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Airborne pollen grains in Yalova, Turkey, 2004

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Abstract: In this study, airborne pollen grains of Yalova province were investigated using VPSS 2000 from January to December 2004. During studying period, a total of 22409 pollen grains/m^3 which belonged to 46 taxa and 74 unidentified pollen grains were recorded. From the identified taxa, 26 belong to arboreal and 20 to non-arboreal plants. Total pollen grains consist of 80.50% arboreal, 19.17% non-arboreal plants and 0.33% unidentified pollen grains. In the investigated region, from arboreal plant taxa *Platanus* spp. (29.08%), Cupressaceae/Taxaceae (21.22%), *Pinus* spp. (7.34%), *Alnus* spp. (4.75%), *Castanea* spp. (3.03%), *Quercus* spp. (3.07%), *Olea* spp. (2.50%), *Acer* spp. (2.21%), *Corylus* spp. (1.41%) and *Fagus* spp. (1.15%), and from non-arboreal plant taxa Poaceae (10.01%), Asteraceae (2.86%), *Plantago* spp. (1.47%) and *Artemisia* spp. (1.11%) were responsible for the greatest amounts of pollen.

Key words: Airborne pollen grains; pollen calendar; Yalova; Turkey

Introduction

Some pollen grains are known to cause allergic ailments in humans, including allergic asthma and hay fever. These diseases appear especially during the flowering periods of plants. Determination of the pollen types and their concentration is very important especially in the atmosphere of highly populated cities. 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 worldwide and Turkey as well (Bicakci & Akyalcin 2000; Bicakci et al. 2000a,b, 2002a,b, 2003, 2004a,b; Celenk & Bicakci 2005; Bicakci 2006; Koivikko et al 1986; Romano et al. 1988; Kasprzyk 1996; Abreu et al. 2003; Ballero & Maxia 2003; Cariñanos et al. 2004; Peternel et al. 2005; García-Mozo et al. 2006).

The aims of this study are to clarify which types of pollen are present in the atmosphere of Yalova; to identify the most representative pollen types and to make quantitative – qualitative analysis of pollen concentration belonging to arboreal and non-arboreal taxa in the Yalova atmosphere.

Material and methods

Pollen sampling was carried out using a volumetric trap (VPPS 2000 Lanzoni, Bologna, Italy). VPPS 2000 was placed in the city centre of a densely populated zone about 25m above ground level. Pollen grains were caught on a 14 mm wide transparent tape coated by a thin film of silicon fluid. The tape was mounted on a cylinder rotating at a speed of 2 mm per hour. A complete rotation of the cylinder took seven days. Weekly tape strips were cut into 7 pieces, each of them measured 48 mm in length. Each piece corresponded to one day sampling. They were then mounted and stained in glycerin-jelly mixed with basic fuchsine and examined microscopically. A sampling method, slide preparation and data interpretation were performed according to the standard method of the Italian Network for the Aerobiological Monitoring (D'Amato & Spieksma 1990), and pollen concentrations were expressed as number of pollen grains per cubic meter (p/m^3/24h).

The analysis of the pollen concentration pattern in 2004 was performed using the annual sum of the daily mean values. The pollen was counted at a magnification of X400, in 24 vertical lines corresponding to every full hour, and total daily counts were converted into the number of pollen grains per m^3 of air. A pollen calendar was prepared on the basis of 10 day means for Yalova.

Description of the study area

Yalova, situated at 40°39′32″ N, 29°16′26.06″ E, with a population of 168593, the field (847 km^2) and coast long (105 km^2) (Fig. 1). Yalova is located in the Marmara Region and surrounded by the Marmara Sea to the north and the Samanlı Range to the south. The following species are found in Samanlı Range as dominant: *Carpinus betulus* L., *Castanea sativa* Mill., *Quercus robur* L., *Q.petraea* (Mattuschka) Liebl., *Populus alba* L., *Acer platanoides* L., *Tilia tomentosa* Moench, *Populus tremula* L., *Pinus nigra* L., *Platanus orientalis* L., *Alnus glutinosa* (L.) Gaertn., *Myrtus communis* L., *Arbutus andrachne* L., *Juniperus oxycedrus* L., *Olea europea* L. var. *oleaster* DC, *Arbutus unedo* L., *Erica arborea* L., *Phillyrea latifolia* L., *Laurus nobilis* L., *Pista-*

