

Incidence of the *Platanus* pollen in the atmosphere of Madrid region (Spain)

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Abstract: Sabariego, S.; Gutiérrez, M. & Cervigón, P. 2008. Incidence of the *Platanus* pollen in the atmosphere of Madrid region (Spain). *Bot. Complut.* 32: 205-211.

The principal aim of this work is to study the aerobiological behaviour of *Platanus*-type pollen in the Madrid region. We used data were generated by 7 sampling stations of the Regional Aerobiological Network of Madrid (Red Palinocam), all located a short distance from each other. The samplings were carried out over a period of 14 years (1994-2007) using Hirst-type spore traps. *Platanus* pollen is present in the atmosphere for a short period in late winter-early spring, and its maximum concentrations are detected during the last two weeks of March and the first week of April. Throughout the study period, a greater presence of *Platanus* pollen was found in Alcalá de Henares, Aranjuez, Madrid (University city) and Getafe, localities in which parks and gardens are abundant and plane trees are highly present, compared to the other localities (Alcobendas and Coslada). Significant quantitative variations can be observed, not only between the different sampling sites but also between the different years analysed.

Key words: aerobiology, *Platanus* pollen, main pollen season, Madrid, España

Resumen: Sabariego, S.; Gutiérrez, M. & Cervigón, P. 2008. Incidencia del polen de *Platanus* en la atmósfera de la región de Madrid (España). *Bot. Complut.* 32: 205-211.

El principal objetivo de este trabajo es estudiar el comportamiento aerobiológico del tipo polínico *Platanus* en la región de Madrid. Los datos utilizados, pertenecen a siete estaciones, próximas entre sí, integradas en la Red Palinológica de la Comunidad de Madrid (Red Palinocam). Los muestreos se han realizado utilizando captadores volumétricos tipo Hirst y comprende un periodo de 14 años (1994-2007). El polen de *Platanus* está presente en la atmósfera durante un corto periodo, desde finales de invierno a principios de primavera, registrándose las máximas concentraciones durante la segunda quincena de marzo y la primera semana de abril. Durante el periodo estudiado se constata una mayor presencia de polen de *Platanus* en las estaciones de Alcalá de Henares, Aranjuez, Madrid (Ciudad Universitaria) y Getafe, ciudades con parques y jardines donde abundan los plátanos, comparadas con otras localidades (Alcobendas y Coslada). Se han observado importantes variaciones cuantitativas, no solo entre las diferentes estaciones sino también entre los distintos años analizados.

Palabras clave: aerobiología, *Platanus* polen, periodo principal de polen, Madrid, España.

INTRODUCTION

Plane trees originate in the eastern Mediterranean area, southeast Europe and western Asia. They have been cultivated since time immemorial in numerous cities in Spain. In Madrid, where they have grown since living memory, they can frequently be found in avenues, boulevards, parks and gardens. There are some outstanding specimens in Aranjuez, and in Madrid itself, where they line the way between the “Puente de los Franceses”

bridge and the “Puerta de Hierro” neighbourhood (López Lillo 2000). The most frequent taxon in our country is *Platanus orientalis* L. (*acerifolia*); less frequent being *Platanus orientalis* L. (*orientalis*) and *Platanus occidentalis* L. species. These are deciduous trees up to 35 meters high with anemophilous pollination and high pollen production, estimated at 13×10^6 pollen grains per inflorescence (Tormo *et al.* 1996). The flowers are small and joined in a spherical, pedunculate and unisexual inflorescence, male and female in the

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same tree (monoecious distribution), developing simultaneously with the leaves.

Platanus pollen type has the highest incidence in most of the volumetric samplings made throughout the region (Gutiérrez *et al.* 2001). The national and regional aerobiological data show that Madrid and Barcelona have the highest concentrations of *Platanus* pollen (Díaz de la Guardia *et al.* 2000, Gabarra *et al.* 2002). Many authors have considered that *Platanus* pollen has moderate allergenicity power (Bousquet *et al.* 1984, D'Amato & Spiekma 1991, Negrini 1992). In Spain, clinical data on allergenic sensitisation to this pollen are very disparate. In Barcelona, it represents 3.6% of pollen allergies (Valero *et al.* 1999) whereas in Toledo this figure reaches 52% (Moral *et al.* 1998) and in Cordoba 62% (Alcázar *et al.* 2004). In Madrid, according to the data presented by Subiza (2001), 28% of patients affected by pollen allergies show symptoms clearly related with exposure to this pollen. Due to the high concentrations of *Platanus* pollen detected in the atmosphere of Madrid and its clinical relevance, our objective was to analyse the seasonal dynamics of this pollen in the Madrid region.

