PLANTAGO ATMOSPHERIC POLLEN IN THE AREA OF TIMIȘOARA IN 2006-2007

NICOLETA IANOVICI
West University of Timişoara, Faculty of Chemistry-Biology-Geography, Department of Biology

ABSTRACT
This article presents the results of a two years qualitative-quantitative study of Plantago airborne pollen. Airpollen belonging to Plantago was sampled during a 2-year (2006-2007) atmospheric pollen-monitoring programme in Timişoara, România, using a VPPS 2000 Lanzoni trap. Annual variations in the concentration of pollen in the atmosphere were analysed by the volumetric method. Plantago airpollen constitutes 1.42% of the annual total of pollen grains. During the studied period, inter-annual variations, concerning the total annual pollen counts and the beginning, peak and ending dates of the APS, were reported.

KEY WORDS: Plantago, airpollen

INTRODUCTION
The annual pollen curve of a given taxon charts daily mean pollen concentrations over the year. Aerobiological studies often use only pollen data from the period over which most of the annual total pollen count is recorded. Various terms are used in the literature to define this period (Jato et al., 2006). Pollen Season appears to refer to a recurring period marked by the presence of pollen, while Main Pollen Season (Mäkinen 1977; Nilsson and Persson, 1981) may be interpreted as that portion of the pollen season during which most pollen is recorded. The term Period of Maximum Pollen Production (González et al., 1998; Nitiu, 2003) appears to refer to the period of time during which pollen is produced by the plant, thus stressing the plants physiological activity more than the presence of pollen in the air. However, it is well known that maximum pollen counts and maximum pollen production are not always recorded simultaneously. Other factors such as transport, resuspension and/or weather-related factors can influence pollen content. Similarly, the terms Pollination Period, Pollination Season, Main Pollination Season and Principal Pollination Period (Lejoly-Gabriel & Leuschner, 1983; Jäger et al., 1996; Clot, 1998; Comtois, 1998; Frenguelli et al., 2002; Syrigon et al., 2003) all allude to the fertilization process, i.e. the transfer of pollen from anther to stigma. The same factors mentioned earlier (transport, resuspension and/or meteorological factors) determine the
presence of pollen in the air outside the fertilization period. The viability of pollen grains can be altered by the influence of environmental factors, including ultraviolet rays and pollution; many captured pollen grains are unable to fertilize due to changes induced in the atmosphere. The term Effective Pollen Season (Giorato et al., 2000) is somewhat ambiguous: it may denote a period of expected pollen production or of effective pollination; it may even be interpreted as the time during which the pollen count is sufficient to provoke allergy symptoms. Finally, the term Atmospheric Pollen Season (Jato et al., 2002) is readily understood as the period of time during which pollen is present in the atmosphere, whilst Main Atmospheric Pollen Season could be used to delimit the period during which most pollen is recorded. Atmospheric Pollen Season appears to be the term best suited to describing this concept (Jato et al., 2006). The criteria for limiting the shortest and longest pollen season periods, as well as the earliest and latest start and end dates, varied according to the city and the taxon under study; in many cases, results for a given taxon also depended on the year (Jato et al., 2006).

On the basis of studies performed in many European cities (Longo & Cristofolini, 1987; Spieksma et al., 1980) the concentration of Plantago pollen in air has been found to be low and irregular. In Europe, the one dominant airborne taxa have been determined as Plantago in Brussels, Belgium (Spieksma, 1990; Spieksma et al., 1991), Montpellier, France (Spieksma et al., 1991), Athens (Apostolou & Yannitsaros, 1977), in Bitlis (Celenk & Bicakci, 2005), in London, Leiden, Brussels, Munich and Marseilles (Spieksma et al., 1980), in Madrid (Subiza et al., 1995), in Salamanca (Hernández Prieto, 1998), NW Spain (Rodríguez-Rajo et al., 2003), Estepona, southern Spain (Recio et al., 2006). Plantago pollen is very infrequently sampled (less than 0.1%) even though several species are common in the western United States Gulf Coast (Lewis et al., 1991). Plantago lanceolata can be found in the air of the city of La Laguna, Tenerife, during the period 1990-1995 in high concentrations of more than 50 grains of pollen per m$^3$ (García Cobaleda et al., 1997). In northwest Spain the maximum concentrations of Plantago pollen never surpassed 52 grains/m$^3$ during the three years of study.

