

Short communication

Airborne pollen concentration in Seville (Spain), 1993–1996. First results obtained with Hirst's method

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Abstract

The data presented constitute the longest historical series of results obtained in Seville with a Hirst-type sampler, and are a further contribution to earlier aerobiological studies carried out in the city with a Cour trap. This work supplies an updated pollen calendar of the city, together with pollen counts and other aerobiological parameters for the 14 most important types in the 4-year period of sampling. These were *Platanus hispanica*, *Olea europaea*, *Quercus*, Cupressaceae, Poaceae, Urticaceae, Moraceae, Chenopodiaceae/ Amaranthaceae, *Plantago*, Pinaceae, *Rumex*, Myrtaceae, Compositae, and *Casuarina*. © 1998 Elsevier Science Ireland Ltd. All rights reserved.

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1. Introduction

The present study is an attempt to construct an updated pollen calendar of Seville, using the data obtained from the longest aerobiological sampling made up to now in the city with a Hirst-type sampler. These data differ from those previously published on the aerobiology of region in two main respects: the data obtained with the Hirst method are more than 15 years old, and have been published as fragments (Chaparro and Conde, 1984); secondly, the most recent aerobiological data (Candau and González Minero, 1992; González Romano et al., 1992; González Minero and Candau, 1997) were obtained using the Cour method, a method not used by the Red Española de Aerobiología (Spanish Aerobiology Network).

The results presented here could be considered as a significant contribution to the knowledge of the

airborne pollen concentration of southern Spain and of other southern Mediterranean cities, following studies published previously (Galán et al., 1989; Belmonte and Roure, 1991; Subiza et al., 1991; Roses-Codinachs et al., 1992; Domínguez Vilches et al., 1993; Díaz de la Guardia et al., 1995; Galán et al., 1995; Munuera Giner et al., 1995).

2. Materials and methods

The city of Seville is located in the south-west of peninsular Spain (37°23'N, 5°58'W). Its climate is Mediterranean with an annual mean temperature of 18.8°C and 600 mm of annual precipitation (data supplied by the Tablada weather station of the National Meteorological Institute for the period 1922–1989). The vegetation of the region is a dense, varied ornamental flora together with, as in every urban area, ruderal habitats. The natural vegetation (*Quercus ilex* and *Q. rotundifolia* woodland) has given way to agricultural land (olive,

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citric fruits, cereals, sunflower, sugar beet, etc.) and forestry (mainly pine and eucalyptus). Nevertheless, there are still enclaves of well-preserved autochthonous forest.

The aerobiological study was carried out with a Hirst-type sampler (Burkard) placed on the roof terrace of the School of Pharmacy. The air of the town has been monitored for four consecutive years (1993–1996). Analysis of samples and determination of pollen concentration were done following the protocol of the Red Española de Aerobiología proposed by Domínguez Vilches et al. (1991). The concentrations achieved (expressed as grains of pollen/m³ per h) were used to calculate daily, weekly mean, and annual total concentrations. The weekly mean concentrations were calculated by summing the daily concentrations and dividing the resulting value by seven. The annual totals were calculated by summing the daily concentrations.

The construction of the pollen calendar was based on the 14 most abundant types in the 4-year period.

3. Results and discussion

Table 1 shows the most important aerobiological features of the pollen types studied, for each of the 4 years and the mean of the period 1993–1996: annual total pollen and percentage of representation in the total pollen collected; starting date and duration of the main pollination period (Pathirane, 1975); and days and weeks of highest pollen concentration. The types are listed in order of the starting date of the main pollination period established from the mean of the period 1993–1996.

The Table is completed with Fig. 1, showing the updated pollen calendar of Seville, constructed from the mean values of the four years of sampling (the types are listed by the same criterion as for Table 1). The Figure illustrates the variation, through the year, in the weekly mean concentrations, represented on the semi-quantitative scale proposed by Spieksma (1991).

The most significant aspects that can be extracted from the joint analysis of Table 1 and Fig. 1 and from the characteristics of the pollen spectrum of Seville are the following:

1. The quantitatively most important types are *Platanus hispanica* (25.58%), *Olea europaea* (11.59%), *Quercus* (10.74%), Cupressaceae (10.12%), and Poaceae (9.99%), which means a predominance of tree pollen and is a reflection of the arboreal mass described above (a dense ornamental urban flora, large areas dedicated to olive growing, and well-preserved enclaves of *Quercus* forest). The presence of entomophilous types within the 14 most important, such as Myrtaceae and Compositae, also reflects the profusion of eucalyptus, sunflower crops, and the ruderal environment of Seville.

