

Airborne pollen and spores of León (Spain)

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Abstract. A qualitative and quantitative analysis of airborne pollen and spores was carried out over 2 years (from September 1987 to August 1989) in the city of León. Slides were prepared daily using a volumetric pollen trap, which was placed on the Faculty of Veterinary Science building (University of León) 12 m above ground-level. Fifty-one pollen types were observed; the most important of these were: Cupressaceae during the winter, *Pinus* and *Quercus* in spring, and Poaceae, Leguminosae and Chenopodiaceae in the summer. The results also showed the existence of a rich mould spore assemblage in the atmosphere. The group of Amerosporae (*Penicillium*, *Aspergillus* and *Cladosporium*) as well as Dictyosporae (*Alternaria*) were the most abundant; *Puccinia* was common in the air in August. Fluctuations in the total pollen and spores m³ of air were compared with meteorological parameters (temperature, relative humidity and rainfall). From the daily sampling of the atmosphere of León, considering the maximum and minimum temperature and duration of rainfall, the start of the pollen grain season was observed generally to coincide with a rise in temperature in the absence of rain.

Key words: Airborne pollen – Airborne spores – Pollen diagrams – Meteorological factors

Introduction

León is a city in the northwest of the Iberian Peninsula, at an altitude of about 860 m above sea-level. It has a continental climate showing strong thermal contrasts between summer and winter, with a yearly mean temperature of about 10–12° C (Ferrerías-Chasco 1981). The summers are short and have very pronounced thermal differences between day and night (about 20° C). The

winters are long, and the minimum temperature during this season is often below 0° C (García de Celis 1988). Storms generally come from the Atlantic and the dominant winds come from the southwest. Bioclimatically, León is in the lower supra-Mediterranean stage, with a growing season of 8 months (Rivas-Martínez 1987).

In the northern part of the city, the autochthonous vegetation is constituted by *Quercus pyrenaica* forest, accompanied in some places by *Juniperus communis* and *J. oxycedrus*. In degraded areas several Ericaceae appear: *Erica australis*, *E. umbellata*, *E. cinerea* and *Calluna vulgaris*. The development of two types of forest is seen in the western part of the city. One on siliceous soils is mainly formed by *Q. ilex* subsp. *rotundifolia* and by

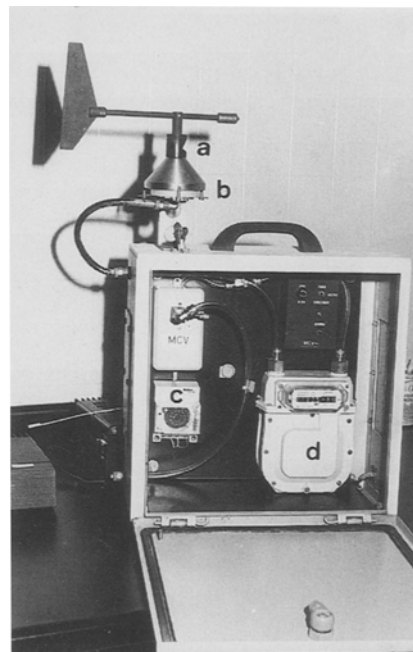


Fig. 1. Photograph of the volumetric pollen and spore trap used in this study. a, Vane device; b, filter chamber; c, vacuum pump; d, volumetric measuring device