Dispersion is another important phenomenon that influences the estimated quantity of pollen grains recorded in the atmosphere. Dispersion is
directly influenced by the wind direction and velocity that act as antisedimentary factors of the aeronavigating pollen, as well as by the rains and humidity preventing the pollen grains from being transported by the air (Nitiu, 2003). Coefficients of correlation between *Plantago* pollen concentration of the Principal Pollen Period (PPP) and main meteorological parameters by using Spearman correlation test are: mean $T^\circ$ with -0.112, max $T^\circ$ with -0.091, min $T^\circ$ with 0.138, rainfall with -0.056, humidity with 0.004 and sun hours with 0.031 (Garcia-Mozo *et al*., 2007). Pollen concentrations were affected positively by temperature, but negatively by relative humidity. The most relevant factor influencing levels of *Plantago* pollen in the atmosphere was wind speed, which was negatively correlated with pollen levels (Molina *et al*., 2001). In relation to wind speed, the correlation was significant and positive in the case of *Plantago*, whose pollen grains are easily transportable over large distances (Wallin *et al*., 1991; Frei 1997). Despite low concentrations, *Plantago* is one of the greatest allergy inducers in Galicia, being the cause of 38–40% of hay fever cases in many areas (Dopazo, 2001). Temperatures lower than 14°C are related with pollen concentration of *Plantago* from 18 to 20 h, while low wind speed determine an increase at 16 h. Low values of relative humidity during daylight hours improve the suspension of pollen grains specially at 8 and 14 h. High values of wind speed promote high pollen concentrations during the day and particularly affect concentration at 20 h. From 10 to 18 h, high temperatures are an important factor for the rise of pollen concentration. Relative humidities higher than 74% seems not to affect *Plantago* as their frequencies occur during the night when this taxon is seldom present with reasonable values (Pérez *et al*., 2001). *Plantago* and *Olea europaea* were grouped according to the similarity of their pattern of intradiurnal variation in pollen concentration (12:00 to 19:00) (González Minero *et al*., 1998). *Plantago* attained its maximum concentrations at 11 am/12 noon (Rodríguez-Rajo *et al*., 2003). A study of the intra-daily variation of pollen reveals for *Plantago* pollen a clear peak in the afternoon (García-Mozo *et al*., 2007). Nocturnal concentrations were very low in the Extremadura Region (Molina *et al*., 2001). *Plantago* is present in the green spaces of the city La Plata - Argentina between 149 and 157 days. From the analysis of IDI (intradiurnal daily index), three groups of pollination rhythms have been recognized. Group II includes all those pollen types with peak pollen...
concentration lasting several hours, they are, Chenopodiaceae/Amaranthaceae and Plantago. For the city of La Plata, during 1998 to 2001, the maximum values of intradiurnal index for each taxon were in general greater in Group II, accumulating 65% of the total daily concentration in the hourly band between 10 h and 14 h (Nitiu, 2004).

**MATERIAL AND METHODS**

Analysis of the pollen count and pollen fall distribution was performed on the basis of the data collected in Timișoara in the seasons of 2006–2007. Atmospheric air pollen quantity monitorization was done through the volumetric sampling method, the device used was pollen collector VPPS 2000 Lanzoni. The qualitative and quantitative analysis of pollen grains in the aeroplankton was performed according to the IAA regulations (Mandrioli et al., 1998). In this paper, we determined the APS (Atmospheric Pollen Season) in accordance with the criteria used by the following authors: Nilsson and Persson (corresponding to 90% of the total pollen catch - the 90% method), Andersen and Torben (corresponding to 95% of the total pollen catch - the 95% method) (Nilsson & Persson, 1981; Jato et al., 2006). The monthly total concentration was the sum of all daily concentrations per one month, while the total annual concentration was the sum of all monthly concentrations per one year. The mean annual concentration for 5 years of study was obtained by the division of the sum of all annual concentrations by 5. Airborne pollen concentration was expressed as a Pollen Index (PI = this index is expressed in percentage from annual sum pollen types during sampling period 2006–2007).

