ORIGINAL ARTICLES AAEM

Ann Agric Environ Med 2001, 8, 235–240

COMPARATIVE ANALYSIS OF POLLEN COUNTS OF *CORYLUS, ALNUS* AND *BETULA* IN SZCZECIN, WARSAW AND LUBLIN (2000–2001)

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Weryszko-Chmielewska E, Puc M, Rapiejko P: Comparative analysis of pollen counts of *Corylus, Alnus* and *Betula* in Szczecin, Warsaw and Lublin (2000–2001). *Ann Agric Environ Med* 2001, **8**, 235–240.

Abstract: The aim of the study was to compare the airborne concentrations of allergenic pollen produced by three early flowering tree taxa (*Corylus, Alnus, Betula*) in the cities of Warsaw (central Poland), Lublin (eastern Poland) and Szczecin (western Poland) during the years 2000–2001. Measurements were performed by the volumetric method. Pollen seasons were defined as the periods in which 95% of the total catch occurred. The highest concentration and annual pollen count of *Corylus* was measured in Lublin in both seasons, while the highest annual pollen counts of *Alnus* and *Betula* were noted in Warsaw, where the annual pollen count of *Betula* in 2001 was four times higher than in 2000 and equalled 5,376 grains in m^3 per 24 h. Significant differences in the pollen count of the examined taxa were observed between two seasons: the pollen count of *Corylus* was higher in 2000 than in 2001, while for *Alnus* and *Betula* the opposite was the case. The longest pollen seasons were observed at low annual pollen counts for the pollen of *Corylus*. Results of the study reveal significant differences between the seasons and the cities. The differences concern the dates of the appearance of pollen grains in the air, the duration of the presence of sporomorphs and the maximum concentrations in particular seasons. The pollen counts of alder, birch and hazel trees are determined by the weather, diversity of local flora and specific rhythm of pollination of particular taxa.

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Key words: pollen grain, pollen counts, plant aeroallergens, allergens, Poland, 2000-2001, *Corylus, Alnus, Betula.*

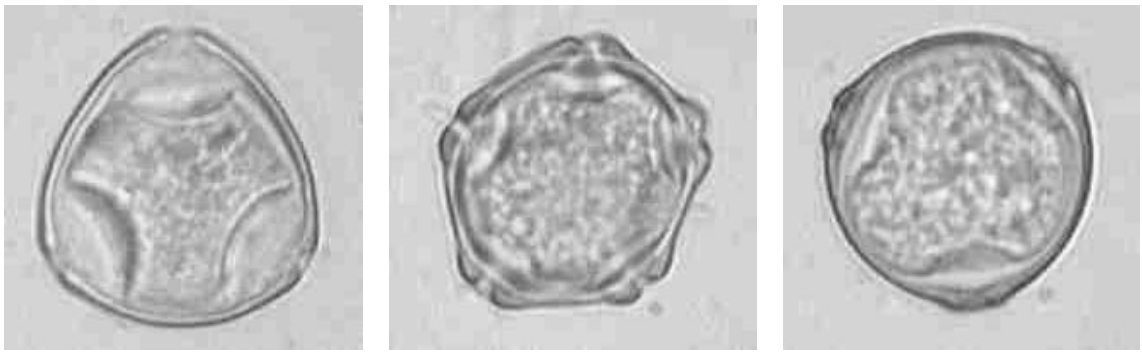
INTRODUCTION

The number of people allergic to plant aeroallergens has substantially increased in big cities and industrial areas [3, 7, 9]. Thus, monitoring of the pollen counts in the atmosphere of cities is of relevant medical importance.

There are significant differences in the number and quality of pollen grains in the air of particular regions of Poland. Therefore, long term monitoring of the composition of aeroplankton in different sites has been undertaken in order to provide the current data to allergologists and to establish tendencies characteristic for a given region [7, 19, 21, 24].

