ELSEVIER

Aerobiologia 11 (1995) 189–194

Aerobiologia
International Journal of Aerobiology

Approaches to airborne pollen in SE Spain. First survey in Murcia: one year of pollen monitoring (1993–94)

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Received 5 September 1994; revision received 1 May 1995; accepted 5 June 1995

Abstract

First data from a pollen survey carried out in the city of Murcia (SE Spain) are given in this paper. Using a Burkard Volumetric Spore Trap, daily slides were prepared and 80 pollen types belonging to 51 families and *Alternaria* spores were identified and counted. Special attention was paid to 14 relevant taxa: Cupressaceae, *Pinus*, Genisteae, *Olea*, *Morus*, *Acer*, *Platanus*, *Plantago*, *Quercus*, Urticaceae, Poaceae, Chenopodiaceae, *Artemisia* and *Alternaria*. The main sources of airborne particles were *Alternaria* (27.7%), Cupressaceae (13.5%), *Olea* (9.36%), Chenopodiaceae (8.31%) and Urticaceae (5.8%). Annual variations in pollen abundance and length of the flowering seasons are given for individual species and are related to environmental factors. Results indicate a main pollen season from March to June and a second minor season in September to October. The relatively high concentrations of Genisteae and the appearance of an *Artemisia* winter season were noted.

Keywords: Aerobiology; Airborne pollen; *Alternaria* spores; *Artemisia*; Genisteae; SE Spain; Murcia

1. Introduction

Within the wide strip of the Spanish Mediterranean area, Murcia is a key site for palynological investigations as its particular flora includes Mediterranean, Holarctic, Irano-Turanian and Maghrebian elements, many of them being endemic. Over recent years, the palynology laboratory at Murcia University has devoted much time to Quaternary paleoenvironmental reconstruction and pollen morphology. Early in 1993 the laboratory began pollen monitoring at Murcia. This station has become of great importance since southeastern Spain has received little attention in this regard up to now.

The present paper presents the first results for the Murcia area, a site whose population suffers a high incidence of pollinosis. Our goal was to identify the airborne flora, to work out a yearly pollen calendar and pinpoint the most important periods of pollen dispersal.

About 50 towns and villages, belonging to seven municipalities, with a total population close to 400 000 people, are found within a radius of 15 km around the sampling site. The main town is Murcia (155 969 inhabitants). The climate is subtropical, with a semi-arid rainfall regime (250–300 mm), relative humidity of 58%, and mean annual temperature of 18°C. As a consequence, there are many xerophytic taxa, which flower for most of the year. This could explain why approximately 15% of the population suffer from pollinosis at some time during the year.

2. Materials and methods

Pollen monitoring was performed from March 1st, 1993 to February 28th, 1994 using a Burkard 7-day Volumetric Spore Trap (Hirst, 1952) located about 19 m above ground level on the exposed flat roof of the Veterinary Faculty, Espinardo Campus, Murcia University (110 m above sea level, 38°01′ N, 1°10′ W, 4 km NW from Murcia city). There are no higher buildings in the immediate vicinity.

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0393-5965/95/$09.50
SSDI 0393-5965(95)00135-E

Daily slides from weekly ribbon strips were prepared following standard methods (Ogden et al., 1974) and examined by light microscopy. Pollen was identified with the aid of the reference collection P-MUB (Murcia University). The data, expressed in grains per cubic metre of air, were obtained by counting all pollen grains on four longitudinal transects. *Alternaria* spores and unidentified pollen were also counted. The daily slides spoiled by insects were not taken into consideration for the calculations.

We especially focused on taxa which were considered of importance, either because of the significant amount of pollen produced and/or because of their allergological impact on man or because their presence was considered unusual in the airborne flora.

The meteorological data used in our analyses include air pressure and rainfall (Fig. 1A), temperature and wind speed (Fig. 1B), humidity and sunshine (Fig. 1C), and wind direction (Fig. 1D). Data were obtained from the monthly bulletin of the Centro Meteorológico Territorial of the Instituto Nacional de Meteorologia in Murcia, 1 km from the sampling site.