MATERIAL AND METHODS

The aerobiological sampling was carried out between 1994 and 2007 in seven sampling stations in the local Aerobiological Network of Madrid (Red Palinocam, Fig. 1). Table 1 shows the aerobiological sampling stations and their main geographical and climatic characteristics. The University city is in Madrid; Alcobendas,

Coslada, Getafe and Leganés are localities near the metropolitan area that have undergone major population growth over the last 50 years; Alcalá de Henares and Aranjuez are historic localities situated further away from the city of Madrid.

Airborne pollen was collected using Hirst volumetric spore traps (Hirst 1952) located at different heights, between 4 and 18 meters above ground level. The trap functioned continuously, sucking in air at a rate of 10 l/min, with pollen grains being trapped on a Melinex strip coated with adhesive substance. The methodology applied for the samplings and slide analysis was proposed by the Spanish Aerobiology Network (Domínguez *et al.* 1991; Galán *et al.* 2007). The preparations were analysed by optical microscope (400x magnification), with four longitudinal sweeps per slide. The data used correspond to the mean daily values expressed as number of pollen grains per cubic meter of air. The main pollen season (MPS) was determined taking 98% out the annual total, the initial and final 1% being eliminated. This method has already been used by other Spanish authors for this type of pollen (Díaz de la Guardia *et al.* 2000).

RESULTS

In the Madrid region, the percentage of *Platanus* pollen recorded as compared to total pollen shows significant variations from one season to another, ranging from 3,4% (Alcobendas) to 32,7% (Alcalá de Henares) (Fig. 2). We analysed the percentage of *Platanus* pollen relative to total pollen for the 14 years studied, as a whole, (1994-2007) in each of the sampler stations. We found that the stations located in Alcalá de Henares (32,7%), Aranjuez (23,9%), Madrid (20,7%) and Getafe (19,2%) showed the highest concentrations,

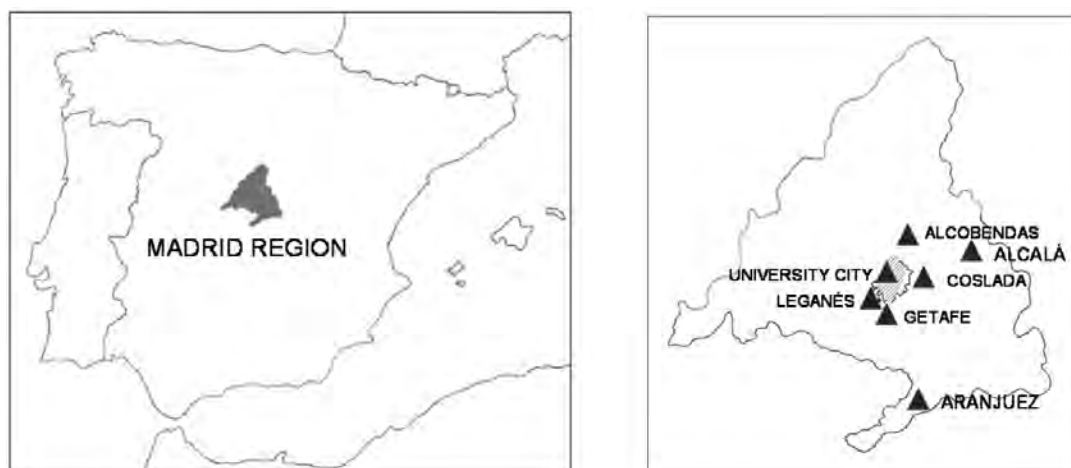


Figure 1— Sampling stations of the Aerobiological Network of Madrid (Palinocam Network).

