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Short communication

Seasonal distribution of airborne pollen in the Coastal Plain of Israel

Yoav Waisel [a,*], Eliezer Ganor [b], Michael Glikman [b], Valentina Epstein [a], Shmuel Brenner [b]

[a] *Department of Botany, Tel Aviv University, Ramat Aviv 69978, Israel*
[b] *Ministry of the Environment, Medical School, Tel Aviv University, Ramat Aviv 69978, Israel*

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Abstract

Airborne pollen was monitored in three major urban centers of the coastal plain of Israel during the years 1993–1995. Results show spatial and temporal variations among the three sites. Altogether, the number of identified species was rather low. Ornamental trees (Cupressaceae, *Pinus*, *Olea*, *Casuarina*, *Ceratonia*) and grasses, have constituted the main source of the pollen rain. A substantial contribution of the wild plants of the region was restricted to *Parietaria*, *Urtica*, *Mercurialis*, *Artemisia*, grasses and members of the Chenopodiaceae and Amaranthaceae. © 1997 Elsevier Science Ireland Ltd.

Keywords: Aerobiology; Pollen; Pollen calendar; Pollen spectrum

1. Introduction

Airborne pollen is being regularly recorded in Israel, since 1993, when three stations were established in the densely populated urban areas of the coastal plain of Israel: Ramat Gan, Tel Aviv (Ramat Aviv) and Haifa. The three areas are characterized by various native and introduced plant species, typical for the Mediterranean region (Keynan et al., 1991; Waisel and Keynan, 1991). Among these plants, the best known for their allergenicity are *Olea europaea*, *Parietaria judaica*, *Cupressus sempervirens*, *Pistacia lentiscus*, *Artemisia monosperma* as well as various grasses, chenopods and amaranths. The aim of the project was to identify the various species of airborne pollen, and to determine their spatial and temporal variations.

2. Materials and methods

Airborne pollen and spores were monitored from January 1993 through December 1995, using two types of instruments: Rotorod volumetric samplers (Model 87, Sampling Technologies, Inc., Los Altos Hills, CA, USA) and Burkard pollen trap (Burkard Manufacturing Company Ltd., Rickmansworth Herfordshire UK).

Monitoring in Tel Aviv (Ramat Aviv) was performed using the Burkard 7-day volumetric trap. The instrument was located on the roof of a two stories building of the Tel Aviv University campus, 8 m above ground level. The tape was changed every week, cut into seven segments, each corresponding to a daily collection. The data present averages of the seven days. The Rotorods were used in Ramat Gan and in Haifa. In Ramat Gan two samplers were used simultaneously, placed at a height of 1.2 and 1.8 m above ground, on a hill top. In Haifa the sampler was placed on a roof (12 m high) in the centre of Mt. Carmel area. Monitoring by the Rotorods was carried out every week. Measurements were made by two instruments, twice a day at 10.30 AM and at noon time, for 30 min each time. Pollen and

* Corresponding author, Tel: (972) 3 640 9189; fax: (972) 3 640 9380.

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spores were counted and their concentrations were expressed as the average concentration per cubic meter of air of the four measurements. No measurements were done in Haifa during the month of August. Identification of the species was done by light microscopy at a magnification of × 400. Results of the airborne spore calendar will be reported separately.

