

## ANNUAL VARIATIONS OF AIRBORNE CASUARINA POLLEN IN THE IBERIAN PENÍNSULA

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**SUMMARY:** This paper examines the incidence of *Casuarina* pollen at nine sampling stations widely distributed throughout Spain. The years to which the counts refer differ between stations, although all fall within the period 1991-1998. The main pollen season was mainly detected during late summer and autumn, higher peaks being recorded in October or late September. In the years studied, the highest concentrations were recorded in Málaga, Antequera and Granada, all located in eastern Andalucía. In general, peaks normally occurred on sunny days after the first autumn rains.

**KEY WORD:** Aeropalynology, environmental influence, rainfall, atmosphere, *Casuarina*.

**RESUMEN:** En el presente trabajo, se realiza un estudio de la incidencia del polen de *Casuarina* en 9 estaciones de muestreo ampliamente distribuidas por toda la geografía española. Los años a los que se refiere dicho estudio varían de unas localidades a otras, quedando en cualquier caso comprendidos en el periodo 1991-1998. El periodo de polinación principal tiene lugar, en la atmósfera de las diferentes localidades, a finales de verano y durante el otoño, detectándose los picos de máxima concentración durante el mes de Octubre o a finales de Septiembre. Durante los años estudiados, las mayores concentraciones se registraron en Málaga, seguidas de las de Antequera y Granada, localidades todas ellas situadas al sudeste de Andalucía. En general, se ha observado que los picos máximos se producen durante los días soleados que suceden a las primeras lluvias otoñales.

**PALABRAS CLAVE:** Aeropalynología, influencia medicambiental, lluvia, atmósfera, *Casuarina*.

### INTRODUCTION

The genus *Casuarina* comprises about 60 species that are mainly native to Australia and southern Asia. Some of these

species have been introduced into the Iberian Peninsula, where they are grown as ornamental plants and are commonly known as «Australian pine» due to their resemblance to the genus *Pinus*. The most frequently

found species of Australian pine grown and occasionally naturalized in Spain is *C. cunninghamiana* Miq. and, to a lesser degree, *C. stricta* Aiton and *C. equisetifolia* Forster & Forster, among others (ROCHA ALFONSO, 1990). *C. cunninghamiana* and *C. stricta* flower between September and November, whereas the other species flower at the end of spring or in the summer.

These are wind-pollinated trees that produce a very large number of pollen grains, whose allergenic properties have been reported by ZIVIT (1942), BUCHOLTZ *et al.* (1987) and, more recently, by GARCÍA *et al.* (1997). Their pollen grains are trizonoporate, isopolar, and radiosymmetric, triangular in polar view, with convex sides and pores located at the angles.

#### MATERIAL AND METHODS

This study includes results obtained for *Casuarina* pollen at nine sampling stations widely distributed throughout Spain: in alphabetic order, Antequera, Barcelona, Córdoba, Estepona, Granada, Jaén, Málaga, Tarragona and Vigo. The years to which the counts refer differ from station to station, although all fall within the period 1991-1998 (Tab. 1). In addition to these nine stations, those of Madrid, León, Ponte-ferrada, Orense, Santiago, Girona and Lleida were also considered. However, these have not been included in this study because no *Casuarina* pollen were detected at any of them, since the species do not grow in these areas. All these stations form part of the Spanish Acrobiology Network (R.E.A.).

Samples were taken using volumetric pollen traps (HIRSH, 1952) in accordance with the method proposed by the Spanish Acrobiology Network for pollen counts

(DOMÍNGUEZ *et al.*, 1991; GALÁN, 1998). This consists of reading four horizontal sweeps per preparation with a magnification of x400. Data were expressed as mean daily concentrations. The main pollen season (MPS) was taken as being the period during which 95% of the total annual pollen of each station was recorded. For this purpose, the initial and final 2.5% of the annual variation curves were eliminated to avoid lengthy tail-offs.

All the pollen traps were placed between 15 and 25 m above ground level, in open spaces, with no nearby buildings to block free air movement. Additional information on the general characteristics and locations of the different sampling stations can be found in REA Bulletin numbers 3, 4 and 5.