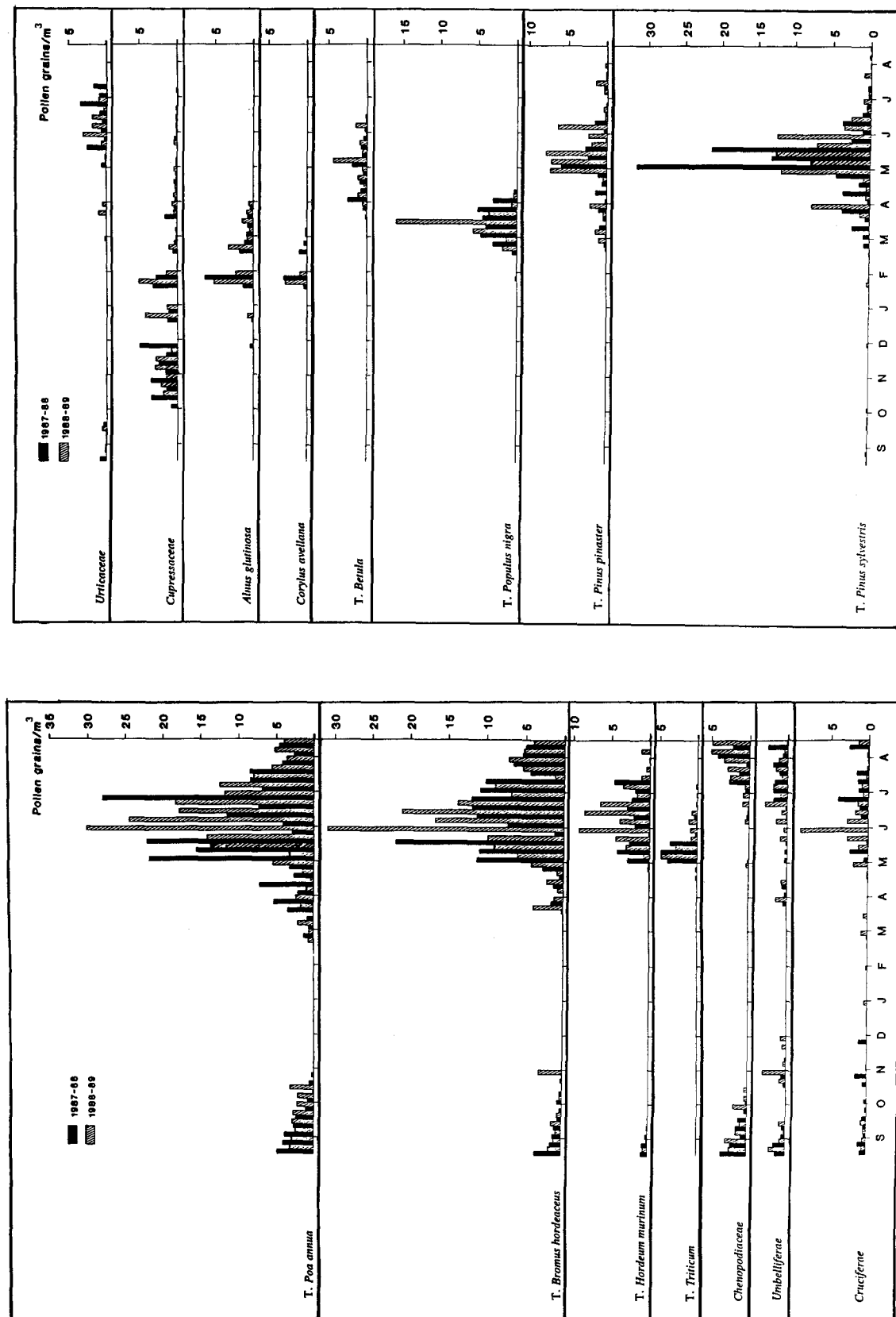


Fig. 2. León pollen calendar for 1987-1989. The 36 most important taxa are presented. Those represented as 'others' correspond to the following important minor taxa: *Taraxacum* sp., *Bellis* sp., *Carex divisa*, *C. halleriana*, *Arctostaphylos uva-ursi*, *Aesculus hippocastanum*, *Juncus* sp., Liliaceae, Iridaceae, Caprifoliaceae, *Zea mays* and Boraginaceae. "T": pollen types. For further diagrams see following page

bushes of various species (*Cistus laurifolius*, *C. ladanifer*, *Halimium umbellatum*, *Thymus zygis*, etc.). The other kind of forest is on basic soils and constituted by *Q. faginea*. On the border, some spiny shrubs appear such

as *Rosa* sp. and *Rubus* sp. In the other regions of the outskirts of the city, we frequently find pastures of wild grass (*Cynosurus cristatus*, *Lolium perenne*, *Holcus lanatus*, *Dactylis glomerata*, *Poa* sp., etc.), and grass cultures

