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COMPARISON OF *ALNUS*, *CORYLUS* AND *BETULA* POLLEN COUNTS IN LUBLIN (POLAND) AND SKIEN (NORWAY)

Krystyna Piotrowska

Department of Botany, Agricultural University, Lublin, Poland

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Abstract: Symptoms of pollen allergy in springtime in Middle and Northern Europe are mainly caused by pollen grains of birch, hazel and alder. The aim of the present study was the pollen fall comparison of the mentioned taxa in Lublin (Poland) and Skien (Norway). These sites are located approximately 1,200 km away apart by air. The pollen monitoring was carried out by gravimetric method in 1999-2000. The start and end of pollen seasons were defined by the 90% method. The beginning of pollen seasons for *Corylus* and *Betula* were observed 1-3 weeks earlier in Lublin than in Skien, but pollen grains of *Alnus* appeared simultaneously in both towns. In 1999, annual totals of *Alnus*, *Corylus* and *Betula* pollen grains were considerably less numerous in Skien than in Lublin. No important differences were observed among the pollen fall amounts of the mentioned taxa in 2000. The maximum values of pollen grains were defined in different terms. The results of investigations differed as regards the years compared as well as the sites.

Address for correspondence: Dr Krystyna Piotrowska, Department of Botany, Agricultural University, Akademicka 15, 20-950 Lublin, Poland.
E-mail: kpbot@agros.ar.lublin.pl

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INTRODUCTION

The constant increase in the incidence of pollen allergies has been observed in many countries in the last ten years. 10–15% of the population in Poland suffer from pollinosis [8, 14] and in Norway - 15% [6]. The main tree plants causing pollinosis in Northern and Eastern Europe are: *Alnus*, *Corylus* and *Betula* [2, 7, 10, 17].

In the countries with a mild climate, the beginning of the pollen season of early flowering plants depends mainly on temperature. The phenomenon is especially seen in the pollen season of deciduous trees and bushes. Pollination is usually preceded by a period of heightened temperature [1, 5]. In the years with a low temperature, at the beginning, the pollen season of *Alnus* and *Corylus* may be significantly delayed. The results of studies conducted in Budapest confirm great differences among pollen seasons in spring. For example, in 1995, the grains of *Corylus* pollen were noted in early February; however, in the cool year of 1996 - in late March only, 46 days later [4]. Similar observations concerning the mentioned years are presented in the studies dealing with conditions in Poland [15, 16].

The climatic conditions in Poland are characterised by great changeability of weather in individual days and years. This is connected with the sea tides or continental masses of air. The climate of Norway is softened by the influence of the warm Golfstrom from the subtropical zone. In spring in Norway, south - easterly winds occur most often and these enable distant transport of pollen [12].

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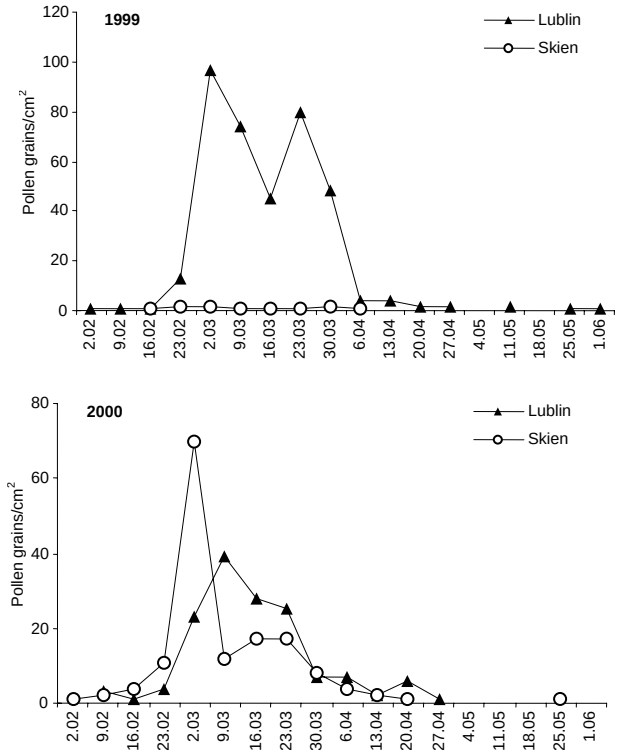

Figure 1. Comparison of *Alnus* pollen fall in Lublin and Skien, 1999-2000.