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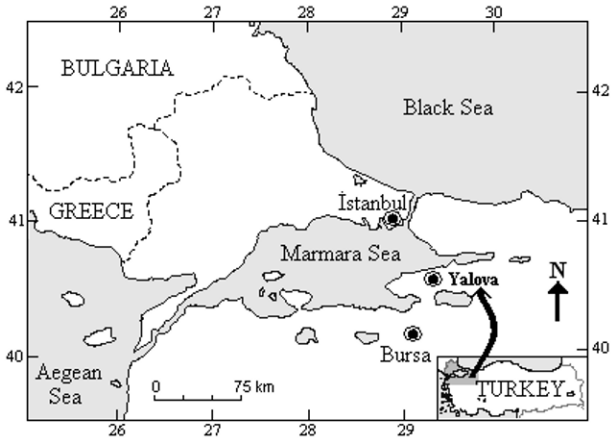

Fig. 1. Map of Yalova Province.

cia terebinthus L., *Cercis siliquastrum* L., *Spartium junceum* L., *Cistus creticus* L., *Daphne pontica* L., *Hypericum calycinum* L., *Fraxinus ornus* L., *Corylus avellana* L., *Crataegus monogyna* Jacq., *Ligustrum vulgare* L., *Rosa sempervirens* L., *Cornus mas* L. and *Prunus laurocerasus* L. (Bilgin 1967; Atalay 1994, 2002).

An arboretum (Karaca Arboretum) where various kinds of arboreal and non arboreal plants belonging to other countries in the world were planted was established in Yalova.

Results and discussion

The annual total of pollen grains in the atmosphere of Yalova is presented in Table 1. The number of total pollen grains collected from 1st January to 31st December 2004 using VPSS 2000 reached 22483 pollen grains/m^3 and 46 taxa were identified. From the identified taxa, 26 belong to arboreal (AP) and 20 to non-arboreal plants (NAP). The total number of pollen grains consists of 18098 (80.50%) arboreal, 4311 (19.17%) non-arboreal and 74 (0.33%) unidentified pollen grains. (Tables 1, 2).

Arboreal pollen grains were dominant in the atmosphere of Yalova. The frequency of arboreal pollen grains generally depends on the distribution and density of the local vegetation and the rate of pollen production. According to other studies carried out in Europe, arboreal pollen grains are also dominant in Finland (82.00%) (Koivikko 1986); Bursa, Turkey (78.61 %) (Bicakci et al. 2003); Ostrowiec Swietokrzyski, Poland (73.00%) (Kasprzyk 1995); Perugia (71.00%) and Ascoli-Piceno (55.00%) (Romano et al. 1988); Balikesir, Turkey (70.92 %) (Bicakci & Akyalcin 2000).

The main pollen producers in the atmosphere of Yalova were the following arboreal plants: *Platanus* spp. (%29,08), Cupressaceae/Taxaceae (21.22%), *Pinus* spp. (7.34%), *Alnus* spp. (4.75%), *Castanea* spp.(3.03%), *Quercus* spp. (3.07%), *Olea* spp. (2.50%), *Acer* spp. (2.21%), *Corylus* spp. (1.41%) and *Fagus* spp. (1.15%). They form 76.65% of the total pollen grains (Tables 1, 2). From non-arboreal plants, Poaceae (10.01%), Asteraceae (2.86%), *Plantago* spp. (1.47%) and *Artemisia* spp. (1.11%) were found frequently in the atmosphere of Yalova, making up 15,46% of the total pollen grains (Tables 1, 2). According to other studies carried out in Europe, the most common pollen producing taxa was identified as *Acer* spp., Cupressaceae, Poaceae, Hamamelidaceae,

Table 1. Annual totals of pollen counts for Yalova.