From among the trees and bushes growing in the Central European climatic zone, the most common plant allergens are pollens of early flowering trees: hazel, alder and birch [6, 11, 12]. The hazel pollen gives allergic reaction even at very low concentrations of 20–30 grains

Received: 8 October 2001
Accepted: 19 November 2001



A B C

Figure 1. Pollen grains of *Corylus* (A), *Alnus* (B), and *Betula* (C), × 1500.

in m^3 per 24 h. The highest pollen concentration in household dust is found five weeks after peak pollination, similar to the case of *Alnus*. Pollen produced by alder trees is a very strong allergen, similar to that produced by hazel. Clinical symptoms can appear at a pollen concentration as low as 50 grains in m^3 per 24 h. The birch tree pollen is also a very strong allergen. Clinical symptoms can appear at the pollen grain concentration of about 80 grains in m^3 per 24 h. The highest concentration of this allergen in household dust is noted three weeks after the peak pollination [3, 13, 16, 19, 25].

The pollen grain surface may be covered with microorganisms, their toxins, organic and inorganic contaminants that may enhance allergic reaction [9, 22].

The flowering period of European hazel (*Corylus avellana* L.) extends over February and March; that of black alder (*Alnus glutinosa* (L.) Gaertn.) and grey alder (*A. incana* (L.) Mnch.) lasts from February to April, whereas the birch tree (*Betula pendula* Roth.) has its flowering period in April and May [18].

The flowering of hazel (*Corylus* sp.) marks the beginning of the botanical early spring season. The pollen grains (18 µm × 26 µm) are triporate (Fig. 1) with a profound oncus at each pore [3, 4].

The grains of *Alnus* (21 µm × 24 µm) have 4-5 pores, with aspides at the pores (Fig. 1). The male flower forms groups of hanging balls and each ball produces about 4.5 million pollen grains [3, 4].

Birch trees (*Betula* sp.) are abundant pollen producers, each ball produces about 5.5 million pollen grains. The grains (20 µm × 23 µm) are triporous (Fig. 1) with pronounced aspides at the pores [3, 4].

The aim of the present study was to perform a comparative analysis of the pollen counts of *Corylus*, *Alnus* and *Betula* in the atmosphere of three big cities: Warsaw (central Poland), Lublin (eastern Poland) and Szczecin (western Poland). This analysis was expected to enable:

- determination of the dates of the beginning of pollen seasons and their duration in particular cities;
- comparison of the character of the pollination curves in the three cities;
- assessment of the pollen counts in the years 2000–2001;
- comparison of the pollen counts in particular vegetation seasons.

MATERIALS AND METHODS

Analysis of the pollen count distribution was performed on the basis of the data collected in Warsaw, Lublin and Szczecin in the seasons of 2000–2001.

In Warsaw, the measuring site was localised in the city centre, at an elevation of 15 m above ground level. In

