

City spore concentrations in the European Economic Community (EEC)

I. Grass pollen, 1973.

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Summary

Although clinical reports on the prevalence of summer hay fever in different parts of Europe have been published, comparative studies on atmospheric pollen concentrations appear to have been rarely undertaken. The present paper describes observations on the grass pollen content of the air at Bologna, Brussels, London, Munich and Strasbourg and is the first of a series involving international collaboration between workers in cities of the European Economic Community*.

Introduction

For many years, the tourist has posed questions concerning the likely severity of his seasonal allergy if he visits another European area than his own. With free mobility of labour among citizens of the EEC, aerobiological evidence on the season and magnitude of the spore and pollen clouds encountered in the different regions acquires a renewed interest and importance.

Methods

Continuous, volumetric air sampling was undertaken with apparatus similar to that

* The authors held their first meeting as a working party under the chairmanship of Professor R Vanbreuseghem on 30th March, 1974 in the Brussels headquarters of 'Fonds nationale de la recherche scientifique', to whom grateful acknowledgment is made for facilities and financial support of the meeting. The working party has taken the title 'Aerobiologists du Marché Commun'. Membership is restricted to not more than one from each member nation, and from time to time the areas sampled and membership of the group may change. The cities from which sampling results are presented stem not from ecological design, but from places where independent work with similar methods was proceeding.

of Hirst (1952). In each city the trap was sited above the general level of the roof tops so that the free air streams blowing over the city were sampled.

The city sampling site provides a useful index of pollution for a wide area (Davies, 1969; Stix, 1971). Moreover, most patients who suffer from allergic disease dwell in cities.

Exposed sticky-faced slides were mounted for microscopy and independently examined by the workers in their respective laboratories; all employed similar methods in scanning a representative area of deposit. The mean daily grass pollen concentrations from each sampling station were assembled and 10-day running means prepared to facilitate a seasonal comparison with respect to such climatic features as temperature.

The climates of the relevant regions include temperate maritime (London and Brussels), cool temperate continental (Munich, Strasbourg) and temperate continentol (Bologna). The geographical location and relevant topographical features for each trapping station is as follows.

Bologna—44, 31°N, 11, 18°E

The trap is on an open terrace of the tower at the University Astronomical Observatory. It is 54 m above street level, and not less than 3 km from the open countryside where arable farming predominates, with a few small areas of grassland and woodlands. Although the tower lies in a densely built-up part of central Bologna, there are numerous trees and a few small parks including the University Botanic Garden. The amount of grass within the conurbation covers about 20 hectares and in the growing season most of this is mown bi-monthly.

Brussels—50, 48°N, 04, 21°E

Here the trap is on a 26 m high flat roof at Faculté de Medecin et de Pharmacie in the centre of the city. It is approximately 5 km from the open countryside. There are very few parks in Brussels, and they are of little significance in relation to the grass pollen content of the air. Beyond the city, 50% of the land is used as meadows, 50% for arable farming, including 25% cereals, 12% root crops, 5% maize and fodder crops and 8% market gardening. A forest with 85% *Fagus sylvatica* and about 4,000 hectares in area lies about 6 km to the south-east.

London—51, 29°N, 00, 19°E

The trap is sited on a flat roof 25 m above the carriageway level, which is 29 m above O.D. This station, at its closest, is about 15 km from the open countryside, which has arable farming, grassland and some woodlands. Within the conurbation, there are large parks, Hyde Park and Kensington Gardens are approximately 0.5 km to the south and Regents Park about 1 km to the north-east. These parks have a total of about 500 hectares of grass, which is mown weekly in the growing season. Most of the grass pollen trapped from the air over London is exogenous in origin, and catches can be correlated with the amount of grassland in the 'Home Counties' quarter from which the wind blows (Davies & Smith, 1973).

Munich—48, 08°N, 11, 42°E

In this city, the trap is situated on the flat roof of the Institute of Botany at the Technical University, which is about 17.5 m above street level. In München, there are very few buildings higher than 20 m, and the trapping site is exposed to the free air

streams flowing above the roof tops. The vegetation and land usage in the countryside beyond the city is typical of that in central Europe, one-third being devoted to arable farming, a third grass and a third forest.