Plant species	Total	%
Arboreal plants (AP)		
Platanus	6538	29.08
Cupressaceae/Taxaceae	4770	21.22
Pinus	1650	7.34
Alnus	1069	4.75
Castanea	884	3.93
Quercus	690	3.07
Olea	561	2.50
Acer	496	2.21
Corylus	316	1.41
Fagus	259	1.15
Caprinus	192	0.85
Moraceae	162	0.72
Ericaceae	124	0.55
Juglans	100	0.44
Fraxinus	90	0.40
Betula	73	0.32
Populus	33	0.15
Tilia	32	0.14
Cedrus	30	0.13
Aesculus	9	0.04
Salix	8	.04
Oleaceae	4	0.02
Ligustrum	4	0.02
Ostyra	2	0.01
Ailanthus	1	0.004
Accacia	1	0.004
Total AP	18098	80.50
Non arboreal plants (NAP)		
Poaceae	2251	10.01
Asteraceae	643	2.86
Plantago	331	1.47
Artemisia	250	1.11
Chenopodiaceae/Amaranthaceae	221	0.98
Mercurialis	188	0.84
Humulus	144	0.64
Urticaceae	110	0.49
Apiaceae	48	0.21
Brassicaceae	25	0.11
Cyperaceae	24	0.11
Cichoriaceae	23	0.10
Boraginaceae	18	0.08
Xanthiun	9	0.04
Rumex	7	0.03
Campanulaceae	7	0.03
Caryophyllaceae	4	0.02
Pistacia	3	0.01
Rubiaceae	3	0.01
Typha	2	0.01
Total NAP	4311	19.17
Unidentified	74	0.33
TOTAL	22483	100.00

Table 2. The highest pollen concentrations in consecutive months and their yearly composition (%), Yalova, Turkey.

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
Platanus	-	-	1.43	24.45	3.20	-	-	-	-	-	-	-	29.08
Cupressaceae/Taxaceae	0.48	10.66	4.33	2.85	2.45	0.23	0.09	0.01	0.07	0.03	-	-	21.22
Poaceae	0.04	0.02	0.08	0.69	5.09	2.04	0.83	0.81	0.33	0.07	0.01	-	10.01
Pinus	-	-	0.05	2.55	3.48	1.16	0.10	-	-	-	-	-	7.34
Alnus	0.05	3.84	0.47	0.35	0.04	-	-	-	-	-	-	-	4.75
Castanea	-	-	-	-	0.04	3.81	0.08	-	-	-	-	-	3.93
Quercus	-	-	0.00	2.50	0.54	0.02	-	-	-	-	-	-	3.07
Asteraceae	-	-	-	0.01	0.03	0.06	0.06	1.73	0.89	0.05	0.01	0.01	2.86
Olea	-	-	-	-	0.61	1.88	-	-	-	-	-	-	2.50
Acer	-	0.05	0.17	1.34	0.64	-	-	-	-	-	-	-	2.21
Plantago	-	-	-	0.10	0.14	0.67	0.24	0,24	0.05	0.03	-	-	1.47
Corylus	0.48	0.64	0.06	0.20	0.03	-	-	-	-	-	-	-	1.41
Fagus	-	-	-	0.97	0.19	-	-	-	-	-	-	-	1.15
Artemisia	-	-	-	-	-	-	0.01	0,54	0.48	0.08	-	-	1.11
Total	**1.05**	**15.22**	**6.60**	**36.00**	**16.49**	**9.87**	**1.42**	**3,33**	**1.82**	**0.26**	**0.03**	**0.01**	**92.11**
Others	0.16	0.12	0.93	2.13	0.77	0.88	0.45	1,12	0.47	0.16	0.25	0.13	7.57
Unidentified	0.02	0.01	0.01	0.16	0.02	0.09	0,01	0.01	-	-	-	-	0.33
TOTAL	**2.29**	**30.56**	**14.14**	**74.30**	**33.76**	**20.72**	**3,30**	**7.79**	**4.11**	**0.68**	**0.31**	**0.16**	**100.00**