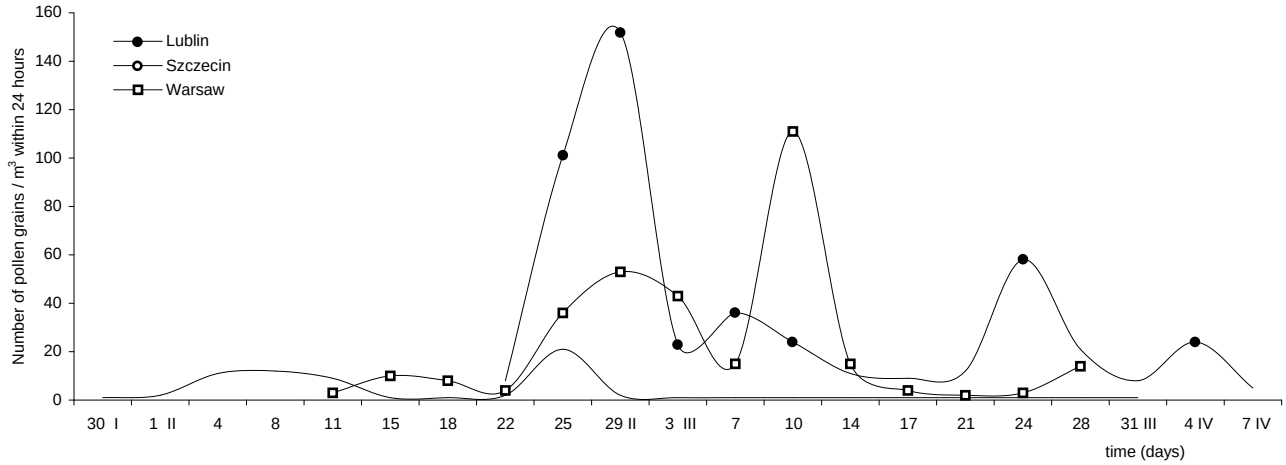


Figure 2. Pollen counts of *Corylus* sp. in the atmosphere of Warsaw, Lublin and Szczecin in 2000.

Table 1. Results of aerobiological study of tree pollen counts in the atmosphere of Polish cities.

	City	Lublin		Szczecin		Warsaw	
		2000	2001	2000	2001	2000	2001
Corylus	ps	22.02–7.04	8.02–7.04	30.01–31.03	8.02–1.04	11.02–28.03	8.02–9.04
	tn	517	823	75	87	341	429
	max	152	114	21	7	111	54
Alnus	ps	10.02–7.04	8.02–7.04	4.02–28.03	12.02–31.03	11.02–7.04	23.02–20.03
	tn	1022	6212	621	838	694	10801
	max	145	1740	295	139	118	2341
Betula	ps	11.04–9.05	18.04–10.05	11.04–5.05	25.04–14.05	11.04–5.05	24.04–12.05
	tn	9058	13648	1339	14122	4729	25147
	max	3232	2069	934	3712	1825	5376

ps – pollen season, tn – total number of pollen grains collected in the season, max – maximum number of pollen grains / 24 hours.

Lublin in 2000 the measurements were performed in the Wrotków quarter of the city, at 7 m above ground level, and in 2001 in the city centre at 14 m above ground level. In Szczecin the measuring site was in the city centre at 21 m above ground level.

The pollen count was measured by the volumetric method [8, 10]. In Warsaw, the measurements were performed by Burkard trap every 24 hours in the two seasons [11]. In Szczecin in 2000 the measurements were made by VST trap and the preparations changed twice a week, and in the season of 2001 the measurements were performed by VST trap every 24 hours [10, 11, 12]. In Lublin in 2000 the measurements were made by VST trap and in 2001 the pollen count was measured by Lanzoni trap every 24 hours [11]. The qualitative and quantitative composition of the samples was determined in preparations on glass slides of the size 22 × 22 mm, and the pollen concentration expressed as the number of grains in m^3 per 24 h. The beginning and end of the season were established by the 95% method, i. e. pollen seasons were defined as the period in which 95% of the total catch occurred [2].

RESULTS

A comparison of hazel pollen observed in the three cities over a period of two years has shown that in the season of 2000 the pollination of this taxon began the earliest in Szczecin where the pollen count was the lowest. In Lublin, the beginning of pollination was three weeks later than in Szczecin and two weeks later than in Warsaw (Tab. 1). The highest pollen count of *Corylus* was found in Lublin in both observation seasons, and the peak of pollination in Lublin in 2000 coincided with that in Szczecin, but was two weeks earlier than in Warsaw (Fig. 2). The highest annual count of this pollen was measured in 2001 in Lublin (Tab. 1).