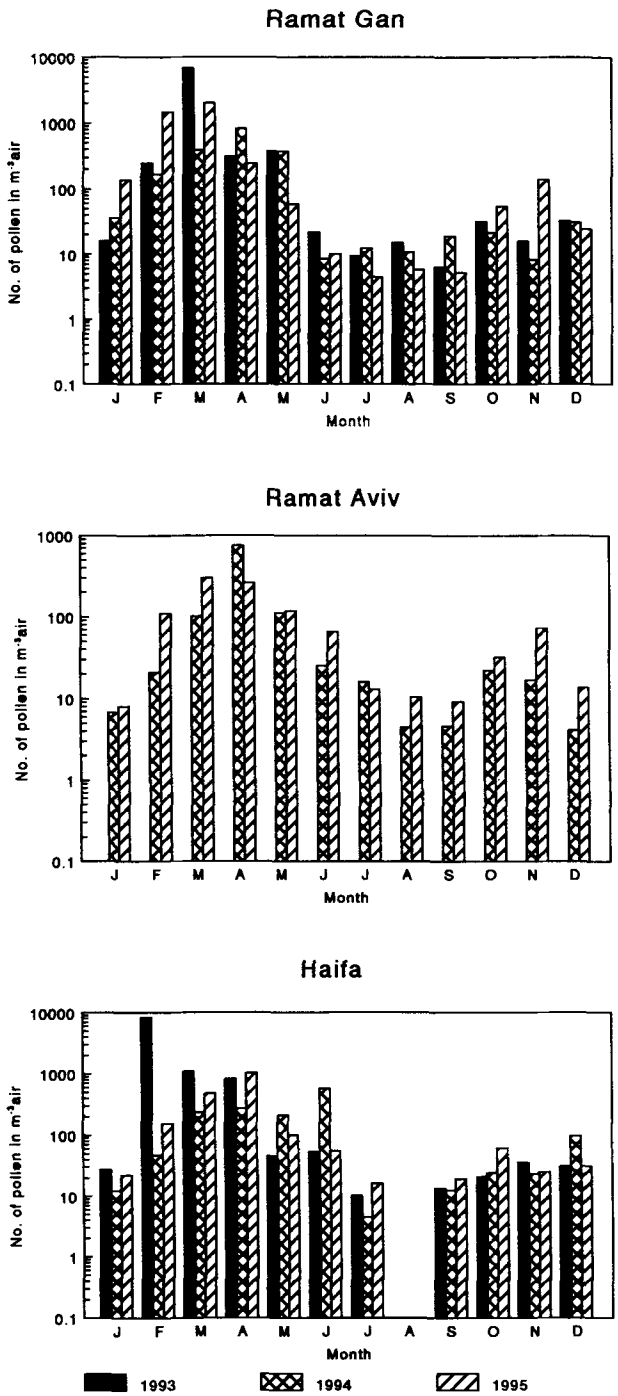

Fig. 1. The time course of the total number of airborne pollen in the three investigated sites, during the years 1993–1995. Data for the month of August, for Haifa, are missing. Note that pollen is on a log scale.

3. Results and discussion

Two periods of high pollen incidence were defined in all three sites: in late winter and early spring (February–May) and in the autumn (October–November) (Fig. 1). The highest peaks, observed during winter and spring (more than 8000 pollen. m^{-3} air), are apparently the result of the greater number of plants that flower at that time. The summer-autumn peak was lower by at least one order of magnitude.

The following pollen were recorded: *Carya*, *Mercurialis*, *Morus*, *Olea*, *Parietaria*, *Pinus*, *Pistacia*, *Plantago*, *Quercus*, *Ricinus*, *Rumex*, *Urtica*, and members of the Cupressaceae and Poaceae. The relative concentration of each of them in Ramat Gan is presented in Fig. 2. Apparently, the late winter season (February) was dominated by pollen of the Cupressaceae with a daily average concentration ranging from 179 to 8294 pollen grains per cubic meter of air.

The summer months were characterized mostly by olives, herbaceous weeds and grasses. The autumn pollen rain was dominated by shrubs (*Artemisia* and Chenopods) and by some of the ornamental trees (e.g. *Eucalyptus*, *Casuarina*, *Schinus*).

Special attention was given to the pollen of allergenic species. The Cupressaceae pollen allergy is a new aspect of pollinosis in some Mediterranean areas — France, Italy and Israel (Panzani et al., 1986; 1991) and high concentrations of airborne pollen of this group (Fig. 4) should raise the attention of the planning authorities.

Olea europaea is one of the major allergenic trees in Israel (Geller-Bernstein et al., 1996). Flowering of the olive trees begins in late March and continues till July and August (Fig. 3).

It is interesting to note that pollen of the Cupressaceae were present during most of the year (Fig. 4). This is probably contribution of various species (*Thuja orientalis*, *Cupressus arizonica* etc.) during different months. The peak was higher and earlier in Ramat Gan, but delayed somewhat in Haifa.

Pistacia (mostly *Pistacia lentiscus*) has a short, but intensive period of pollen release, from mid-February to mid-April. In Ramat Aviv the concentration of airborne pollen of *Pistacia* was much lower, by one order of magnitude, than in Ramat Gan or in Haifa (Fig. 5).

Airborne pollen grains of the various members of the Poaceae were present throughout the year (Fig. 6). However, concentrations above 2 pollen per cubic meter, were recorded, in all three stations only in spring time (March–May).

