ENVIRONMENTAL VARIABLES VERSUS PLATANUS POLLEN AND ALLERGENS. PRINCIPAL COMPONENT ANALYSIS

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Introduction

Platanus acerifolia (Aiton) Willd (Fig. 1) is considered an important source of aeroallergens in urban areas worldwide. In the city of Valladolid (Spain), it is an abundant ornamental shade tree and the special methods of pruning affect their flowering and pollen release into the air. Nowadays *Platanus* allergy prevalence is moderate in the area, although the percentage of sensitized patients is low, and environmental factors play an important role in epidemiology.
The present study aims to investigate the relationship between Pla a 1 aeroallergen, airborne *Platanus* pollen (Fig. 2) and selected environmental variables.

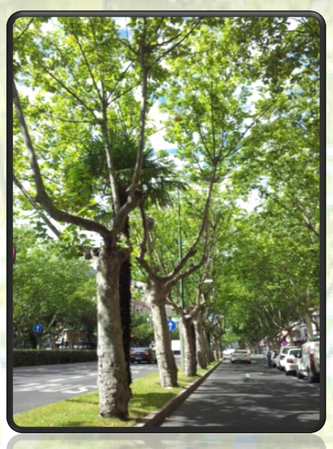

Fig. 1. Overview *Platanus acerifolia*.

Fig. 2. Pollen grains of *Platanus* (OM, x40).

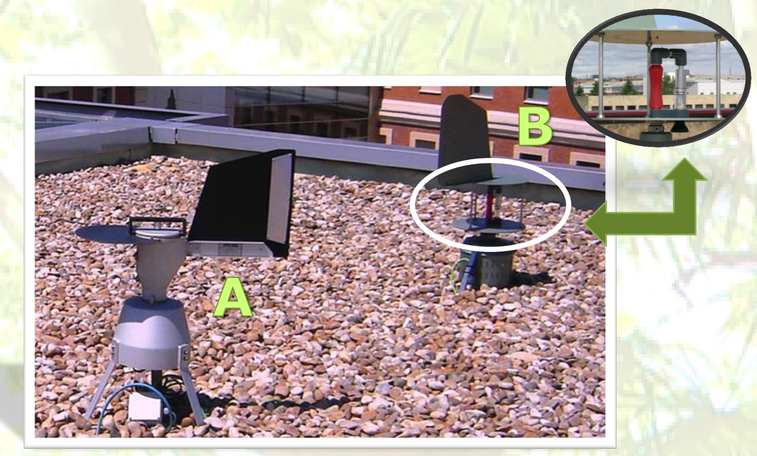

Fig. 3. A. Hirst-type volumetric trap
B. Burkard Cyclone sampler.

Fig. 4. ELISA plate reader.

Material and Methods

The pollen sampling was carried out using a Hirst-type volumetric trap (Lanzoni©) for pollen grains (Fig. 3A) and a Burkard Cyclone sampler (Burkard©) for Pla a 1 allergen (Fig. 3B) over a period of 3 years (2009–2011). Allergens were quantified by a modified ELISA (Fig. 4).
Meteorological data were supplied by an AEMET weather station in Valladolid. Data on air pollutants have been provided by the Valladolid Air Pollution Control Network.
Principal Component Analysis (PCA) has been applied to identify the environmental variables (meteorological variables as well as air pollutants) that affect *Platanus* pollen and Pla a 1 allergen.

Results and Discussion

The *Platanus* pollen represents the 39%, 29.3% and 30.2% of the total pollen in the airborne pollen spectra of years 2009, 2010 and 2011, respectively.
The dates of the peak concentration of aeroallergen and *Platanus* pollen are coincident (Table 1).
The statistical study shows six PCs that explain 72.6% of the total variance (Table 2). Only the 2nd PC presents significant and positive Pearson correlation coefficients with *Platanus* pollen and Pla a 1 concentrations (Table 3) and it is strongly positively correlated with particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen oxides (NO and NO_2) concentrations, and negatively correlated with wind speed and ozone concentration (Table 4).
The higher concentrations of Pla a 1 have been recorded with low ozone levels (Fig. 5) coinciding with what has been shown in in vitro studies.

Platanus	2009	2010	2011
Peak day of Pla a 1	March 27 and April 3	April 20	April 6
Pla a 1 concentration on the peak day	216.27 and 177.73	284.03	751.79
Peak day of pollen Platanus	March 28 and April 4	April 20	April 7
Pollen *Platanus* grains on the peak day	884 and 1276	605	2460

Table 1. Peak days of proteins Pla a 1 and *Platanus* pollen.

