

AIRBORNE *PINUS* POLLEN DIVERSITY AND ANNUAL POLLINATION PATTERN IN SPAIN

Diversidad de polen de Pinus aerovagante y patrón anual de su polinización en España

DE LINARES, C.^{1,2}; BELMONTE, J.^{1,2}; DÍAZ DE LA GUARDIA, C.³; CARIÑANOS, P.³;
ALONSO-PÉREZ, S.⁴ & CUEVAS, E.⁴

¹ Institut de Ciència i Tecnologia Ambientals, ICTA. Universitat Autònoma de Barcelona. Bellaterra (Cerdanyola del Vallès). Spain

² Departament de Biologia Animal, Biologia Vegetal i Ecologia. Universitat Autònoma de Barcelona. Bellaterra (Cerdanyola del Vallès). Spain. jordina.belmonte@uab.cat

³ Departamento de Botánica. Universidad de Granada. Granada. Spain

⁴ Centro de Investigación Atmosférica de Izaña. Agencia Estatal de Meteorología. Santa Cruz de Tenerife. Spain

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PALABRAS CLAVE: aerobiología, Índice Anual (AI), biogeografía, *Pinus*, polen.

INTRODUCTION

Pinus is one of the plant genera dominating the Spanish forested landscape. There are eight pine species that occur naturally or under cultivation in Spain: *P. canariensis* (an endemic species of western Canary Islands),

P. halepensis, *P. nigra*, *P. pinaster*, *P. pinea*, *P. radiata* (introduced species), and the species from mountain areas *P. sylvestris* and *P. uncinata*. These pine species show different geographical distribution, and consequently different phenology. Their flowering follows an altitudinal gradient, beginning at the

littoral and low land areas and ending in the mountain and subalpine regions. The aim of this study is to analyze the *Pinus* pollination registered in Eastern Spain and Canary Islands and to characterize it in order to establish if the variables related to pollination are good indicators of the Spanish pine species distribution in the territory.

METHODS

For the airborne analysis, *Pinus* pollen data from 12 Spanish aerobiological sampling sites were considered (Figure 1, Tab. 1): 8 in Catalonia (Barcelona, Bellaterra, Girona, Lleida, Manresa, Roquetes-Tortosa, Tarragona and Vielha), 2 in Andalusia (Almería and Granada) and 2 in The Canary Islands (Izaña and Santa Cruz de Tenerife).

In most cases, a 15 years period (1996-2010) was taken into consideration; in others (Almería, Izaña, Roquetes-Tortosa, Santa Cruz de Tenerife and Vielha) the period comprised 6 years (2005-2010).

Pollen sampling and analysis has been done following the methodology proposed by the Spanish Aerobiology Network (REA) (GALÁN *et al.*, *Manual de Calidad y Gestión de la REA*. 2007).

RESULTS AND CONCLUSIONS

Figure 1 shows that *Pinus* pollen represent between 2% of the atmospheric pollen spectra in Santa Cruz de Tenerife (corresponding to an Annual

Index [AI] of 121 pollens) and Granada (AI 1036 pollens) and 20% in Bellaterra (AI 8094 pollens). The mean highest AI and the absolute highest [AI] correspond to Roquetes-Tortosa (8428 and 14468 pollens); the lowest values correspond to Santa Cruz de Tenerife (121 and 243) and Izaña (134 and 309), in the Canary Islands. The peak dates occur later in mountain areas (Vielha, Izaña) and inland (Lleida, Manresa) than in lowland and littoral areas (Tab. 2). There is a clear decrease of airborne *Pinus* pollen with the number of *Pinus* species in the area, the latitude, in cities versus open areas, and inland versus littoral.

Littoral (Barcelona, Tarragona, Roquetes-Tortosa and Almería) and low land (Girona, Bellaterra, Manresa, Lleida and Granada) stations register pollination since early spring and they show a second pollination body from May on (Figure 2).

The species from lower territories (*P. halepensis*, *P. pinea*, *P. pinaster*, and *P. radiata*) pollinate mostly during the first part of the year, while mountain species (*P. nigra* and *P. sylvestris* and *P. canariensis* in Tenerife) and subalpine species (*P. uncinata*) pollinate from May on. Mountain stations (Vielha and Izaña) have a single pollination period. Tropical stations (Tenerife) pollen dispersion occurs mostly in spring.