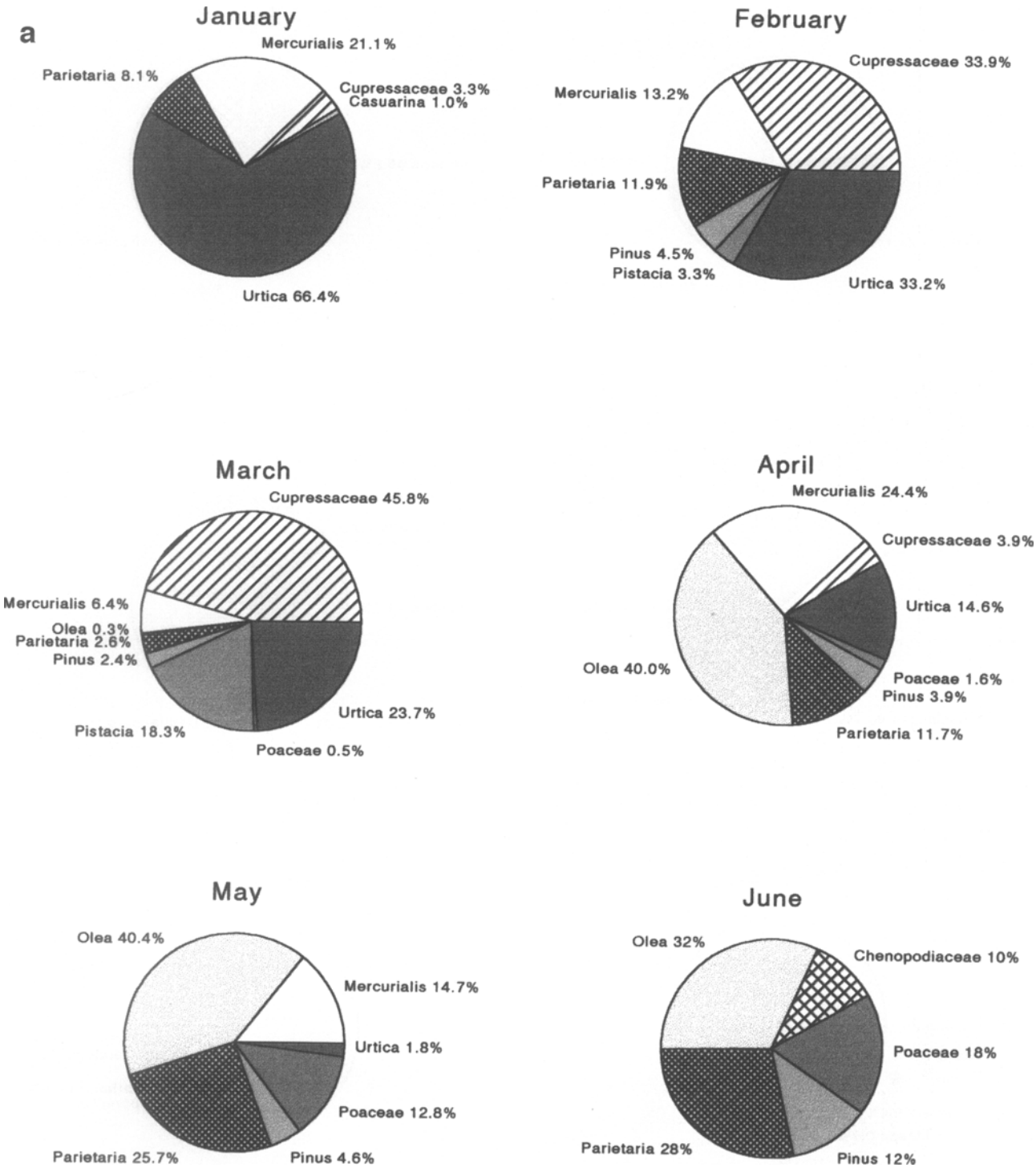

Fig. 2. Annual changes in the airborne pollen spectrum. Percent of the total pollen counts, Ramat Gan, 1995.

Airborne pollen grains of the various species of *Parietaria* were found almost throughout the year, with relatively small fluctuations between years (Fig. 7).

Pollen of the various members of the Chenopodiaceae and Amaranthaceae was observed during the period starting in April and ending in October. Highest daily concentrations (5–13 pollen grains per cubic meter) were recorded in spring and autumn months.

Casuarina pollen was detected in the late autumn and winter months (December–January), with an average daily concentration ranging between 8 and 108 pollen grains per cubic meter of air. During this sea-

