



Short communication

Seasonal distribution of pollen in the atmosphere of Melbourne: an airborne pollen calendar

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Abstract

Environmental monitoring of pollen grains in the atmosphere of Melbourne has been achieved using Burkard volumetric traps. Twenty-two families of flowering plants and conifers were identified in the pollen counts. About 62% of these pollen grains belonged to trees, 20% to grasses and 9% to herbs and weedy plants. During spring and summer, the atmosphere contained about 70% of the total annual pollen count. Tree pollen, predominantly elm and cypress, occurred abundantly in late winter and spring, with grass pollen predominantly in spring and early summer. These three types of pollen grains occurred in significant amounts, together accounting for more than 60% of the total annual catch. A seasonal incidence chart (pollen calendar) for Melbourne based on 2 years observation has been constructed. This pollen calendar is useful in identifying sources of allergies against particular seasonal airborne pollen types. Comparison of the time of occurrence of a particular pollen type using the pollen calendar and the time of allergic symptoms, can lead to accurate diagnosis and preventive measures being taken. This study has confirmed that grass pollen is the major source of allergenic pollen in the external environment triggering hay fever and allergic asthma in spring and early summer in Melbourne, Australia.

Keywords: Aerobiology; Pollen count; Pollen calendar; Pollen; Pollinosis

1. Introduction

In the southern hemisphere city of Melbourne, previous quantitative studies of airborne pollen grains were focused on the incidence of grass pollen in spring and early summer, and did not provide any information on other recognizable pollen types (Smart and Knox, 1979; Smart et al., 1979). Since then, the spectrum of vegetation has changed with urbanization and industrialization. The climate is generally temperate, with warm dry summers and cool wet winters. The mean daily maximum temperature ranges from 26°C in January, the hottest month, to 13°C in July, the coldest month. The mean daily minimum temperature ranges from 14°C in January to 6°C in July. Total rainfall varies considerably. In this cool temperate climate, many introduced plants that are known to release allergenic pollen grains are able to flourish. In addition, there are some native plants which are able to cause hay fever (Derrick, 1962). Here we report the daily seasonal and

monthly variations of various pollen types and use these data to construct a pollen calendar for Melbourne.

2. Materials and methods

2.1. Pollen count

The September 1991–August 1993 pollen counts were performed using a Burkard 7-day recording volumetric trap (Burkard Manufacturing Co. Ltd., Rickmansworth, Hertfordshire, UK). Airborne pollen grains were trapped on an adhesive (10% Dow Corning A280 series in xylene) tape by intake of air at a flow of 10 l min⁻¹. The tape was mounted on a rotating drum driven by clockwork and enabled recording of the time variance during the day. The exposed tape was cut into seven pieces, each representing daily values and each was mounted on a separate glass slide. Pollen grains were stained with Calberla's stain and counted by light microscopy. The amount of pollen was expressed as the number of pollen grains m⁻³ of air. Daily concentration of pollen was determined by randomly scanning the middle of the tape along the length of the tape (lengthwise traverse).

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2.2. Location of sampler

The trap was located on the roof of the Natural Philosophy building at the University of Melbourne, 14 m above ground level. The site is just north of the central business district. The siting of the trap conforms to Australian Standard AS 2922-1987, Ambient air — guide for the siting of sampling units (Standards Association of Australia, Sydney, NSW) for environmental monitoring.

2.3. Pollen classification

The recognition and identification of specific or generic characters of isolated pollen grains is not always possible. Where specific identification was given, it was based on material in a collection of slides prepared directly from known plants. In general, pollen grains were listed as belonging to a type of plant, a family or a genus. Continuous observation of the flowering periods of plant species in the vicinity has made it possible to assess the major contributing sources of each type of pollen appearing on the sample slides. In addition to the slide collection, reference works by Lewis et al. (1983) and Smith (1984) were consulted.

