URBAN ATMOSPHERIC LEVELS OF ALLERGENIC POLLEN: COMPARISON OF TWO SAMPLERS LOCATED IN SALAMANCA (MIDDLE WEST SPAIN)

Sergio Fuentes Antón[1], David Rodríguez de la Cruz[2], Asunción García Sánchez[3], Ignacio Dávila[3], José Sánchez Sánchez[1, 2] & Estefanía Sánchez Reyes[1]

[1] Hispano-Luso Agrarian Research Institute (CIALE), University of Salamanca, Villamayor Campus, Río Duero Street N°12, 37185 Villamayor, Salamanca, Spain.
[2] Department of Botany and Plant Physiology, Faculty of Pharmacy, University of Salamanca, Licenciado Mendez Nieto s/n, 37007, Salamanca, Spain.
[3] Department of Biomedical and Diagnostic Sciences, Faculty of Medicine, University of Salamanca, Alfonso X, El Sabio s/n, 37007, Salamanca, Spain.

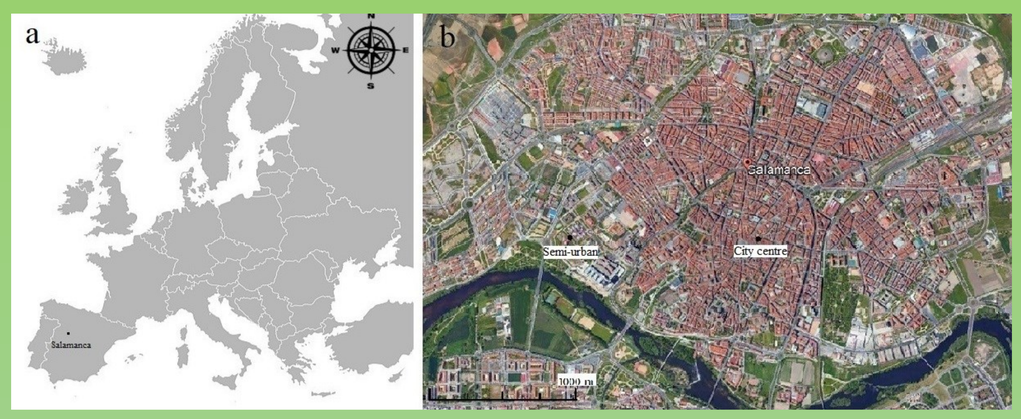

Figure 1. Location of the city under study in Europe (a) and location of pollen traps (b)

Material and methods

The distance between the two collectors was 1.4 km (fig. 1b) and the two samplers operated continuously from 17 February 2014 to 16 February 2016. Both samplers were Hirst volumetric traps placed at a height of 14m (City centre) and 25m (Semi-urban). Pollen collection and sample processing were carried out according to the methodology established by the Spanish Aerobiology Network (Galán et al., 2007), along with the threshold levels established by the same authors. Only pollen types known to be allergenic were considered for further analysis. Along with the seasonal patterns, we calculated the peak day, peak value and days which surpassed the threshold levels. The effect of the main meteorological factors on pollen levels was also evaluated taking into consideration the Atmospheric Pollen Season (APS), calculated at 90%, except for Cupressaceae and *Fraxinus* where, in both cases, were considered the whole study period due to the seasonal distribution of these pollen types. Correlations between meteorological parameters and pollen levels were performed using the Spearman's non-parametric correlation test (in the SPSS software v.23).

Results

The main pollen types identified in both samplers were Cupressaceae, *Fraxinus, Olea*, *Platanus,* and Poaceae, with *Olea* and *Fraxinus* being more abundant in the city centre (fig. 2) and herbaceous types as Amaranthaceae, *Rumex* and Urticaceae, in the semi-urban. The days with threshold levels over risky concentrations (table 1) were higher for Poaceae and Cupressaceae, nearly follow by *Fraxinus*. During 2015, the days were also high for *Olea, Plantago* and *Platanus* in both areas. Meteorological parameters and pollen levels (table 2) showed significant positive coefficients for temperature and hours of sunshine, except *Betula*, Cupressaceae, *Fraxinus*, *Platanus* and *Rumex*, which had negative significant or not significant coefficients. Rain and relative humidity were negatively correlated with all pollen types, except *Fraxinus*.

