



Airborne pollen data of Platanaceae in Santiago de Compostela (Iberian Peninsula)

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Abstract

The pollen count of the *Platanus* genus in the atmosphere of Santiago de Compostela (Galicia, Spain) was carried out from 1993 to 1998, with the pollen of this taxon representing 6% of total identified pollen. The principal pollination period (P.P.P.) was centred on the months of March and April, with an average duration of 23 days. During the study period we obtained negative correlations with precipitation and humidity and positive ones with temperature and hours of sunshine, with a confidence index of more than 90%. On the basis of the six-year study period, we also calculated the average accumulated temperature required to trigger the onset of flowering, which oscillated between 330 and 456 °C, with this result being confirmed for 1999 (437 °C). We also observed that the values of maximum pollen concentration of this taxon in the last 7 years (1993–1999), were obtained on days during the P.P.P. with maximum temperatures above 18 °C. The model of intradiurnal variation reflects, for the majority of years, a greater representation during the central hours of the day.

Abbreviations: Principal Pollination Period (P.P.P.)

1. Introduction

The Platanaceae family is formed by the *Platanus* genus, which includes 10 species from temperate areas in North America, SE Europe, the Himalayas and Indochina. By Iberian Flora, the most abundant in Europe is *Platanus hispanica* Miller ex Munchh. (Castroviejo et al., 1990). In the Iberian Peninsula it is cultivated in parks, squares and streets, except in very dry or very cold regions. It also appears along river banks, sometimes naturalized.

Plane tree pollen has been cited in numerous Spanish and European cities as an important spring allergen (Bousquet et al., 1984; Subiza et al., 1994, 1995; Varela et al., 1997). Studies carried out in Toledo (Spain) tested positive to this pollen type in 50% of skin tests (Moral et al., 1996) and in 2% in the peninsular NW (Belmonte et al., 1996).

This study includes data of *Platanus* pollen content in the atmosphere of Santiago de Compostela during six years (1993–1998), analyzing its variations throughout the study period and its relation to meteorological factors, especially with regard to the influence of temperature. The principal pollination period and hourly representation of this taxon were also calculated.

2. Materials and methods

Santiago de Compostela (Figure 1) is situated in the north-west corner of the Iberian Peninsula. It has a subhumid-temperate climate with high humidity, an average annual temperature of the order of 13.7 °C and annual precipitation of over 1,078 mm (Martínez and Pérez, 1999).

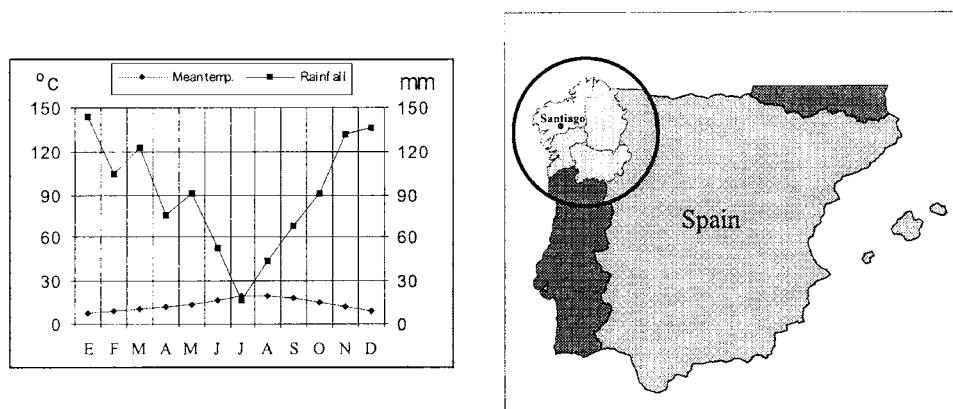


Figure 1. Geographic location and ombrothermal diagram.

Airborne pollen was collected weekly using a Hirst volumetric spore trap (Hirst, 1952), located in the south campus of the University of Santiago de Compostela, at a height of 27 m above the ground. In the surroundings of the trap there is an abundance of ornamental species, mainly trees of the Cupressaceae, Platanaceae and Betulaceae families.

In this study we followed the methodology proposed by the Spanish Aerobiology Network (Domínguez et al., 1991). Meteorological data was provided by the Astronomical Observatory of the University of Santiago, which is situated near the sampling point.

3. Results

In the pollen count of the atmosphere of Santiago de Compostela during the six years (1993–1998) we identified a total of 103,557 pollen grains, of which 5,870 belonged to *Platanus*. In the first four years of the study the values were low with regard to the total (Figure 2), but starting from 1997 an important increase was observed, more than doubling the count of previous years.