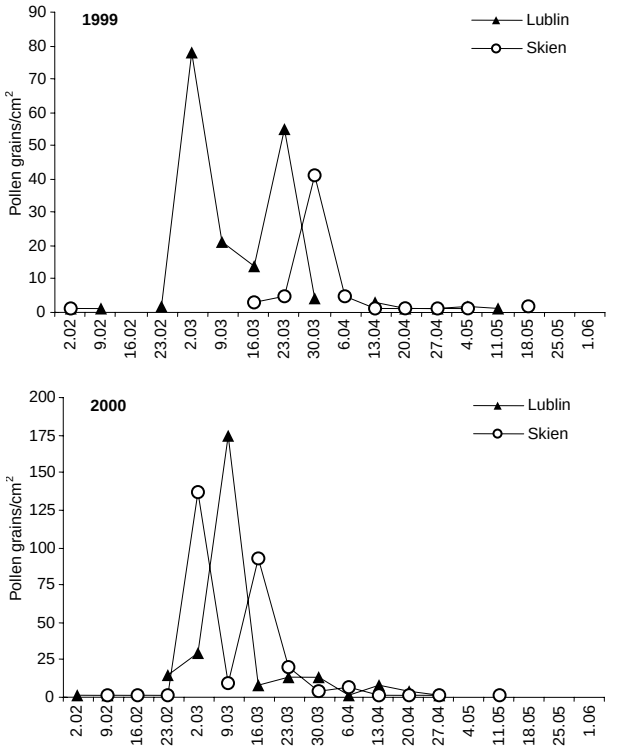

Figure 2. Comparison of *Corylus* pollen fall in Lublin and Skien, 1999-2000.

The objective of the study was to determine the annual total of pollen grains and compare the course of pollen seasons of *Alnus*, *Corylus* and *Betula* in the atmosphere of Lublin and Skien.

MATERIAL AND METHODS

The measurements of pollen fall were performed by the gravimetric method, using Durham traps [3]. The slides were changed every week. The quantity of pollen was determined by the number of grains/cm^2/week. Three allergenic taxa were chosen for the pollen analysis: *Alnus*, *Corylus* and *Betula*. The following species of the *Alnus* and *Betula* genera were present in the neighbourhood of Lublin: *A. glutinosa*, *A. incana* and *B. pendula*, *B. pubescens*, *B. humilis* and in Skien: *A. incana*, *A. viridis* and *B. pendula*, *B. pubescens* [11].

Pollen monitoring was carried out in 1999 and 2000 in two places, Lublin and Skien, distant from each other by about 1,200 km. Lublin (51º14′N, 22º34′E) is the largest industrial centre in Eastern Poland. The annual mean temperature for Lublin in the period 1951–1990 amounted to 7.4ºC and average precipitation amounted to 550 mm. The measurement site was situated in an area of quite densely located blocks of flats. In the neighbourhood there were trees of the following genera: *Betula*, *Salix*, *Acer*, *Quercus*, *Fraxinus* and *Populus*. The Durham trap was placed at the height of 9 m above ground.

Skien (59º20′N, 9º50′E) is situated in south-east Norway, in Telemark region, about 100 km south-west of Oslo and about 20 km north of Skagerrak Strait. The annual mean temperature for Skien during the period of 1961–1990 amounted to 5.9ºC and average precipitation amounted to 840 mm. The measurement site in Skien was situated in the Gjerpen district on the outskirts of the town. In close proximity there was a mixed forest consisteing mainly of the genera: *Picea*, *Betula*, *Quercus*, *Corylus*, *Fraxinus*. Durham trap was fixed at the height of 3.5 m above the ground.

The starting week and the end of the pollen season were determined by the 90% method: the beginning of the season was the moment when 5% of the total pollen was obtained, and the end of the season – with 95% of total pollen [9].

