**Zeitschrift:** Botanica Helvetica

**Herausgeber:** Schweizerische Botanische Gesellschaft

**Band:** 110 (2000)

**Heft:** 1

**Artikel:** Allergenic pollen types in the atmosphere of Santiago de Compostela (NW Spain) : a pollen calender for the last six years

**Autor:** Dopazo Martínez, A. / Jato Rodríguez, V. / Aira Rodríguez, M.J.

**DOI:** https://doi.org/10.5169/seals-73586

Bot. Helv. 110 (2000): 51–60
0253-1453/00/010051-10 $ 1.50+0.20/0


Botanica Helvetica

# Allergenic pollen types in the atmosphere of Santiago de Compostela (NW Spain): A pollen calender for the last six years

**A. Dopazo Martínez[1], V. Jato Rodríguez[2] and M. J. Aira Rodríguez[1]**

[1] Departamento de Biología Vegetal. Facultad de Farmacia. Campus Sur. 15706 Santiago de Compostela (Spain).
[2] Departamento de Biología Vegetal y Ciencias del Suelo. Edificio Politécnico. Campus As Lagoas. 32004 Ourense (Spain).

Manuscript accepted January 25, 2000

## Abstract

Dopazo A., Jato V. and Aira M. J. 1999. Allergenic pollen types in the atmosphere of Santiago de Compostela (NW Spain): A pollen calender for the last six years. Bot. Helv. 110: 51–60.

In this study the main allergenic taxa present in the atmosphere of Santiago de Compostela was analyzed. A volumetric pollen trap (model Lanzoni VPPS-2000) in the south campus of the city constantly recorded atmospheric pollen for six years (1993–1998). During this time 103 557 pollen grains were registered, with different portions throughout the years; in 1997 24% of the six-year total was recorded, while in 1996 only 5% was obtained. The distribution between the remaining years was almost uniform, ranging from 15% to 20% for each year. Highest pollen levels were observed during spring and summer, regardless of the year, mainly due to the flowering of *Betula*, *Platanus*, *Pinus*, *Quercus* and Poaceae. We also present a pollen calender for the study period.

*Key words*: Pollen calender, aerobiology, meteorology, Santiago de Compostela.

## Introduction

Respiratory allergic processes may be caused by fungal spores, dust mites, hair and/or animal desquamation cells and, above all, pollen grains entering the respiratory tract. Spring and summer allergic reactions are generally associated with the atmospheric presence of different allergenically active pollen types, although it has been demonstrated that pollen sensibility may also take place outside the pollination period (Bicakci et al. 1996; Emberlin et al. 1990; González et al. 1997; Nardi et al. 1996; Rizzi and Cristofolini, 1987; Rogers, 1997; Satheeshkumar and Ranga, 1998) due to the possibility of cross reactions.

In Spain the first aerobiological studies were published about fifty years ago and since then numerous pollen calenders have been prepared, which represent graphically, both qualitatively and quantitatively, the pollen content of different cities of the Iberian Peninsula (Candau et al. 1998b; Recio et al. 1998; Rodríguez et al. 1998b; Subiza et al. 1995; among the more recent). In Galicia the first aerobiological studies were carried out by Vieitez (1946, 1947) using gravimetric methods. Starting in 1992 and coinciding with the creation of the R. E. A. (Spanish Aerobiological Network), three volumetric pollen traps were installed in the Galician community, which allowed systematic monitoring of the atmosphere of the cities of Orense (since 1992), Santiago y Vigo (since 1993) (Aira et al. 1998a, 1998b; Iglesias et al. 1993; Rodríguez et al. 1998a). The number of sampling points has presently been increased to seven, with continuous monitoring being carried out in Coruña, Lugo, Orense, Santiago, Verín, Vigo and Viveiro.

This study presents the data corresponding to the airborne pollen content of the city of Santiago de Compostela during a six-year period (1993–1998). On the basis of this data, it is possible to predict the principal pollination periods of the region's most abundant plants in the years to come.

## Materials and methods

Santiago de Compostela is situated in the north-western corner of the Iberian Peninsula (UTM 29TNH3647) within the Atlantic Province of the Euro-Siberian Region (Izco, 1987). The vegetation surrounding the sampling point includes deciduous forests of *Quercus robur* along with numerous coniferous species used for reafforestation (*Pinus pinaster*, *Pinus radiata*) or as ornamental flora (mainly Cupressaceae, Taxaceae and Taxodiaceae).

Santiago de Compostela has a maritime-temperate climate with an average annual temperature of 12,9°C, a daily maximum of 24°C in August and a minimum of 4°C in January. Precipitation concentrates on the autumn and winter months, decreasing considerably from the first quarter of the year onwards. Annual values of around 1300 mm are recorded (Carballeira et al. 1983).

The atmospheric pollen content was monitored with a Hirst volumetric spore trap, model Lanzoni VPPS-2000 (Hirst, 1952), situated in the south of the city at a height of 27 m above the ground (270 m above sea level). The samples were collected on a weekly basis; airborne particles stuck to Melinex tape soaked in silicone, which is cut into 48 mm-long segments (corresponding to the days of the week) and put onto a microscope slide, were inspected using a coloured glycerol-gelatine solution for fixation. A microscope with a magnifying power of 400 was used. The final concentrations being expressed as the number of grains/m$^3$ of air (Domínguez et al. 1991).