In order to calculate the principal pollination period, we followed the proposal of Nilsson and Persson (1981). During 1993, 1994 and 1995 it ranged from mid-March/end of March to mid-April/end of April, with small variations according to the year. In 1996 it spanned almost the entire month of April, while in 1997 and 1998 it took place in the second half of March (Figure 3). In relation to its duration, it progressively decreased during the study period, going from 51 days in 1993 to 12 in 1998, with

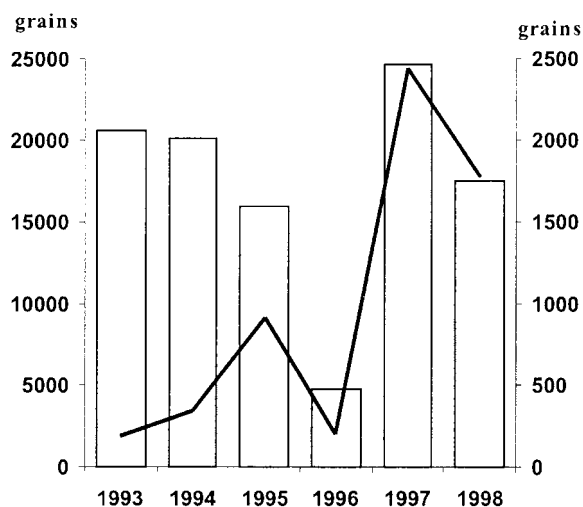


Figure 2. Total annual *Platanus* pollen.

the same tendency being observed in the number of days equalling or surpassing the average value of the P.P.P. On the other hand, we observed an increase in the number of grains both within and outside the period, except in 1996 and 1998. The maximum daily value of 478 grains/m³ was recorded on March 18th, 1997, coinciding with a mild, cloudless day with a predominance of N/NNE winds and an absence of precipitation (Table 1).

A statistical analysis with the data of each year's P.P.P. and of the study period as a whole in relation with the principal meteorological parameters has been made (Table 2). In the cases in which there was a correlation between pollen content and precipitation and humidity, it was negative with a significance of 99% for the period 93–98. On the other hand, the great