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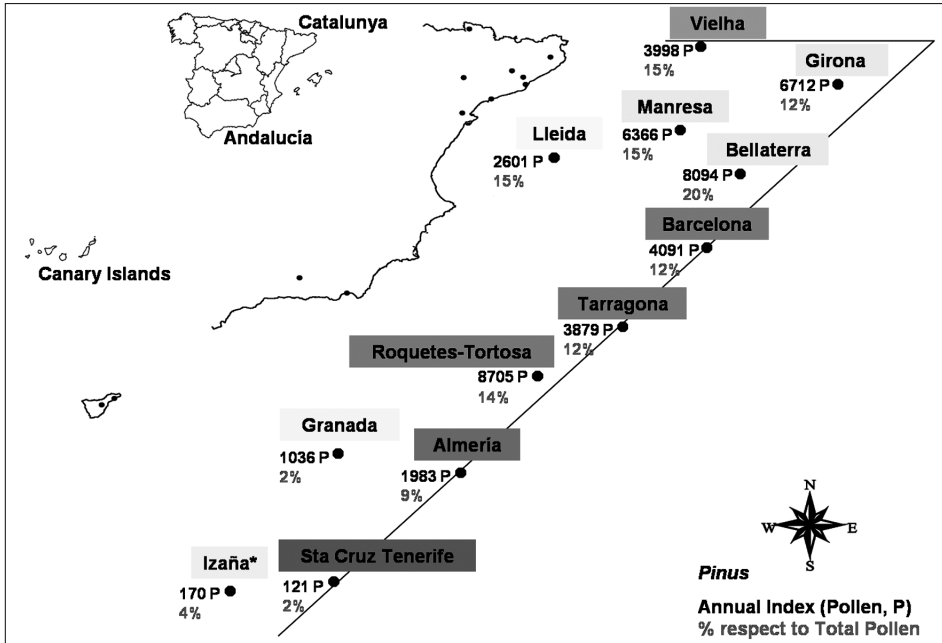


FIGURE 1. Geographical situation of the aerobiological stations within the study territory and schematic representation of the mean Annual Index and the corresponding percentage with respect to the Total Pollen count during the study period along the territory. * The study period is from April 15 to October 31.

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Geographical characteristics			Climatic characteristics		
Sampling stations	Altitude (m.a.s.l)	Geographical Coordinates	Mean annual temperature (°C)	Precipitation (mm)	Phytoclimates (Allue Andrade 1990)
Vielha	974	42°42' N, 00°47' E	9.9	899	Fresh-Continental Oriental- humid
Girona	98	41°59' N, 02°50' E	15.0	740	Fresh-Continental Oriental-semihumid
Manresa	291	41°44' N, 01°30' E	13.6	619	Fresh-Continental Oriental-semihumid
Lleida	202	41°37' N, 00°35' E	15.1	385	Fresh-Transitional-semiarid
Bellaterra	245	41°34' N, 02°08' E	15.2	594	Fresh-Continental Oriental-semihumid
Barcelona	93	41°24' N, 02°09' E	16.4	593	Fresh-Tethyc-semiarid
Tarragona	44	41°07' N, 01°15' E	15.8	478	Fresh-Tethyc-semiarid
Roquetes-Tortosa	14	40°29' N, 00°58' E	16.8	576	Fresh-Tethyc-semiarid
Granada	685	37°11' N, 03°35' W	15.6	448	Fresh-Continental Occidental-semiarid
Almería	23	36°50' N, 02°27' W	17.9	231	Subtropical-Continental Oriental-semiarid
Sta Cruz Tenerife	37	28°28' N, 16°15' W	20.8	251	Subtropical-Atlantic-semiarid
Izaña	2367	28°18' N, 16°30' W	9.4	464	Fresh-Atlantic-semiarid

TABLE 1. Geographical characteristics of the aerobiological stations and corresponding climatic characteristics (mean annual temperature, annual precipitation and phytoclimate). Different colors are used for different phytoclimates.

	<i>Pinus</i> pollen					
	Annual Index (AI)	Percentages Annual Index	Mean daily maximum concentration		Absolute maximum day concentration period	
	Pollen	(%)	Pollen/m ³	Data	Pollen/m ³	Data
Vielha (2005-2010)	3998	15.0	61	11-Apr	620	8-Jun-10
Girona (1996-2010)	6712	12.3	138	18-May	697	23-Mar-02
Manresa (1996-2010)	6366	15.3	146	11-Apr	662	10-Apr-10
Lleida (1996-2010)	2601	8.5	61	11-Apr	445	10-Apr-09
Bellaterra (1996-2010)	8094	20.4	200	20-Mar	1084	18-Mar-07
Barcelona (1996-2010)	4911	11.6	72	27-Mar	798	11-Apr-97
Tarragona (1996-2010)	3874	12.1	112	24-Apr	736	24-Mar-09
Roquetes-Tortosa (2005-2010)	8705	14.3	400	16-Mar	2230	11-Mar-09
Granada (1996-2010)	1036	2.0	27	28-Mar	213	28-Mar-02
Almería (2005-2010)	1983	8.7	123	25-Mar	659	25-Mar-05
Sta Cruz Tenerife (2005-2010)	121	2.0	5	17-Mar	25	18-Mar-10
Izaña (2005-2010)	361	4.3	20	23-Apr	39	3-May-07