The meteorological data of the University of Santiago's Astronomical Observatory, situated near the pollen trap, was supplied by the Territorial Meteorological Centre of Galicia.

In order to prepare the pollen calender, we used the average values of 1993–1998 in periods of seven consecutive days, which coincide with the weeks of the year. In the graph the same scale was maintained in order to facilitate interpretation of the results, establishing an order for the taxa represented according to the order in which the maxima were found.

## Results

Throughout the six years 103 557 pollen grains were counted. The smallest value ocurred 1996 (below 5000 grains), followed by 1995 and 1998 with 15 909 and 17 538 grains, and 1993 and 1994 with values close to 20 300 grains. The year of the highest pollen concentration was 1997, with 24 655 grains (Fig. 1).

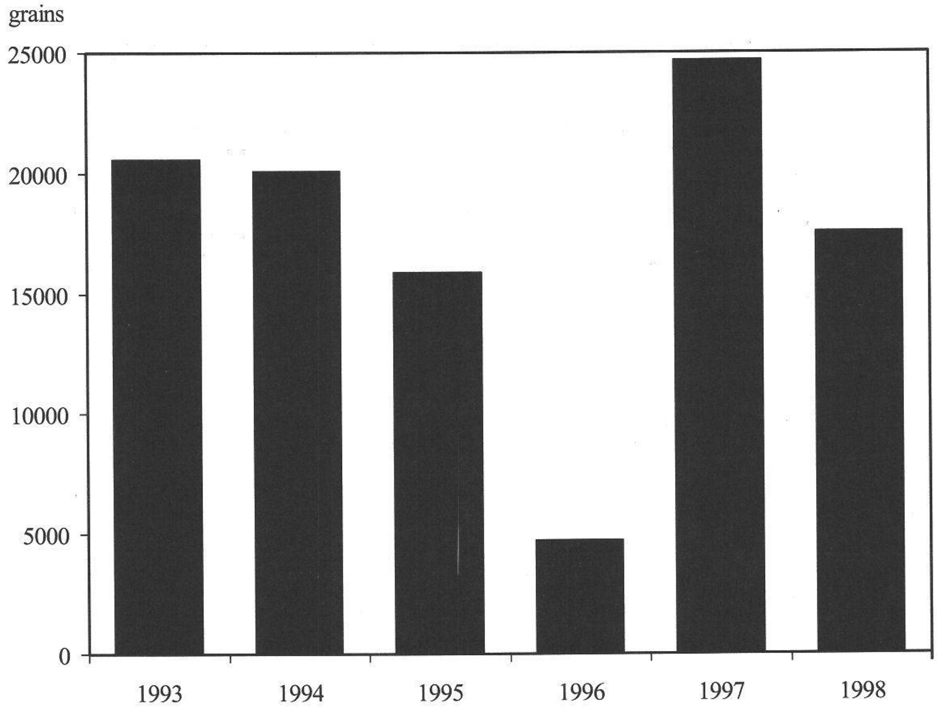


Fig. 1. Total annual pollen.

The representation of the most important pollen types from a quantitative point of view is shown in Fig. 2. In the winter months the most important taxa were *Alnus* and Cupressaceae, although small quantities of *Cedrus* were also recorded. The most abundant precipitations and the lowest annual temperatures were recorded during these months (Fig. 3). The daily pollen maxima of the above taxa were attained on days with no or very little precipitation. The maximum level of *Alnus* during the entire six-year period was attained on January 30$^{th}$, 1994 (232 grains/m$^3$), that of Cupressaceae on January 12$^{th}$, 1997 (118 grains/m$^3$) and that of *Cedrus* on February 21$^{st}$, 1993 (52 grains/m$^3$).

The spring months were characterized by a decrease in precipitation and an increase in temperature, which favoured the atmospheric presence of arboreal pollen types that are abundant in the area studied (Agashe and Alfadil, 1989). *Platanus*, *Pinus*, *Betula* and *Quercus* were the pollen types with the highest counts. The first one is cultivated as an ornamental tree in this area and its surroundings; its pollination period is short and intense in March and April. *Pinus* and *Quercus* are used for reafforestation and form part of small forests; the pollination period begins in January for *Pinus* and in February for *Quercus* (depending on the year); however, their maximum values are not attained until April. *Betula* pollen was the most abundant in the first two years, and the second (after Poaceae) in the other four (Aira et al. 1998c); its pollination period lasted until May, with annual pollen levels that oscillated between 966 grains in 1996 and 4608 grains in 1997.

During summer the highest pollen levels of herbaceous plants were attained; only *Castanea* stood out as the most important arboreal specimen. This genus, represented by *Castanea sativa* Muller, is widely distributed as isolated trees and as part of small groves, which explains the common presence of its pollen in the city's atmosphere. Highest daily peaks were attained between the last week in June and the first week in July, exceeding 70 grains/m$^3$ daily, except in 1996, where the maximum was 16 grains/m$^3$ (July 14$^{th}$).