3. Results and discussion

During the period between March 1993 and February 1994, a total of 38 943 pollen grains per cubic metre were encountered and classified into 80 pollen types and one spore type (*Alternaria*). The pollen types belonged to 51 families of the spematophytes. However, this paper details only 14 of these (Figs. 2C–H, 3), which accounted for 93.54% of the yearly count of airborne pollen in Murcia. The unidentified types amounted to 610 grains m^{-3} throughout the study. The maximum daily count was 608 grains m^{-3} on June 10th and the minimum was 6 grains per m^{-3} on January 19th. The highest monthly pollen concentration (Fig. 2A) was observed in June (17.7%) followed by May (15.6%), March (15.2%) and April (13.9%). The incidence of pollen was lower than 7% during the other months. January was the month with the lowest pollen concentration (2.6%). In spring, pollen diversity (Fig. 2A) was higher than during the other seasons of the year, with an almost uniform decrease from April to November, except during September.

Two airborne pollen seasons were clearly identified throughout this study (Fig. 2A,B). The main season started in March and continued until June, coinciding with spring, with a decrease in April to May related to a fall in temperatures and a period of rain (Fig. 1A,B). The pollen count during the main period represented 65.4% of the annual average. From July to early February the airborne pollen concentrations were low. A minor blooming period was observed, beginning in late summer and lasting until late October. In late February 1994 the main pollen season started again (Fig. 2B) as temperatures began to rise (Fig. 1B). The fall in pollen concentration recorded in April during the

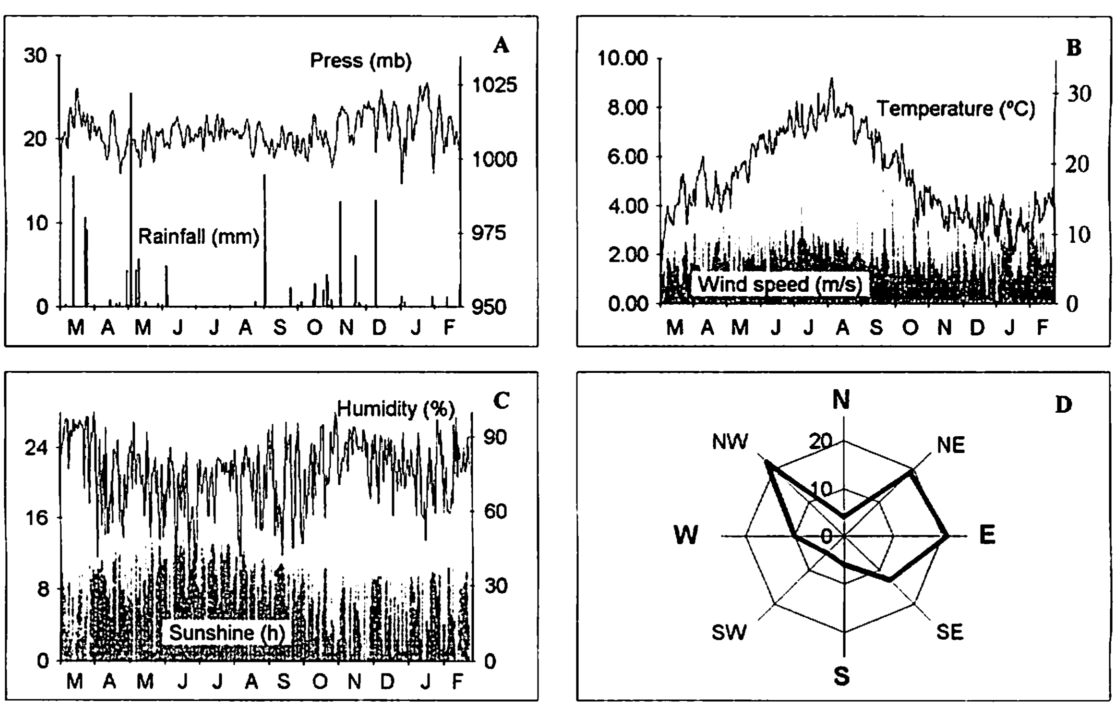

Fig. 1. Meteorological data. (A) Daily average atmospheric pressure and total rainfall. (B) Daily average temperature and average wind speed. (C) Daily average relative humidity and total sunshine. (D) Frequency of wind direction expressed in percentages.