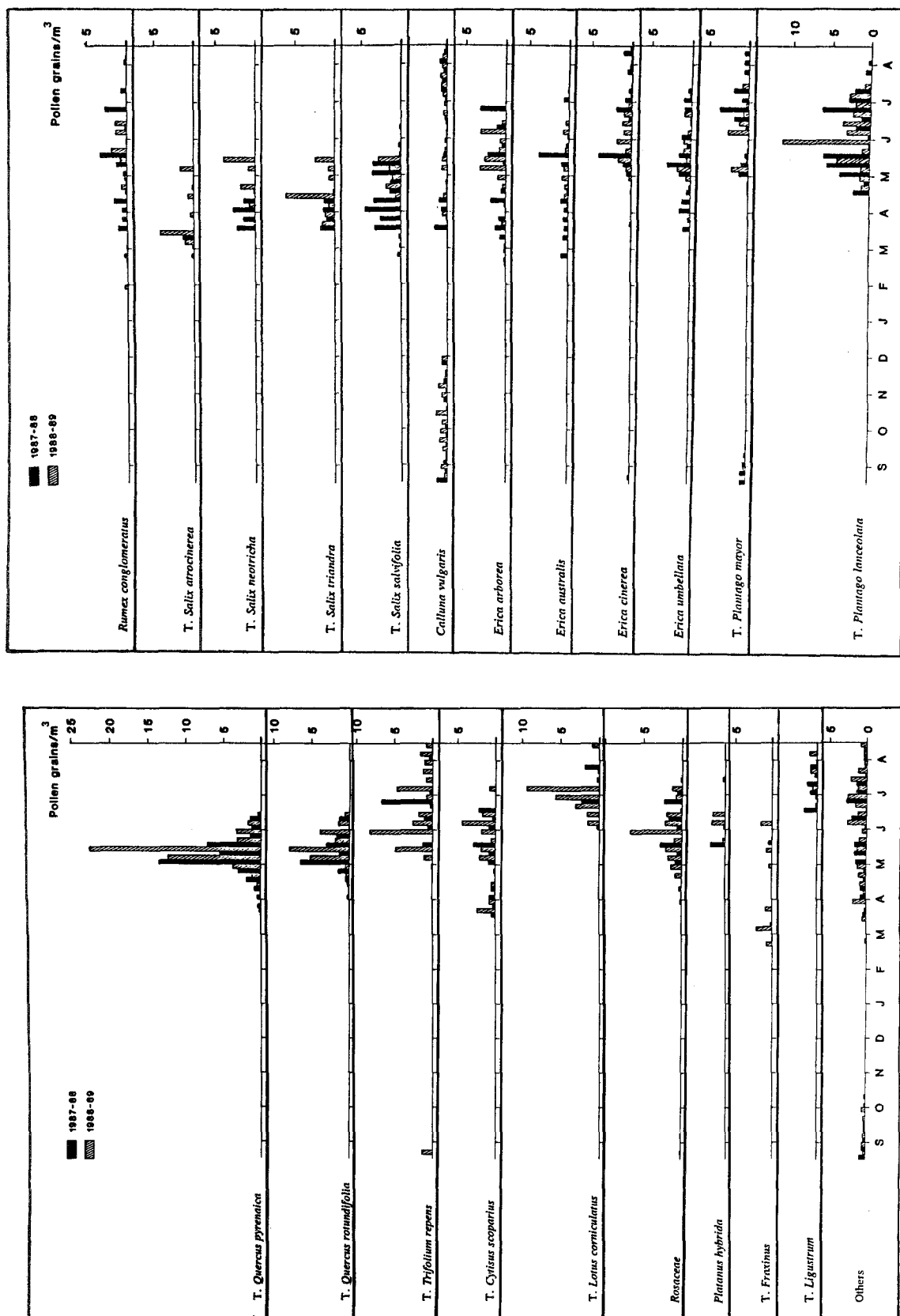


Fig. 2. (continuation) León pollen calendar for 1987-1989

(*Triticum* sp., *Secale* sp.), legumes (*Trifolium* sp.) and *Plantago* sp.