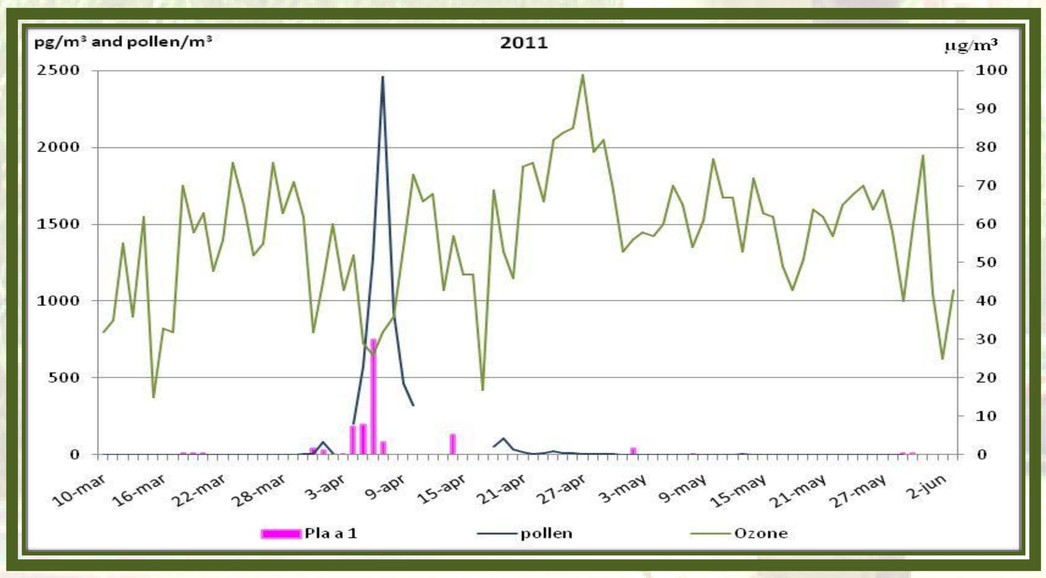

Fig. 5. Variations of daily concentrations Pla a 1 (pg/m³) and *Platanus* pollen (pollen/m³), ozone (ug/m³) in Valladolid in 2011.

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	5.016	20.900	20.900
2	4.149	17.286	38.185
3	3.145	13.106	51.291
4	2.207	9.196	60.487
5	1.487	6.195	66.682
6	1.411	5.880	72.562

Table 2. PCs study. Total variance explained.

2009-2011	Pla a 1	polen	CP1	CP2	CP3	CP4	CP5	CP6
Pla a 1	1	0.627(**)	-0.013	0.246(**)	0.048	-0.061	-0.017	-0.102
polen	0.627(**)	1	-0.001	0.288(**)	0.070	-0.112	-0.012	-0.105

Table 3. Spearman correlation indices among Pla a 1, *Platanus* pollen and Principal Components. (**) Significance level of 0.01.

ENVIRONMENTAL VARIABLES	Component					
	1	2	3	4	5	6
Maximum temperature	**0.840**	0.220	0.426	-0.104	-0.031	0.005
Minimum temperature	**0.937**	-0.132	-0.058	0.088	0.109	-0.050
Mean temperature	**0.955**	0.076	0.238	-0.024	0.031	-0.020
Wet-bulb temperature	**0.986**	-0,007	0.018	0.011	-0.004	-0.062
Dew point	**0.865**	-0.114	-0.356	0.075	-0.024	-0.135
Relative humidity	-0.153	-0.196	**-0.845**	0.137	-0.034	-0.148
Rain fall	0.098	-0.035	**-0.684**	0.078	0.204	0.068
Evaporation	**0.610**	-0.089	**0.522**	-0.165	-0.072	0.066
Insolation	0.007	0.085	**0.630**	0.022	-0,007	-0.023
Wind speed	-0.329	**-0.641**	0.123	0.281	0.130	0.138
Wind frequency 1st quadrant	-0.048	-0.019	0.156	**-0.938**	0.153	0.089
Wind frequency 2nd quadrant	0.159	0.170	-0.299	0.373	**0.567**	-0.258
Wind frequency 3rd quadrant	-0.078	-0.195	-0.105	**0.864**	0.124	0.071
Wind frequency 4th quadrant	0.046	0.130	0.123	0.115	**-0.864**	-0.017
Wind frequency calm	0.122	**0.434**	-0.073	**0.326**	-0.072	**-0.324**
Radiation	0.388	-0,025	**0.691**	-0.294	-0.279	0.186
PM_{10}	0.011	**0.804**	0.353	-0.073	0.126	-0.040
$PM_{2.5}$	0.009	**0.755**	0.232	-0.200	0.165	-0.075
NO	-0.054	**0.853**	0.049	0.042	-0.133	0.202
NO_2	0.036	**0.863**	0.092	-0.056	0.014	0.200
CO	-0.012	0.127	-0.060	-0.069	0.096	**0.721**
SO_2	0.120	0.003	-0.145	-0.071	0.327	**-0.645**
O_3	0.119	**-0.618**	0.269	-0.043	0.199	0.252
C_6H_6	-0.227	**0.490**	0.058	0.134	0.001	0.167

Table 4. Principal Component Analysis. Standardized variables. Rotated Component Matrix.

Conclusions

Further studies on the air pollutants related to Pla a 1 and *Platanus* pollen are important to implement models also useful with other aeroallergens.
The idea of an interaction between pollen and air pollutants outside the organism, which in turn can promote pollinosis-related symptoms, would open an interesting research field for future studies and the improvement of clinical knowledge.

Acknowledgements

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