#### RESULTS AND DISCUSSION

In general, the main pollen season (MSP) generally occurred during late summer and autumn, between September and December, except in the case of the Vigo station (northwestern Spain), where the MPS took place from August to mid-October (Tab. 1, Fig. 1), probably due to the presence of different species.

Maximum pollen concentrations tended to occur during October or at the end of September, although the concentrations recorded on peak days, as well as the total annual pollen count and MPS duration, varied from station to station and from year to year (Tab. 1, Fig. 2-3).

In the years studied, the highest concentrations were recorded in Málaga, Antequera and Granada, all in eastern Andalusia; this is probably due to the fact the climate is ideal for this species in these

Stations and years		MPS	Nº Days	Peak day and mean daily concentration $\mu\text{g}/\text{m}^3$	Total annual pollen grains/ $\text{m}^3$
Antequera	1998	10 Oct-25 Nov	76	13 Oct - 45	273
Barcelona	1994	1 Sept-27 Oct	57	6 Oct - 13	52
	1995	6 Sept-25 Dec	111	10 Oct - 8	48
	1996	17 Sept-20 Nov	65	26 Sept - 4	29
	1997	2 Oct-25 Dec	85	1 Oct - 9	54
	1998	13 Sept-2 Dec	81	2 Oct - 10	51
Córdoba	1992	10 Oct-1 Dec	32	Various - 1	11
	1993	7 Sept-9 Dec	94	7 Sept - 30	47
	1994	4 Oct-19 Nov	47	15 Oct - 2	5
	1995	25 Sept-31 Oct	37	26 Sept - 5	20
	1996	12 Sept-21 Nov	71	30 Oct - 8	45
	1997	11 Oct-2 Nov	53	12 Oct - 16	30
	1998	2 Oct-30 Nov	60	13 Oct - 15	73
Estepona	1995	30 Sept-31 Dec	93	5 Oct - 6	36
	1996	6 Sept-1 Dec	87	29 Oct - 19	19
	1997	16 Sept-13 Dec	89	12 Oct - 17	17
Granada	1992	27 Oct-2 Dec	37	31 Oct - 16	43
	1993	14 Sept-20 Dec	98	1 Nov - 8	81
	1994	15 Sept-8 Nov	55	13 Oct - 27	161
	1995	23 Sept-18 Nov	57	25 Sept - 12	81
	1996	1 Sept-11 Nov	72	6 Oct - 38	171
	1997	10 Sept-16 Dec	98	19 Oct - 39	146
	1998	5 Oct-25 Nov	52	16 Oct - 8	35
Jaén	1996	29 Sept-30 Oct	32	Various - 2	16
	1997	16 Oct-12 Nov	27	Various - 2	12
	1998	9 Sept-26 Nov	79	16 Sept - 2	15
Málaga	1991	29 Sept-29 Dec	92	20 Oct - 44	284
	1992	19 Sept-30 Dec	103	27 Oct - 25	272
	1993	26 Sept-28 Dec	94	22 Oct - 166	786
	1994	4 Oct-16 Dec	74	10 Oct - 221	715
	1995	30 Sept-28 Dec	90	12 Oct - 76	719
	1996	9 Sept-24 Dec	107	10 Oct - 252	2250
	1997	8 Oct-28 Dec	82	13 Oct - 516	1756
	1998	26 Sept-30 Dec	96	18 Oct - 205	1231
Tarragona	1996	15 Sept-11 Dec	88	19 Sept - 14	36
	1997	13 Sept-29 Nov	78	11 Oct - 4	22
	1998	10 Oct-24 Nov	55	9 Oct - 6	35
Vigo	1995	7 Aug-14 Nov	100	25 Sept - 4	30
	1996	10 Aug-8 Oct	60	28 Aug - 18	85
	1997	4 Aug-20 Oct	78	12 Oct - 5	93
	1998	6 Aug-22 Nov	109	11 Aug - 3	17

TABLE 1. Duration of the MPS, peak day and daily concentration, and total annual *Casuarina* pollen counts in the atmosphere at the stations and in the years studied.