Along the rivers, in those soils influenced by the water, the vegetation is principally formed by several

riparian series of elm, poplar and arboreal willow, and some shrubby willow plantations. Besides the autochthonous flora, there is afforestation of *Pinus* sp. and of different ornamental species cultivated in the parks

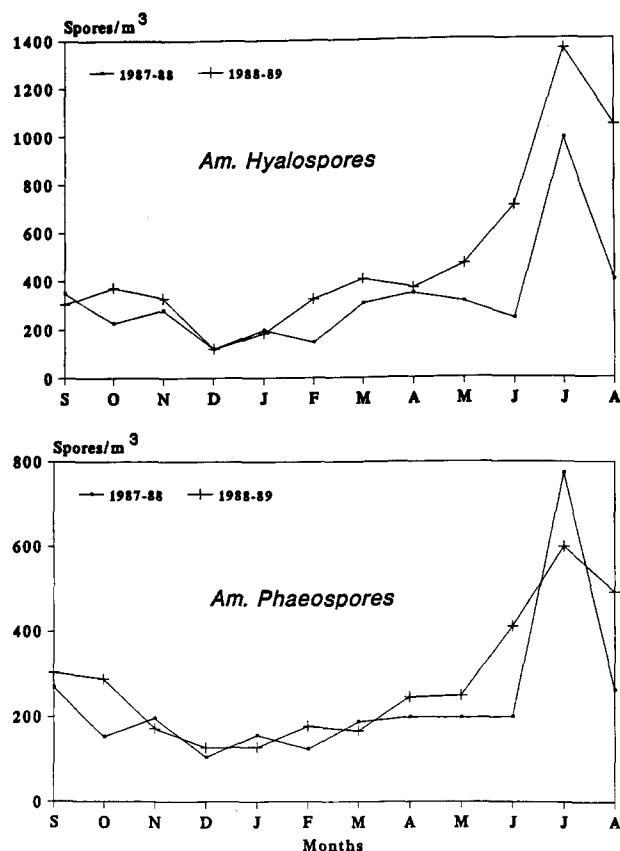


Fig. 3. Daily mean counts/m³ atmospheric air of Amerospores hyalosporos and Amerospores phaeosporos for the period September 1987 to August 1989

and gardens of the city: *Aesculus hippocastanum*, *Platanus hybrida*, *Ligustrum japonica* and Cupressaceae. The present paper reports the first results of daily monitoring of pollen and spores in the atmosphere of León during 1987–1989. In addition, fluctuations in pollen grains and spore concentrations are compared with meteorological parameters.

Materials and methods

This study was carried out for 2 years (from September 1987 to August 1989) using a volumetric pollen and spore collecting method by means of active filtration (Suarez-Cervera and Seoane-Camba 1983). This device (Fig. 1) consists mainly of a filtration chamber with a vane, a Millipore filter 7 cm in diameter with a 5 µm pore size, a timer that switches off the device automatically every 24 h and a gas counter that measures the volume of air filtered, usually adjusted to about 4 m³/day. The collecting device was placed 12 m above ground level, on a flat roof at the Faculty of Veterinary Science (University of León). The samples were collected every day from Monday to Friday at 12.00 midday.

The filters were prepared for light microscopic observation as follows: a film of immersion oil was spread on three slides placed side by side. Then the filter was placed on them in such way that the oil impregnated the filter by capillary action. Finally, three cover glasses of 24 × 60 mm were placed over the filter and the filter was cut with a scalpel running between the slides. Three preparations were obtained from each filter without further manipulation. A full analysis of every filter was recorded, and the results expressed as the number of pollen grains and spores/m³ of air.