Pollen type	Trap	T_{max}	T_{min}	T_{mean}	R	RH	WS	Wind NE	Wind SE	Wind SW	Wind NW	CF	Sunshine
Amaranthaceae	City centre							0.243**	0.172*		-0.265**		
	Semi-urban	0.569**	0.425**	0.550**	-0.206**	-0.434**		0.109*		-0.125*	0.222**		0.374**
Betula	City centre	0.275**				-0.263*	-0.225*					0.253*	
	Semi-urban						-0.252**		0.285**			0.222**	
Cupressaceae[a]	City centre	-0.181**	-0.266**	-0.230**			0.085*						
	Semi-urban	-0.413**	-0.464**	-0.456**		0.265**		0.090*	0.075*	-0.116**	-0.192**		-0.273**
Fraxinus[a]	City centre	-0.236**	-0.315**	-0.285**			0.107**						
	Semi-urban	-0.589**	-0.547**	-0.605**	0.140**	0.429**		-0.111**		0.081*	-0.092*		-0.404**
Olea	City centre	0.264*		0.244*			-0.308**	-0.486**		0.427**	0.474**	0.481**	
	Semi-urban	0.319**	0.224**	0.297**		-0.426**	0.216**					-0.179**	0.375**
Plantago	City centre					-0.151*			0.223**			0.190**	
	Semi-urban	0.402**	0.273**	0.382**	-0.285**	-0.487**	0.149**				0.201**	-0.203**	0.516**
Platanus	City centre		-0.300*			-0.357*		0.500**	0.388**	-0.388**			0.413**
	Semi-urban	-0.329**	-0.269**	-0.357**		0.324**			0.282**				-0.312**
Poaceae	City centre	0.364**	0.268**	0.340**	-0.188**	-0.537**	0.183**		-0.100*		0.149**	-0.162**	0.511**
	Semi-urban	0.530**	0.455**	0.531**	-0.187**	-0.517**	0.137**		-0.182**	0.091*	0.292**	-0.126**	0.538**
Rumex	City centre	-0.225**	-0.312**	-0.269**				-0.175**	-0.130*	0.126*	0.134*		
	Semi-urban	-0.342**	-0.377**	-0.387**			0.209**					-0.166**	
Urticaceae	City centre						-0.104*					0.109*	
	Semi-urban	0.289**	0.240**	0.288**	-0.145**	-0.341**	0.162**		-0.136**		0.225**	-0.187**	0.390**
Total	City centre	0.333**	0.246**	0.315**	-0.113**	-0.482**	0.246**		-0.166**		0.162**	-0.242**	0.445**
	Semi-urban	0.264**	0.169**	0.240**	-0.082*	-0.374**	0.194**		-0.110**		0.132**	-0.167**	0.370**

T_{mean} Mean daily average temperature (°C), T_{max} maximum daily average temperature (°C), T_{min} minimum daily average temperature (°C), *R* total daily rainfall (mm), *RH* daily average relative humidity (%), *WS* daily average wind speed (km/h), *Wind NE* daily average frequency of north-easterly winds (%), *Wind SE* daily average frequency of south-easterly winds (%), *Wind SW* daily average frequency of south-westerly winds (%), *Wind NW* daily average frequency of north-westerly winds (%), *CF* daily average frequency of calms (%), *Sunshine* daily average sunshine (hours)

Significance levels: *95%; **99%

[a] Correlation with meteorological parameters using the whole sampling year instead of the APS period

Table 2. Spearman correlation coeficientes between APS and meteorological factors

Introduction

This study was aimed to quantify and compare the atmospheric pollen content of Salamanca (fig. 1a) using two samplers at different locations.
We decided to analyse a two years period as a continuation of a previous study performed in the same locations (Rodríguez de la Cruz et al., 2016). The present research also takes into consideration the threshold levels established for pollen types, dangerous for the allergic population, analysing the days in which those levels were surpassed and compares the results obtained between the two areas with different urbanization levels.

Table 1 Aerobiological data from two pollen traps separated by years

	City centre				Semi-urban			
	Total Pollen	Peak Value[a]	Peak Day	Days with moderate/high levels	Total Pollen	Peak value	Peak Day	Days with moderate/high levels
2014								
Amaranthaceae	145	20	Aug 18	0	400	29	May 28	1
Betula	80	15	Apr 11	0	152	25	Apr 10	0
Cupressaceae	1900	150	Mar 17	12	2577	196	Mar 5	13
Fraxinus	805	105	Mar 20	8	609	51	Feb 20	4
Olea	700	65	May 18	2	584	96	May 28	3
Plantago	395	25	May 11	0	431	22	May 18	0
Platanus	830	225	Apr 10	4	1246	245	Apr 12	7
Poaceae	3495	180	May 18	42	3659	113	May 18	37
Rumex	460	40	May 1	4	845	74	May 6	7
Urticaceae	315	15	Aug 19	0	407	18	Mar 18	1
Total	26370	2810	May 8	61	32264	1086	May 8	61
2015								
Amaranthaceae	245	30	Aug 21	1	623	27	Aug 20	1
Betula	50	10	Apr 4	0	121	17	Mar 21	0
Cupressaceae	2396	350	Mar 31	12	2325	132	Mar 28	10
Fraxinus	1100	100	Mar 17	10	2156	149	Mar 1	14
Olea	1945	545	May 12	9	1557	135	May 11	11
Plantago	1110	150	May 12	11	1426	69	May 9	13
Platanus	2360	555	Apr 8	9	2084	465	Apr 6	11
Poaceae	3755	700	May 12	32	5279	208	May 11	54
Rumex	610	55	May 12	4	1049	72	May 9	14
Urticaceae	230	15	Apr 1	0	512	12	May 31	0
Total	22373	2470	May 12	60	34035	1067	May 13	93