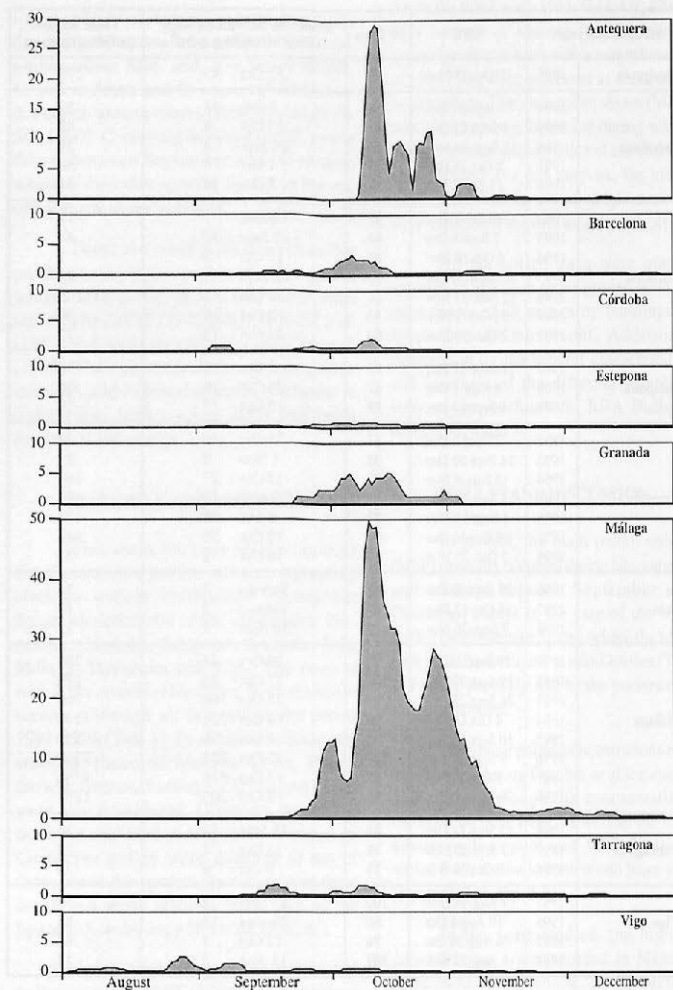


FIGURE 1. Mean seasonal variation of *Casuarina* pollen at the different stations during the study period. 3-day running means. Note the different scales.

areas, where the tree is often used to decorate roadsides and as a windbreak. Málaga showed particularly high values, with total annual counts of over 1,000 pollen grains per  $m^3$  during the last three years of the study period and a record count of 516 pollen grains/ $m^3$  on 13 October 1997.

At the other stations, it was unusual to obtain an average daily mean of more than 30 pollen grains/ $m^3$ ; such levels were only recorded in Antequera, Granada and Córdoba, whereas lower values were always recorded at the other stations. Indeed, in most cases the pollen was only occasionally detected. There was therefore no real peak, as in the case of Jaen and other locations, where, in some years, the values never reached a daily mean of 5 pollen grains/ $m^3$  (Tab. 1).

As regards seasonal behaviour, although pollen grains of this species were sometimes detected on a certain number of days prior to the peak day, this peak normally occurred without warning, perhaps after the first rains of autumn, and very little time elapsed between the beginning of the season and the peak day. The frequent ups and downs in pollen counts were usually associated with rainfall.

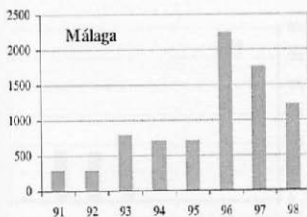


FIGURE 2. Total annual counts (pollen grains/ $m^3$  vs years) for *Casuarina* pollen at the Málaga station during the years studied. Note the different scale from Figure 3.

The interannual behaviour of this pollen type varied from station to station (Fig. 3). In Málaga, for example, the annual counts in 1996 and 1997 were much higher than at other stations. Similar results, albeit less pronounced, were obtained in Vigo and Granada; 1994 also yielded a high annual count in the latter, whereas results at other stations were nothing out of the ordinary. Nonetheless, it is clear that *Casuarina* is a pollen whose presence in the air is closely associated with seasonal rainfall, which in the Mediterranean Basin normally occurs in autumn, coinciding with the main pollination period of the more frequent species. In general, the highest pollen concentrations are recorded on sunny days following the first autumn rains.