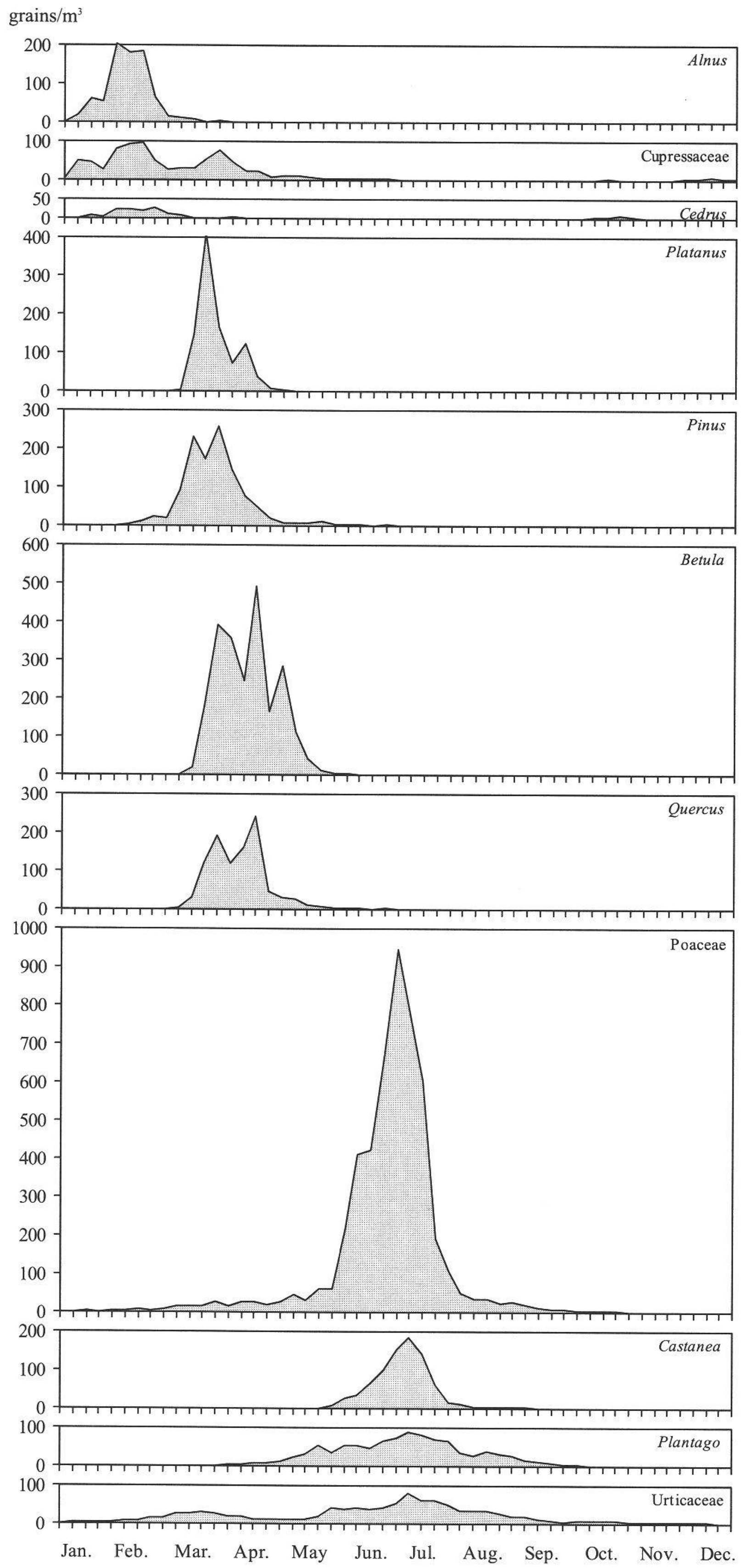


Fig. 2. Pollen calender with average weekly values of 1993–1998.