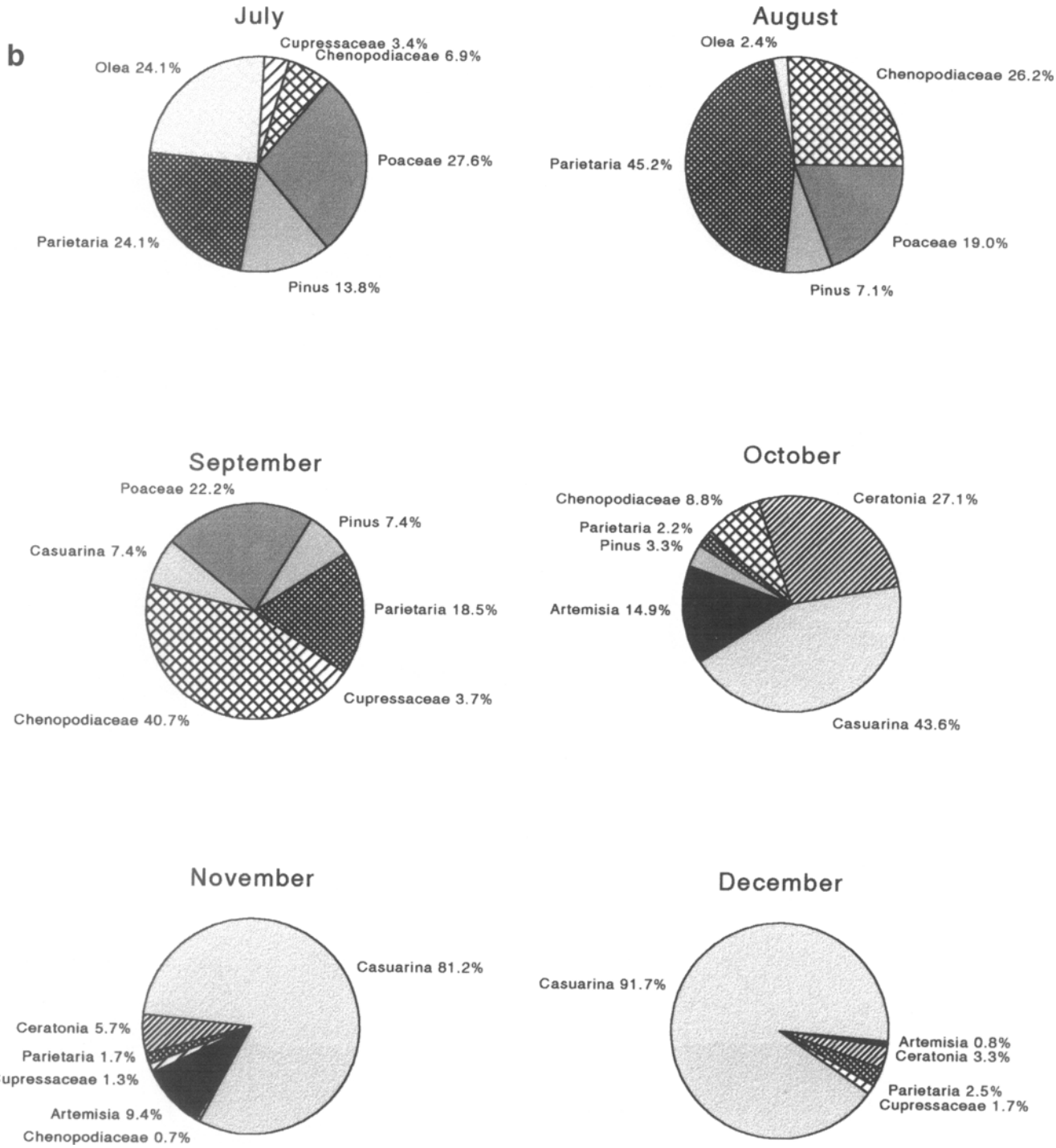

Fig. 2. (continued)

son, *Casuarina* pollen constitute a major part of the airborne pollen.

Differences in the dominance of pollen in the general pollen spectrum, were observed among the various sites. In Ramat Aviv the dominant pollen were of the Cupressaceae, *Olea* and *Pinus*. In Haifa, most pollen was of *Casuarina*, Cupressaceae, *Olea*, *Pistacia* and *Pinus*.

Though the concentrations of airborne pollen of *Artemisia* were rather low in all three monitoring stations, less than 50 pollen $\cdot m^{-3}$ air, such pollen have a significant effect in the induction of autumn allergy (Fig. 8). In general, the concentrations of the pollen grains of these dominant plants exceeded the critical threshold concentrations (30–50 pollen grains, per cubic meter of air), which were reported as critical for the induction of clinical symptoms in atopic patients (Strandhede et al., 1984; Spieksma, 1988; D'Amato and Lobefalo, 1989; D'Amato and Liccardi, 1994).

4. Conclusions

Airborne pollen concentrations in three cities, along the Coastal Plain of Israel, showed annual fluctuations. These were exceptionally high for the pollen of the winter and spring plants. During the summer and the autumn the differences in airborne pollen concentrations in the three sites were smaller. The highest average annual concentration of pollen was in Ramat Gan a city renown for its large green areas. The lower concentrations were recorded in Ramat Aviv are result probably caused by proximity to the coast, where the fresh sea breeze moves pollen contaminated air, eastwards. The pollen of trees is predominating during most of the year, whereas during the summer the atmosphere was mostly contaminated by pollen of grasses, shrubs and herbaceous weeds. The airborne pollen spectrum of Israel are comprised of many other