Table 1
Aerobiological sampling stations and their main geographical and climatic characteristics.

Stations	Geographical characteristics				Climatic characteristics		
	Altitude	Geographical coordinates	Population	Distance to Madrid (Km)	Mean annual temperature (°C)	Annual rainfall (mm)	Bioclimate
Alcalá de Henares	588	40° 28'N, 03° 22'O	200000	30 E	13,8	418	Meso-mediterranean
Alcobendas	637	40° 32'N, 03° 38'O	92000	18 N	15,6	462	Meso-mediterranean
Aranjuez	503	40° 02'N, 03° 45'O	47000	47 S	14,7	349	Meso-mediterranean
Coslada	615	40° 25'N, 03° 33'O	80000	12 E	17,5	399	Meso-mediterranean
Getafe	531	40° 18'N, 03° 44'O	150000	14 S	16,7	378	Meso-mediterranean
Leganés	668	40° 19'N, 03° 46'O	175000	12 S	16,7	378	Meso-mediterranean
Madrid (University city)	637	40° 05'N, 03° 07'O	3500000		15,6	462	Meso-mediterranean

this pollen type being the most abundant in the annual pollen spectrum. In Leganés (Fig. 2), it represents 13,5% of the total annual pollen concentration, with similar values to *Quercus* pollen (Gutiérrez *et al.* 2001). In Alcobendas and Coslada, its relative importance is much lower (3,4% and 3,8% respectively), well below Cupressaceae and *Quercus* pollen types, which are the most abundant (Gutiérrez *et al.* 2001).

Platanus pollen is present in the atmosphere for a short period in spring, and its maximum concentrations are detected in the last two weeks of March and the first week of April (Fig. 3). The main pollen season (MPS) of *Platanus* is very short and usually occurs during March and April (Fig. 4). Although it is normal for the MPS to extend some days into May, in stations such as Alcobendas the MPS lasts until the beginning of July,

or in the case of Getafe, Leganés and Madrid until end-May. The duration of the MPS is generally of only a few days, due to the short flowering period of *Platanus*. In our study it varies between 111 days in Alcobendas (1995) and 16 days in Alcalá de Henares (1999), lasting an average of 35 days.

The evolution of the total annual *Platanus* pollen (Fig. 4) shows important quantitative variations, not only between the different sites but also between the years analysed. The main inter-annual variations correspond to the sampler located in Alcalá de Henares, with very high annual values between 1999-2002 and 2005 (above 33000 grains) and below 13000 grains the rest of the years; Madrid with 910 grains (2005) and 27777 grains (1998), and Aranjuez with 1363 grains in 2003 and 21763 grains in 1997. However, more moderate inter-annual variations

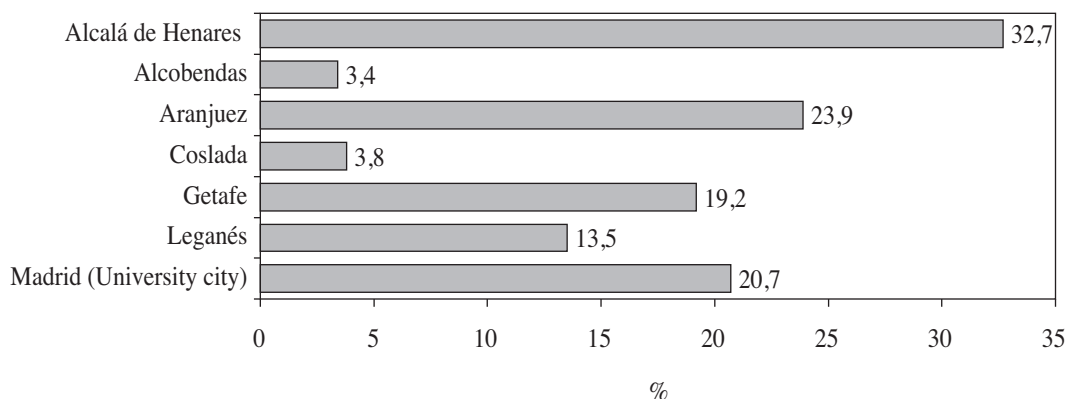


Figure 2— Percentage of *Platanus* pollen, as average, over the total annual pollen spectrum.