In 2000, the *Corylus* pollen count was generally lower than in 2001. In 2001, a high pollen count of over 50 grains in m^3 per 24 h was noted in Warsaw as early as the

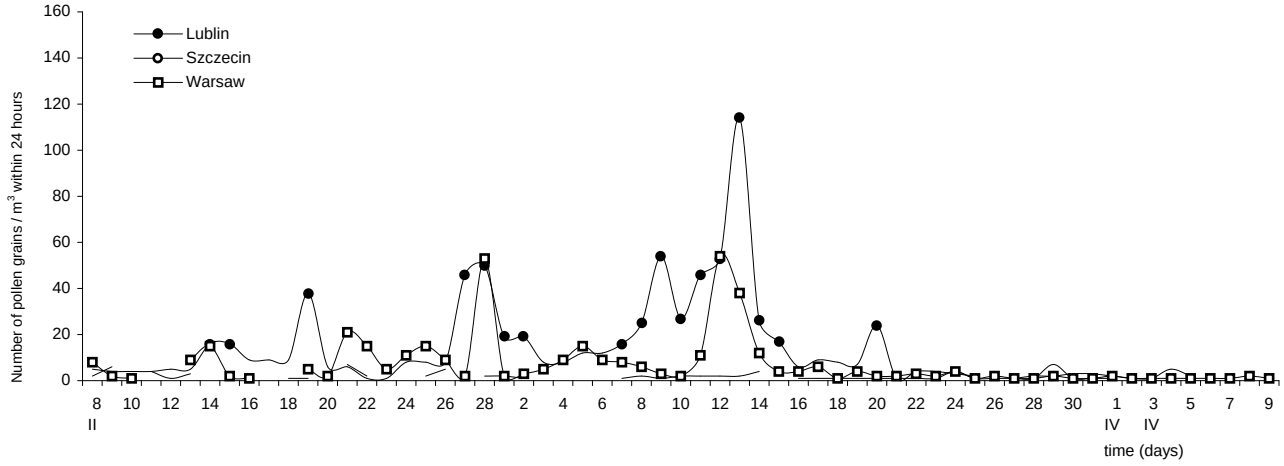


Figure 3. Pollen counts of *Corylus* sp. in the atmosphere of Warsaw, Lublin and Szczecin in 2001.

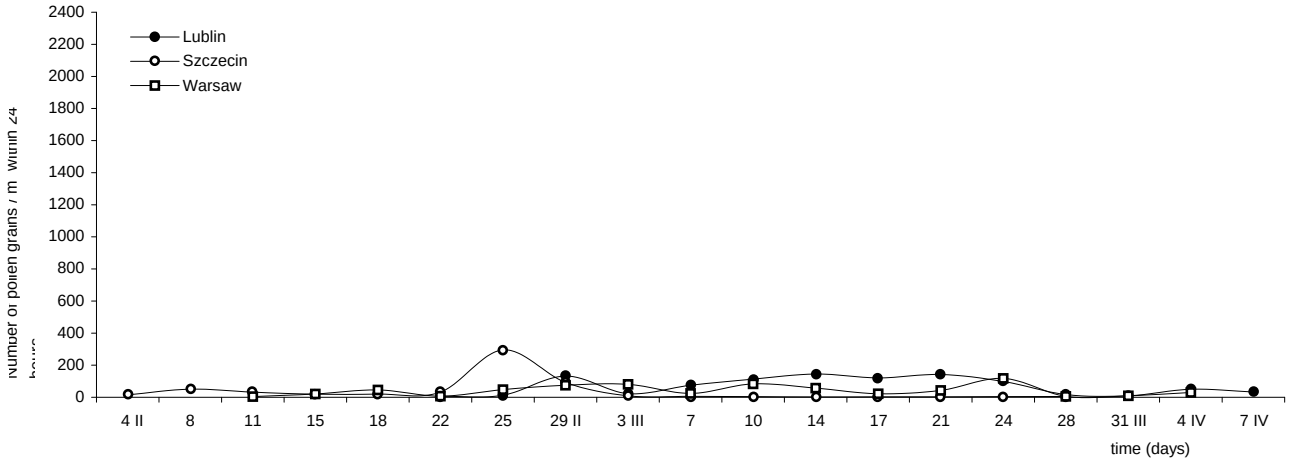


Figure 4. Pollen counts of *Alnus* sp. in the atmosphere of Warsaw, Lublin and Szczecin in 2000.