Strasbourg—48, 33°N, 07, 38°E

Here the trap was on the 20 m high roof of the Laennec Hospital. Strasbourg is 140 m above sea level. The hospital is situated to the south-east of the town, not far from l'Ill; on the outskirts of the town, the immediate approaches are planted with ash, birch, maples, chestnuts and planes. For about 15 km around, the land is cultivated and there is mixed woodland, predominantly oak and birch.

Results

The sensitivity of patients to grass pollen varies. Patients may suffer pollen asthma after inhaling a single grain, whereas patients with hay fever may be symptom free when exposed to concentrations of 20–30 grains/m³. Since it has been found that when concentrations over Central London rise to 50 grains/m³ or more, all patients in the area who are clinically sensitive to grass pollen experience symptoms (Frankland & Davies, unpublished), mean daily pollen concentrations greater than 50/m³ are given in Figs. 1, 2 and 3. A 10-day running mean of the daily pollen concentration curves is given in Fig. 4.

In Bologna the pollen season began with a concentration of 60/m³ on 1 April and extended through April and May (Fig. 1). There were seventeen high counts or 100% symptom days in April and fourteen in May, as shown in Fig. 1. In addition, a count of 50/m³ was recorded on 30 May, and counts ranging from 50 to 70 on five days in June. Such marginally high counts occurring later than the main season are unlikely to provoke symptoms in patients exposed to pollen throughout April and May. At the end of the season, patients appear to be less sensitive to airborne pollen than when it begins (Davies, 1973). On the other hand, persons from the more northerly parts of the EEC who visit Bologna in June can be exposed to what is for them clinically significant concentrations of grass pollen, at a time when the season is over for the pollen-sensitive population of Bologna.

In Munich and Strasbourg (Fig. 2), the number of 100% symptom days were six and eleven. However, since on three days no observations were made in Strasbourg, a possible maximum of fourteen 100% symptom days must be assigned to Strasbourg. At Strasbourg the season began with a count of 70/m³ on 2 June, and at Munich on 8 June with 75 grains/m³. At both cities the grass pollen season was confined to June.

In Brussels the season began on 6 June with a count of 55/m³, in London on 9 June with 60/m³ (Fig. 3). In both these cities the pollen season extended throughout June to mid July. In Brussels there were twenty-three high count days in June and nine in July, in London seventeen in June, five in July. The curve for Brussels (Fig. 3) shows a steady, less steep rise to the peak June concentration than that for London, and once the season started in Brussels, in the 35-day period over which high counts were recorded there were only 3 days when the count dropped below 50/m³. During the 32-day season of high counts at London, there were 10 days with counts of less than 50/m³.

The 100% symptom day curves for Bologna, Brussels and London (Figs. 1 & 3) show two pollination peaks and this was most conspicuous at Bologna. A succession of two peaks for each city is shown by the smoothed curves in Fig. 4.

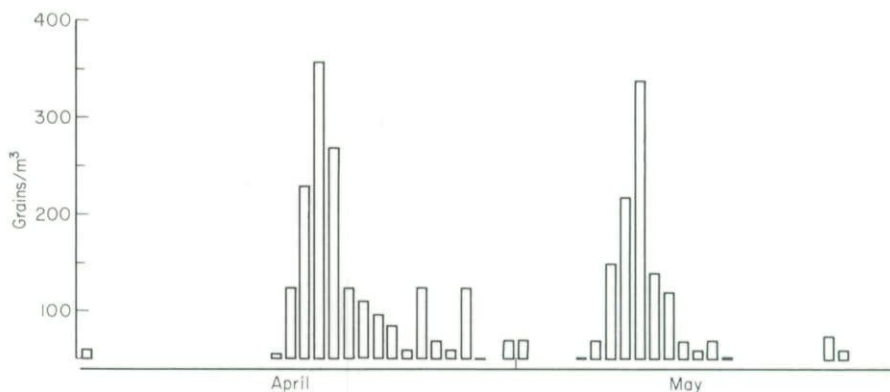


Fig. 1. Mean daily grass pollen concentrations greater than $50/\text{m}^3$ at Bologna in 1973.