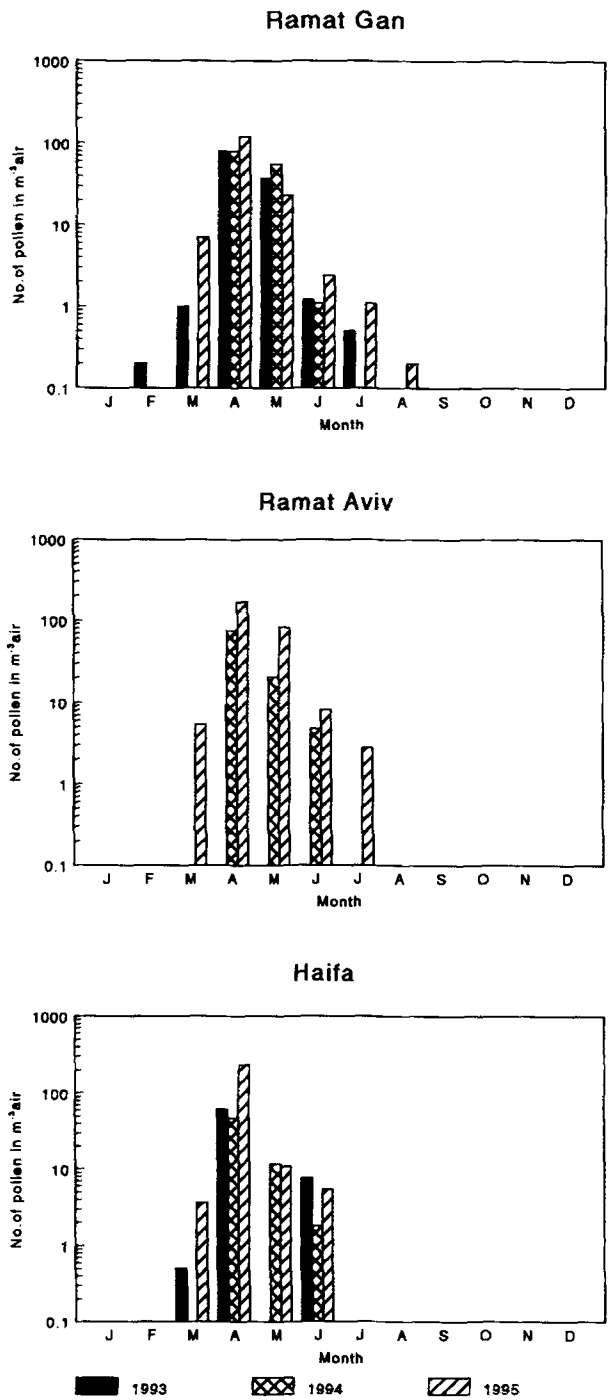

Fig. 3. Airborne pollen distribution of *Olea europaea* during the years 1993-1995, in the investigated sites.

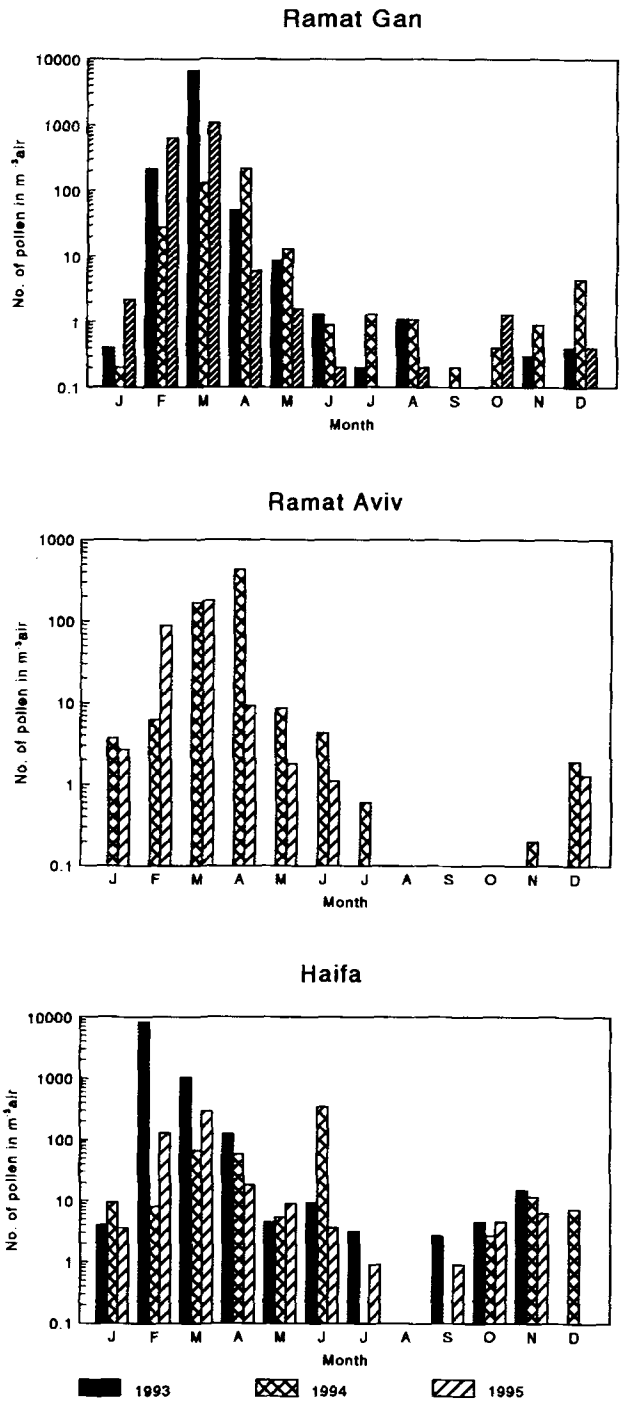

Fig. 4. Airborne pollen distribution of Cupressaceae during the years 1993-1995, in the investigated sites.