2. The types can be divided artificially into three groups, according to their permanence in the air (quantified by the duration of the main pollination period, Table 1):

- 2.1. Types with a main pollination period shorter than 75 days: *Platanus hispanica* (20 days), Moraceae (44 days), *Olea europaea* (50 days), *Casuarina* (51 days), *Quercus* (53 days), and Myrtaceae (74 days). These types are of a single species, or of a few species which flower at the same time, so that the pollen curve is uniform, and characterized by a rise in concentration leading to a maximum peak, followed by a decrease.
- 2.2. Types with a medium-length main pollination period—from 75 to 150 days: *Plantago* (86 days), Pinaceae (99 days), and *Rumex* (118 days).
- 2.3. Types with a long main pollination period—more than 150 days: Chenopodiaceae/Amaranthaceae (181 days), Compositae (189 days), Poaceae (197 days), Urticaceae (263 days), and Cupressaceae (277 days). These types are taxonomically families, and include numerous species which flower gradually through the year, giving pollen curves that extend over the year, normally without great differences between weekly mean concentrations. Such characteristics are shared, to a lower degree, by the members of the second group (*Plantago*, Pinaceae, and *Rumex*).

3. Taking into account the starting date of the main pollination period, the monthly pollen diversity, and the maximum concentrations reached, the pollen calendar of Seville can be summed up in the following way:

In January and February, Urticaceae and Cupressaceae are the most abundant types. February sees the highest concentrations of Cupressaceae, and *Rumex* pollen appears in the air.

March is characterized by the presence of *Platanus hispanica*, Moraceae, and Poaceae. The main pollination period of Poaceae begins in this month (the date may be earlier or later depending on the year), and the highest concentrations of Urticaceae are reached. In the second half of the month, *Quercus*, *Plantago*, Chenopodiaceae/Amaranthaceae, and Compositae appear in the air.

April sees the highest concentrations of *Rumex*, *Plantago* (which remains high until June), and *Quercus*. The concentrations of Poaceae increase progressively, and *Olea europaea* appears (and in some years, may reach its highest concentration).

The first half of May sees the highest concentrations of *Olea europaea*, and the second half the highest concentrations of Poaceae. Types that begin pollination

Table 1

Aerobiological data of the quantitatively most important pollen types of Seville: sum of the daily pollen concentrations or annual total pollen (grains/m³), percentages of representation in the total pollen collected (%), starting date of main pollination period (day of the month and day from 1st January), duration of main pollination period (number of days), week of the year with highest pollen concentration, day of the year with highest concentration (day of the month and day from 1st January)

Pollen type	Annual pollen	% respect to total pollen	Starting date of MPP	Duration of MPP (days)	Week of peak	Day of peak
Urticaceae						
93	2909	7.18	11/01; 11	309	14	2/04; 92
94	2623	4.60	27/01; 27	316	11	10/03;69
95	2635	6.01	21/01; 21	276	12	26/03;85
96	5338	13.47	31/01; 31	149	12	23/03;83
Mean	3377	7.81	23/01; 23	263	12	23/03;83
Cupressaceae						
93	4739	11.61	10/01; 20	325	8	13/02;44
94	5784	10.15	14/01; 14	252	11	25/02;56
95	3138	7.15	21/01; 21	274	7	18/02;49
96	4582	11.56	23/02; 54	257	12	22/03;53
Mean	4561	10.12	27/01; 27	277	10	20/02;51
Rumex						
93	638	1.56	23/02; 54	112	15	7/04; 97
94	595	1.04	12/02; 43	161	13	18/04;77
95	285	0.65	17/02; 48	102	13	28/03;87
96	930	2.35	10/03; 69	97	22	27/5;148
Mean	693	1.36	23/02; 54	118	16	12/4;102
Moraceae						
93	1446	3.54	23/01; 23	70	13	21/03;80
94	1646	2.89	7/03; 66	36	12	18/03;77
95	2043	4.66	9/03; 68	43	12	29/03;88
96	1395	3.52	24/03; 84	25	15	14/4;105
Mean	1633	3.65	1/03; 60	44	13	29/03;88
Pinaceae						
93	434	1.06	4/03; 63	106	18	1/05;151
94	286	0.50	22/02; 53	79	10	7/03; 66
95	378	0.86	7/03; 66	117	10	7/03; 66
96	619	1.56	5/03; 65	95	10	4/03; 64
Mean	429	1.00	3/03; 62	99	12	28/03;87
Poaceae						
93	2943	7.21	14/02; 45	225	23	4/06;155
94	3331	5.84	10/03; 69	168	19	5/05;125
95	1742	3.97	9/03; 68	239	20	18/5;125
96	9096	22.94	10/04; 101	154	23	2/06;125
Mean	4278	9.99	12/03; 71	197	21	23/5;143
Platanus hispanica						
93	13333	32.67	11/03; 70	14	12	16/03;75
94	12482	21.90	7/03; 66	15	11	13/03;72
95	15697	35.78	8/03; 67	23	11	13/03;72
96	4741	11.96	22/03; 82	26	13	29/03;90
Mean	11563	25.58	12/03; 71	20	12	18/03;77
Compositae						
93	481	1.18	22/01; 22	196	15	17/7;168
94	302	0.53	7/04; 97	211	19	5/05;125
95	160	0.36	22/03; 81	188	22	29/5;149
96	452	1.14	10/04; 101	162	22	20/5;141
Mean	349	.80	16/03; 75	189	20	4/06;146
Quercus						
93	4548	11.14	28/03; 87	36	15	7/04; 97
94	6919	12.14	21/03; 80	48	15	4/04; 94
95	5304	12.09	28/03; 87	62	14	30/03;89
96	3014	7.60	29/03; 89	66	16	17/4;108
Mean	4946	10.74	27/03; 86	53	15	7/04; 97