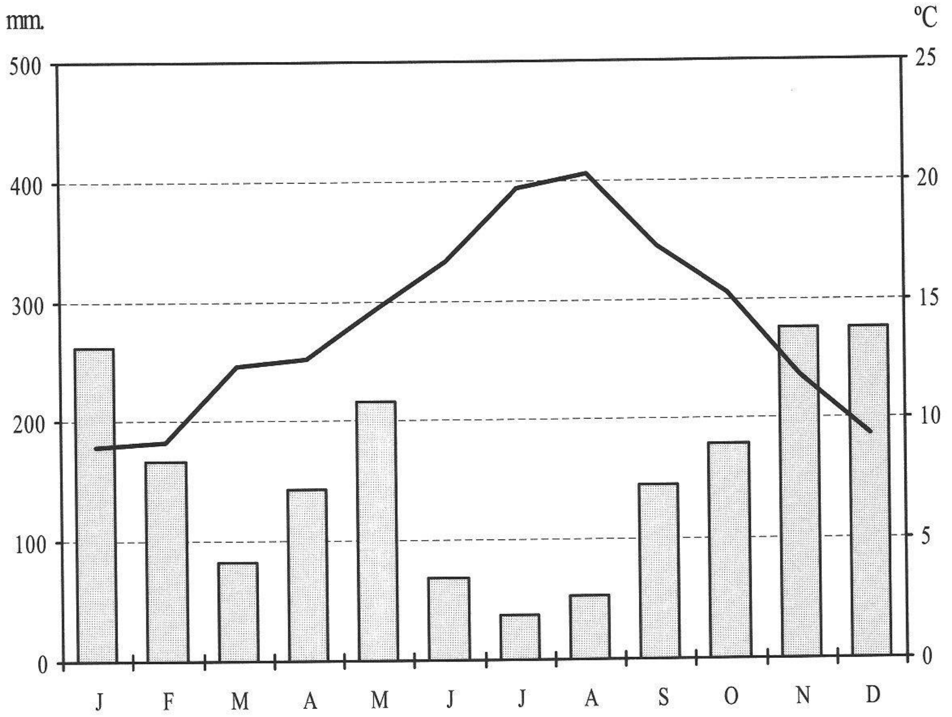


Fig. 3. Average values of precipitation and temperature.

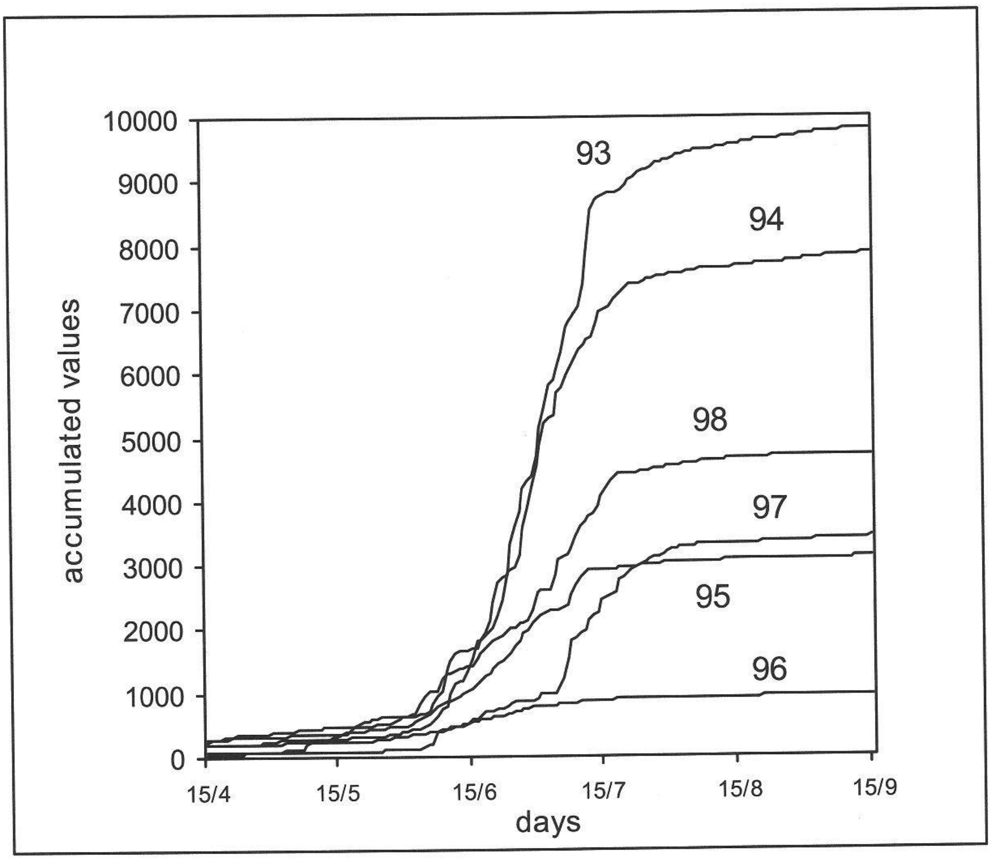


Fig. 4. Accumulated Poaceae pollen concentration for each year studied.

