and Pecs in 2019.*



Plane tree, due to the frequent occurrence and frequent plantings in big cities, probably belongs to the strongly sensitizing taxa of local significance [9].

Plane trees are often planted in cities in Europe, because they tolerate air pollution well, both as a result of industrialization as well as from combustion processes. They occur abundantly in parks, as well as along streets and avenues. *Platanus acerifolia* belongs to the group of the most resistant trees to adverse environmental conditions [10]. In cities, where plane tree accounts for a significant share in the stand, this should be a noted taxon for pollen allergen risk.

Plane trees are used especially for planting boulevards, roads and avenues. The hybrid London plane (*Platanus* × *acerifolia*) has proved particularly tolerant of urban conditions, and has been widely planted in London and many other cities in Great Britain. *Platanus* in London is a strongly sensitizing taxon of local significance [11]. The results of this work confirm that in Poland (tab. 1, fig. 1–4) but especially in Hungary (tab. 2, fig. 5–8) plane tree pollen can reach very high concentration [12]. Therefore, especially in cities with a large plane tree stand, this taxon should be monitored for allergy, especially since the variability of weather [11] affects the intensity of plant pollination in subsequent years. Therefore, allergic persons are recommended to follow pollen messages on an ongoing basis.

The plane tree pollen season is compact. In 2019 he first pollen grains were observed in Hungary, in Pecs (fig. 8) on the April 1st, in Poland the pollen season started in Szczecin and Zielona Gora on the April 4th. The plane tree pollen season in both countries, in Poland an in Hungary lasted until mid-May, like in 2009 and 2010 [12]. Comparison of the onset of pollen season in Polish cities in 2014 [13] showed similar dates for the beginning of the pollen season in those years.

At the latest, a pollen season ended in Poland, in Warsaw and Bydgoszcz on May 11th–12th, similarly in Hungary – on May 11th in Budapest and Kaposvar. The differences of pollen seasons duration were very considerable, from 15 to 40 days. Also the differences of the highest airborne concentration especially between both countries were extremely considerable: 2105 pollen grains/m^3 in Nyíregyháza and 3 pollen grains/m^3 in Bialystok). The maximum values of seasonal pollen count in Polish cities occurred between April 25th and 28th, and in Hungarian cities between April 7th and 10th, i.e. in Poland more than 2 weeks later than in Hungary (fig. 1–8). The highest plane tree pollen allergen hazard occurred in 2019 undoubtedly in Hungary: in Pecs, Kaposvar and Nyiregyhaza, and was ten times higher than in Poland (tab. 1, 2). The risk of plane tree pollen allergens in 2019 was very low at all measuring points in Poland. The highest variability in the analysed seasons was found in the peak value and annual total. The lowest diversity concerned the length of the pollen season.

Increased air temperature in metropolitan areas, functioning as *heat islands*, accelerates flowering of trees mainly in spring [14]. Despite the fact that the plane tree is a species resistant to adverse changes and transformations of the natural environment, it also exhibits high sensitivity to short-term, but significant cooling [14]. Most likely, this sensitivity could be the reason for the lack or very low concentration of *Platanus* pollen in many Polish cities in 2019 (fig. 1–4) and such a high concentration in Hungary (fig. 5–8). The peak value of concentration of plane tree pollen was observed in Poland at the end of April, and in Hungary mainly May 9th and 10th.

Conclusions

Platanus pollen grains are present in the air of Polish and Hungarian cities usually in April and at the beginning of May.

Plane tree pollen season in both countries lasted 15–40 days and was characterized by extremely different total annual pollen SPI, in Poland from 15 to 646; in Hungary from 372 to 11 321.

The start of *Platanus* pollen season in 2019 occurred in the beginning of April and ended in mid-May.

The highest plane tree pollen allergen hazard occurred in 2019 mainly in Hungary. The number of days with concentrations above the established threshold was very different in individual cities and the highest in Pecs. In Poland, exposure to plane tree pollen allergens was incomparably lower.

The highest variability in the analysed seasons was found between both countries in the peak value, annual total and exposure to pollen allergens.

Plane tree, due to the frequent occurrence and frequent plantings in big cities (they are used especially for planting boulevards, roads and avenues), probably belongs to the strongly sensitizing taxa of local significance.

References

1. *Mayer J, Schwegler HW. Wielki atlas drzew i krzewów. Delta W-Z Oficyna Wyd., 2016.*
2. *Sunset Western Garden Book. 1995; 606-7.*
3. *APG III. An update of The Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. Bot J Linn Soc. 2009; 161(2): 105-21. https://doi.org/10.1111/j.1095-8339.2009.00996.x.*
4. *Hofman T, Michalik J. Alergia pyłkowa. Centrum Alergologii, Poznań 1998.*
5. *Rodriguez-Rajo FJ, Iglesias I, Jato V. Allergenic airborne-pollen monitoring of Vigo (NW Spain) in 1995–2001. Grana 2004; 43: 164-73.*
6. *Burge HA. Monitoring for airborne allergens. Ann Allergy. 1992; 69: 9-21.*
7. *Mandrioli P, Comtois P, Dominguez E et al. Sampling: Principles and Techniques. In: Mandrioli P, Comtois P, Levizzani V (ed). Methods in Aerobiology. Pitagora Editrice Bologna, Bologna 1998; 47-112.*
8. *Emberlin J, Savage M, Woodman R. Annual variations in the concentrations of Betula pollen in the London area 1961–1990. Grana 1993; 32: 359-63. https://doi.org/10.1080/00173139309428965.*
9. *Jochner-Oette S, Stitz T, Jetschni J et al. The Influence of Individual-Specific Plant Parameters and Species Composition on the Allergenic Potential of Urban Green Spaces. Forests 2018; 9: 284. https://doi.org/10.3390/f9060284.*
10. *Łukasiewicz S. Drzewa i krzewy polecane do obsadzeń ulicznych w miastach. Monografia pod red. Moniki Drozdek. Rośliny do zadań specjalnych. PWSZ, Sulechów 2010; 328.*
11. *Norris-Hill J, Emberlin J. Diurnal variation of pollen concentration in the air of north-central London. Grana 1991; 30: 229-34.*
12. *Puc M. Pyłek platanu w powietrzu Szczecina (2009–2010). Alergoprofil. 2010; 6(3): 31-2.*
13. *Puc M, Rapiejko P, Lipiec A et al. Pyłek platanu w powietrzu wybranych miast Polski w 2014 r. Alergoprofil. 2014; 10(3): 54-7.*
14. *Mimet A, Pellissier V, Quenol H. et al. Urbanisation induces early flowering: evidence from Platanus acerifolia and Prunus cerasus. Int J Biometeorol. 2009; 53: 287-98.*

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