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Airborne Pollen Grains of Burdur，Turkey

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Abstract： The pollen grains in the atmosphere of Burdur have been studied for a two-year period (1996 through 1997) with a Durham sampler. A total of 11 881 pollen grains belonging to 39 taxa have been identified and recorded with some unidentified ones. Of them，5 726 were identified in 1996 and 6 155 in 1997. Of the total pollen grains，76.51% were arboreal，21.62% non-arboreal and 1.87% unidentified. The majority of the investigated pollen grains were from *Pinus* L.，Cupressaceae，Gramineae，*Quercus* L.，*Platanus* L.，Chenopodiaceae/Amaranthaceae，*Salix* L.，*Cedrus* L.，Compositae，*Juglans* L. and Urticaceae respectively. The highest level of pollen concentration was in May.

Key words： Turkey；Burdur；pollen calendar；pollen concentration
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Pollen grains cause some respiratory system diseases such as allergic asthma and hay fever. These diseases appear especially in flowering periods of plants. Determination of the type and concentrations of pollen grains will be helpful for patients suffering from allergic diseases. For this reason，the airborne pollen grains have been evaluated all over the world for several years by various studies to determine their dispersal[1－8]. The purpose of this study is to identify pollen grains and to determine the weekly，monthly and annual changes in their concentrations (grains/cm^2) in order to guide the doctors to diagnose allergic diseases.

1 Materials and Methods

Burdur is a region located in the South-West of Turkey (co-ordinates：36°53′ N，29°24′ E). It has an altitude of 950－1 050 m above the sea level. Generally，the Mediterranean climate，and Mediterranean and Irano-Turanion vegetation dominate in the region.

Fifty five percent of the Burdur area is covered by forest and shrubbery，35% by planted fields，and 10% by meadow and pasture. Roses，orchards (apple，carop，cornelian cherry，cherry，pomegranate，blackcherry，apricot，pear，plum，quince，etc.) are grown in the majority of the agricultural lands and in the lands suitable for the growth of wheat，barley，etc. The vegetation in the forest area consists of *Juniperus excelsa*，*J. oxycedrus*，*Cedrus libani*，*Pinus nigra* subsp. *pallasiana*，*P. brutia*，*Quercus cocciferae*.

In addition to the natural vegetation，the species，i.e. *P. nigra*，*P. brutia*，*Cedrus libani*，*Cupressus atlantica*，*Platanus orientalis*，*Acer* sp.，*Morus* sp.，*Populus* sp.，*Robinia* sp.，*Aesculus* sp.，*Tilia* sp.，*Juglans* sp.，*Catalpa* sp.，*Ailanthus* sp.，*Pyrus* sp.，*Cercis* sp.，*Syringa* sp.，can be frequently seen in the parks，gardens and streets of the Burdur town.

In this study，the gravimetric method and a Durham sampler[9－11] were used. The Durham sampler was placed on the office roof at the height of 25 m above the ground-level. Slides placed on the Durham sampler were changed weekly.

Before exposure，the slides were covered with glycerine jelly mixed with basic-fuchsin[12]. The slides were examined by light microscope weekly. The grains were identified and counted at genus level in most cases，and at family level in the least. The grains which could not be identified were considered as unidentified types.

2 Results and Discussion

A total of 11 881 pollen grains from 39 taxa were identified during two year period (5 726 in 1996 and 6 155 in 1997) in the Burdur atmosphere. Of 39 taxa，23 were arboreal plants and the rest of them were non-arboreal plants. Of the pollen grains，9 090 (76.51%) have been found as arboreal，while 2 569 (21.62%) as non-arboreal and 222 (1.87%) as unidentified (Table 1). The arboreal pollen types were dominant probably due to the vegetation and geographical location of the town. According to other studies carried out in Europe，arboreal pollen types are also dominant in other regions for the same reason，i.e. Finland 82%[3]，Ankara 76%[7]，Perugia 71%[13]，Bursa 70.01%[8]，and Ascoli Piceno 55%[13].