Table 1 (Continued)

Pollen type	Annual pollen	% respect to total pollen	Starting date of MPP	Duration of MPP (days)	Week of peak	Day of peak
Chenopodiaceae/Amaranthaceae						
93	1641	4.02	2/04; 92	163	25	17/6;168
94	1232	2.16	23/02; 54	214	19	3/05;123
95	1148	2.62	3/4; 93	179	14	5/04; 95
96	961	2.42	16/04; 107	166	16	27/4;118
Mean	1246	2.81	28/03; 87	181	19	6/05;126
Plantago						
93	901	2.21	29/03; 88	79	23	21/5;141
94	998	1.75	18/03; 77	84	15	5/05;125
95	402	0.92	24/03; 83	108	14	29/03;88
96	1761	4.44	9/04; 99	72	16	15/4;105
Mean	1016	2.33	28/03; 87	86	17	25/4;115
Olea europaea						
93	4489	11.00	25/04; 115	54	19	8/05;128
94	6767	11.87	14/04; 104	52	18	27/4;148
95	6029	13.74	13/04; 103	43	15	14/4;104
96	3870	9.76	27/04; 118	50	21	23/5;144
Mean	5289	11.59	20/04; 110	50	18	11/5;131
Myrtaceae						
93	540	1.32	7/05; 127	94	28	27/6;178
94	1508	2.64	11/06; 192	59	27	30/6;181
95	592	1.35	25/05; 145	80	24	14/6;165
96	510	1.29	23/05; 144	62	27	4/7; 186
Mean	788	1.65	1/06; 152	74	27	27/6;178
Casuarina						
93	108	0.26	12/09; 255	47	43	29/10; 302
94	251	0.44	7/10; 280	43	41	9/10;282
95	233	0.53	25/09; 268	80	40	7/10;280
96	220	0.55	26/09; 268	34	40	1/10;275
Mean	203	0.44	25/09; 268	51	41	11/10; 284

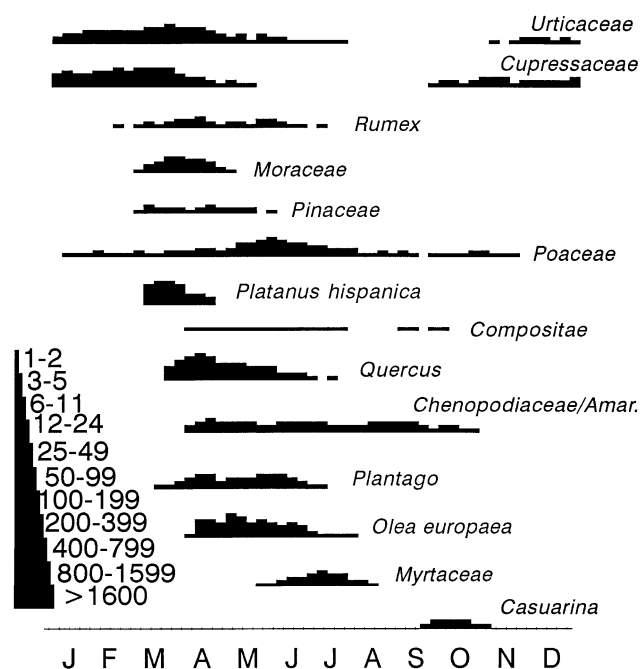


Fig. 1. Pollen calendar of Seville (Mean values of the period 1993–96).

in earlier months (*Quercus*, *Pinaceae*, *Plantago*, *Rumex*, *Cupressaceae*, and *Urticaceae*) maintain high levels throughout the month. Thus, while May is not the month of absolute highest pollen concentration (those in March and April are higher), it is the severest from the allergenic point of view (González Romano et al., 1992).

In June, the *Myrtaceae* type begins its main pollination period and reaches maximum concentrations. *Poaceae*, *Chenopodiaceae/Amaranthaceae*, and *Olea europaea* concentrations are lower than in previous months, and continue to fall during the following summer months.

From October to the end of the year, *Casuarina* appears. *Cupressaceae* and *Urticaceae* begin flowering, with the appearance of their pollen, though in lower concentrations than at the beginning of the year.

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