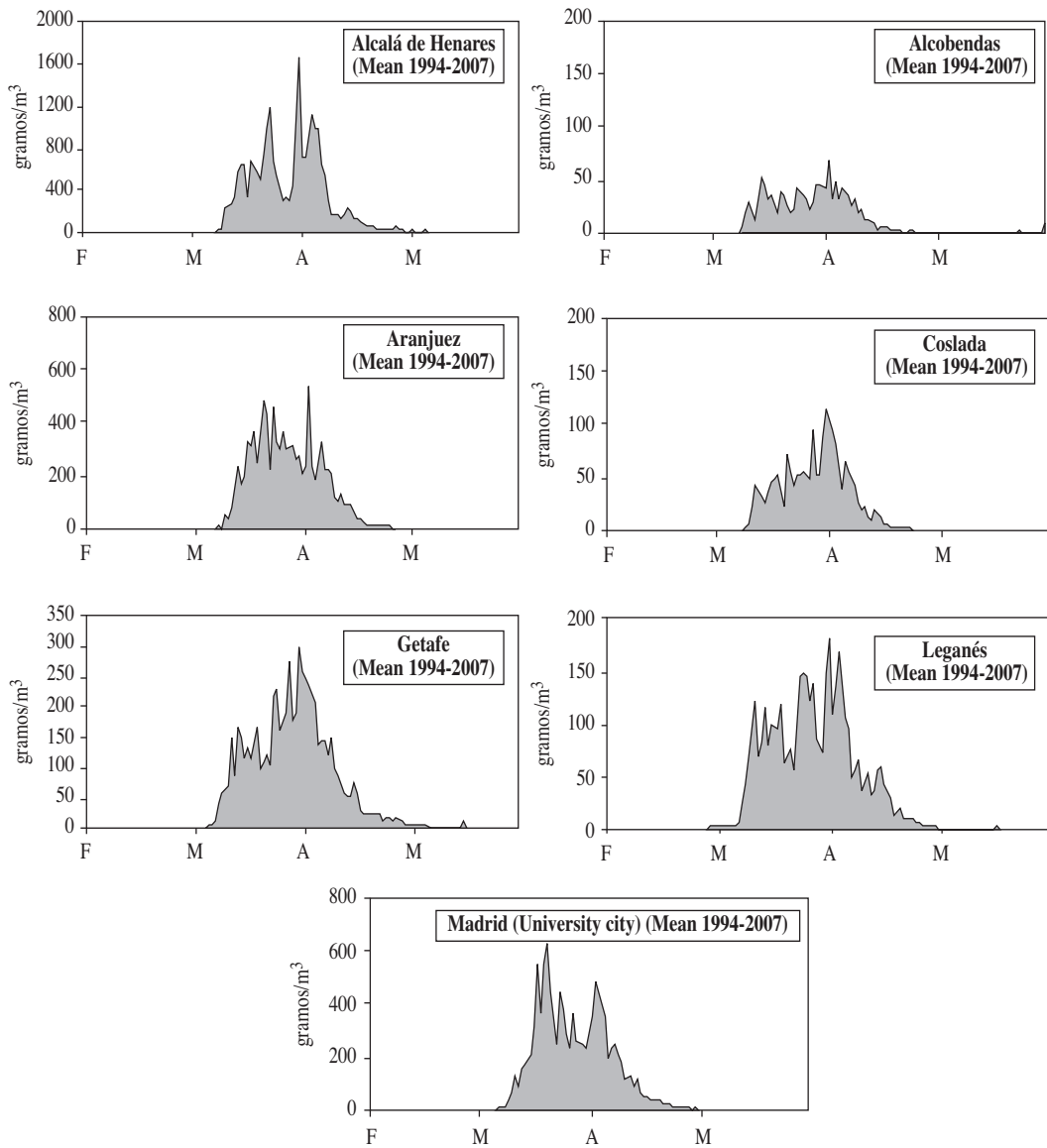


Figure 3— Mean daily concentrations of *Platanus* pollen during period 1994-2007 in the different localities. In the graphic different types of scales appear for a better visualization of the results.