Pinaceae, *Quercus* spp., Urticaceae in Porto region (Portugal), (Abreu et al. 2003); *Pinus* spp., Cupressaceae/Taxaceae, *Platanus* spp., *Quercus* spp., *Ailanthus* spp., Moraceae, Chenopodiaceae/Amaranthaceae and Asteraceae in Afyon, Turkey, (Bicakci et al. 2002b); Cupressaceae, *Quercus* spp., *Populus* spp., *Poaceae* spp., *Olea* spp. *Platanus* spp., *Ulmus* spp. and *Morus* spp. in Toledo, Central Spain, (García-Mozo et al. 2006); *Cupressus* spp., *Platanus* spp., *Quercus* spp., *Olae* spp., Poaceae, Urticaceae, *Artemisia* spp.and Chenopodiaceae in Iberian Peninsula (Cariñanos et al. 2004); *Alnus* spp., *Ambrosia* spp., *Betula* spp., *Carpinus* spp., Poacae, *Quercus* spp., *Taxus/Juniperus* and Urticaceae in Croatia (Peternel et al. 2005); Poaceae, *Pinus* spp., *Quercus* spp., Cupressaceae/Taxaceae, *Salix* spp., *Platanus* spp., *Populus* spp., *Carpinus* spp., *Fagus* spp., Chenopodiaceae/Amaranthaceae, *Xanthium* spp., Moraceae, *Corylus* spp., *Fraxinus* spp. and Urticaceae in Sakarya, Turkey (Bicakci 2006); *Pinus* spp., *Olea* spp., *Platanus* spp., Cupressaceae/Taxaceae, *Quercus* spp., *Acer* spp., *Morus* spp., *Castanea* spp., *Corylus* spp., *Fraxinus* spp., Poaceae, *Xanthium* spp., Chenopodiaceae/Amaranthaceae, *Artemisia* spp. in Bursa, Turkey, (Bicakci et al. 2003); Cupressaceae, Pinaceae, Urticaceae, Anacardiaceae, Oleaceae and Polygonaceae in Cagliari, Italy, (Ballero & Maxia 2003).

Monthly variation of arboreal and non-arboreal pollen grains recorded in the atmosphere of Yalova is shown in Fig. 2. Arboreal pollen grains are dominant in the springtime, non-arboreal in the summer and autumn (Fig 2). The earliest pollen grains in the atmosphere of Yalova were noted in January. During this month, low amounts were recorded for Cupressaceae/Taxaceae (0.48%), *Corylus* spp. (0.48%), *Alnus* spp. (0.05%), Poaceae (0.04%) and other pollen grains (0.18%) (Table 2). In February, Cupressaceae/Taxaceae (10.66%) and *Alnus* spp. (3.84%); in March Cupressaceae/Taxaceae (4.33) and *Platanus* spp. (1.43%) were recorded as dominant taxa. Pollen grains began to increase in March and reached their maximum levels in April (74.30%). *Platanus* spp. (24.45%), Cupressaceae/Taxaceae (2.85%), *Pinus* spp. (2.55%), *Quercus* spp. (2.50%) and *Acer* spp. (1.34%) were releasing high amounts of pollen into the atmosphere throughout their pollination period, and formed more than 33% of the total pollen grains in April (Table 2). The numbers of pollen grains were also high in May and June. In May, Poaceae (5.09%), *Pinus* spp. (3.48%), *Platanus* spp. (3.20%), Cupressaceae/Taxaceae (2.45%) and in June, *Castanea* spp. (3.81%), Poaceae (2.04%), *Olea* spp. (1.88%) and *Pinus* spp. (1.16%) were recorded as dominant taxa. In July, the pollen grains of weeds became dominant, but the amount of pollen was lower than in springtime. This decrease correlated with the end of the pollination period of many arboreal plants which produce and release high amounts of pollen grains into the atmosphere. In July, Poaceae (0.83%), *Plantago* spp. (0.24%) and in August, Asteraceae (1.73%), Poaceae (0.81%) and *Plantago* spp. (0.24%) were recorded as dominant taxa. From September to November, pollen

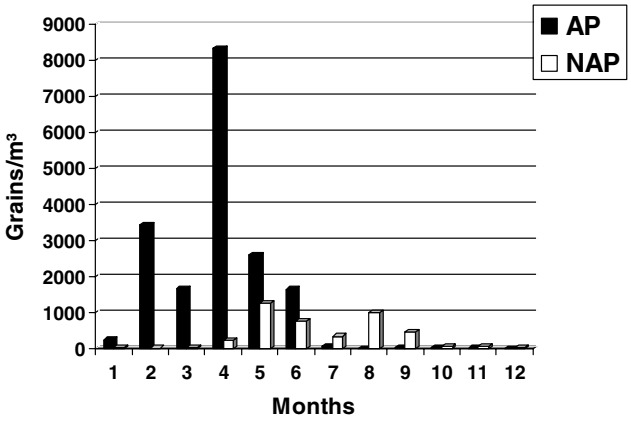

Fig. 2. Monthly variation in AP and NAP pollen grains in the atmosphere of Yalova.