plant species (Keynan et al., 1991). However, the pollen concentrations of each of those species are lower than the concentrations that are known to provoke clinical responses. Nevertheless, the appearance of additional and uncommon species, should not be disregarded. In many cases the synergistic effects of various plant species, or of additional air pollutants, may lower the threshold level for pollen allergy. For some species e.g., *Plantago*, *Rumex* and Compositae, which induce pollinosis, might have a combined effect, and several types of pollutants may sum up and induce clinical responses (Pierson and Koenig, 1992), even at low airborne pollen concentrations.

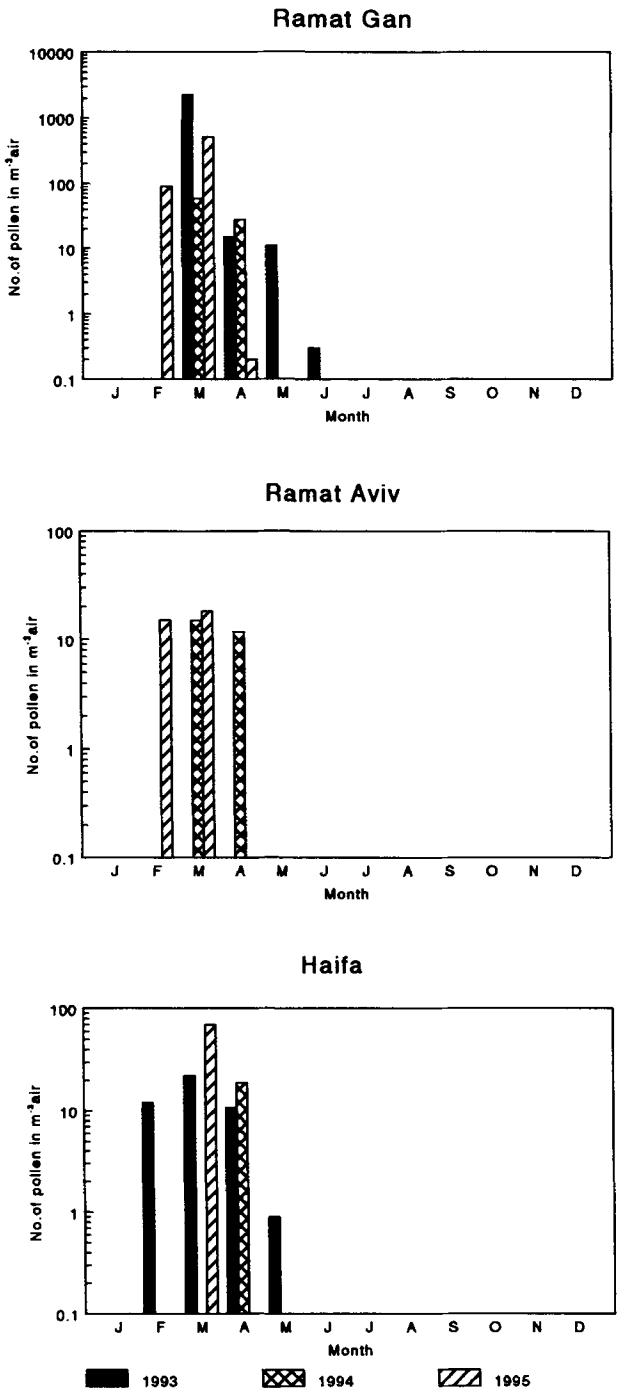

Fig. 5. Airborne pollen distribution of *Pistacia* sp. during the years 1993–1995, in the investigated sites.

