

Analysis of airborne pollen fall in Sakarya, Turkey

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Abstract: In this study, pollen grains were identified using Durham sampler in the atmosphere of Sakarya in 2000 and 2001. During these two years, a total of 10 805 pollen grains were recorded. A total of 5 386 pollen grains per cm² were recorded in 2000 and a total of 5 419 pollen grains per cm² in 2001. Pollen fall in the years 2000–2001 comprised grains belonging to 40 taxa and some unidentified pollen grains. Of these taxa, 22 belonged to arboreal and 18 taxa to non arboreal plants. Total pollen grains consisted of 69.45% grains from arboreal plants, 28.11% grains from non-arboreal plants and 2.44% unidentified pollen grains. In the region investigated, Gramineae, *Pinus* sp., *Quercus* sp., Cupressaceae/Taxaceae, *Salix* sp., *Platanus* sp., *Populus* sp., *Carpinus* sp., *Fagus* sp., Chenopodiaceae/Amaranthaceae, *Xanthium* sp., Moraceae, *Corylus* sp., *Fraxinus* sp., and Urticaceae released the greatest amounts of pollen. The season of maximum pollen fall was from March to May, with a prevalence of arboreal pollen in the first months, and of pollen from non-arboreal plants in the last months of the year.

Key words: Turkey; Sakarya; pollen calendar; pollen fall

Introduction

Airborne pollen grains are inhalant allergens natural-source related. When released by the sources in sufficient amounts, allergenic pollen may evoke allergic responses in sensitive patients, leading to pollinosis. These diseases appear especially in flowering periods of plants. Determination of the pollen types and their concentration in the atmosphere of highly populated cities are very important. These data prove helpful in the treatment of patients suffering from such diseases. For this reason; studies of the pollen content in the atmosphere of different areas have been carried out by researchers (ROMANO et al., 1988; SPIEKSMAN et al., 1989; D'AMATO & SPIEKSMAN, 1990; SPIEKSMAN et al., 1991; BİCAKCI et al., 2000, 2002, 2003, 2004a,b; CELENK & BİCAKCI, 2005).

The aim of this study is to present the results of two years (2000–2001) on airborne pollen in the Sakarya atmosphere, their percentage values, pollen season periods and pollen calendar for Sakarya. The pollen calendar for the region presented in this paper may be useful for allergologists to establish an exact diagnosis.

Area description

Sakarya is situated at 40°17'–41°13' N and 29°57'–30°53' E in the northwest of Turkey at an altitude of 31 m above the sea level. Most of the land lies within the Sakarya Valley, broadening towards the Black Sea. It also contains mildly rough terrain with elevation varying from 500 to 1500 me-

tres. A temperate sea climate is dominant in most of the province, while there is a dry continental climate in a small section of the area. The plain near the metropolitan district comprises agricultural land: hazelnut, walnut, chestnut, apple, pear, quince, plum, cherry and land suitable for the growing of wheat, potato, sunflower, tobacco etc.

Twenty five percent of the Sakarya area is covered by forest and shrubbery, arable 47% by planted fields, and 4% by meadow and pasture. Some of the species appearing in the study area are: *Abies nordmanniana* (STEV.) SPACH subsp. *bornmülleriana* (MATTF.) COODE et CULLEN, *Acer platanoides* L., *Aesculus hippocastanum* L., *Castanea sativa* MILL., *Carpinus betulus* L., *Corylus avellana* L., *Cupressus sempervirens* L., *Fagus orientalis* L., *Pinus nigra* L. subsp. *pallasiana* (LAMB.) HOLMBOE, *Pinus brutia* TEN., *Pinus sylvestris* L., *Platanus orientalis* L., *Populus alba* L., *Populus tremula* L., *Quercus robur* L., *Quercus ilex* L. var. *cerris*, *Quercus paatraea* (MATTUSCHKA) LIEB., *Quercus frainetto* TEN., *Salix alba* L., *Taxus baccata* L. (CİCEK & ÖZDEMİR-TURK, 1998).

Material and methods

In this study, the gravimetric method and a Durham sampler were used. The Durham sampler was placed on the office roof at the height of 6 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 (CHARPIN & SURINACH, 1974). The slides were examined with 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. The number of pollen grains was expressed as grains

Table 1. Annual totals of weekly pollen counts and percentages.