[a] Pollen grains/m³

Table 1. Aerobiological data from two pollen traps separated by years

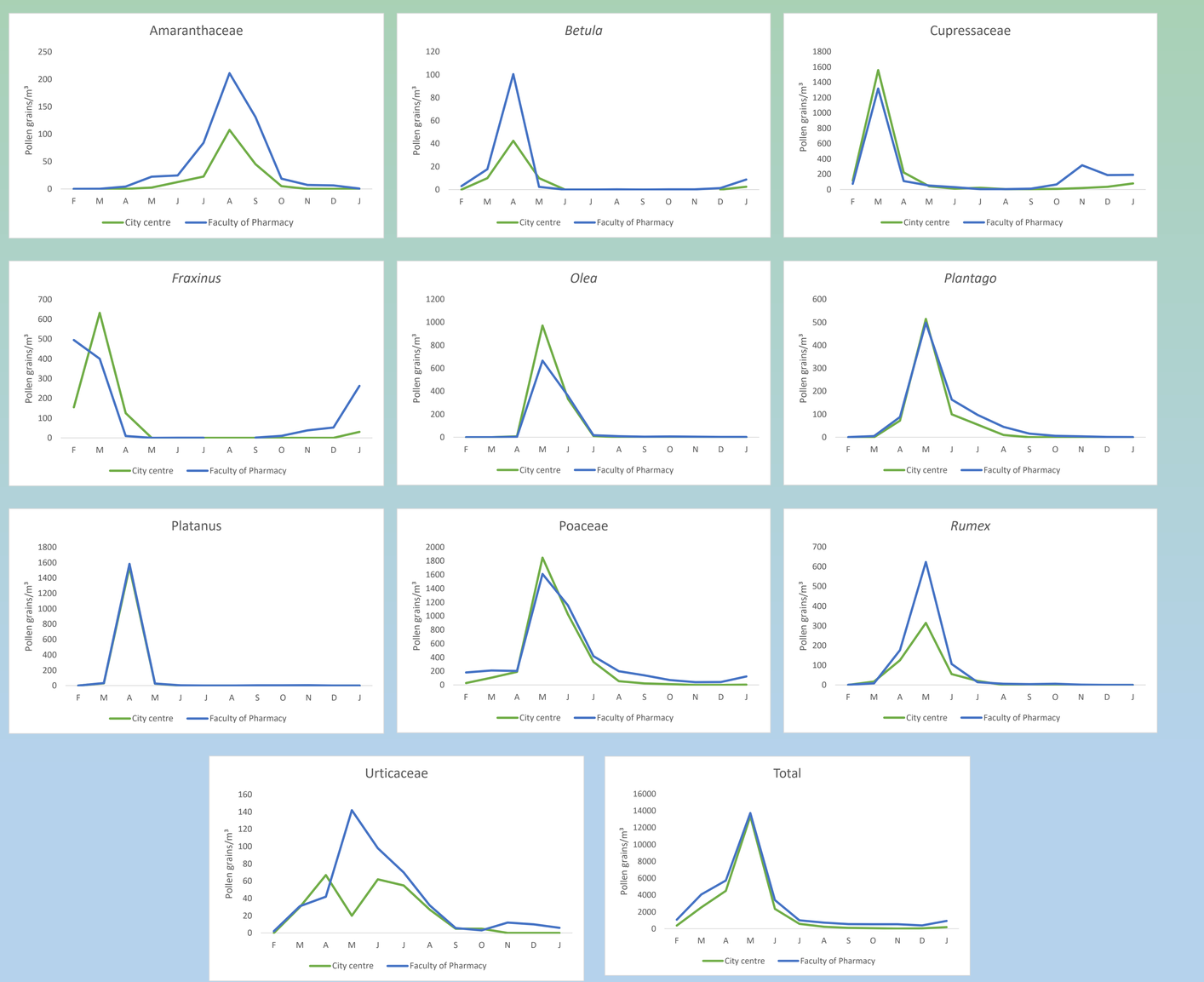

Figure 2. Seasonal patterns from the analysed pollen types during the period 2014-2016

Conclusions

We found positive significant correlations between both samplers, although slight differences were detected between them. The city centre could lead to further problems for people allergic to *Olea* with *Platanus* depending on the year and the pollen emission. On the outskirts of the city, Amaranthaceae, *Rumex* and Urticaceae might cause the main allergic problems for people sensitized to these pollen. Poaceae obtained similar results between both zones and the total pollen concentration had few differences except during February, March, April and June, with higher values in the semi-urban zone.

Bibliography

Galán, C., Cariñanos, P., Alcázar, P., & Domínguez, E. (2007). *Spanish aerobiology network (REA: Management and quality manual*. Servicio de Publicaciones de la Universidad de Córdoba.

Rodríguez de la Cruz, D., Dávila, I., Sánchez, E., Lorente, F. & Sánchez, J. (2016). Comparison of pollen levels between 2 pollen traps in Salamanca, Spain. *Journal of Investigational Allergology and Clinical Immunology*, 26, 111-143.