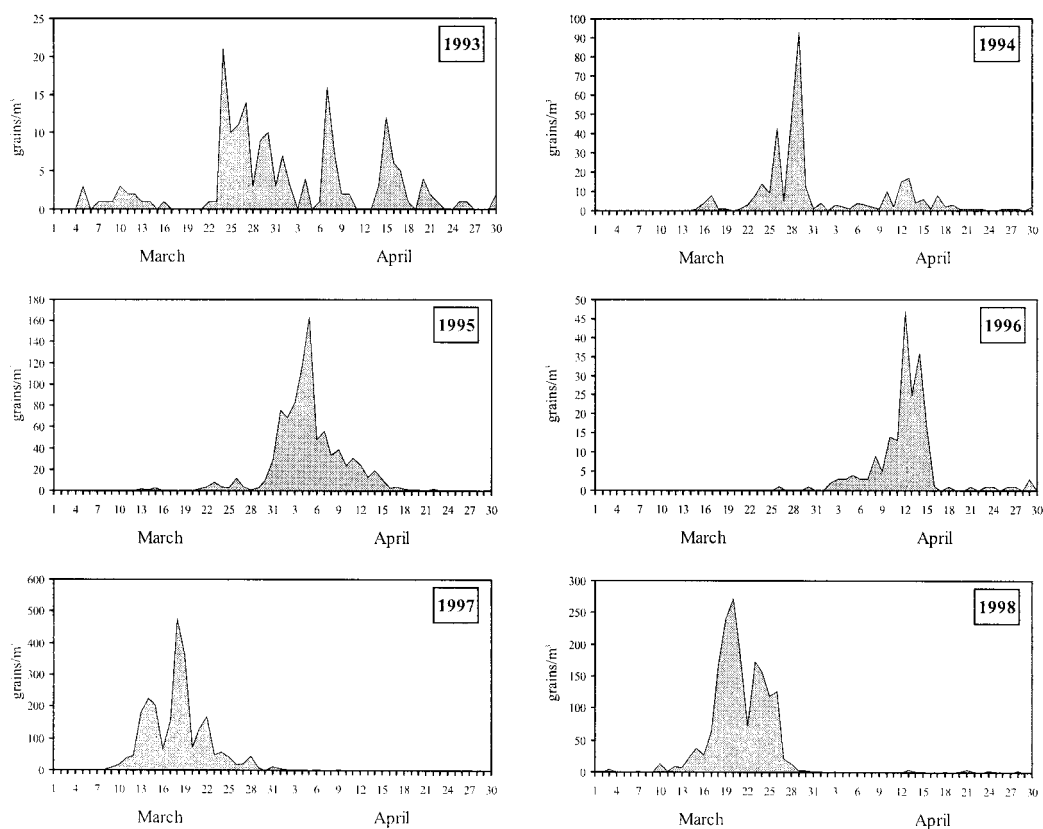


Figure 3. Daily pollen representation.

Table 1. Date of the principal pollination period.

	1993	1994	1995	1996	1997	1998
Start of PPP	11-Mar	22-Mar	28-Mar	05-Apr	13-Mar	15-Mar
End of PPP	30-Apr	17-Apr	13-Apr	21-Apr	26-Mar	26-Mar
Number of days PPP	51	27	17	17	14	12
Total grains per year	187	350	911	198	2445	1779
Total grains PPP	178	313	819	178	2199	1601
Average value year	0.51	0.95	2.49	0.54	6.69	4.87
Average value PPP	3.5	11.6	48.17	10.47	157.07	133.41
N° of days = average PPP	14	7	7	6	6	6
Maximun value (grains/m ³)	21	93	164	47	478	272
Maximun value day	24-Mar	29-Mar	05-Apr	12-Apr	18-Mar	20-Mar
Average temperature	10.6	15.7	16.6	16.3	17.3	17.5
Precipitation (mm)	0	0	0	0	0	0
Hours of sunshine	7.4	9.5	10.9	6.9	10.5	9.1
Dominant wind direction	NE	N	N	N/NE	N/NNE	N/NNE

Table 2. Correlations between pollen concentration and principal meteorological parameters.

	1993	1994	1995	1996	1997	1998	1996–1998
Rainfall	−0.326*	−0.152***	—	−0.569**	—	—	−0.602***
Humidity	−0.511***	−0.192	−0.327	−0.283	+0.068	−0.554*	−0.625***
Hours of sunshine	+0.373**	+0.335*	+0.179	+0.263	+0.264	−0.141	+0.550***
Temperature							
Maximum	+0.038	+0.378*	+0.196	+0.721***	+0.046	+0.621**	+0.682***
Minimum	−0.354**	+0.071	−0.254	+0.375	+0.174	+0.692**	−0.014
Average	−0.284	+0.411**	+0.190	+0.856***	+0.123	+0.680**	+0.601***
Two-day accumulate temperature							
Maxium	+0.054	+0.609***	+0.150	+0.592**	+0.314	+0.727***	+0.724***
Minium	−0.300*	+0.073	−0.113	+0.453	+0.165	+0.753***	+0.009
Average	−0.226	+0.515***	+0.145	+0.606**	+0.301	+0.751***	+0.635***
Shift of wind							
First (NE)	+0.124	+0.528***	−0.287	+0.642**	−0.064	+0.133	+0.533***
Second (SE)	+0.010	+0.460**	+0.421*	−0.036	+0.046	+0.357	+0.461***
Third (SW)	−0.101	−0.185	+0.467*	−0.692***	+0.348	+0.106	−0.325***
Fourth (NW)	−0.107	−0.108	+0.158	−0.061	+0.322	−0.456	−0.156*
					>90%*	>95%**	>99%***

majority of correlations were positive with hours of sunshine and temperature (maximum, minimum and average), with the confidence index ranging between 90% and 99%. Average temperature was the most significant. In 1994 and 1998, the results were a lot more significant taking into account the accumulated average two-day temperature, but it hardly influenced the study period as a whole. In relation to the influence of wind, the NE or SE direction was positive with a high significance index (90% to 99%) in 1994, 1995, 1996 and in the period 93–98, while the SW direction was clearly significant (99%) with a negative correlation and the NW direction was hardly significant. In general, the correlations were more significant taking into account the data corresponding to the overall study period, due to the fact that the number of correlated values is also higher.

In order to ascertain in greater detail the influence of temperature, we compared the daily values of *Platanus* pollen with the average values of the maximum temperatures, obtaining daily concentrations of less than 50 grains with temperatures of 13–29 °C, 50 to 100 grains between 22–27 °C, 100 to 200 grains from 21 to 28 °C, 200 to 300 grains between 20 and 26 °C and more than 300 grains with temperatures of 21 to 26 °C.