were registered in Alcobendas and Coslada, where the difference between the year of highest concentration of pollen and the lowest does not exceed 3600 grains. In Fig. 4 can be observed the pollen levels reached in the different years and the different sampling stations, thus in Alcalá de Henares they emphasize the registered annual totals in 1999 (45995 grains) and 2000 (52559), in Alcobendas the years 1998 (2354 grains) and 2000 (2175 grains), in Aranjuez 1994 (19450 grains) and 1997 (21753

grains), in Coslada 1996 (2875 grains) y 1998 (3832 grains), in Getafe 2002 (10026 grains) and 2007 (12135 grains), in Leganés 2000 (8037 grains) and 2002 (7292 grains) and in Madrid 1997 (21254 grains) and 1998 (27777 grains). The evolution relative to the total annual counts for this pollen type seems to show an upward trend in Alcalá de Henares, Getafe and Leganés and a downward trend in Alcobendas, Aranjuez, Coslada and Madrid (University city) (Fig. 4).

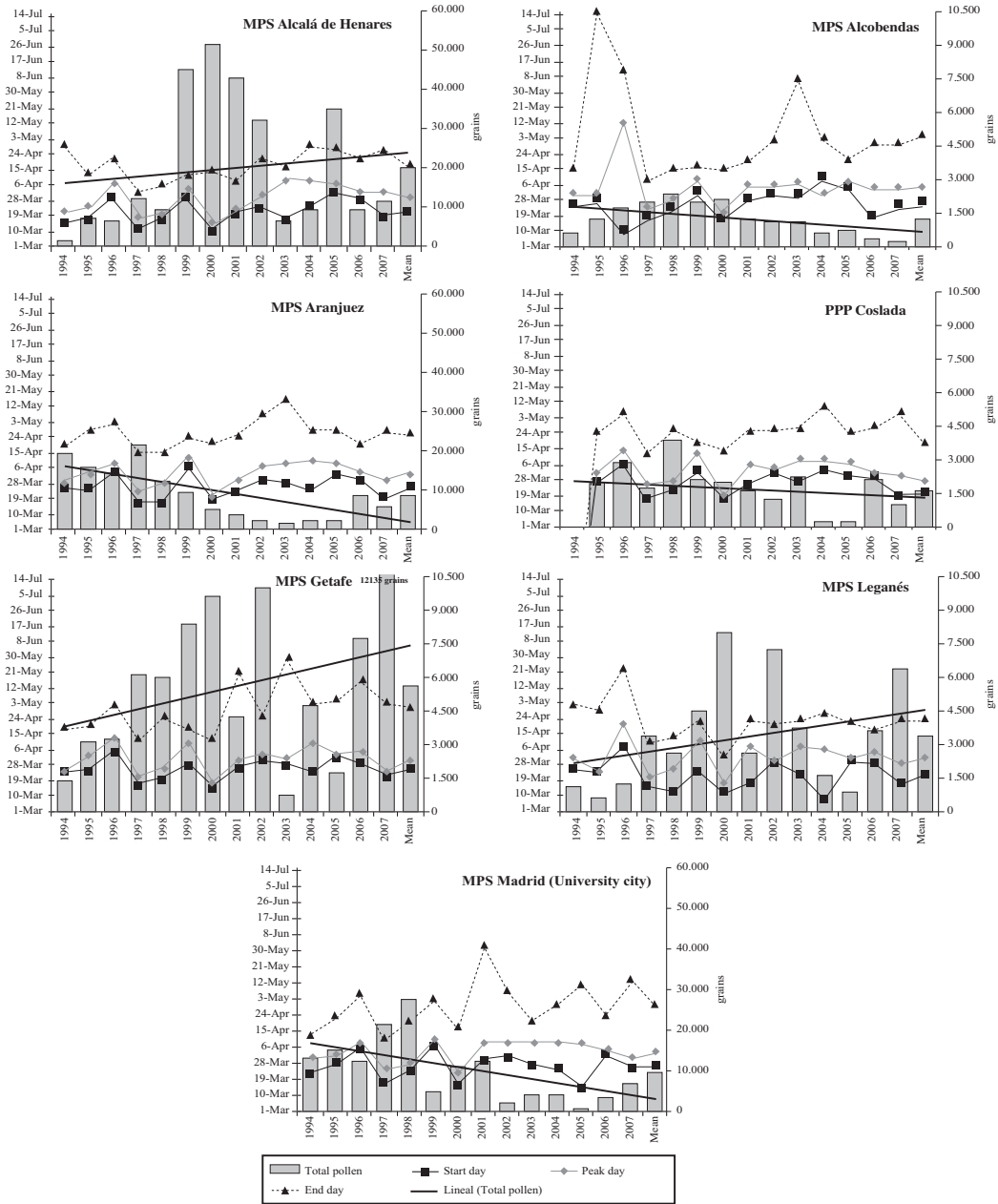


Figure 4— Main pollen season data (start, end and peak day), annual variation of total pollen concentrations and logarithmic line trend in the seven stations analysed between 1994 and 2007. In the graphic two types of scales appear for a better visualization of the results.

DISCUSSION

The total annual concentrations of *Platanus* pollen recorded in the different stations of the local Aerobiological Network of Madrid were higher than those

obtained in other cities of the Iberian Peninsula such as Ourense, Tarragona, Málaga or León among others, but similar to those obtained in Barcelona (Díaz de la Guardia *et al.* 2000, Gabarra *et al.* 2002).

We found important quantitative variations in

Platanus pollen in the different localities analysed (all of which are within a relatively small area and close one to another), with no phytoclimatic differences that could justify them. Pollen counts detected in each sampler site clearly show that there is a relationship with the presence of *Platanus* trees in the surrounding, within a 3 or 4 kilometre