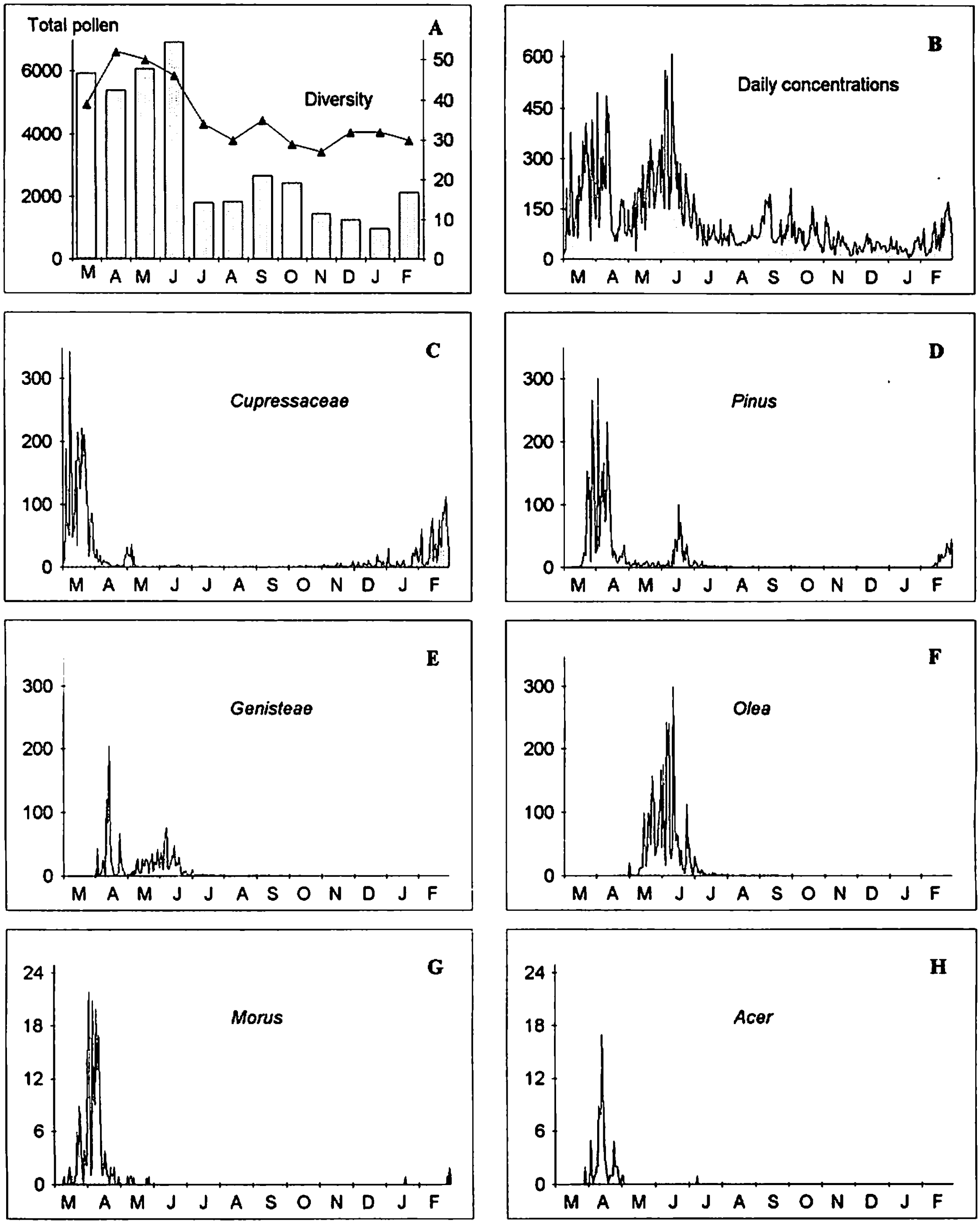

Fig. 2. Pollen concentrations. (A) Monthly pollen concentration calculated as the sum of daily concentrations and diversity of taxa. (B) Variations of daily pollen concentrations. (C–H) Daily pollen concentrations. All concentrations are expressed in grains per cubic metre. Note the different scales.

main pollen season corresponded to a fall in temperatures (Fig. 1B) and a rise in humidity (Fig. 1C).