	2000		2001		2000–2001	
	Total	%	Total	%	Total	%
Arboreal pollen grains (AP)						
<i>Pinus</i>	593	11.01	930	17.16	1 523	14.10
<i>Quercus</i>	589	10.94	545	10.06	1 134	10.50
Cupress./Taxa.	551	10.23	563	10.39	1 114	10.31
<i>Salix</i>	363	6.74	551	10.17	914	8.46
<i>Platanus</i>	450	8.35	196	3.62	646	5.98
<i>Populus</i>	218	4.05	276	5.09	494	4.57
<i>Carpinus</i>	51	0.95	366	6.75	417	3.86
<i>Fagus</i>	134	2.49	116	2.14	250	2.31
Moraceae	102	1.89	99	1.83	201	1.86
<i>Corylus</i>	112	2.08	43	0.79	155	1.43
<i>Fraxinus</i>	61	1.13	78	1.44	139	1.29
<i>Juglans</i>	51	0.95	54	1.00	105	0.97
<i>Erica</i>	51	0.95	52	0.96	103	0.95
<i>Alnus</i>	70	1.30	26	0.48	96	0.89
Rosaceae	31	0.58	12	0.22	43	0.40
<i>Castanea</i>	22	0.41	20	0.37	42	0.39
<i>Ostrya</i>	15	0.28	26	0.48	41	0.38
<i>Ulmus</i>	15	0.28	20	0.37	35	0.32
<i>Tilia</i>	21	0.39	5	0.09	26	0.24
<i>Pistacia</i>	12	0.22	9	0.17	21	0.19
<i>Acer</i>	–	–	4	0.07	4	0.04
<i>Aesculus</i>	1	0.02	–	–	1	0.01
Total AP	3 513	65.22	3991	73.65	7 504	69.45
Non-arboreal pollen grains (NAP)						
Gramineae	1 177	21.85	871	16.07	2 048	18.95
Cheno./Amaranth.	112	2.08	118	2.18	230	2.13
<i>Xanthium</i>	134	2.49	78	1.44	212	1.96
Urticaceae	83	1.54	28	0.52	111	1.03
<i>Artemisia</i>	19	0.35	58	1.07	77	0.71
Compositae	61	1.13	11	0.20	72	0.67
<i>Rumex</i>	39	0.72	22	0.41	61	0.56
<i>Typha</i>	41	0.76	18	0.33	59	0.55
<i>Plantago</i>	24	0.45	22	0.41	46	0.43
<i>Luzula</i>	12	0.22	22	0.41	34	0.31
Leguminosae	15	0.28	18	0.33	33	0.31
<i>Carex</i>	19	0.35	6	0.11	25	0.23
<i>Taraxacum</i>	2	0.04	6	0.11	8	0.07
Umbelliferae	5	0.09	2	0.04	7	0.06
<i>Centaurea</i>	–	–	6	0.11	6	0.06
<i>Helianthus</i>	6	0.11	–	–	6	0.06
Boraginaceae	–	–	1	0.02	1	0.01
Caryophyllaceae	1	0.02	–	–	1	0.01
Total NAP	1 750	32.49	1 287	23.75	3 037	28.11
Unidentified	123	2.28	141	2.60	264	2.44
	5 263	97.72	5 278	97.40	10 541	
Total	5 386	100.00	5 419	100.00	10 805	100.00

per square centimetre of microscope cover glass (22 × 22 mm). The pollen was counted at a magnification of ×100. Counts were made at one week, and total weekly counts were converted to the number of pollen grains per cm².

Results and discussion

A total of 10,805 pollen grains from 40 taxa, 5,386 in 2000 and 5,419 in 2001, were been identified in the atmosphere of Sakarya during these two years. Out of 40 taxa, 22 were arboreal while the others were non-arboreal plants. Of the total pollen grains, 69.45% were

arboreal, 28.11% non-arboreal and 2.44% unidentified (Tab. 1).

The main pollen producers in the atmosphere of Sakarya were the following arboreal plants: *Pinus* sp. (14.10%), *Quercus* sp. (10.50%), Cupressaceae/Taxaceae (10.31%), *Salix* sp. (8.46%), *Platanus* sp. (5.98%), *Populus* sp. (4.57%), *Carpinus* sp. (3.86%), *Fagus* sp. (2.31%), Moraceae (1.86%), *Corylus* sp. (1.43%), *Fraxinus* sp. (1.29%). They form 64.67% of the total pollen fall (Tab. 1).

Of the herbaceous plants, Gramineae (18.95%), Chenopodiaceae/Amaranthaceae (2.13%), *Xanthium*

Table 2. Maximal airborne pollen falls in subsequent months and their yearly composition (%), Sakarya Turkey.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	TOTAL (%)
<i>Pinus</i>	—	—	1.44	6.23	5.73	0.69	—	—	—	—	14.10
<i>Quercus</i>	—	—	1.03	8.72	0.75	—	—	—	—	—	10.50
Cupress./Taxa.	—	0.71	4.94	3.72	0.92	—	0.02	—	—	—	10.31
<i>Salix</i>	—	0.02	2.44	5.96	0.04	—	—	—	—	—	8.46
<i>Platanus</i>	—	—	0.85	5.02	0.11	—	—	—	—	—	5.98
<i>Populus</i>	—	0.04	3.80	0.73	—	—	—	—	—	—	4.57
<i>Carpinus</i>	—	—	3.00	0.84	0.02	—	—	—	—	—	3.86
<i>Fagus</i>	—	—	0.03	2.03	0.26	—	—	—	—	—	2.31
Moraceae	—	—	0.68	1.01	0.18	—	—	—	—	—	1.86
<i>Corylus</i>	0.03	1.29	0.11	—	—	—	—	—	—	—	1.43
<i>Fraxinus</i>	—	74	0.51	0.01	—	—	—	—	—	—	1.29
Gramineae	—	—	0.30	2.91	8.91	2.73	2.26	1.16	0.57	0.12	18.95
Chenop./Amar.	—	—	—	0.01	—	—	0.17	1.30	0.65	0.01	2.13
<i>Xanthium</i>	—	—	—	—	—	—	—	1.32	0.64	—	1.96
Urticaceae	—	—	—	—	0.53	0.21	0.08	0.13	0.07	—	1.03
Total	0.03	2.80	19.13	37.18	17.44	3.64	2.53	3.91	1.93	0.13	88.74
Others	—	0.53	1.40	2.31	0.61	2.09	0.75	0.34	0.79	0.00	8.82
Unidentified	—	0.02	0.42	1.04	0.89	0.01	0.03	0.01	0.02	—	2.44
TOTAL	0.03	3.35	20.95	40.53	18.94	5.74	3.31	4.26	2.74	0.13	100.00