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Table 1 Annual totals of weekly pollen counts

	1996	1997	1996 – 1997	%
Taxa				
Pinus	1 645	1 697	3 342	28.13
Cupressaceae	1 751	1 554	3 305	27.82
Quercus	292	408	700	5.89
Platanus	259	366	625	5.26
Salix	109	112	221	1.86
Cedrus	19	155	174	1.46
Juglans	53	93	146	1.23
Moraceae	41	45	86	0.72
Alnus	42	36	78	0.66
Ailanthus	32	45	77	0.65
Sophora	42	27	69	0.58
Populus	22	20	42	0.35
Rosaceae	19	23	42	0.35
Pistacia	18	23	41	0.35
Oleaceae	9	28	37	0.31
Robinia	20	13	33	0.28
Fraxinus	9	21	30	0.25
Ericaceae	5	12	17	0.14
Acer	–	10	10	0.08
Ligustrum	4	6	10	0.08
Poterium	3	–	3	0.03
Acacia	1	–	1	0.01
Eleagnus	1	–	1	0.01
Total AP[1)]	4 396	4 694	9 090	
%	37.00	39.51		76.51
Gramineae	571	710	1 281	10.78
Chenopodiaceae/Amaranthaceae	320	293	613	5.16
Compositae	69	93	162	1.36
Urticaceae	57	78	135	1.14
Plantago	43	71	114	0.96
Artemisia	53	54	107	0.90
Rumex	18	20	38	0.32
Umbelliferae	8	19	27	0.23
Caryophyllaceae	17	7	24	0.20
Cyperaceae	11	8	19	0.16
Rubiaceae	6	6	12	0.10
Typha	4	8	12	0.10
Leguminosae	9	–	9	0.08
Luzula	8	–	8	0.07
Cruciferae	6	–	6	0.05
Papaveraceae	2	–	2	0.02
Total NAP[2)]	1 202	1 367	2 569	
%	10.12	11.50		21.62
Unidentified	128	94	222	1.87
Total	5 726	6 155	11 881	
%	48.19	51.81		100.00

1) AP, arboreal pollen grains; 2) NAP, non-arboreal pollen grains.

The predominant pollen producers of arboreal plants in the atmosphere of Burdur are *Pinus* sp., Cupressaceae, *Quercus* sp., *Platanus* sp., *Salix* sp., *Cedrus* sp. and *Juglans* sp. They form 71.65% of the total pollen concentration (Table 1). The herbaceous plants such as Gramineae, Chenopodiaceae/Amaranthaceae, Compositae and Urticaceae make up 18.44% of the total vegetation in the area (Table 1).

The 11 pollen types which were seen most frequently are shown in Fig. 1. The *Pinus* sp. has the highest concentration with a maximum value of 1 697 grains/cm^2 during 1997. The total mean values of other taxa analysed for the two-year period were: 1 671 grains/cm^2 for Cupressaceae, 641 grains/cm^2 for Gramineae, 350 grains/cm^2 for *Quercus* sp., 313 grains/cm^2 for *Platanus* sp., 307 grains/cm^2 for Chenopodiaceae/Amaranthaceae, 111 grains/cm^2 for *Salix* sp., 87 grains/cm^2 for *Cedrus* sp., 81 grains/cm^2 for Compositae, 73 grains/cm^2 for *Juglans* sp. and 68 grains/cm^2 for Urticaceae.

Monthly variations of the recorded pollen grains are shown in Fig. 2. The seasonal variation in arboreal and non-arboreal pollen concentrations is given in Fig. 3.

The earliest pollen grains appeared in January (Fig. 2). The main arboreal pollen grains were observed in this month. Pollen grains began to increase in February, March and April, and reached to their maximum levels in May (2 541 pollen grains in 1996, and 2 464 in 1997). *Pinus* sp., Gramineae, *Quercus* sp., *Platanus* sp., Cupressaceae, *Salix* sp., *Juglans* sp., Urticaceae and Compositae are dispersing high amounts of pollen, more than 33%, into the atmosphere throughout their pollination period, especially in May. The amounts of pollen grains were also in high levels in June. From the beginning of July, the pollen grains of weeds became dominant, but the amount of pollen was lower than it was in spring. The reason for this decrease after June might be correlated with the end of the pollination periods of many arboreal plants which produce and release high amount of pollen grains into the atmosphere (Fig. 3). In July, the nonarboreal pollen grains from Gramineae, *Plantago*, Urticaceae, Compositae, Umbelliferae, Chenopodiaceae/Amaranthaceae, Caryophyllaceae and *Artemisia* were observed and arboreal pollen grains from *Ailanthus*, Cupressaceae, *Pinus*, *Sophora* and *Cedrus* were observed. High amounts of pollen grains of Chenopodiaceae/Amaranthaceae, *Cedrus* sp., *Artemisia* sp. were recorded in August-September and low amounts of pollen grains for *Cedrus* sp., Chenopodiaceae/Amaranthaceae, Gramineae, Compositae, and *Artemisia* sp. were recorded in October. Low amounts of Cupressaceae and