RESULTS

In Skien, the fall of pollen of comparable taxa was many times lower in 1999 than in 2000. In Lublin, an opposite tendency concerning *Alnus* and *Betula* was observed, but the differences in annual totals of the pollen were less significant (Tab. 1).

In both years, the beginning of the pollen season of *Alnus* was determined during the same week in Skien and Lublin (Tab. 2). In 1999, at both measurement sites, the season ended at the same time however, in 2000 in Lublin, pollen grains of alder was registered longer by two weeks. In 1999, the fall of pollen in Skien was very low and stayed at a similar level all season long (Fig. 1). The annual total of the pollen of this taxon in Skien was 28 times lower than in Lublin; yet in 2000 the annual total of *Alnus* pollen was slightly higher in Skien (Tab. 1). In

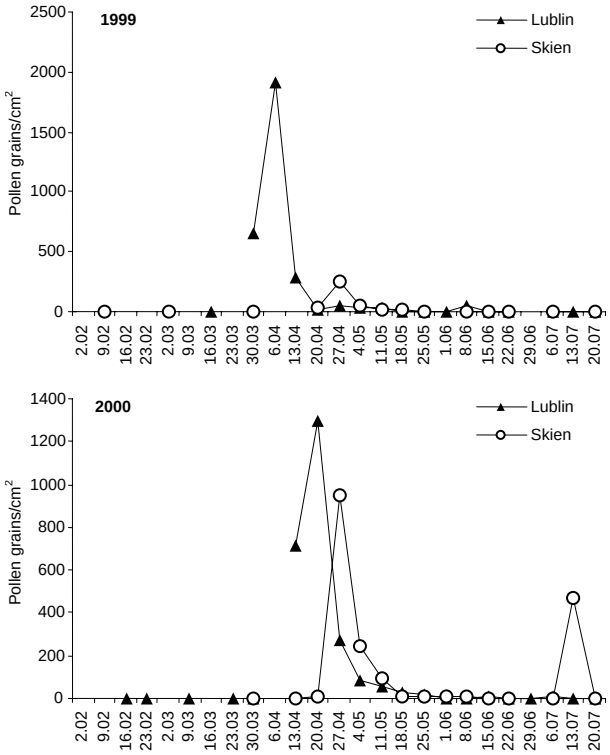

Figure 3. Comparison of *Betula* pollen fall in Lublin and Skien, 1999-2000.

Table 1. Annual totals of pollen grains of three taxa in Lublin and Skien.

	Annual totals			
	Lublin		Skien	
	1999	2000	1999	2000
Alnus	390	148	14	171
Corylus	193	275	61	412
Betula	3057	2524	387	1803

Table 2. The start and end of pollen season of three taxa in Lublin and Skien.

Taxon	Site	Pollen season					
		Start	End	Duration (weeks)	Start	End	Duration (weeks)
		1999			2000		
Alnus	Lublin	23.02	6.04	6	22.02	18.04	7
	Skien	23.02	6.04	6	22.02	4.04	5
Corylus	Lublin	2.03	6.04	5	22.02	11.04	7
	Skien	16.03	20.04	5	29.02	28.03	4
Betula	Lublin	30.03	4.05	5	11.04	16.05	5
	Skien	20.04	25.05	5	25.04	16.05	3

2000, the maximum concentration of alder pollen in Skien was registered in early March, in Lublin a week later. At the measurement site in Norway the seasonal maximum of pollen concentration was higher than in Lublin (Fig. 1).

Annual totals of *Corylus* pollen grains in 1999 in Lublin were 3 times higher than at the measurement site in Norway; however, in 2000, 1.5 times as many hazel grains were registered in Skien (Tab. 1). In both years of the studies the pollen season of *Corylus* started earlier in Lublin than in Skien: in 1999 by two weeks and in 2000 by a week (Tab. 2). The length of the hazel season was the same in both cities in 1999 – 5 weeks, yet in 2000 in Lublin, hazel pollen was noted for 7 weeks, whereas in Skien for 4 weeks. Maximum concentrations of hazel pollen at both measurement sites occurred at different periods. In 1999, the greatest number of hazel pollen grains in Lublin was noted in early March, and in Skien in early April. In 2000, the seasonal maximum of pollen concentration of this taxon in Lublin was noted in the second week of March, and in Skien a week earlier (Fig. 2). At the time of maximum concentration of hazel pollen in both years, more pollen grains were noted in Lublin than in Skien.