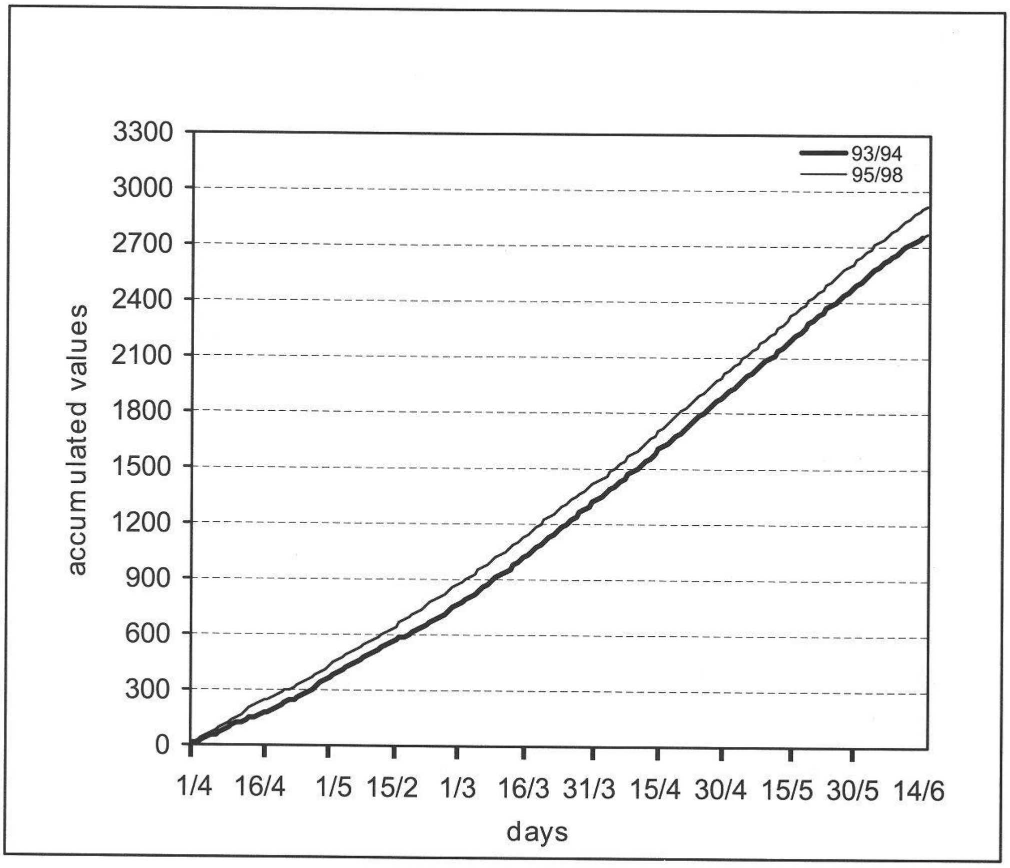


Fig. 5. Accumulated average temperature in the period of Poaceae pollination.

Of the herbaceous pollen types, Poaceae represent approximately 30% of the total annual pollen recorded, depending on the year, and is the dominant taxon from May to July. It is considered to be the main cause of summer hay fever since it may attain maximum daily peaks in the order of 600 grains/m$^3$ (679 grains/m$^3$ were recorded on July 13$^{th}$, 1993). Fig. 4 shows its development during the six years of the study; the onset of flowering in the last four years was observed to be shifted by two weeks compared with 1993 and 1994, in addition, total annual values of less than 50% of those two years were obtained. The six year accumulated average temperature of the Poaceae flowering period (Fig. 5) shows that there is an inverse relationship between these values and the total annual pollen concentrations obtained.

Other taxa that are worth mentioning at this time of the year are *Plantago* and Urticaceae. Each of them represents 6% of total identified pollen. Although they maintained analogous variations in the total concentrations during the years under study, they differ in their pollination periods. The Urticaceae (including the genera *Urtica* and *Parietaria*) are present practically all year round, while *Plantago* is more abundant from April to September.

Table 1 lists the pollen types that are under-represented in the atmosphere but which help to increase the total pollen census, representing on average 6% of the six year total count. Of the ten pollen types included, the most important were Myrtaceae, *Salix* and Oleaceae, attaining daily maximums of 25, 28 and 52 grains/m$^3$, respectively. For the others, daily maxima between 4 and 16 grains/m$^3$ were attained.

The average daily values for the study period (Fig. 6) show two phases of higher pollen concentrations: the first in March and April, which coincides with the flowering of highly al-

Tab. 1. Under-represented taxa in the atmosphere of Santiago de Compostela.

| | 1993 | | | 1994 | | | 1995 | | | 1996 | | | 1997 | | | 1998 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Annual total** | 20,597 | | | 20,099 | | | 15,909 | | | 4,759 | | | 24,655 | | | 17,538 | | |
| | | Maximum peak | | | Maximum peak | | | Maximum peak | | | Maximum peak | | | Maximum peak | | | Maximum peak | |
| | % total | Day | Value | % total | Day | Value | % total | Day | Value | % total | Day | Value | % total | Day | Value | % total | Day | Value |
| *Chenopodiaceae* | 0,34 | 05-Sep | 3 | 0,21 | 10-Sep | 2 | 0,23 | 31-May | 2 | 0,25 | 07-Jun | 1 | 0,25 | 29-Jul | 2 | 0,31 | 18-Jun | 4 |
| *Compositae* | 0,51 | 08-Jul | 4 | 0,49 | 13-Abr | 12 | 0,33 | 06-Abr | 6 | 0,17 | 07-Jun | 2 | 0,42 | 19-Jul | 5 | 0,50 | 27-Mar | 4 |
| *Corylus* | 0,26 | 20-Feb | 4 | 0,08 | 16-Feb | 2 | 0,16 | 16-Ene | 2 | 0,80 | 05-May | 8 | 0,19 | 18-Mar | 4 | 0,02 | 08-Feb | 1 |
| *Ericaceae* | 0,81 | 04-May | 13 | 0,60 | 01-May | 6 | 0,51 | 10-Abr | 5 | 0,40 | 14-May | 3 | 0,78 | 16-Abr | 16 | 0,76 | 07-May | 8 |
| *Myrtaceae* | 1,72 | 19-Ago | 20 | 1,39 | 29-Ago | 11 | 1,86 | 09-Mar | 9 | 1,72 | 06-Feb | 4 | 2,98 | 12-Abr | 25 | 1,17 | 26-Feb | 5 |
| *Oleaceae* | 0,86 | 29-May | 16 | 0,27 | 07-Mar | 2 | 0,84 | 05-May | 22 | 1,41 | 07-Jun | 26 | 1,21 | 16-Abr | 52 | 0,87 | 03-Jun | 6 |
| *Populus* | 0,05 | 24-Mar | 2 | 0,16 | 17-Mar | 8 | 0,05 | 24-Mar | 3 | 0,00 | | 0 | 0,01 | 01-Feb | 2 | 0,00 | | 0 |
| *Rumex* | 0,83 | 29-May | 5 | 0,43 | 17-Sep | 3 | 0,80 | 14-Abr | 5 | 0,80 | 05-Jun | 2 | 0,79 | 07-Jul | 10 | 1,37 | 17-May | 16 |
| *Salix* | 0,78 | 27-Feb | 28 | 0,39 | 10-Mar | 14 | 0,74 | 03-Mar | 9 | 1,03 | 07-Mar | 12 | 0,52 | 10-Mar | 10 | 0,68 | 27-Feb | 9 |
| *Ulmus* | 0,01 | 26-Mar | 1 | 0,01 | 10-Mar | 1 | 0,06 | 26-Mar | 5 | 0,04 | 05-Abr | 1 | 0,08 | 04-Feb | 5 | 0,03 | 16-Mar | 2 |
| **% total representation** | 6,18 | | | 4,04 | | | 5,59 | | | 6,62 | | | 7,23 | | | 5,71 | | |