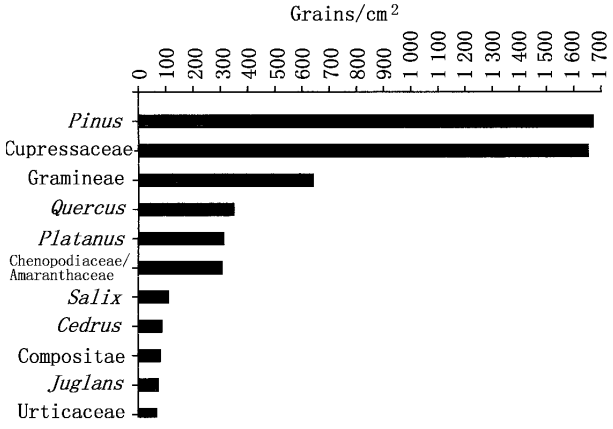

Fig.1. Total annual mean values of the main pollen types in the atmosphere of Burdur, from 1996 to 1997.

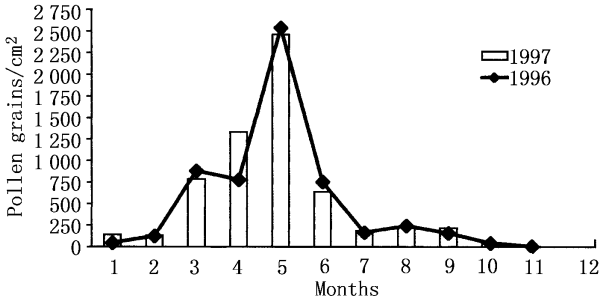

Fig. 2. Monthly total pollen concentration in the atmosphere of Burdur, 1996 – 1997.

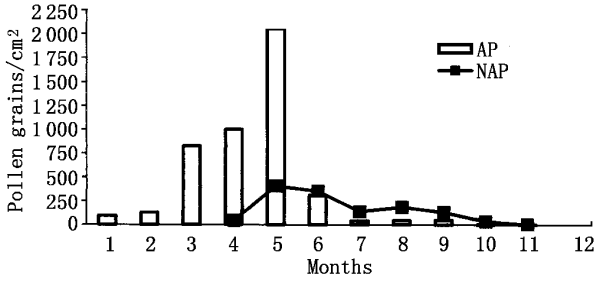

Fig. 3. Monthly mean variation of arboreal and non-arboreal pollen grains, Burdur, 1996 – 1997.
AP, arboreal pollen grains; NAP, non-arboreal pollen grains.