TABLE 2. Summary of the aerobiological *Pinus* data during the study period: Mean Annual Index [AI] and the corresponding percentage with respect to the Total Pollen count, maximum mean daily concentration and corresponding date (dd-mmm) and absolute maximum daily concentration and date (dd-mmm-yy).

* The study period is from April 15 to October 31.

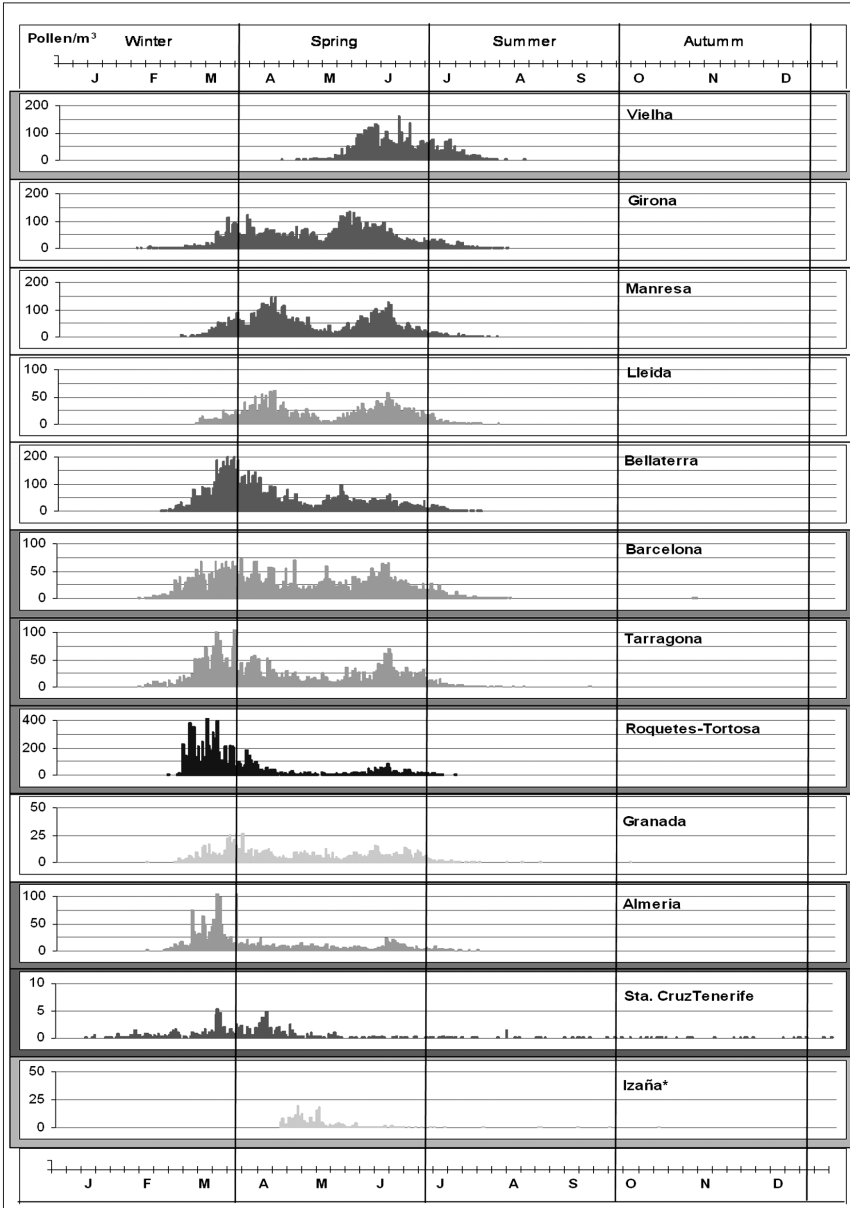


FIGURE 2. Yearly dynamics of the mean daily *Pinus* pollen concentrations in the sampling stations during the study period. Different color codes are used to better show the change of scale in the graphs. * The study period is from April 15 to October 31.