In the United Kingdom, the earlier the commencement of the pollen season, the more severe is the season likely to be for the hay fever sufferer, the later the onset the shorter is its duration (Davies, 1969). It has been reported by Davies and Smith (1973), that in the London region, the pollen potential for the season is determined by the temperature for grass development in April and May, the months which precede the season of summer hay fever. By ranking the date of the first pollen count of $50 \text{ grains}/\text{m}^3$ or more with the mean air temperatures for April and May at four stations around London during the years between 1961 and 1970, Davies & Smith (1973), produced a table which has been of value in forecasting the start of the hay fever season in London (see Table 1). Since the sum of the mean April and May temperatures were only greater than 21° in two of the years studied in London, in order to meet the higher temperatures encountered at Strasbourg the data has been extrapolated upwards in Table 2.

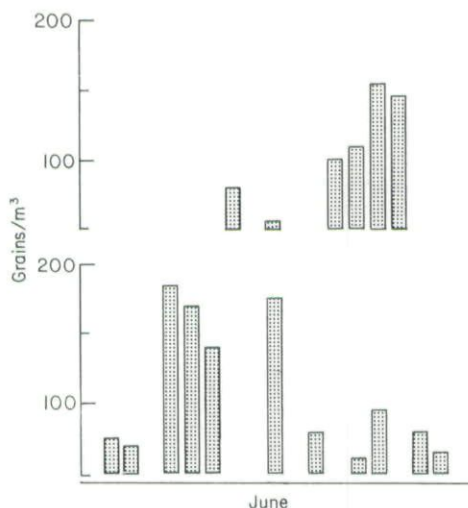


Fig. 2. Mean daily grass pollen concentrations greater than $50/\text{m}^3$ at Munich (top) and Strasbourg (bottom) in 1973.

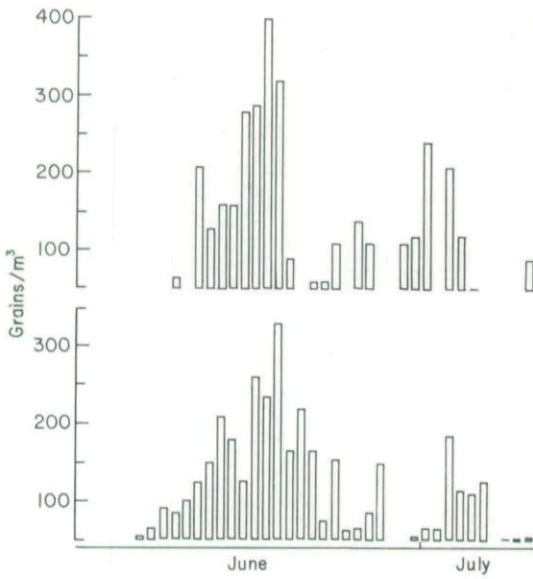


Fig. 3. Mean daily grass pollen concentrations greater than $50/\text{m}^3$ at Brussels (bottom) and London (top) in 1973.

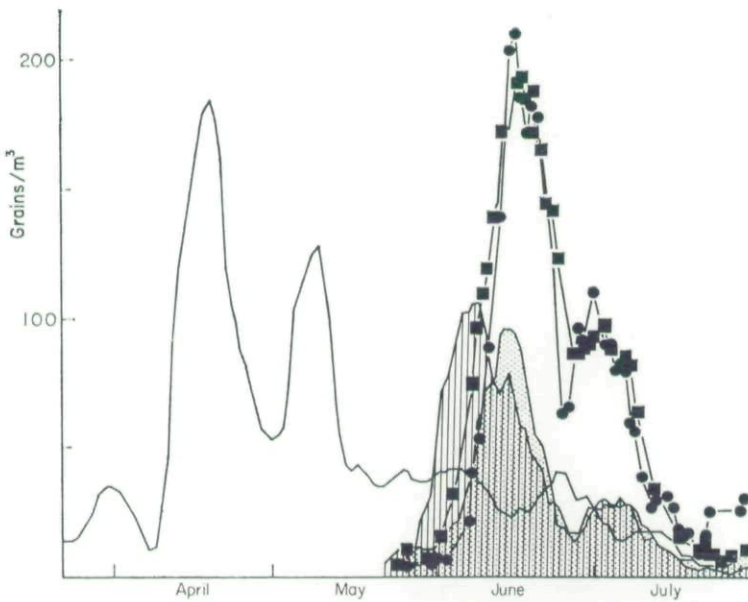


Fig. 4. Ten day running means of the daily grass pollen concentrations at five cities in the EEC. —, Bologna; ■—■, Brussels; ●—●, London; ⊠, Munich; ▤, Strasbourg.