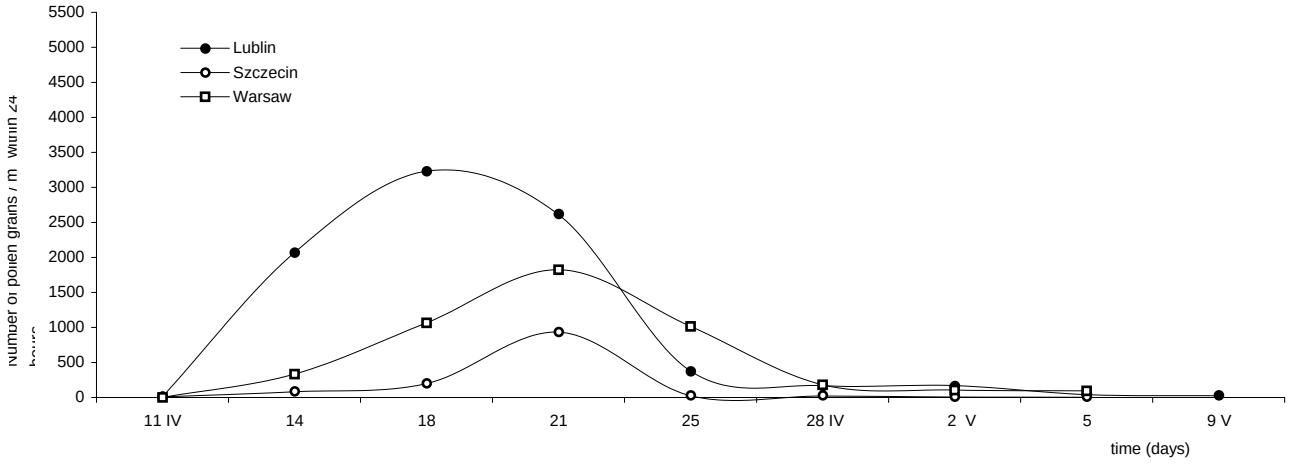


Figure 6. Pollen counts of *Betula* sp. in the atmosphere of Warsaw, Lublin and Szczecin in 2000.

end of February. In the middle of March we noted in Warsaw another increase of the pollen count of hazel coincident with the pollination peak in Lublin (Fig. 3).

In the season of 2000, the beginning of *Alnus* pollination in Szczecin was one week earlier than in the other two cities (Tab. 1). The highest count of alder tree pollen of about 300 grains in m^3 per 24 h was observed in Szczecin at the beginning of the third week of February. In the other cities the pollen count was lower, and the pollination peaks were by 4 -7 days later than in Szczecin (Fig. 4).

In the season of 2001, the alder tree pollen count reached very high values in Warsaw, rising in the middle of March to over 2,300 grains in m^3 per 24 h, while in Lublin its highest value was 1,740 grains in m^3 per 24 h, and the pollination peak was noted six days earlier than in Warsaw. In Szczecin, the alder pollen count was very low with only a few grains in m^3 per 24 h, and was observed in the period not coinciding with the time of pronounced pollination noted in the other two cities (Fig. 5).

The highest annual count of *Alnus* was measured in 2001 in Warsaw (Tab. 1).

The course of pollination of birch trees was well pronounced and similar in both seasons in Lublin and Warsaw. The beginning of pollination was observed at the same time in all the cities (Tab. 1).

In the season of 2000 the highest birch tree pollen count of over 3,000 grains in m^3 per 24 h was observed in Lublin. In this city the peak of pollination occurred a few days earlier than in the other two cities (Fig. 6).

In 2001 in Warsaw the birch tree pollen count reached over 5,300 grains in m^3 per 24 h, which was the highest value in the cities studied during the whole time of observation. In Szczecin, the maximum pollen count was over 3,500 grains in m^3 per 24 h, while in Lublin - over 3,000 grains in m^3 per 24 h. In Lublin, the maximum value was noted one week earlier than in Warsaw and Szczecin (Fig. 7).