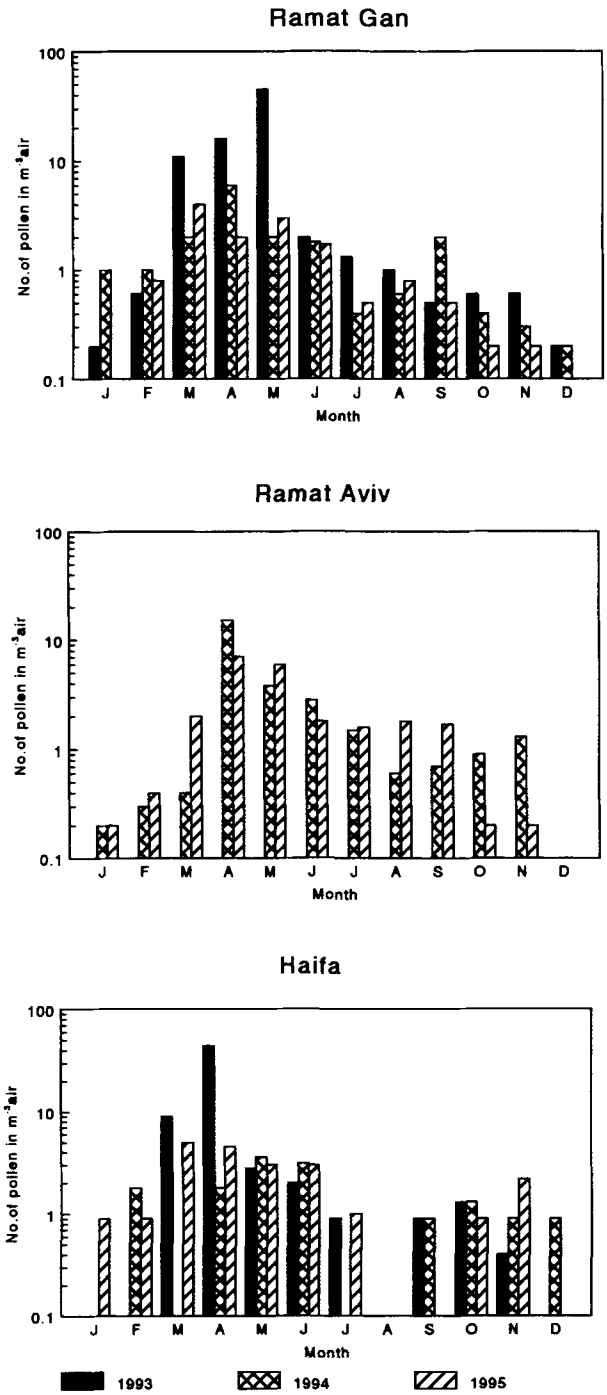

Fig. 6. Airborne pollen distribution of Poaceae during the years 1993–1995, in the investigated sites.

Acknowledgements

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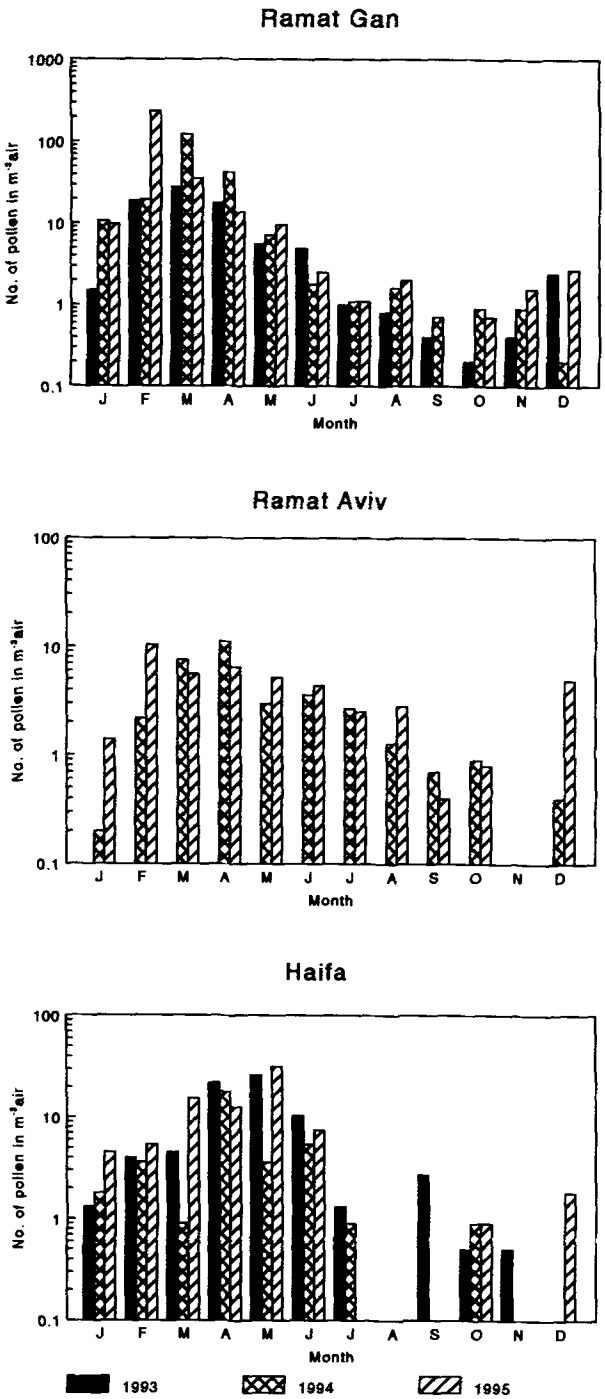

Fig. 7. Airborne pollen distribution of *Parietaria* sp. during the years 1993–1995, in the investigated sites.