Table 1. Relationship between air temperature in April and May at four stations around London and the date of the first possible 100% symptom day (after Davies & Smith, 1973)

Mean air temperature T4 value (°C)	Date of first possible 100% symptom day
Over 21.0	4 June
20.0–20.9	5 June
19.5–19.9	6 June
19.0–19.4	7 June
18.5–18.9	8 June
18.0–18.4	9 June
17.5–17.9	10 June
Below 17.5	11 June

Table 2. Mean air temperatures for April and May extended to give an earlier start of the season by a day for each degree above 21°C

Mean air temperature for April and May (°C)	Date of first possible 100% symptom day
23 or more	1 June
22.0–22.9	2 June
21.0–21.9	3 June
20.5–20.9	4 June
20.0–20.4	5 June
19.5–19.9	6 June
19.0–19.4	7 June
18.5–19.9	8 June
18.0–18.4	9 June

Table 3. Comparison of the date of the first possible 100% symptom day on the basis of spring air temperatures with that actually observed

	Mean April & May air temperature (°C)	Date of first possible 100% symptom day	Date first 100% symptom day was observed in 1973
Strasbourg	22.74	2 June	2 June
London	21.40	4 June	9 June
Brussels	20.80	5 June	6 June
Munich	18.60	8 June	8 June

The mean April and May air temperatures, the first possible 100% symptom day obtained from Table 2, and the first observed 100% symptom day at the cities other than Bologna are given in Table 3. The data from Bologna is excluded because of the high pollen counts in April, and clearly the climate of this region and the possibilities of an early flowering grass require further investigation. Although a method of forecasting the first possible 100% symptom day according to the air temperatures for April and May seems promising in the light of the data given in Table 3, a fuller evaluation under the conditions of Central Europe is necessary. Emphasis must also be given to the fact that a forecast based on the weather of April and May, and which can be made on 1 June, refers to the first possible day. The actual start may be delayed by a cold spell and days with high rainfall in early June, as was the case at London in 1973 (Table 3).

Discussion and conclusions

In an atlas of European pollen edited by Charpin, Surinyach and Frankland (1975), the grass pollen seasons for the countries relevant to this study are given as April to June, Italy; end of May to end of June, Germany (Mannheim); end of May to end of July, France; and June to July, Great Britain and Belgium. The pollen seasons recorded in this study all occurred during the periods given in the calendars. However, three of the calendars give no guide as to the amounts of pollen inhaled, since this can only be calculated from volumetric data, such as that given for Germany by Stix & Ferretti (1975) and for the United Kingdom by Frankland (1975). The present results reveal great differences between the pollen challenge in the five cities. Similar concentrations were recorded in Bologna, Brussels and London and lower concentrations were found in Munich and Strasbourg. These lower concentrations may be related either to the amounts of farm land in grass or the continental climate. The 33% of farm land in grass in the area around Munich must be compared with areas of about 50% around London and Brussels. The mean maximum June temperatures at Munich, London and Brussels were 21.2°C, 21.7°C and 22.1°C respectively. Temperature differences of this order render it more likely that the relatively low grass pollen concentrations at Munich reflect land usage rather than climate. On the other hand, the higher mean maximum temperature for June of 23.7°C encountered in Strasbourg could be indicative of higher convection, which in turn could lead to a lowering of pollen concentrations. Clearly in the regions of the EEC, the effect of climatic features in relation to atmospheric pollen concentrations would seem worthy of further study.

It may be concluded that in 1973 the grass pollen concentrations varied in the cities described. The numerical challenge was least severe in Munich followed by Strasbourg. Higher mean daily pollen concentrations, and greater numbers of 100% symptom days were encountered in Bologna, Brussels and London. In London the daily fluctuation between high and low counts (Fig. 3) was greater than that found in Brussels. It is possible that this presents a greater allergenic stimulus than that provoked by the more steadily increasing concentrations encountered in Brussels. This would seem worthy of clinical investigation. At Bologna there appear to be earlier flowering varieties of grass, and although the main season finished before June, patients travelling into the area from regions where the season is later and whose annual exposure has not begun, may have occasional exposure to a clinically significant level of grass pollen in June.

Acknowledgments

We wish to thank all our colleagues who have helped in obtaining the data for these studies.

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