Table 3. Correlations between T^a max and value of P.P.P in dry days.

T ^a max	Dry days PPP	N° cases	% Representation
≥ 18	+0.416***	68	60
< 18	−0.104	20	—
≥ 19	+0.356***	60	58.3
< 19	+0.151	28	—
≥ 20	+0.329***	55	58.1
< 20	+0.117	33	—
		> 90%*	> 95%** > 99%***

We also correlated the values of maximum temperature with the daily average concentration at that temperature, for the interval recorded during the study period (9 to 31 °C). The daily average value of the total study period was less than 1 between 9–18 °C, from 2 to 6 between 19–25 °C, from 10 to 15 between 26–27 °C and less than 5 from 27 to 31 °C.

We obtained highly significant correlations (99%) when the daily maximum temperature oscillated between 18 and 20 °C (Table 3), taking 18 °C as a reference value since it is the most indicative of this

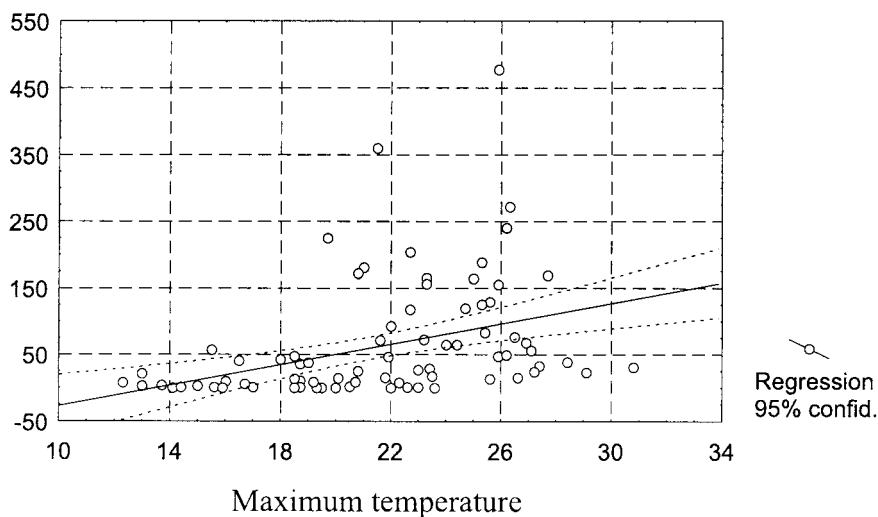


Figure 4. Regression analysis.

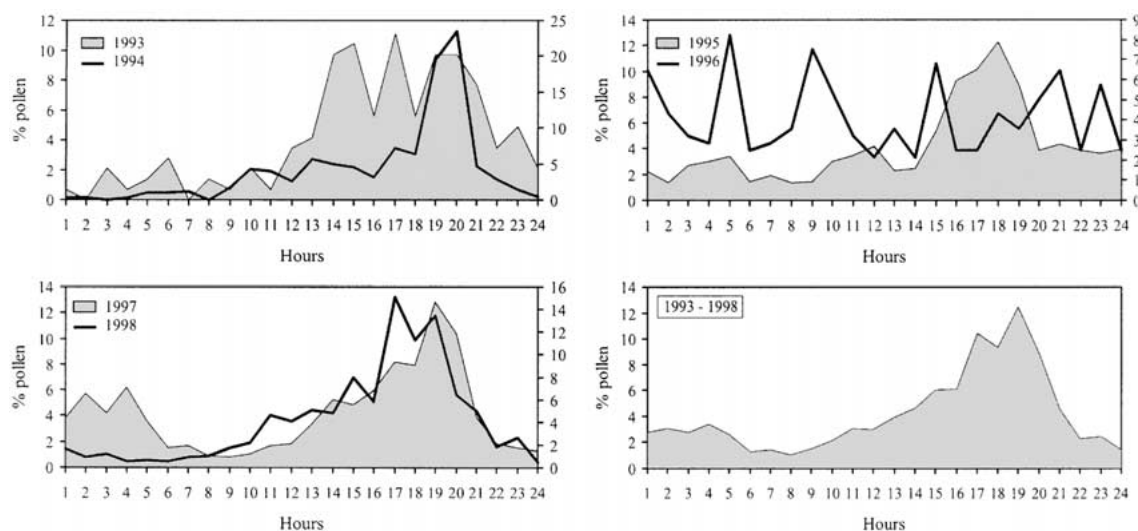


Figure 5. Intradiurnal pollen representation.