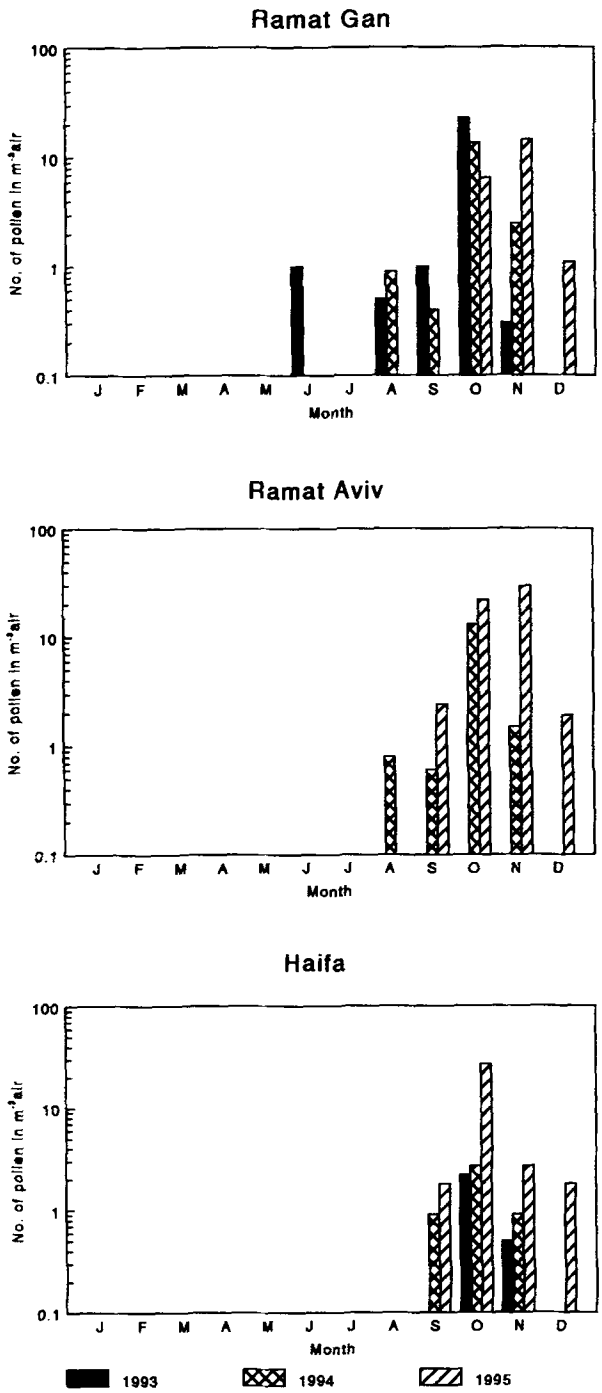

Fig. 8. Airborne pollen distribution of *Artemisia* sp. during the years 1993–1995, in the investigated sites.

References

D'Amato G, Lobefalo G. Allergenic pollen in the Mediterranean area. J Allergy Clin Immunol 1989;83:116–22.

D'Amato G, Liccardi G. Pollen related allergy in the European Mediterranean area. Clin Expt Allergy 1994;24:210–9.

Geller-Bernstein C, Arad G, Lahoz C, Cardaba M, Waisel Y. Allergy to pollen of *Olea europaea* in Isreael. Allergy 1996;51:356–9.

Keynan N, Waisel Y, Shomer-Ilan A, Goren A, Brenner S. Annual variations of airborne pollen in the Coastal Plain of Israel. Grana 1991;30:477–80.

Panzani R, Cemtanni G, Brunel M. Increase of respiratory allergy to the pollen of cypresses in the south of France. Ann Allergy 1986;56:460–3.

Panzani R, Zerboni R, Ariano R. Allergic significance of Cupressaceae pollen in some parts of the Mediterranean area. In: D'Amato G, Spieksma F, Bonini S, editors. Allergic pollen and pollinosis in Europe. Oxford: Blackwell Scientific Publications, 1991:81–84.

Pierson WE, Koenig JQ. Respiratory effect of air pollution on allergic disease. J Allergy Clin Immunol 1992;90:557–66.

Spieksma FThM. Retrospective and predictive systems of information on airborne pollen concentrations in relation to hayfever. Aerobiologia 1988;4:8–11.

Strandhede SO, Whil JA, Eriksson NE. Tree pollen allergy. 1. Feature plant, geography and pollen counts.. Allergy 1984;39:602–9.

Waisel Y, Keynan N. Urban pollution with allergic pollen: sources and consequences. Proc. Symp. Urban Pollution. Imzir, Turkey, 1991:24–28.