radius. Thus in the Madrid region, samplers in Alcalá de Henares, Aranjuez and Madrid (University city), located in metropolitan areas, with parks and gardens with an abundance of large plane tree specimens dating from the 17th century, recorded the highest pollen counts. Conversely, in Alcobendas and Coslada, recently developed localities inside the metropolitan area with a high population density and few parks, the pollen counts registered were low and similar to those observed in most Spanish cities (Díaz de la Guardia *et al.* 2000, Gabarra *et al.* 2002).

The starting dates of the MPS and the peak day in the Madrid zone, coincide with those published for other Spanish cities (Díaz de la Guardia *et al.* 2000, Jato *et al.* 2001, Gabarra *et al.* 2002, Alcázar *et al.* 2004). In this study we observed that the peak day take place very closely after the date of the start of the MPS, and therefore very few days elapsing between the appearance of *Platanus* pollen in the atmosphere and the sharp rise in

daily concentrations. The end of the MPS occurs farther from the peak day, this means, the post-peak period is much longer than the pre-peak period.

Regarding the inter-annual variations observed in each station, these may be due on one hand to meteorological parameters which determine the flowering intensity, and on the other hand to drastic prunings, frequent with these trees, which reduces flower production and consequently pollen emission (Belmonte *et al.* 1990, González Minero & Candau 1997, Díaz de la Guardia *et al.* 2000, Alcázar *et al.* 2004). Thus the drop in *Platanus* pollen concentrations in the stations of Aranjuez and Madrid (University city) in the last years can be due to the pruning made during these years and not to the reduction in the number of trees. However, the upward trend of total annual *Platanus* pollen counts in the stations located in Alcalá de Henares, Getafe and Leganés must be related to the recent development of parks in the area, especially the vast "Nueva Polvoranca" park in Leganés.