The highest annual pollen count of *Betula* measured in 2001 in Warsaw was five times higher than in 2000. In Lublin and Szczecin the annual pollen counts of this taxon were also higher in 2001 (Tab. 1).

A long pollination period was observed for *Corylus* in Szczecin, with low annual total counts of sporomorphs.

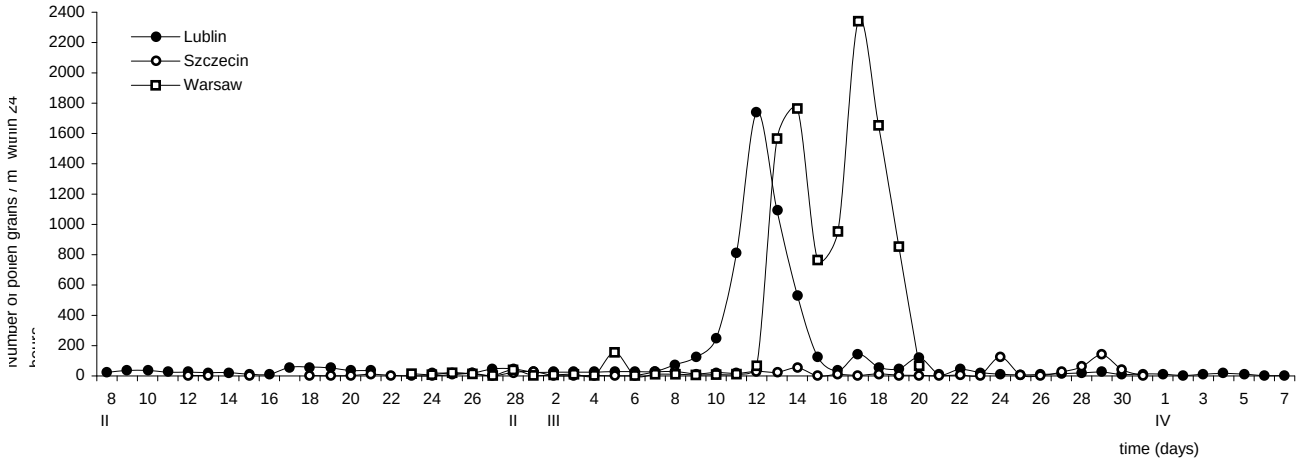


Figure 5. Pollen counts of *Alnus sp.* in the atmosphere of Warsaw, Lublin and Szczecin in 2001.