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#### REFERENCES

- BUCHOLTZ, G.A.; HENSEL A.E.; LOCKEY, R.F.; SERBOUSEK, D. & WUNDERLIN, R.P. (1987). Australian pine (*Casuarina equisetifolia*) pollen as an aeroallergen. *An. Allergy* 59:52-56.
- DOMÍNGUEZ VILCHES, E.; GALÁN, C.; VILLAMANDOS, F. & INFANTE, F. (1991). Manejo y evaluación de los datos obtenidos en los muestreos aerobiológicos. *REA Monogr.* 1:1-18.

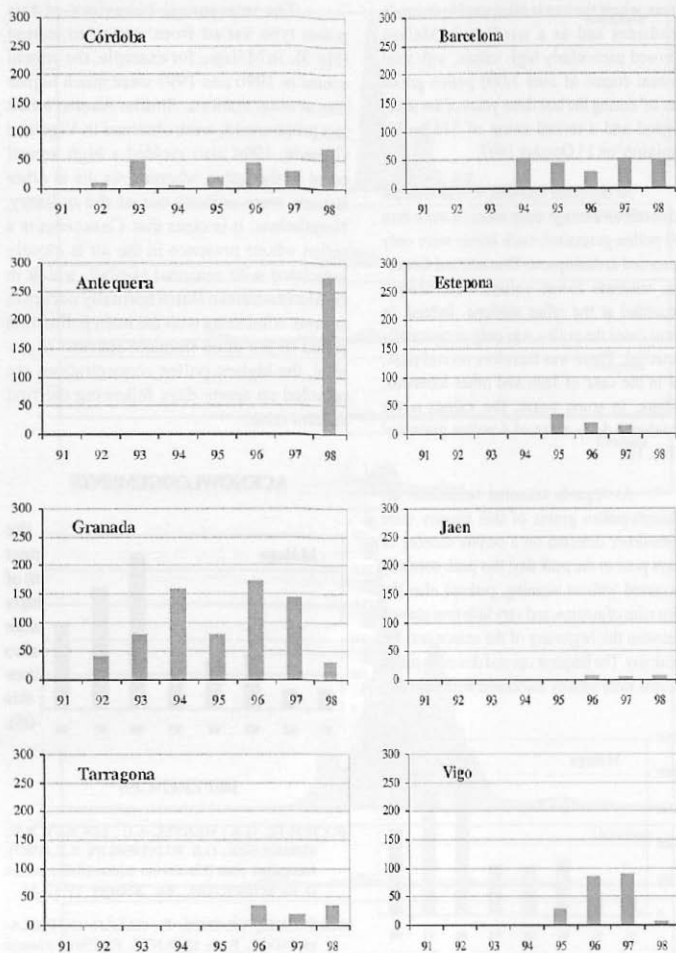


FIGURE 2. Total annual counts (per m<sup>2</sup> vs years) for *Coscinus* pollen at the Antequera, Barcelona, Córdoba, Granada, Jaén, Tarragona and Vigo stations during the years studied. Note the different scales from Figure 2.

- GALÁN SOLDEVILLA, C. (1988). Introducción al Boletín nº 3 de la Red Española de Aerobiología. *Bol. Red Esp. Aerobiol.* 3:5-6.
- GARCÍA, J.J.; TRIGO, M.M.; CABEZUDO, B.; RECIO, M.; VEGA, J.M.; BARBER, D.; CARMONA, M.J.; CERVERA, J.A.; TORO, E.J. & MIRANDA, A. (1997). Pollinosis due to Australian pine (*Casuarina*): an aerobiologic and clinical study in southern Spain. *Allergy* 52:11-17.
- HIRST, J.M. (1952). An automatic volumetric spore trap. *Ann. Appl. Biol.* 39:257-265.
- ROCHA ALFONSO, M.L. (1990). *Casuarina* Adanson. In: CASTROVIEJO *et al.* (eds). *Flora Iberica* 2:50-52.
- ZIVIT, N. (1942). Allergy to Australian pine. *J. Allergy* 13:314-316.