Cupressaceae (Fig. 2C) is the earliest flowering taxon and the most common airborne pollen type in Murcia, representing 13.5% of the total. Its main pollen period begins in late January (with a first-half winter pre-season) and ends in March. Its presence was recorded sporadically throughout the year. The species belonging to the Cupressaceae family which flower within the area during the period described, are mostly *Cupressus sempervirens*, and to a lesser extent, *Cupressus arizonica*, *Platycladus orientalis* and *Chamaecyparis lawsoniana*.

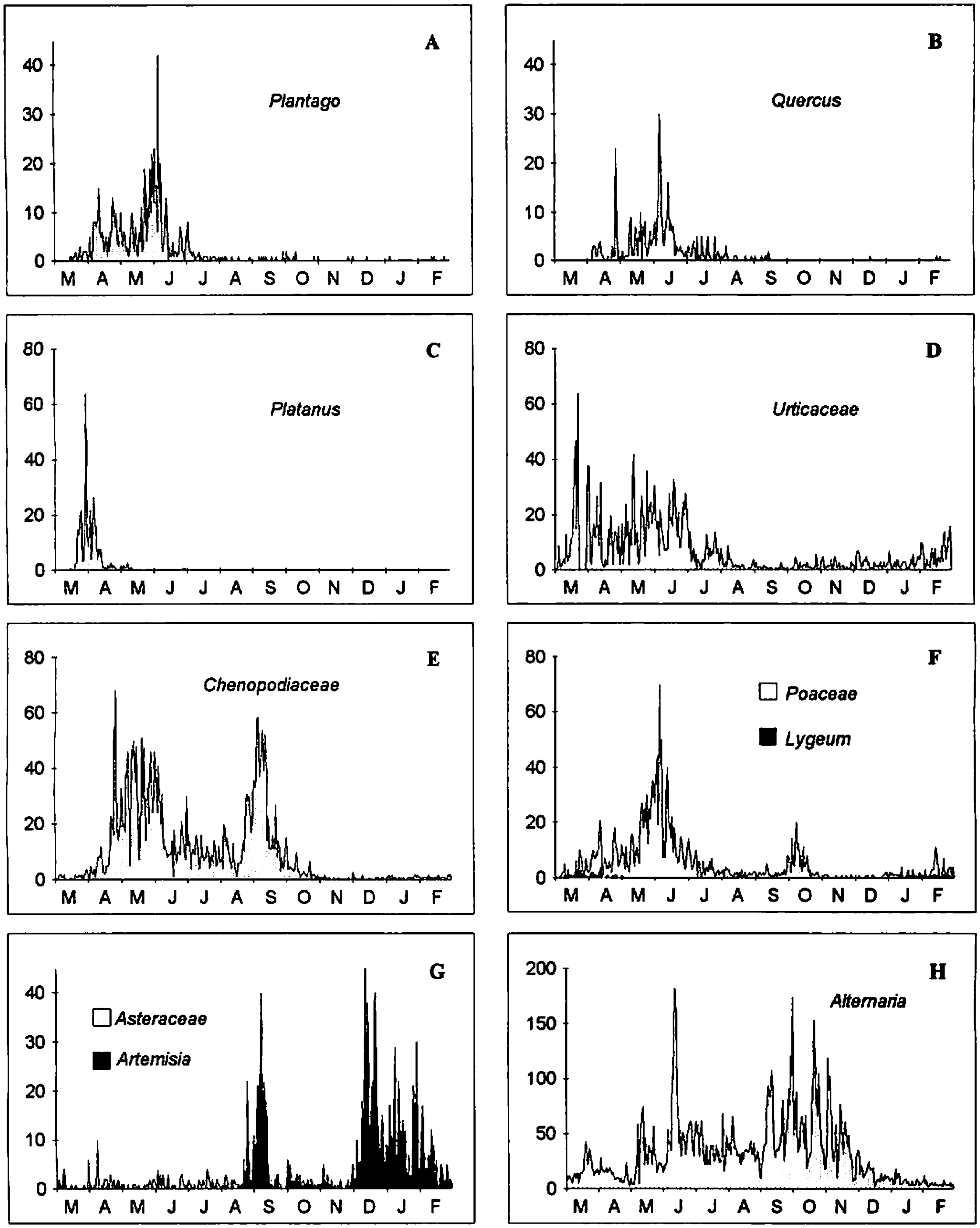

Fig. 3. Daily pollen and *Alternaria* spore concentrations expressed in grains per cubic metre. Note the different scales.

All of them are widely cultivated as ornamental plants.

Pinus (Fig. 2D) was found in high concentrations (more than 100 grains m^{-3}) for a short time in March to April (mainly April) matched by an increase in average temperature (Fig. 1B). Its concentration fell to low levels until mid-June, when it showed a second minor pollen season. In 1994 the main pollen season for *Pinus* began presumably 1 month earlier than in 1993 (February). Iglesias et al. (1988) in Orense (NW Spain) observed a similar two-season pattern for *Pinus*, the first (main season) occurring 1 month later than in Murcia and the second (minor season) 2 months later. In

Barcelona (NE Spain) Roses-Codinachs et al. (1992) observed two similar seasons, the first around April and the main one in June.

Genisteae is an unusual airborne pollen. Its dissemination (Fig. 2E) occurred during two successive seasons, the first, rather short and pronounced, can be related to *Robinia pseudoacacia* flowering. The second season was characterized by lower pollen concentrations, which lasted nearly 2 months, approximately from May to June. The second period coincided with the blooming of wild species (*Lygos sphaerocarpa*, *L. monosperma*, *Genista* sev. sp., *Cytisus* sev. sp.). Apart from its novelty, it is an interesting taxon because, in the concentrations reported here, this pollen could well be involved in allergenic diseases. Because its alleged zoophily, its presence in archaeological sediments has often been viewed as a consequence of biotransport into the deposits (Carrión, 1992). Perhaps these legumes, which are heavy pollen producers, disperse much more pollen by wind than was initially believed.