3. Results

3.1. Seasonal pollen incidence

The pollen grains sampled in the atmosphere of Melbourne from September 1991 to August 1993 can be classified into 22 families of flowering plants and conifers. The total pollen concentration of all taxa exhibited seasonal periodicity. Three distinct periods of high pollen incidence were recognized: winter (July–August); spring (September–November); and summer (December–January) (Fig. 1). The winter and spring peaks were higher and were due to a greater number of plants that were flowering during this time. Most trees flower in late winter and spring. The summer peak was lower and was due to grasses and some herbs and weedy plants. About 62% of these pollen grains belonged to trees. Grasses, herbs and weeds accounted for 20% and 9%, respectively.

Trees pollen grains could be classified into 14 taxa, while five taxa were identified for herbs and weeds, two taxa for grass-like plants (Cyperaceae and Typhaceae), and grasses (family Poaceae).

In autumn, winter and spring, tree pollen grains accounted for an average of 61.5, 97.5 and 61.0% of the total pollen grains collected from the atmosphere, respectively. The most important pollen grains during autumn came from families Myrtaceae and Oleaceae with an average of 43% of the total pollen grains collected. In winter, *Ulmus*, *Cupressus*, Oleaceae, *Pinus* and *Alnus* represented most of the airborne pollen grains with an average of 93% of the total pollen. The atmosphere during spring contained pollen from *Ulmus*,

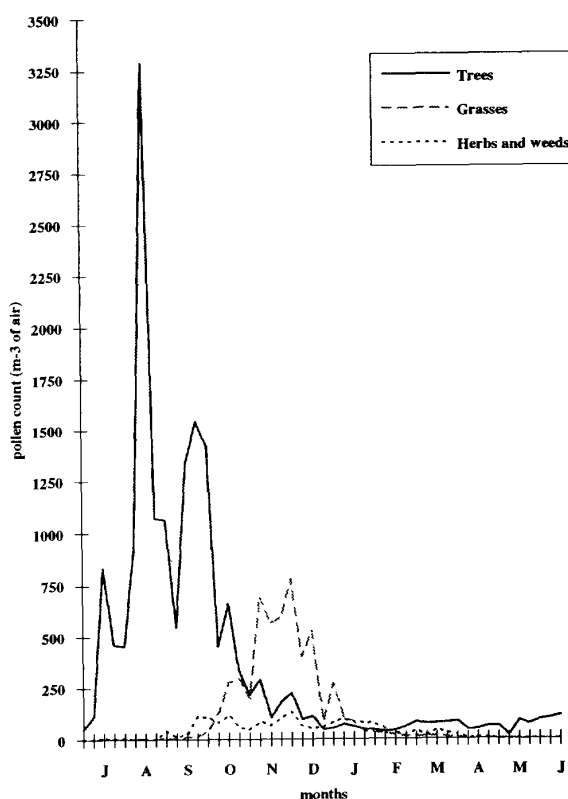


Fig. 1. Pollen counts of plants classified into three groups: trees, grasses, and herbs and weeds. The graph shows the average for the 2 years of weekly pollen counts from July to June the following year.

Cupressus, *Betula* and grasses to an average of more than 60% of the total pollen sampled. Grass pollen accounted for 52% of the total pollen collected during summer.

Each type of plant flowers at a certain time of the year. Variation occurred in the quantity of pollen sampled each month. From April to May, few pollen grains were detected in the atmosphere except for Oleaceae, suggesting that few plants flower at this time. A seasonal incidence chart (pollen calendar) is presented in Fig. 2. The graphs show the average for the 2 years of weekly totals from July to June of the following year.

4. Discussion

4.1. Pollen calendar

We have now presented a pollen calendar for Melbourne, which shows the precise seasonal progression of pollen types from tree pollen in winter, grasses in spring and herbs and weeds in summer.