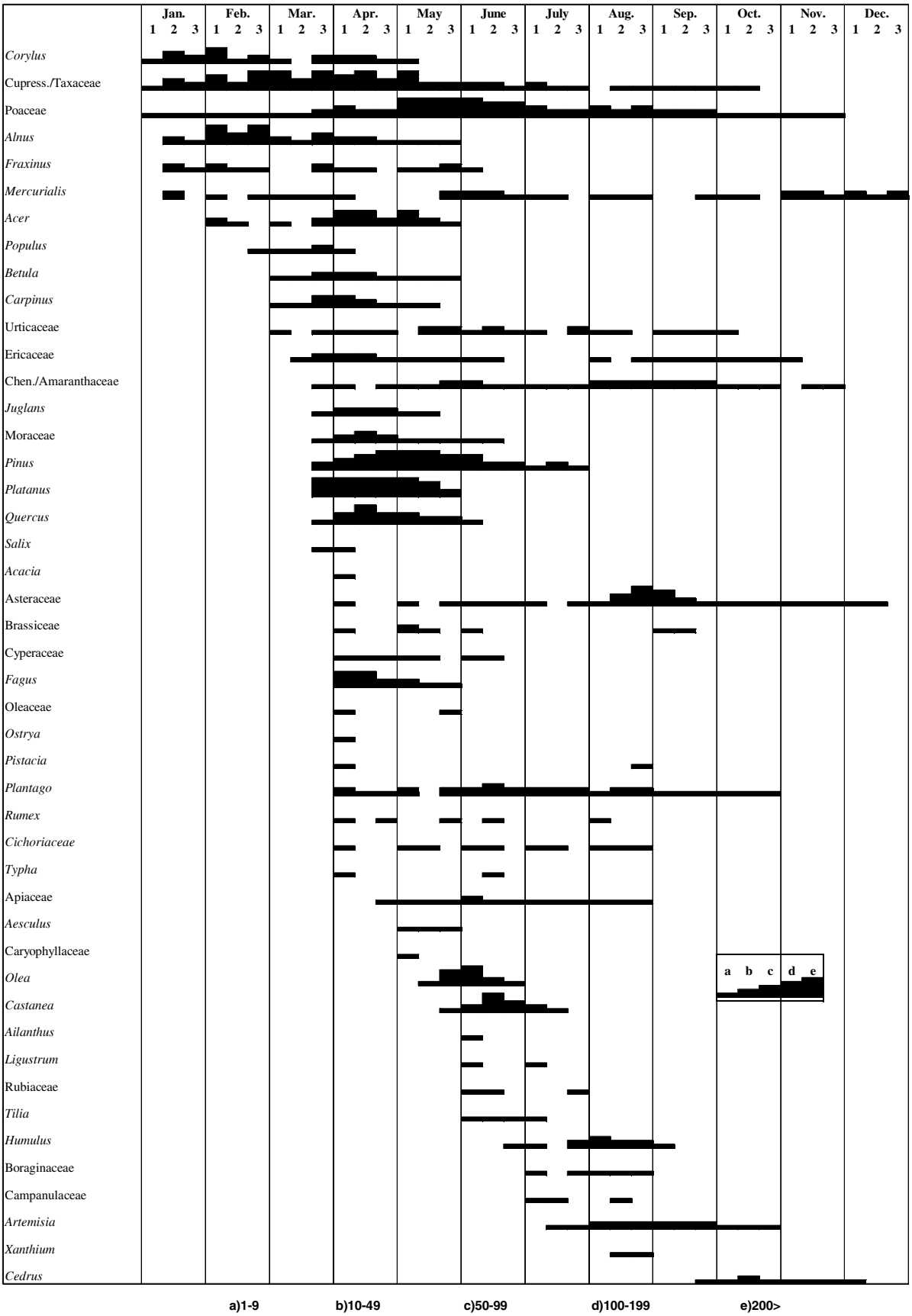

Fig 3. Pollen calendar of Yalova.

grains of Asteraceae and Poaceae and in December only Asteraceae were recorded (Table 2).