**RESULTS AND DISCUSSIONS**

In the conditions of Timișoara the most important cause of pollinosis is allergenic pollen of some deciduous trees as well as grasses and weeds. The vegetation is in the region typical urban because of the introduction of ornamental plants and trees. Registered data in Timișoara confirm the fact that at least quantitatively Plantago pollen is not an important allergenic factor (Ianovici & Faur, 2004; Ianovici & Faur, 2005; Ianovici, 2007).

A weekly programmed Hirst trap was used to sample airborne pollen grains, calibrated to handle a flow of 10 L/min of air, which roughly corresponds to a human breathing rhythm. In Timișoara the Lanzoni model was used. The results of pollen count for all years are shown in Table 1.
Monthly variations of total pollen grains recorded in the atmosphere of Timişoara during the years 2006-2007 are shown in table 2.

**TABLE 1.** Most important data characterising the pollen season of *Plantago* in the atmosphere of Timişoara

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>The starting data of the <em>Plantago</em> pollen season</td>
<td>7 V</td>
<td>25 IV</td>
</tr>
<tr>
<td>The ending data of the <em>Plantago</em> pollen season</td>
<td>12 IX</td>
<td>18 IX</td>
</tr>
<tr>
<td>Number of days, when was <em>Plantago</em> pollen in the air</td>
<td>129</td>
<td>147</td>
</tr>
<tr>
<td>Atmospheric Pollen Season (Nilsson &amp; Persson, 1981); 90%</td>
<td>106</td>
<td>119</td>
</tr>
<tr>
<td>Atmospheric Pollen Season (Andersen, 1991; Torben, 1991); 95%</td>
<td>115</td>
<td>128</td>
</tr>
<tr>
<td>Pollen Index</td>
<td>1.34%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Pollen concentrations higher than 30 PG/m$^3$</td>
<td>-</td>
<td>1 day</td>
</tr>
<tr>
<td>Number of <em>Plantago</em> pollen on the peak days</td>
<td>10</td>
<td>43</td>
</tr>
</tbody>
</table>

**TABLE 2.** Monthly pattern of *Plantago* airborne pollen (%), Timişoara, România

<table>
<thead>
<tr>
<th>Year</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>annual total of pollen grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23%</td>
<td>31.3%</td>
<td>18%</td>
<td>22.7%</td>
<td>5%</td>
<td>0</td>
<td>278</td>
</tr>
<tr>
<td>2007</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.3%</td>
<td>18.2%</td>
<td>29%</td>
<td>35.2%</td>
<td>11.1%</td>
<td>4.2%</td>
<td>0</td>
<td>307</td>
</tr>
</tbody>
</table>

The mean annual pollen count obtained during the period studied was 292.5 PG/m$^3$, the lowest value being recorded in 2006. The peak count of each season fluctuated between 10-43 PG/m$^3$. The longest Atmospheric Pollen Season was observed in the year 2007. Two year average pollen season duration were 112.5 days (the 90% method) and 121.5 days (the 95% method). The starts of these APS were fairly uniform, finishing in September. For Timişoara was characteristic lower average number of days with pollen concentrations higher than 30 PG/m$^3$ (part of season when *Plantago* pollen reached critical concentrations – 1 day in 2007). Daily concentrations were very low, only exceeding 10 grains/m$^3$ on a few occasions. Interannual differences can be seen in the seasonal behaviour of the pollen, 2007 being the year in which the highest levels of airborne pollen were reached. *Plantago* airpollen constitutes between 1.34% and 1.5% of the annual total of pollen grains. The months in which maximum pollen concentrations were recorded: May and June in 2006, June and July in 2007. *Plantago* pollen is present in the air in Timişoara from end of April to mid of September.
The abundant literature available on the composition of the pollen spectrum in the air of Spanish cities shows that *Plantago* pollen is present in all of them, albeit in varying amounts and generally never more than 10% (Gutierrez *et al*., 1999). Only on two other occasions did this exceed 100 grains/m$^3$: 116 in Madrid in 1997 and 142 in Málaga in 1996. Average maximum concentrations above 50 grains/m$^3$ were only recorded in Madrid, Jaén, Córdoba, Priego and Málaga. In Orense, Barcelona and Granada, daily concentrations were very low, only exceeding 20 grains/m$^3$ on a few occasions. Only at sites where annual values exceeded or approached 1,000 pollen grains did average daily concentrations exceed 20 grains/m$^3$ on a relatively high number of days (Gutierrez *et al*., 1999). *Plantago* pollen is present in the air in Spain from March to October; the period from April to July presents the highest concentrations, which rarely exceed 50 g/m$^3$. Málaga presented the highest average annual values, and Granada the lowest. Interannual variations for the same site were sometimes significant, and minimum annual values appeared to coincide with periods of severe drought. In general, *Plantago* pollen is more present in the air of the southern half of the Peninsula, where the MPA (main pollen season) starts earlier and is shorter. At the sites in Galicia and Cataluña, the MPS starts later (in April or May) and lasts longer (until September or October) (Gutiérrez *et al*., 1999). Sites in the southern half of Spain presented higher average *Plantago* pollen counts than those in the North. Only in Santiago, Vigo, Lérida, Madrid, Jaén, Córdoba, Málaga and Estepona did the annual pollen count exceed 1,000. As regards the incidence of *Plantago* pollen at each site, the authors consider that that the trap surroundings are more important than factors such as latitude. Average daily concentrations of over 20 grains/m$^3$ were recorded over a period of more than ten days in Vigo, Madrid, Jaén, Córdoba, Priego, Málaga and Estepona. In Orense, Barcelona and Granada concentrations of over 20 grains/m$^3$ were seldom reached. The MPA starts earlier, and is shorter, in the Andalusian stations. The pollen season at stations in Catalunya and Galicia began later, lasted longer and did not end until September or even October (Gutierrez *et al*., 1999).