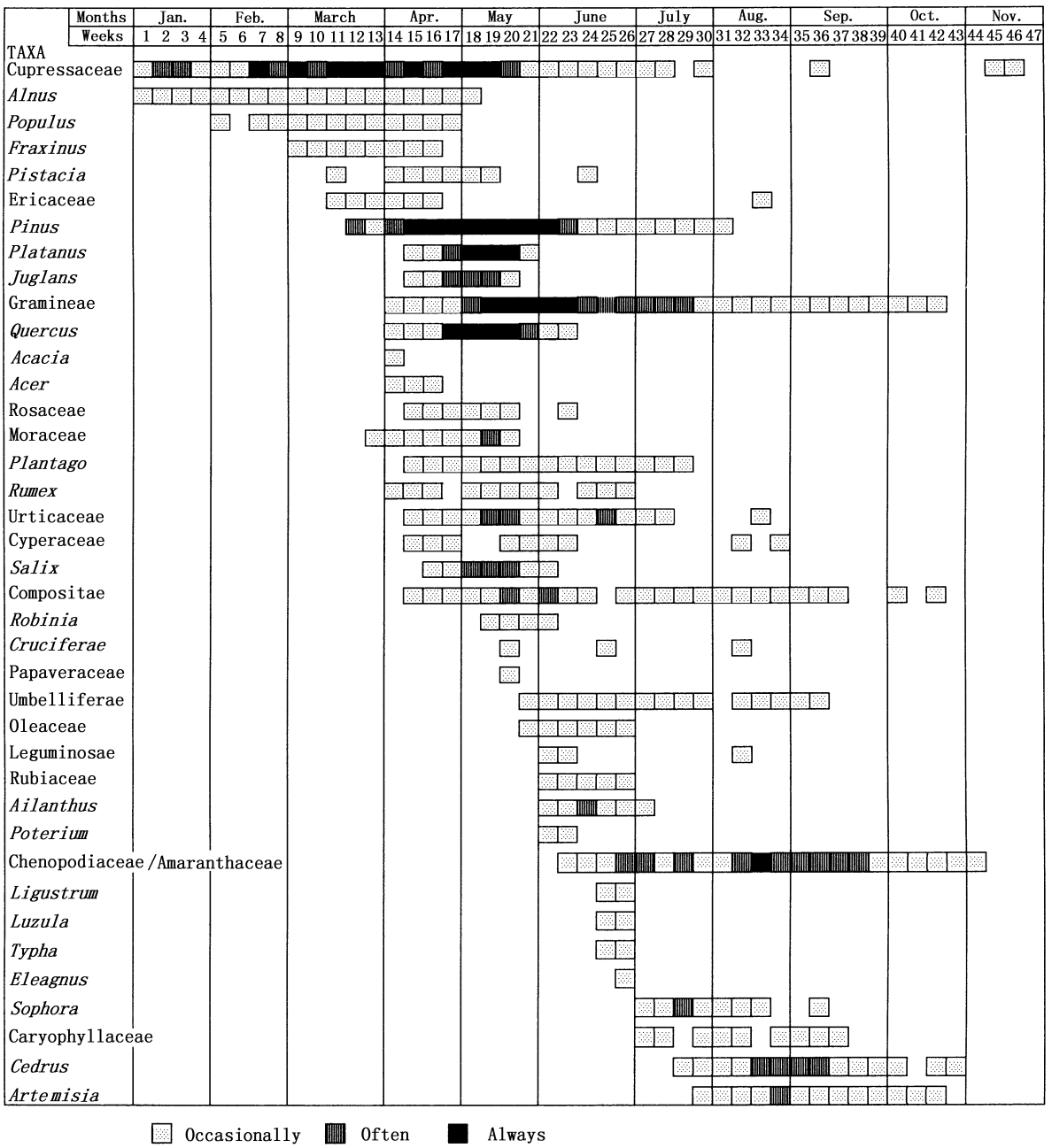

Fig. 4. Pollen calendar of Burdur.

Chenopodiaceae/Amaranthacea were recorded in November, but no pollen grains were observed in December (Fig. 4).

Even though they represent only a small proportion of the airborne particles present in the atmosphere, pollen grains can be the cause of allergic responses in susceptible humans, and pollinosis (ocular rhinitis and/or asthma) is now a public health problem. *Alnus*[6,14], Cupressaceae[15], *Quercus*[6,14], *Platanus*[4,14], *Juglans*[14], Moraceae[14,15], *Pinus*[16], Oleaceae[17], *Fraxinus*[14,15], *Acer*[14,15], Gramineae[18], Chenopodiaceae/Amaranthaceae[15], Compositae[19], Urticaceae[20], *Plantago*[21], *Artemisia*[15], *Rumex*[21], Umbelliferae[19], which can be detected in the atmosphere of Burdur, may cause asthma and allergic rhinitis in susceptible humans. The pollen grains of *Salix*[3], *Populus*[14,15], Rosaceae[15], Cyperaceae[15], Leguminosae[15,19], Cruciferae[19], *Cedrus*[22], *Ailanthus*[15], *Robinia*[19], *Ligustrum*[17], *Elaeagnus*[19], Caryophyllaceae[19], *Typha*[15], Papaveraceae[19] taxa have also been shown to produce milder allergic reactions.

Of the arboreal pollen grains, *Pinus*, *Quercus*, *Platanus*, *Juglans*, Moraceae and of the non-arboreal pollen grains, Gramineae, Chenopodiaceae/Amaranthaceae, Compositae, Urticaceae, *Plantago* were recorded at such high concentrations that they must be considered as the most important allergic pollen grains in Burdur.

The most important airborne pollen grain types in all European countries are Gramineae, followed by Urticaceae[23]. In Northern Europe[2,3,6], the pollen grains of Betulaceae (*Betula*, *Alnus*, *Corylus*), Gramineae and Urticaceae are significant in contributing to the incidence of pollinosis, whereas Gramineae, Urticaceae and *Olea* pollen grains are responsible for many cases of pollinosis in the Mediterranean region[4,17,20].

In conclusion, we have established the airborne pollen calendar for Burdur (Fig. 4) in order to determine the number of pollen grains causing allergenic disease in the area and enable the doctors to help people suffering from these diseases.