Table 4. Pollination data of *Platanus*.

Year	Date	n1	T1	n2	T2
1993	11-Mar	69	330	51	6.5
1994	22-Mar	80	366	27	13.5
1995	28-Mar	86	449	17	26.4
1996	05-Apr	95	456	17	26.8
1997	13-Mar	71	407	14	29.1
1998	15-Mar	73	440	12	36.6
Mean	24-Mar	79	408	23	17.7

n1. – No. of days from January 1st

T1. – T^a accumulated

taxon's pollen count (60% of the cases), as indicated by the regression analysis (Figure 4).

To determine the accumulated temperature required to trigger the onset of flowering, we followed the proposals of Alba and Díaz (1998) and Dennis (1984), using the values of daily average temperature from January 1st to the day corresponding to the beginning of each year's P.P.P., which was calculated with the criterion of Nilsson and Persson (1981). The obtained results (Table 4) show that during the study period the said temperature oscillated between 330 and 456 °C according to the year, with an average of 408 °C.

In order to obtain the models of intradiurnal variations of *Platanus*, we used the method proposed by Galán et al. (1991), selecting the days of each year's P.P.P. whose value equalled or surpassed that year's average and in which no precipitation was recorded (Figure 5). In most years the greatest pollen concentration was recorded between 5 pm and 8 pm, the same as in the model proposed for the total study period. In 1993 and 1996 the intradiurnal variation did not have a clear distribution, which may be due to the briefness of the pollination period.

4. Discussion

The obtained results show that the pollination period of *Platanus* in the city of Santiago is characterized by its briefness with moderately high values. The pollen of this taxon was mainly present in the atmosphere in March and April (1993–1998), with only a few grains in February and May. In general, in all of the Spanish Aerobiology Network's national sampling points, the pollination period coincides at the same time of the year, while in some Italian cities the maximum values are recorded between April and May (Rizzi and Cristofolini, 1987).

In relation to the quantity of pollen compared to other sampling points located in Galicia (Ourense and Vigo), it varies according to the year. The maximum value was recorded in Santiago in 1997 with 2,445 grains compared to 873 grains and 813 grains in Vigo and Ourense respectively (Aira et al., 1998; Iglesias et al., 1998; Rodríguez et al., 1998).

In comparison with other Spanish cities, in Santiago the annual values of *Platanus* are a lot lower than those of large cities such as Madrid, Barcelona or Seville (Belmonte et al., 1998; Candau et al., 1998; Gutiérrez et al., 1998) in which more than 20,000 grains of this taxon are recorded annually. These differences are evidently related to the greater abundance of shade plane trees in the parks and streets of large cities. The quantities obtained in 1997 in Santiago, of the order of 2,000 grains (Aira et al., 1998), came close to those recorded in León (Fernández et al., 1998) and surpassed the majority of southern cities (Díaz and Alba, 1998; González et al., 1998; Recio et al., 1998; Ruiz et al., 1998; Silva et al., 1998; Tavira et al., 1998).

With regard to the correlations between *Platanus* pollen concentration and meteorological factors, the negative correlation with precipitation and humidity

and the positive influence of temperature (maximum and average) stand out. Similar results have been obtained by other authors (Norris-Hill and Emberlin, 1991). In Santiago the daily pollen concentration was higher on dry days during the principal pollination period on which the maximum temperature was greater than 18 °C, in the six years under study and in 1999.

In comparison with other Spanish cities further south and with a milder climate, in which the P.P.P. of *Platanus* lasts longer (Alba and Díaz, 1998), in Santiago we observed that the accumulated average temperature required to trigger the onset of flowered was lower and the P.P.P. began at a later date. The proposed temperature interval of 330 to 456 °C was valid in order to determine the onset of flowering this year (1999), with an accumulated average temperature of 437 °C being obtained on March 29th.

The month with the highest quantity of *Platanus* pollen during the entire study period was March 1997 (2,409 grains), climatically characterized by the absence of precipitation and moderate average temperatures.

The model of intradiurnal variation obtained for *Platanus* in Santiago indicates a greater atmospheric concentration of this pollen type between 5 pm and 8 pm, unlike the case of Cordoba (south Spain), where the maximum values, with slight variations, are always recorded in the morning (Galán et al., 1991). Norris-Hill and Emberlin (1991), recorded the maximum values in London around 4 pm, although the anthesis could take place in the morning if there was an increase in temperature and the Hdd decreased, which would result in the drying and opening of the anthers.

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