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REFERENCES

- ALCÁZAR, P.; CARIÑANOS, P.; DE CASTRO, C.; GUERRA, F.; MORENO, C.; DOMÍNGUEZ-VILCHES, E. & GALÁN, C. 2004. Airborne plane-tree (*Platanus hispanica*) pollen distribution in the city of Córdoba, South-western Spain, and possible implications on pollen allergy. *J. Invest. Allergol. Clin. Immunol.* 14:3: 238-243.
- BELMONTE, J.; BOTÉY, J.; CADAHIA, A. & ROURE, J. M. 1990. *Estudio polínico de la atmósfera de Cataluña*. Laboratorios Leti, Barcelona.
- BOUSQUET, J.; COUR, P.; GUÉRIN, B. & MICHEL, F. B. 1984. Allergy in the Mediterranean area. I. Pollen counts and pollinosis of Montpellier. *Clin. Allergy* 14: 249-258.
- D'AMATO, G. & SPIEKSMAN, F. TH. M. 1991. Allergenic pollen in Europe. *Grana* 30: 67-70.
- DÍAZ DE LA GUARDIA, C.; SABARIEGO, S.; ALBA, F.; RUIZ, L.; GARCÍA MOZO, H.; TORO, F. J.; VALENCIA, R.; RODRÍGUEZ RAJO, F. J.; GUÀRDIA, A. & CERVIGÓN, P. 2000. Aeropaly-nological study of the genus *Platanus* L. in the Iberian Peninsula. *Polen* 10: 93-101.
- DOMÍNGUEZ, E.; GALÁN, C.; VILLAMANDOS, F. & INFANTE, F. 1991. Manejo y evaluación de los datos obtenidos en los muestreos aerobiológicos. *Monografías REA/EAN* 1: 1-18.
- GALÁN, C.; CARIÑANO, P.; ALCÁZAR, P. & DOMÍNGUEZ, E. 2007. *Manual de calidad y gestión de la Red Española de Aerobiología*. Universidad de Córdoba, Córdoba.
- GABARRA, E.; BELMONTE, J. & CANELA, M. 2002. Aerobiological behaviour of *Platanus* L. pollen in Catalonia (North-East Spain). *Aerobiologia* 18: 185-193.
- GONZÁLEZ MINERO, F. J. & CANDAU, P. 1997. Study on *Platanus hispanica* Miller pollen content in the air of Seville, southern Spain. *Aerobiologia* 13: 109-115.
- GUTIÉRREZ, M.; SÁENZ, C.; CERVIGÓN, P. & ARÁNGUEZ, E. 2001. *Polen atmosférico en la Comunidad de Madrid*. En M. Gutiérrez, C. Sáenz, E. Aránguez & J. M. Ordóñez (Eds.), *Atlas y Calendario polínico de la Comunidad de Madrid*, 57-203. Documentos Técnicos de Salud Pública, Madrid, Spain.
- HIRTS, J. M. 1952. An automatic volumetric spore-trap. *Ann. Appl. Biol.* 36: 257-265.
- JATO, M. V.; DOPAZO, A. & AIRA, M. J. 2001. Airborne pollen data of *Platanaceae* in Santiago de Compostela (Iberian Peninsula). *Aerobiologia* 17: 143-149.
- LÓPEZ LILLO, A. 2000. *Árboles de Madrid*. Ediciones Mundi-Prensa. Madrid, Spain.

- MORAL, A.; SENENT, C.; CABAÑES, N.; GARCÍA, Y. & GÓMEZ-SERRANILLOS, M. 1998. Pólenes alergénicos y polinosis en Toledo durante 1995-96. *Rev. Esp. Alergol. Inmunol. Clín.* 13:2: 126-134.
- NEGRINI, A.C. 1992. Pollens as allergens. *Aerobiologia* 8: 9-15.
- SUBIZA, J. 2001. *Polen atmosférico en la Comunidad de Madrid*. En M. Gutiérrez, C. Sáenz, E. Aránguez & J.M. Ordóñez (Eds.), *Polinosis de Madrid*, 27-35. Documentos Técnicos de Salud Pública, Madrid, Spain.
- TORMO, R.; MUÑOZ, A.; SILVA, I. & GALLARDO, F. 1996. Pollen production in anemophilous trees. *Grana* 35: 38-46.
- VALERO, A. L.; ROSELL, E.; AMAT, P.; SANCHO, J.; ROIG, J.; PIULATS, J. & MALET, A. 1999. Hipersensibilidad a polen de *Platanus acerifolia*: detección de las fracciones alergénicas. *Rev. Esp. Alergol. Inmunol. Clín.* 14: 220-226.