In 1999 in Lublin, 8 times more birch pollen was determined than in Skien, yet in 2000 - 1.4 as many (Tab. 1). In 1999, the pollen season of birch lasted 5 weeks at both measurement sites, yet it started three weeks earlier in Lublin. In 2000, the beginning of the pollen season of birch was registered in Lublin two weeks earlier than in Skien however, the end occurred on the same date. The pollen season of birch was shorter in Skien than in Lublin and lasted 3 weeks. The periods of maximum concentrations were seen in Lublin 1 and 3 weeks earlier in 2000 and 1999, respectively, than at the measurement point in Norway. Maximum values of birch pollen concentration were higher in Lublin than in Skien in both years of the studies. In July 2000, a significant growth of birch pollen was registered, probably linked with the inflow of pollen from the distant transport from the regions north of Skien (Fig. 3).

DISCUSSION

In the course of two years, significantly greater differences in annual totals of pollen grains of the studied taxa were observed in Skien than in Lublin. The annual total of *Alnus* pollen in Skien in 1999 was 12 times lower than in 2000, in the case of *Corylus* the annual total was 7 times lower, and for *Betula* – 5 times. Also Ramfjord [12] observed very significant differences in annual totals of the mentioned taxa in individual years at various measurement sites in Norway.

According to Ramfjord [12], *Alnus* pollen occurs in the atmosphere of Oslo earlier than the pollen of *Corylus*. Also in Skien in both years of the studies, *Alnus* pollen was registered earlier than *Corylus*, i.e. in late February, much the same as in Lublin.

The geographical location of Skien compared with Lublin suggests a later occurrence of pollen of the studied taxa in south-east Norway. The start of pollen season of *Corylus* and *Betula* was registered earlier in Lublin than in Skien in both years. This seems to be related with air

temperature at the beginning of the year. The mean temperature in February and March in Skien amounted respectively to –3.8ºC and 0.1ºC. The mean temperature in February and March in Lublin amounted respectively to –2.9ºC and 1.1ºC. However, the pollen season of *Alnus* started at both sites in the same period.

According to the studies conducted in Skien in 1999–2000, the beginning of the pollen season of *Alnus* occurred in last week of February. In 2000, the maximum concentrations of *Alnus* and *Corylus* pollen, appeared earlier (in first week of March) in Skien than in Lublin by a week, perhaps due to exceptionally positive weather conditions in the area of south-east Norway. According to the literature data, the beginning of the alder and hazel pollen season in Northern Europe falls at the end of March and the highest concentrations of pollen of these taxa are noted in April [6, 12].

However, Frostad [6] has noticed that, in recent years, with favourable weather conditions, *Alnus* and *Corylus* have started releasing pollen in January and February.

In Skien, birch pollen appeared after 20 April and the maximum concentrations were registered on the turn of April and May. The beginning of the pollen season of birch in Oslo, described by various authors, also took place after 20 April or in early May; however, the highest concentrations of birch pollen were noted in the latter part of May [6, 12, 13].

Probably the earlier dates of the beginning of pollen seasons in Skien rather than in Oslo, determined by the author of the study, result from the greater effect of Golfstrom in Skien, which is connected with the geographical location of both places.

CONCLUSION

In 1999 and 2000, the beginning of *Alnus* pollen season was determined at the same time in Lublin and in Skien; however, the pollen season of *Corylus* and *Betula* started earlier in Lublin than in Skien.

For all studied taxa in 1999 the length of pollen seasons was identical in both places, but in 2000 pollen seasons in Skien lasted a shorter time.

Maximum concentrations of birch pollen in both years were noted earlier in Lublin, but in the case of alder and hazel in 2000, the highest concentrations of pollen grains were registered a week earlier in Skien than in Lublin.

Step changes of pollen concentrations in individual years in Skien and the differences in the results obtained at the two measurement sites confirm the necessity of performing local pollen monitoring.

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