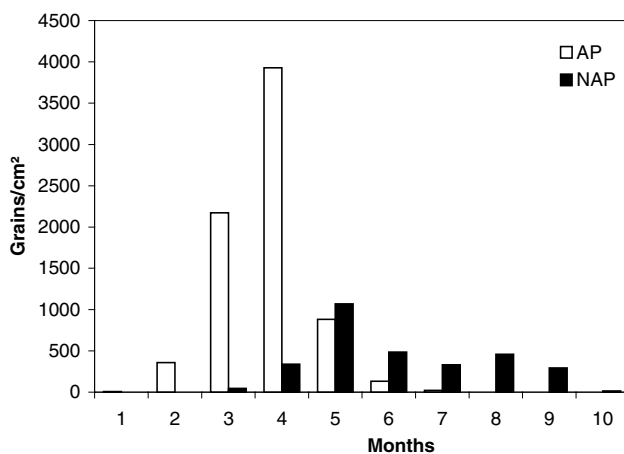


Fig. 1. Monthly variation of arboreal (AP) and non-arboreal (NAP) pollen grains, Sakarya, 2000–2001.

sp. (1.96%) and Urticaceae (1.03%) were found frequently in the atmosphere of Sakarya making up 24.07% of the total (Tab. 1).

The seasonal variation of arboreal and non-arboreal pollen fall is given in Fig. 1. The season of maximum pollen fall was from March to May, with prevalence of arboreal pollen in the first months, and of pollen from non-arboreal plants in the last months of the year (Fig. 1). The earliest pollen grains in the atmosphere of Sakarya were noted in January (Fig. 1). In January, only arboreal pollen types such as *Corylus* sp. (0.03%) were recorded (Tab. 2). The number of pollen grains increased in February–March and reached its maximum level in April (40.53%) (Tab. 2, Fig. 1). *Quercus* sp. (8.72%), *Pinus* sp. (6.23%), *Salix* sp. (5.96%), *Platanus* sp. (5.02%), Cupressaceae/Taxaceae (3.72%), Gramineae

(2.91%), *Fagus* sp. (2.03%), Moraceae (1.01%), *Carpinus* sp. (0.84%), *Populus* sp. (0.73%), *Fraxinus* sp. (0.01%) and Chenopodiaceae/Amaranthaceae (0.01%) were releasing high amounts of pollen into the atmosphere throughout their pollination period, and formed more than 37% of the total pollen grains in April (Tab. 2). The number of pollen grains was also high in May. From June, the pollen grains of weeds became dominant, but the amount of pollen was lower than in springtime. This decrease was correlated with the end of the pollination periods of many arboreal plants which produced and released high amounts of pollen grains into the atmosphere (Fig. 1). In June and July, Gramineae (2.73–2.26%); in August *Xanthium* sp. (1.32%), Chenopodiaceae/Amaranthaceae (1.30%), Gramineae (1.16%), Urticaceae (0.13%); in September Chenopodiaceae/Amaranthaceae (0.65%), *Xanthium* sp. (0.64%), Gramineae (0.57%), Urticaceae (0.07%); in October Gramineae (0.12%), Chenopodiaceae/Amaranthaceae (0.01%) were recorded as dominant taxa. In November and December, no pollen grains were recorded (Tab. 2, Fig. 1).

In the atmosphere of Sakarya, arboreal pollen types were dominant. The frequency of arboreal pollen grains generally depends on the distribution and density of the local vegetation and rate of pollen production. According to the other studies carried out in Turkey, arboreal pollen types are also dominant in Izmir (84.05%) (GUVENSEN & OZTURK, 2003), Usak (79.12%) (BICAKCI et al., 2004b), Bursa (78.61%) (BICAKCI et al., 2003), Burdur (76.1%) (BICAKCI et al., 2000), Edirne (71.81%) (BICAKCI et al., 2004), Balikesir (70.92%) (BICAKCI & AKYALCIN, 2000) and Afyon (69.67%) (BICAKCI et al., 2002). Similarly in Europe, arboreal pollen types are also dominant in Ostrawiec Swietokrzyski, Poland (73%) (KASPRZYK, 1996), Peru-

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