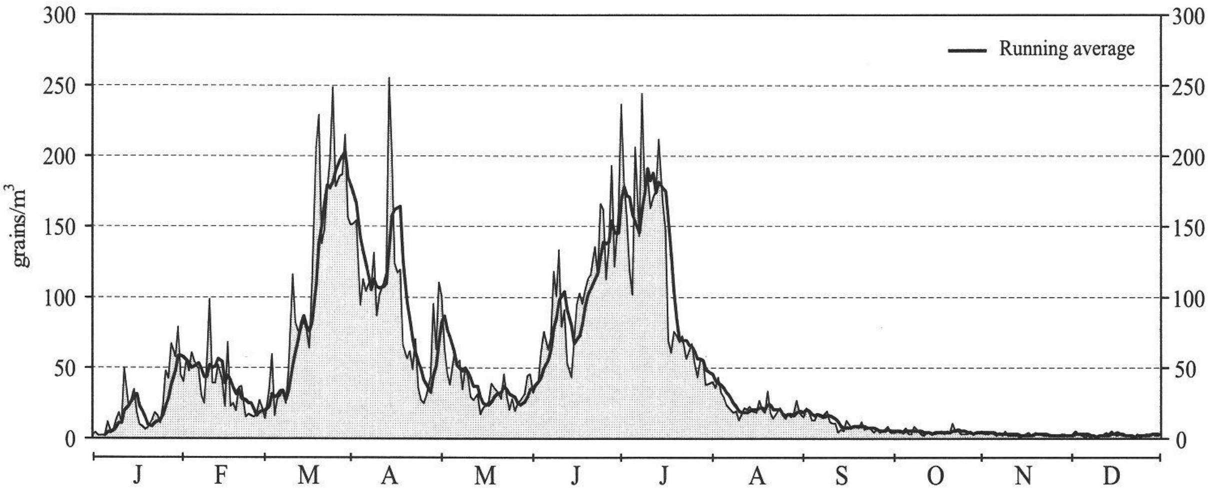


Fig. 6. Average values of daily pollen concentration.

lergenic arboreal taxa (*Betula*, Cupressaceae, *Fraxinus*, Myrtaceae, *Pinus*, *Platanus*, *Quercus* and *Salix*), and the second between June and July, due mainly to the flowering of different herbaceous plants (mainly Poaceae and *Plantago*) and *Castanea*. This last phase corresponds to the driest period of the annual cycle, with low precipitations and temperatures above 20°C. The running average, calculated from the average values of five consecutive days, shows some important peaks during these four months. Taking into account the overall data of the study period, from September to December the pollen count decreases drastically, maintaining an atmospheric residue of less than 50 grains/m$^3$ daily.

## Discussion

In the atmosphere of Santiago de Compostela, arboreal pollen types account for 51% of the total number, while the other half is divided between herbaceous plants and small bushes. We mainly identified taxa that are widely distributed in the surroundings of the sampling point, such as *Betula*, *Quercus*, *Pinus*, Poaceae or Urticaceae; and other pollen types that, although less abundant, are important allergenically (*Ligustrum*, *Fraxinus*, *Platanus*, among others).

Meteorological factors influenced the total concentrations obtained for each individual year. During the six years of sampling, precipitation was concentrated in the winter months, with maximums being recorded between October and January. During these months the level of atmospheric pollen was low, with minimum values in November and December. Spring and summer meteorological conditions influenced pollen counts the most, since the highest values of atmospheric pollen are obtained in these seasons.