References:

[1] Aytuğ B. Pollen calendar for Istanbul, Turkey. Charpin J, Surinyach R. Atlas of European Allergenic Pollens. Paris: Sandoz Editions, 1974. 205 – 216.

[2] Nilsson S, Palmberg-Gothard J. Pollen calendar for Huddinge (Sweden), 1973 – 1980. *Grana*, 1982, **21**: 183 – 185.

[3] Koivikko A, Kupias R, Makinen Y, Pohjola A. Pollen seasons: Forecasts of the most important allergenic plants in Finland. *Allergy*, 1986, **41**: 233 – 242.

[4] Bousquet J, Cour P, Guerin B, Michael F B. Allergy in the Mediterranean area, Ⅰ. Pollen counts and pollinosis of Montpellier. *Clin Allergy*, 1984, **14**: 249 – 258.

[5] Spieksma F Th M, Frenguelli G, Nikkels A H, Mincigrucci G, Smithvis L O M J, Bricchi E, Dankaart W. Comparative study of airborne pollen concentrations in central Italy and the Netherlands, 1982 – 1985. *Grana*, 1989, **28**: 25 – 36.

[6] D'Amato G, Spieksma F Th M. Allergenic pollen in Europe. *Grana*, 1990, **30**: 67 – 70.

[7] Inceoğlu Ö, Pinar N M, Sakiyan N, Sorkun K. Airborne pollen concentration in Ankara, Turkey, 1990 – 1993. *Grana*, 1994, **33**: 158 – 161.

[8] Bicakci A, Inceoğlu Ö, Sapan N, Malyer H. Airborne pollen calendar of the central region of Bursa (Turkey). *Aerobiol*, 1996, **12**: 43 – 46.

[9] Anderson J H. A survey of allergenic airborne pollen and spores in the fairbanks area, Alaska. *Ann Allergy*, 1984, **52**: 26 – 31.

[10] Hansen B C S, Wright H E. The modern pollen rain of the North Dakota, U. S. A. *Pollen Spores*, 1987, **29**: 167 – 184.

[11] Paiva J, Teresa Leitao M. Five year air sampling study in Coimbra, Portugal. *Bol Soc Brot*, 1989, **62**: 131 – 138.

[12] Charpin J, Surinyach R. Atlas of European Allergenic Pollen. Paris: Sandoz Editions, 1974. 9 – 18.

[13] Romano B, Mincigrucci G, Frenguelli G, Bricchi E. Airborne pollen content in the atmosphere of central Italy (1982 – 1986). *Experientia*, 1988, **44**: 625 – 629.

[14] Eriksson N E, Whl J A, Arrendal H, Strandhede S O. Tree pollen allergy. *Allergy*, 1984, **39**: 610 – 617.

[15] Levetin E, Buck P. Hay fever plants in Oklahoma. *Ann Allergy*, 1980, **45**: 2 – 32.

[16] Newmark F M, Itkin I H. Asthma due to pine pollen. *Ann Allergy*, 1967, **25**: 251 – 252.

[17] Bousquet J, Guerin B, Hewitt B, Lim S, Michael F B. Allergy in the Mediterranean area, Ⅲ. Cross reactivity among Oleaceae pollens. *Clin Allergy*, 1985, **15**: 439 – 448.

[18] Gioulekas D, Chatzigeorgiou G, Lylogiannis S, Papakosta D, Mpalafoutis C, Spieksma F Th M. *Olea europea* 3-year pollen record in the area of Thessaloniki, Greece and its sensitizing significance. *Aerobiologia*, 1991, **7**: 57 – 61.

[19] Lewis V H, Vinay P. North American pollinosis due to insect pollinated plants. *Ann Allergy*, 1979, **42**: 309 – 318.

[20] Bousquet J, Hewitt B, Guerin B, Dhivert H, Michael F B. Allergy in the Mediterranean area, Ⅱ. Cross allergenicity among Urticaceae pollens (Parietaria and Urtica). *Clin Allergy*, 1986, **16**: 57 – 64.

[21] Spieksma F Th M. Pollinosis in Europe: New observations and developments. *Rev Paleobot Palynol*, 1990, **64**: 35 – 40.

[22] Chapman J A. Aeroallergens of Southern Missouri, USA. *Grana*, 1986, **25**: 235 – 246.

[23] Jager S, Spieksma F Th M, Nolard N. Fluctations and trends in airborne concentrations of some abundant pollen types, monitored at Vienna, Leiden and Brussels. *Grana*, 1991, **30**: 309 – 312.

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