In the southern hemisphere, the beginning of the annual growth cycle is in July (winter). Tree pollens

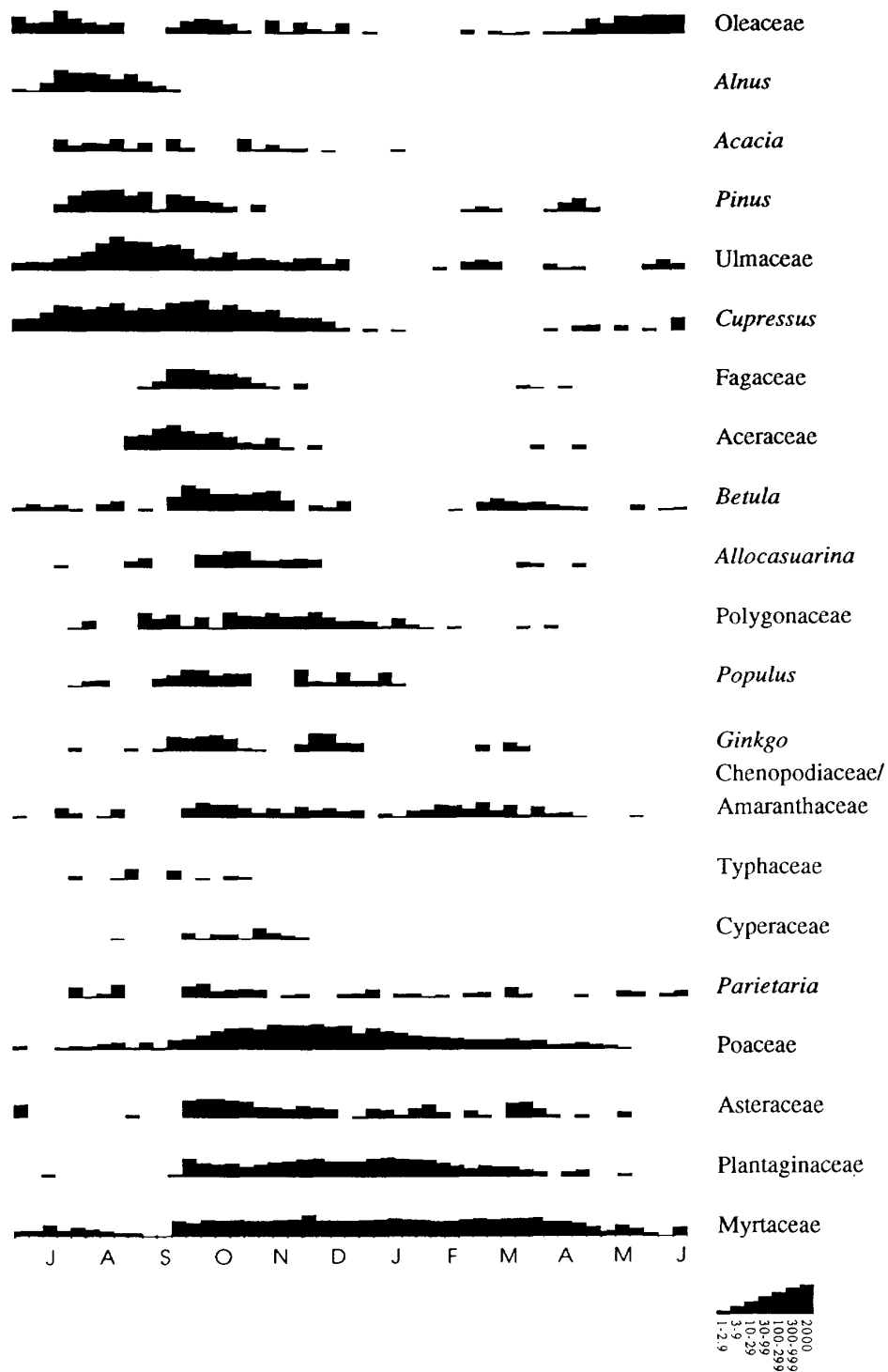


Fig. 2. Seasonal incidence (pollen calendar) of airborne pollen of 22 taxa collected from the atmosphere of Melbourne (1991–1993). The graph shows the average for the 2 years of weekly pollen counts from July to June the following year, in exponential classes as indicated at lower right of figure, following the method of Spiekma et al. (1985).