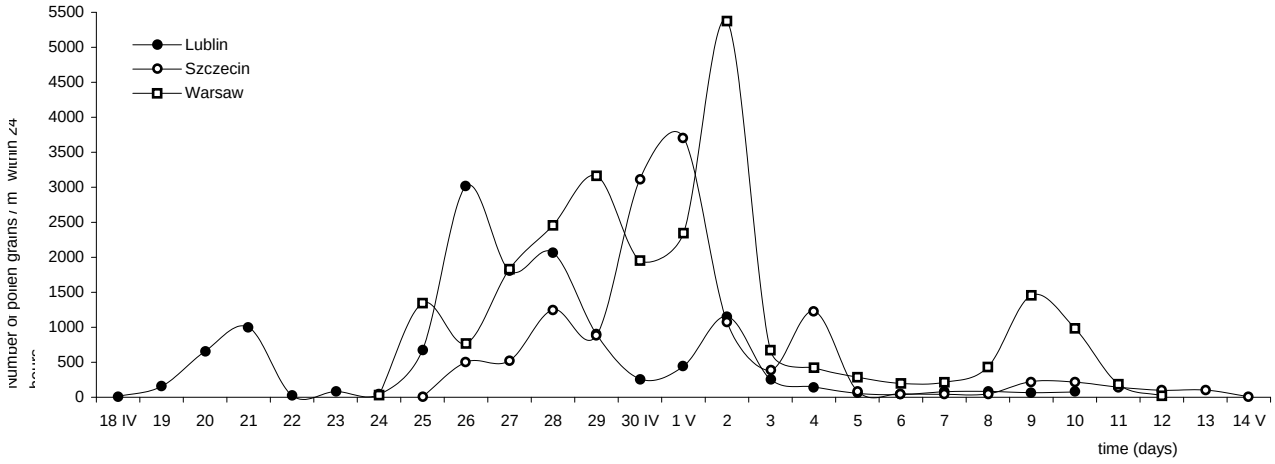


Figure 7. Pollen counts of *Betula sp.* in the atmosphere of Warsaw, Lublin and Szczecin in 2001.

For *Alnus*, a very short pollination period was noted in Warsaw in 2001 (27 days). In the other cities during the two seasons studied, the duration of the pollination periods was comparable (over 50 days). The pollination period of birch trees was relatively short and of similar duration of over 20 days in the two seasons and in all the cities studied (Tab. 1).

DISCUSSION

The results presented above testify to significant differences in the pollen counts of the three taxa studied between the cities in particular seasons and between the seasons.

The concentration of pollen grains in the air over a city is determined by the individual rhythm of plant pollination, meteorological conditions, composition of local flora, geographic location and kind of urban structure (loose or compact housing, areas with many gardens or with scarce vegetation, industrial areas, agricultural areas or forests) [7, 9, 17, 24, 25].

The differences in the beginning of pollination of *Alnus* and *Corylus* noted in 2000 are most probably due to the weather conditions which are known to affect their pollination, as indicated by Szczepanek [20], Szczepanek *et al* [21], and Weryszko-Chmielewska [24].

The much higher pollen counts of *Betula* in Lublin and Warsaw in 2001 than in 2000 can be explained by the natural rhythm of pollination of these trees. According to Nilsson and Persson [7], *Betula* shows a two-year rhythm of more pronounced pollination. As follows from long-term studies performed in recent years in Switzerland, the *Betula* pollination begins 19 days earlier nowadays than in 1980 [1].

Schmid-Grendelmeier *et al.* have suggested that in France and Switzerland the ash tree (*Fraxinus excelsior*) is a strongly allergenic species [14, 15]. The results obtained by Wahl *et al.* indicate the occurrence of the cross-reactivity between birch and ash pollen allergens [23]. The period of the presence of airborne ash tree pollen (April, May) coincides with the pollen season of birch trees. Fortunately, in Poland ash tree pollen rarely

produces allergic reactions, despite its local high concentration [3].

The differences noted in the character of pollination of the three trees studied indicate the need for local observations to be carried out to supply the data for local allergologists [3, 5, 6, 17, 19].

CONCLUSIONS

The pollen counts of the taxa studied differ in both seasons at the time of grain appearance in the air, the period of sporomorph presence in the air and the maximum values of pollen counts.

• The differences in the time of the beginning of pollination were significant only in the season of 2000. In Szczecin, the pollen of *Corylus* appeared in the air 2–3 weeks earlier than in Lublin and Warsaw, and the pollen of *Alnus* - one week earlier than in Lublin and Warsaw.

• The highest pollen counts and annual total pollen counts of *Corylus* were noted in Lublin in both seasons, and those of *Alnus* and *Betula* in Warsaw in 2001.

• The differences in the pollen counts of particular taxa in the two seasons were also significant. The pollen count of *Corylus* was higher in 2000 than in 2001, while for *Alnus* and *Betula* the opposite was the case. In 2000, the pollen count of *Corylus* in all the cities was from 1.3–3 times higher than in 2001. The pollen count of *Alnus* in 2001 in Lublin and Warsaw was from 12–20 times higher than in 2000. The pollen count of *Betula* in Warsaw and Szczecin was from 3–4 times higher in 2001 than in 2000.

• In Szczecin in both seasons, the hazel and alder pollen counts were very low compared to those in Warsaw and Lublin. These differences may be due to a different composition of local flora and the influence of weather.

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