Olea (Fig. 2F) is a seasonal taxon. It was registered in moderate and high concentrations for a relatively short time between mid-May and late June. After this maximum, a sharp drop in concentrations announced the end of blooming. In Bari (C Italy) Macchia et al. (1987) observed a nearly coincident but contrary pattern: a peak during the second week of May and a slow decrease from the last week of June. In any case, the behaviour of the *Olea* curve herein should be treated with caution because the olive is likely to have a prevalent biannual rhythm of flowering (Macchia et al., 1987; Belmonte and Roure, 1992).

From mid-March onwards pollen production from a group of cultivated tree taxa with short anthesis commenced: *Morus* (Fig. 2G), *Acer negundo* (Fig. 2H) and *Platanus* × *hispanica* (Fig. 3C). *Acer* presented the shortest season and the lowest concentration. *Morus* and *Platanus* were practically synchronous and showed similar patterns (Figs. 2G, 3C (note the different scale)), probably related to a rise in temperature (Fig. 1B); only the maximum recorded for *Platanus* in late March breaks this pattern.

The patterns for *Plantago* and *Quercus* (Fig. 3A,B) are also similar, although *Plantago*'s was 20 days earlier. Both presented a nearly constant 1-month pre-season followed by a short main flowering time and a long period of low concentration, particularly in the case of *Plantago*.

There was a constant low concentration of Urticaceae, Chenopodiaceae and Poaceae throughout the year (Fig. 3D,E,F). Urticaceae showed an irregular daily distribution, and their highest pollen concentrations occurred during spring and early summer, concurrently with an increase in temperatures (Fig. 1B) and hardly affected by precipitation and/or humidity (Fig. 1A,C). The most important species belonging to this family is *Parietaria judaica*, which is very abundant in the human influenced habitats of the zone. The main pollen period occurred about 2 months earlier than reported by Fornaciari et al. (1992) in Perugia (C Italy) and was similar to the one observed by Roses-Codinachs (1992) in Barcelona.