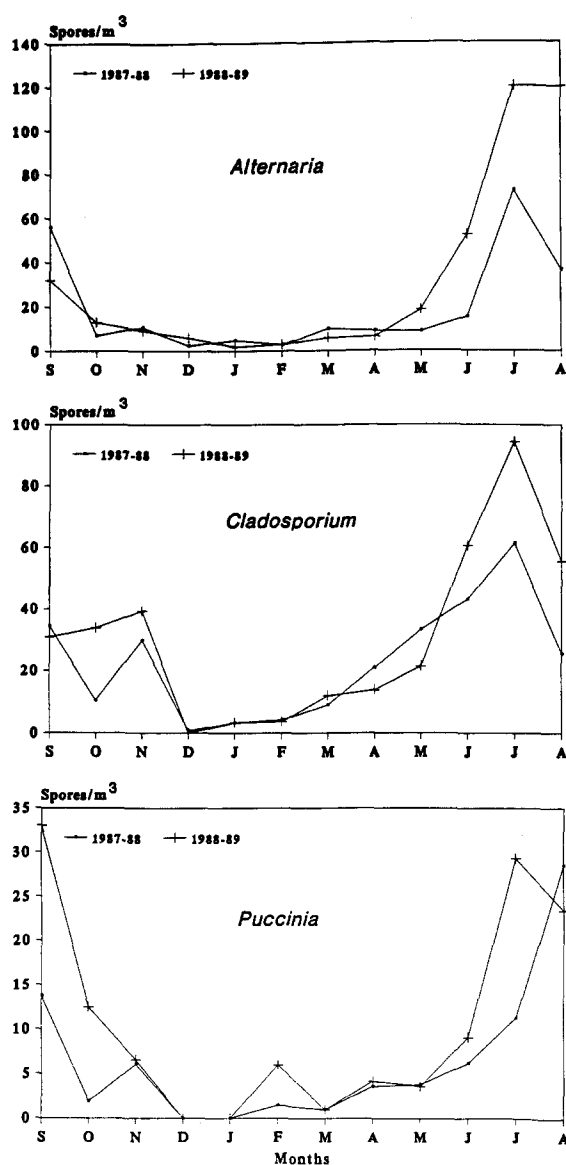


Fig. 4. Daily mean counts/m³ atmospheric air of *Alternaria*, *Cladosporium* and *Puccinia* for the period September 1987 to August 1989

Preparations of fresh pollen of the local flora as well as spores of fungi were used as references. The distinction of pollen types of the Poaceae, *Salix*, Ericaceae, Plantaginaceae, Pinaceae, Fagaceae, Leguminosae and Oleaceae follow the description of Fernández-González (1990). For spore terminology, the papers of Nilsson (1983) were followed.

Meteorological data (rainfall, relative humidity, and wind speed and direction) were provided by the Meteorological Station of La Virgen del Camino (León), and the temperature was recorded by means of a maximum and minimum thermometer placed close to the collecting device. The meteorological data are presented as monthly means.

Results

A general pollen calendar of the atmosphere of the city of León was made with the data obtained from this work (Fig. 2). The diagram contains the 36 most impor-