During the summer months of 1993 and 1994, the values of accumulated average temperature were lower than in the other years; however, no precipitations (or only very small levels) were recorded, which helped to increase the presence of airborne Poaceae (Iglesias et al. 1998a) and *Castanea* pollen. 1996 was the year with the lowest pollen count of those studied in Santiago and also in other points included in the Spanish Aerobiology Network (Candau et al. 1998a; Iglesias et al. 1998b; Moreno et al. 1998; Silva et al. 1998); this is mainly due to

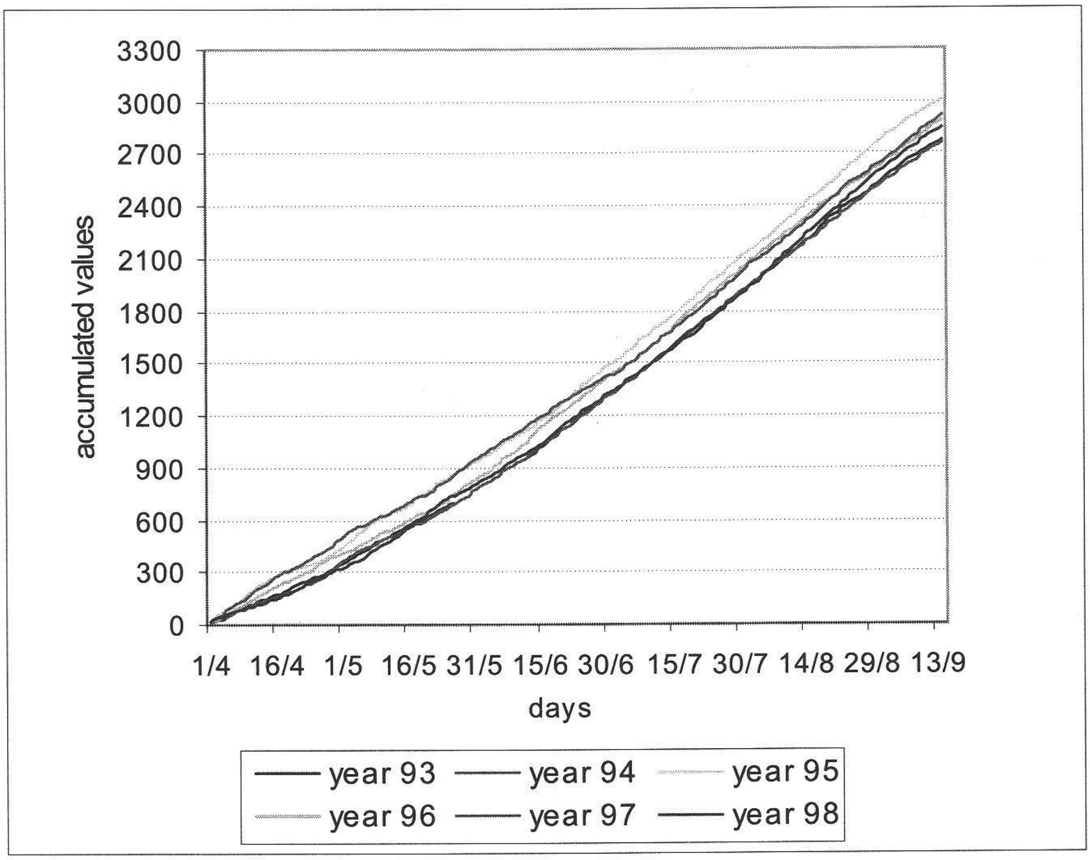


Fig. 7. Accumulated average temperature in each year data of Poaceae pollination.

the important spring rainfall that affected early-flowering species (Aira et al. 1998c). On the other hand, in the following year there was an important increase in the temperatures of March and April compared to February and an almost complete lack of precipitation. These factors favoured an increase in the total monthly concentration, due to the almost simultaneous flowering of *Betula*, *Platanus*, *Quercus* and *Pinus*, the most abundant taxa of the annual cycle. This increase was also noticed in other sampling points in both the NW part and the rest of the Iberian Peninsula (Galán et al. 1998; Rodríguez et al. 1998a; Tavira et al. 1998). During 1998 there was a slight increase in temperature in March in comparison with the previous months. This also holds for precipitation, although this was restricted to the first days of the month.

To Xunta de Galicia. Consellería de Educación y Ordenación Universitaria (Proyecto XUGA-20006B/97).

## References

Agashe S. N. and Alfadil A. G. 1989. Atmospheric biopollutant monitoring in relation to meteorological parameters. Grana 28: 97–104.

Aira M. J., Dopazo A. and Rodríguez F. J. 1998a. Aerobiología en Galicia: Estación de Santiago de Compostela (1995 1996). R. E. A. 3: 77– 80.

Aira M. J., Dopazo A., Jato M. V. and Rodríguez F. J. 1998b. Aerobiología en Galicia: Estación de Santiago de Compostela (1997). R. E. A. 4: 107–110.