Percentage content of *Plantago* pollen in annual total count did not differ significantly between volumetric and gravimetric methods in the atmosphere of Lublin in 1997-1998. The beginning of *Plantago* airborne pollen grains occurrence in 1997 was recorded two weeks earlier with the
volumetric method, and in 1998 at the same time for both methods. Maximum concentrations of airborne pollen were registered at different dates: in 1997 - by three weeks earlier with the volumetric method, and in 1998 - by a week earlier using the same method (Piotrowska & Weryszko-Chmielewska, 2003). The average duration of the pollen season of Plantago in Lublin and Krasnystaw was 126 days. The highest pollen grain concentration was 124 grains/cm² and the total pollen was relatively small, an average of 1.3% (Dabrowska, 2003). Plantago taxa studied in the aeroplankton of Lublin in 2001–2002 was characterised by similar values of the maximum pollen (28 and 26 grains/m³), the lowest values of the annual total of pollen grains and the longest pollen seasons (62 and 98 days) (Weryszko-Chmielewska & Piotrowska, 2004). Many pollen types in Ankara atmosphere do not reflect the typical steppe vegetation (Kaplan, 2004). According to the main pollination period (MPP) of the various types recorded three groups could be distinguished:

• Pollen with a short principal period (<10 weeks): Aesculus, Ailanthus, Fagus, Juglans, Macchura, Tilia, Ulmus, Castanea sativa, Sambucus and Typha;
• Pollen with a medium principal period (between 10 and 15 weeks): Acer, Platanus, Quercus and Salix;
• Pollen with a long principal period (>15 weeks): Pinaceae, Populus, Cupressaceae, Moraceae, Gramineae, Chenopodiaceae, Betula, Artemisia, Robinia pseudoacacia, Oleaceae, Urticaceae, Plantago, Rubiaceae and Boraginaceae (Kaplan, 2004).

In this study the smallest differences were obtained for Plantago.

CONCLUSIONS

The highest level of pollen emission was recorded during 2007. Plantago taxa studied in the aeroplankton of Timișoara in 2006–2007 was characterised by similar values of the maximum pollen, the lowest values of the annual total of pollen grains and the longest pollen seasons. The pollen shedding course of the Plantago in Timișoara corresponds to that already described during the pollen season in Europe.

REFERENCES
4. Clot B. - Forecast of the Poaceae pollination in Zurich and Basel (Switzerland), Aerobiologia 14, 267–268, 1998


9


Contact Address: Ianovici Nicoleta
Department of Biology, Faculty of Chemistry-Biology-Geography, West University of Timisoara, Pestalozzi street, nr. 16, Romania
E-mail: nicole_ianovici@yahoo.com