In other studies, dominant pollen grains were recorded in Toledo, Spain from March to May and also

in January (García-Mozo et al. 2006); inland Croatia in April and August (Peternel et al. 2005); in Cagliari, Italy between February and May (Ballero & Maxia 2003); in Porto, Portugal between the end of March and the first two weeks of April (Abreu et al. 2003); in Bursa, Turkey in April (Bicakci et al. 2003); in Afyon, Turkey in May (Bicakci et al. 2002b); in Balikesir, Turkey May (Bicakci & Akyalcin 2000).

The types of pollen present in the atmosphere of Yalova are shown as a pollen calendar in Fig. 3 based on the total counts of pollen grains in days/m^3 in 2004. The following taxa produced the greatest amount of pollen (Table 2, Fig. 3):

Platanus spp.: Pollen grains of this genus constituted 29.08 % of total pollen in the atmosphere of Yalova. The pollen season started at the end of March and lasted until the end of May. The peak value was noted between the end of March and the beginning of May.

Cupressaceae/Taxaceae: Pollen grains of these taxa represented 21.11% of total pollen. The pollen season started in the beginning of January and ended in the middle of October. The peak value of pollen was determined between February and the beginning of May.

Poaceae: Pollen grains of this family were represented 10.01% of total pollen. The pollen season started in the beginning of January and lasted until the end of November. The peak value of pollen was determined between May and the beginning of July.

Pinus spp: Pollen grains of this genus represented 7.34% of total pollen. The pollen season started in the last week of March and lasted until the end of July. The peak value of the pollen was determined between the end of April and the middle of May.

Alnus spp: Pollen grains of this genus represented 4.75% of total pollen. The pollen season started in the middle of January and lasted until the end of May. The peak value of the pollen was determined in the beginning and at the end of February.

Castanea spp: Pollen grains of this genus represented 3.93% of total pollen. The pollen season started in the end of May and lasted until the middle of July. The peak value of the pollen was determined in the middle of June.

Quercus spp.: Pollen grains of this genus represented 3.07% of total pollen. The pollen season started at the end of March and lasted until the beginning of June. The peak value of the pollen was determined in the middle of April.

Asteraceae: Pollen grains of this family represented 2.86% of total pollen. The pollen season started in the beginning of April and lasted until the middle of December. The peak value of pollen was determined at the end of August.

Olea spp.: Pollen grains of this genus represented 2.50% of total pollen. The pollen season started in the middle of May and lasted until the end of June. The peak value of the pollen was determined in the beginning of June.

Acer spp.: Pollen grains of this genus represented 2.21% of total pollen. The pollen season started in the beginning of February and lasted until the end of May. The peak value of the pollen was determined in the first twenty days of April and in the beginning of May.

Plantago spp.: Pollen grains of this genus represented 1.47% of total pollen. The pollen season started in the beginning of April and lasted until the end of October. The peak value of the pollen was determined in the middle of June.

Corylus spp.: Pollen grains of this genus represented 1.41% of total pollen. The pollen season started in the beginning of January and ended in the beginning of May. The peak value of the pollen was determined in the beginning of February.

Fagus spp.: Pollen grains of this genus represented 1.15% of total pollen. The pollen season started in the beginning of April and lasted until the end of May. The peak value of the pollen was determined in the first twenty days of April.

Artemisia spp.: Pollen grains of this genus represented 1.11% of total pollen. The pollen season started in the middle of July and lasted until the end of October. The peak value of the pollen was determined during August and September.

We can conclude that pollen grains of 46 taxa were determined during the pollen season in the atmosphere of Yalova, 14 of them formed about 92.11% of the total spectrum (Table 2). In the investigated region, pollen grains were recorded all year round and reached their maximum levels in April. The pollen calendar for this region presented in this study may be useful for allergologists to establish exact diagnosis.

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