Aira M. J., Dopazo A., Rodríguez J. and Jato V. 1998c. Incidencia del polen de abedul (*Betula* sp.) en la atmósfera de Santiago de Compostela (1993–1998). XII Simposio de Palinología, Universidad de León, 141.
Bicakci A., Inceoglu Ö., Sapan N. and Malyer H. 1996. Airborne pollen calendar of the central region of Bursa (Turkey). Aerobiologia 12: 43–46.
Candau P., Tomás C., González F. J., Morales J. and Pérez A. M. 1998a. Aerobiología en Andalucía: Estación de Sevilla (1995–1996). R. E. A. 3: 41–44.
Candau P., Tomás C., Morales J. and González F. J. 1998b. Airborne pollen concentration in Sevilla (Spain), 1993–1996. First results obtained with Hirst's method. Aerobiologia 14: 391–395.
Carballeira A., Devesa C., Retuerto R., Santillán E. and Ucieda F. 1983. Bioclimatología de Galicia. Fundación Pedro Barrié de la Maza, La Coruña.
Domínguez E., Galán C., Villamandos F. and Infante F. 1991. Manejo y Evaluación de los datos obtenidos en los muestreos de los datos aerobiológicos. Monografías REAN/EAN 1: 1–18.
Emberlin J. C., Norris Hill J. and Bruant R. H. 1990. A calendar for tree pollen in London. Grana 29: 301–309.
Galán C., Cariñanos P., Alcázar P., Infante F., Castro A. and Domínguez E. 1998. Aerobiología en Andalucía: Estación de Córdoba (1997). R. E. A. 4: 21–24.
González F. J., Candau P. and González M. L. 1997. Importancia de la flora ornamental en la aeropalinología de Sevilla (España). Act. Bot. Malac. 22: 83–91.
Hirst J. M. 1952. An automatic volumetric spore trap. Ann. Appl. Biol. 36: 257–265.
Iglesias I., Jato V., Álvarez E., Aira M. J. and Segura A. 1993. Variaciones anuales y diarias de la concentración de polen de la atmósfera de la ciudad de Orense. An. Asoc. Palinol. Leng. Esp. 6: 103–112.
Iglesias I., Aira M. J. and Jato V. 1998a. Poaceae pollen in the atmosphere of Santiago de Compostela: its relationship with meteorology. Aerobiologia 14: 141–145.
Iglesias I., Méndez J. and Seijo C. 1998b. Aerobiología en Galicia: Estación de Ourense (1995–1996). R. E. A. 3: 73–76.
Izco J. 1987. Galicia. In: Peinado Lorca M. and Rivas Martínez S. (eds.) La vegetación de España. Servicio de Publicaciones de la Universidad de Alcalá de Henares, Madrid, 385- 418.
Moreno S., Elvira B., Angosto J. M., Bayo J., Moreno J. and Moreno J. 1998. Aerobiología de Murcia: Estación de Cartagena (1995–1996). R. E. A. 3: 89–92.
Nardi G., Canziani A., Striani P., Santini N., Coccia,C., Seghetti L. and Kranic R. 1996. Cupressaceae pollen in the atmosphere of Ascoli Piceno (Central Italy) and sensitization of allergic subjects. Aerobiología 12: 269–271.
Recio M., Cabezudo B., Trigo M. M. and Toro F. J. 1998. Pollen calendar of Málaga (Southern Spain), 1991–1995. Aerobiologia 14: 101–107.
Rizzi L. and Cristofolini G. 1987. Airborne pollen sampling in Trieste (Italy). Grana 26: 91–96.
Rodríguez F. J., Díaz M. R. and Jato,V. 1998a. Aerobiología en Galicia: Estación de Vigo (1997). R. E. A. 4: 115–118.
Rodríguez F. J., Méndez,J., Díaz M. R., Jato V. and Iglesias I. 1998b. Pollen calendar of Vigo, North-West Spain (1995). Aerobiologia 14: 269–276.
Rogers Ch. 1997. An aeropalynological study of metropolitan Toronto. Aerobiologia 13: 243–257.
Satheeshkumar S. and Ranga B. P. 1998. A preliminary survey of airborne pollen in Madras City. Aerobiologia 14: 69–73.
Silva I., Muñoz A. F., Tormo R. and Recio D. 1998. Aerobiología en Extremadura: Estación de Badajoz (1995–1996). R. E. A. 3: 61–64.
Subiza J., Jerez M., Jiménez J. A., Narganes M. J., Cabrera M., Varela S. and Subiza E. 1995. Allergenic pollen and pollinosis in Madrid. J. Allergy and Clin. Immunol. 96 (1): 15–23.
Vieitez E. 1946. Estudios botánicos sobre la flora alergógena y contenido del polen de la atmósfera de la comarca de Santiago de Compostela. Anal. Inst. Edaf. Ecol. y Fisiol. Veget. 5(1): 308–439.
Vieitez E. 1947. Análisis polínico atmosférico de Pontevedra y estudio de la flora alergógena de su comarca. Anal. R. Acad. Farmacia 13(3): 191–244.
Tavira J., Tormo R., Silva I. and Muñoz A. F. 1998. Aerobiología en Extremadura: Estación de Cáceres (1997). R. E. A. 4: 103–106.