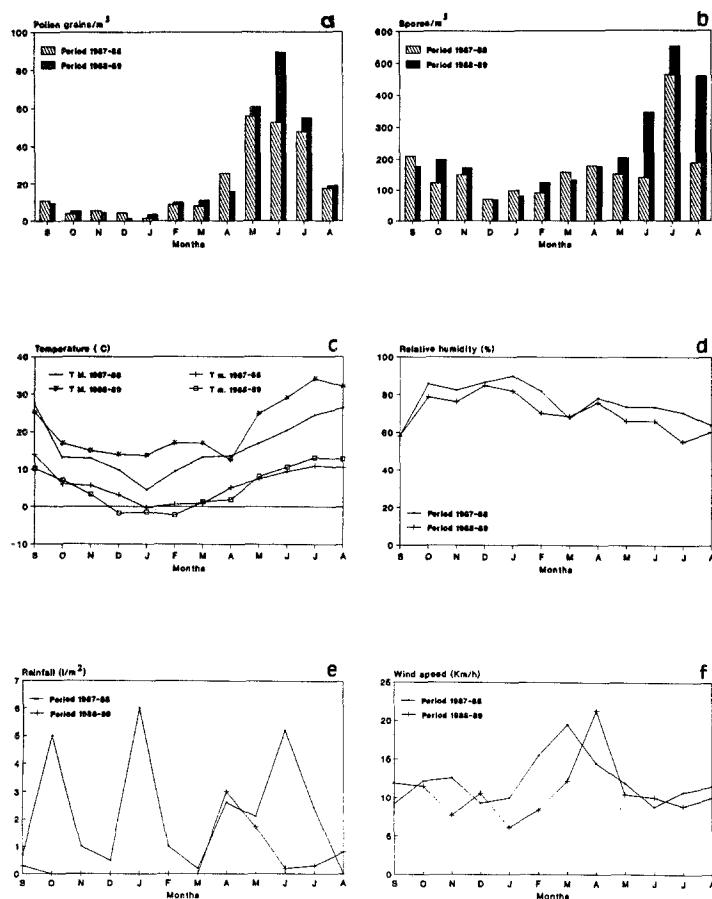


Fig. 5. Comparison between a pollen and b spore concentration with meteorological factors: c temperature, d relative humidity, e rainfall and f wind speed for the period September 1987 to August 1989

tant pollen types identified from the two sampling years. Fifteen other taxa were also present in the atmosphere but at lower concentration, including *Taraxacum* sp., *Bellis* sp., *Carex divisa*, *C. halleriana*, *Arctostaphylos uva-ursi*, *Aesculus hippocastanum*, *Juncus* sp., Liliaceae, Iridaceae, Caprifoliaceae, *Zea mays* and Boraginaceae. The monthly distribution of airborne pollen shows that only three types (Cupressaceae, *Alnus glutinosa* and *Corylus avellana*) were high in winter (December, January, February). The maximum pollen concentration was reached at the end of May and during June, when the pollen types *Quercus*, *Pinus*, *Salix*, *Plantago*, Ericaceae, Leguminosae and mainly Poaceae were especially apparent. There was a slight decrease in pollen concentration beginning at the middle of July and ending in September. The most numerous pollen types at this time belong to the Chenopodiaceae. This pollen calendar shows, therefore, that the pollen season is really placed between the end of spring and summer.

Fungal spores of most common types were identified in León during 1987–1989. Amerospores, phaeospores and hyalospores (including *Aspergillus* and *Penicillium*) were the most highly represented. These spores types were present during the whole year, but reached their highest concentrations during autumn and summer (Fig. 3). *Cladosporium* (Amerospore phaeospore) reached the highest concentration during autumn and spring-summer (Fig. 4). The form-genus *Alternaria* showed a pronounced seasonal periodicity. Its maximal concentration

coincided with the end of spring and the beginning of summer (Fig. 4). Other types of spore were also present in the León atmosphere, although their concentrations were lower than the previously mentioned groups. However, *Puccinia* (Fig. 4), *Nigrospora* and the group of Scolecospores and Didymospores were present almost through out the year.

Discussion

Temperature appears to have a direct effect on the atmospheric pollen concentration (Fig. 5a, c). These results are in good agreement with the conclusions of Sorsa (1973) and van den Assen (1973); the maximum temperature average moves between 20 and 25° C during the months of highest pollen concentration, while in July and August, when the temperature reaches 30° C, the pollen concentrations decline notably. The lack of pollen during the winter is clearly related to freezing, which occurs more or less intermittently from October to March in León.

Between certain limits, an increase in temperature produces higher concentrations of fungal spores in the atmosphere. However, extreme conditions (excessive cold or heat) prevent any increase in spore concentration. According to Agarwal and Shivpuri (1974), the optimal average temperature is in the range 20–30° C. In the present study, the maximum spore concentration co-