predominate in winter and early spring. Members of the family Oleaceae start flowering (especially *Fraxinus*) from May to July. A minor peak in October and November is olive and privet pollen, which are primarily insect-pollinated trees. These quantitative observations confirm those of Derrick (1966) in Melbourne. Once the pollen of *Fraxinus* decreased, the air is filled with pollen from other trees, *Alnus*, *Acacia* and *Cupressus*. The pollen of *Alnus* and *Acacia* last until September while *Cupressus* flowering persists until November. July–September is the main flowering period of *Acacia* trees but the pollen count gave only low values since the trees are insect-pollinated and the large compound grains do not travel long distances. By early spring, *Ginkgo*, oak, Aceraceae and *Populus* are flowering and the pollen persists until October. As pollen of *Ginkgo*, oak, Aceraceae and *Populus* diminished in number, those of *Betula*, *Allocasuarina* and Myrtaceae species appeared. *Betula* and *Allocasuarina* persisted until November whereas the flowering time of Myrtaceae extended until April. There is a minor peak occurring for *Populus* pollen in December. The two distinct peaks of *Populus* pollen are due to separate flowering of lombardy and golden poplars (Derrick, 1966).

In spring, while the tree pollens subsided to low levels except for Myrtaceae, grass pollens predominate from November to December. The main season for herb and weed plants occurs from October to March. The only tree pollen from *Liquidambar* appears from January to March.

The most significant contribution to the pollen calendar is that of grasses, *Ulmus* and *Cupressus*. The period of these plants spanned from end of June to end of February, accounting for 67% of the time in a year. The greatest contributors to grass pollen are from introduced species such as perennial and annual rye-grasses and canary grasses (Smart et al., 1979). These grasses are grown extensively as pasture grasses and the rye-grasses occur as weeds in wheat crops in Victoria. In Melbourne, elms are planted along the roads and in public gardens. The most popular elms are the ornamental variegated elm (*U. minor* 'Variegata'), weeping wych elm (*U. glabra* 'Camperdownii'), golden wych elm (*U. glabra* 'Lutescens') and Chinese elm (*U. parvifolia*). Other contributors that present airborne pollen in considerable amounts are Oleaceae, *Alnus*, *Pinus*, Aceraceae, Fagaceae, *Betula*, Myrtaceae and *Plantago*. Most of these plants where high pollen counts were recorded are not amply represented near the trap site and thus the pollen counts obtained cover a wider part of Melbourne.

Pollen calendars are useful in identifying allergies against particular airborne pollen types. Comparison of the time of sensitivity with the pollen calendar can lead to diagnosis and preventive measures being taken. However, the limitation of this type of pollen calendar is the

occurrence of year to year variation in both the number and time of appearance of each type of pollen grains. In this case, data are the average of 2 years but 5 or 10 years data might prove even more reliable.

4.2. Annual pollen catches

Concentrations of airborne pollen showed large day to day, seasonal as well as yearly variations. Among the types recorded over the 2-year period, grasses, *Ulmus* and *Cupressus* occurred in significant amounts, together accounting for more than 60% of the total annual catch. The tree pollen grains peak in late winter and spring, notably in the months of September and October followed by grass pollen grains in late spring and early summer, especially November and December. During spring, 49% of the total pollen grains were counted, while 20% were found in summer.

Are Melbourne pollen counts (especially grass) comparable with those of other areas? For example, in Leiden, The Netherlands, which also has a cool temperate climate, the total grass pollen count over a 5-year period varied from 3834 to 5816 per annum (Spieksma et al., 1985; Spieksma, 1986). In Madrid, Spain, which has a Mediterranean climate, the total grass pollen count over a 14-year period varied from 2568 to 6624 per annum (Subiza et al., 1992). These values are in the same general range as those of Melbourne (2319–6798 per annum; Ong, 1994).

5. Conclusions

The atmosphere of Melbourne during spring and summer contains approximately 70% of the total annual pollen. Twenty-two types of pollen grains have been identified and the levels averaged over 2 years. Tree pollen occurred predominantly during late winter and spring while in summer, the air contained mostly grass pollen.

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