Chenopodiaceae (Fig. 3E) is a very interesting taxon and was present in the counts for a long period of time between late April and mid-September, with a fall in concentration due to the high summer temperatures (Fig. 1B). A shorter but similar distribution pattern was recorded by Belmonte (1988) in Barcelona. As regards the constant presence of Chenopodiaceae pollen, it must be remembered that the semiarid southeastern area of Spain is one of the most favourable areas for the development of this family, which has become abundant with anthropogenic pressure and ruderalization.

Poaceae (Fig. 3F) showed a shorter pollen season 1 month later, just as the Chenopodiaceae season was ending. Poaceae pollen grains were recorded mainly in May to June, as was reported by Galán et al. (1989) in Córdoba and by Bricchi et al. (1992) in Perugia. A second minor blooming period was observed around October, again when the Chenopodiaceae pollen season was ending. *Lygeum spartum* (Fig. 3F) is a grass species with a relatively early flowering season (February to April).

Asteraceae (Fig. 3G) is another taxa with a constantly low concentration throughout the year. *Artemisia* pollen represented almost 89% of the total of this family. *Artemisia* flowered briefly in late summer and had a main pollen season starting in late autumn and lasting the most part of the winter. Galán et al. (1990) in Córdoba observed an important summer season for *Artemisia* with concentrations higher than those of Murcia, although they do not mention the second and the winter blooming. Spieksma et al. (1989) in Ascoli Piceno (C Italy) and Caramiello et al. (1989, 1990) in Turin (C Italy) detected a second, short, flowering time, starting in late September. Interestingly, Calleja et al. (1993) detected high concentrations of *Artemisia* in December in the northern sections of the marine atmosphere pollen load off West Africa. They noted that *Artemisia* blossoming takes place from June to January (mainly October to November) in Oran (Algeria), similar but 1–2 months earlier than at Murcia in 1993. More closely, in Valencia (E Spain), the blossoming takes place from August to December (mainly September to October), but only in 1 year between 1977–1979 the blooming occurred in November to December. Additional aerobiological and phenological investigations are needed to better understand this phenomenon and the species involved.

Alternaria spores were the most common particles we found in the Murcian atmosphere, representing 27.7% of total airborne particles identified from March 1993 to

February 1994. *Alternaria* appeared every day of the year (Fig. 3H) with a short season in June and a long main season during autumn, while average temperatures ranged from 16 to 24°C, similar to, but 4–6°C lower than those reported by Hjelmroos (1993) in Stockholm (Sweden). Really, *Alternaria* spores seem to be well related to temperature in Murcia atmosphere during 1993 (Munuera and Carrión, 1995).

4. Conclusions

Two main pollen seasons can be distinguished: the first in March to June, and the second (corresponding to the Chenopodiaceae-Poaceae blooming) in September to October. Minor pollen seasons occur during midsummer and for 3 months around the winter solstice. Worthy of mention are the concentrations of the contrasted allergenic taxa Chenopodiaceae and *Artemisia*, the latter with a winter flowering period recorded at Murcia as a novelty. Likewise, the abundance of Genisteae pollen, traditionally ignored as allergenic because of its reputed zoophily, should be noted.

Obviously, the fact that airborne pollen has only been studied for 1 year means that the results are only provisional. Although 1 year is clearly insufficient to establish the length of the reproductive rhythms, the described patterns could serve as an interesting approximation, particularly in the absence of any previous surveys.

Acknowledgements

This work has been funded by the PB91-0897 D.G.I.C.Y.T. and PIB93-08 projects. The authors thank the Centro Meteorológico Regional de Murcia for providing meteorological data. We are indebted to Dr E. Domínguez, Dr C. Galán, Dr P. Cariñanos, Dr F. Villamandos and Dr P. Alcázar, and to F. Romero, for their teaching in aerobiological and monitoring techniques.

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