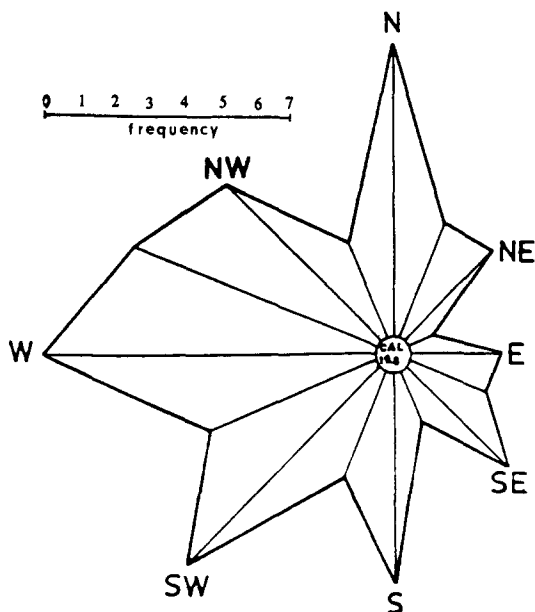


Fig. 6. Average yearly wind frequency in León. The lengths of the lines approximating to the points of the compasses represent the relative frequency of wind direction

incides with the maximum temperature increase as well as the minimum (Fig. 5b, c). In winter, temperatures below 0° C are reached during the night, which could explain the decrease in spores. In summer, the temperature is suitable for fungal spore development, although spore concentration declines considerably in August. This behaviour could perhaps be explained by the circadian rhythm itself, because the temperature difference between night and day is sometimes more than 20° C in León.

The effect of relative humidity is usually negative, and is in inverse relation to the atmospheric pollen concentration, although this factor is usually linked to temperature and rainfall variation (Fig. 5a, d). The effect of the relative humidity on spore concentration is not clear and we tend to agree with some authors (Aller et al. 1971; Rubulis 1984; Ebner and Haselwandter 1989), who claim that it depends on the spore type.

Rainfall produces its main effect by two mechanisms: blocking the release of pollen and reducing the concentration in the atmosphere by pollen sedimentation (Hirst 1953; Hamilton 1959; Leuschner and Boehm 1981; Suarez-Cervera and Seoane-Camba 1983, 1985; Roses-Codinachs et al. 1992). Figure 5a, e shows that there is an inverse relation between rainfall and atmospheric pollen content. In 1988–1989 rainfall was relatively abundant during April–May, and was nearly absent in June when the maximum average temperature was about 25° C. These favourable meteorological conditions probably contribute to the maximum pollen concentration. However, in 1987–1988 the rainfall occurred during the end of June, so it was in this month that the pollen concentration decreased. Atmospheric spore concentrations resembled those of pollen in relation to rainfall. When the amount of rainfall was high, the atmospheric spore content was low (Fig. 5b, e).

Wind speed and direction can also be significant for pollen concentration. When wind speeds are high, the pollen and spore concentration in the atmosphere usually increase as deposition is reduced (Fig. 5a, f). On the other hand, wind direction seems to have an interesting effect on the residence of the Poaceae pollen in the study area. When the direction of the wind is from the north and northeast during summer, Poaceae pollen is likely to be conveyed in the boundary layer from places where anthesis later occurs (Fig. 6). Thus this type of pollen usually has a longer residence time in the atmosphere than that of the local vegetation. Wind direction does not seem to affect spore concentration, since most of the spores identified belong to fungi that develop on organic matter and could be found anywhere in León. From the daily counts in the atmosphere of León, considering the daily maximum temperature and duration of rainfall, the start of the pollen grain season generally is observed to coincide with a rise in temperature in the absence of rain, which agrees with the results of Spieksma et al. (1985) in Leiden.

Conclusions

Fifty-one pollen types were observed in the atmosphere of the city of León, the most important of which were: Cupressaceae during the winter, *Pinus* and *Quercus* in spring, and Poaceae, Leguminosae and Chenopodiaceae in the summer. The results also show the existence of a rich mould spore assemblage in the atmosphere. The group of Amerospores (*Penicillium*, *Aspergillus* and *Cladosporium*) as well as Dictyospores (*Alternaria*) are the most abundant; *Puccinia* is common in the air during August. Fluctuations in the total pollen and spores/m³ of air, compared with meteorological parameters (temperature, relative humidity and rainfall) confirm the general interpretation of the role of these parameters in the airborne pollen grain and spore concentration.

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