Turkish Journal of Botany

Volume 23 | Number 2 Article 1

1-1-1999

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Tr. J. of Botany
23 (1999) 75–81

Research Article

Airborne Pollen Concentration in Kütahya

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Received: 19.10.1998
Accepted: 25.12.1997

Abstract: The airborne pollen cocentration in the atmosphere of Kütahya was determined by gravimetry with a Durham sampler in 1996. During this study, 23 taxa of arboreal and 14 taxa of herbaceous pollen grains were collected and identified. Pollen from the following taxa were also found to be prevalent in the atmosphere of Kütahya: *Pinus* L., *Cupressaceae, Platanus orientalis* L., *Quercus* L., *Oleaceae, Gramineae, Urticaceae, Chenopodiaceae/ Amaranthaceae, Compositae* and *Plantago* L. The effects of meteorological factors (temperature, humidity, wind speed, rainfall) on pollen production, dispersal and concentration in the atmosphere of Kütahya were observed.

Key Words: Pollen grains, Pollen concentration, Meteorological factors.

Kütahya Atmosferinin Polen Konsantrasyonu

Özet: Bu çalışmada, Durham aracı kullanılarak gravimetrik yöntem ile 1996 yılına ait Kütahya ili atmosferindeki polen konsantrasyonları belirlendi. Çalışma süresi boyunca, 23 odunsu ve 14 otsu taksonlara ait polen toplandı ve tanımlandı. Kütahya atmosferinde sırası ile *Pinus* L., *Cupressaceae, Platanus orientalis* L., *Quercus* L., *Oleaceae, Gramineae, Uritcaceae, Chenopodiaceae/Amaranthacaea, Compositae* ve *Plantago* L. taksonlara ait polenler dominant olarak bulunmuştur. Kütahya atmosferinde, bazı meteorolojik faktörlerin (sıcaklık, nispi nem, rüzgar hızı, yağış) polen üretimi, dağılımı ve konsantrasyonlarına etkisi gözlemlendi.

Anahtar Sözcükler: Polen, Polen konsantrasyonu, Meteorolojik faktörler.

Introduction

Some kinds of pollen grains that can cause respiratory system problems (asthma, hay fever etc.) are dispersed in the atmosphere during the flowering periods of plants. Determination of concentration cocentration in the atmosphere would certainly helf people suffering from allergies. Many studies on this subject have been carried out throughout the world (1, 2, 3).

Studies on the presence of pollen in the atmosphere in Ankara Turkey were conducted by Özkaragöz and Karamanoğlu in Ankara using Durham samplers (4). Aytuğ carried out an aeropalynologica study in the forest of Belgrad, in İstanbul, using the Hirst-Burkard trap to study the effects meteorological factors on pollen concentration over a period of three years, from 1966 to 1968 (5). Other aeropalynological studies have been carried out by Yurdukoru in Samsun (6), Ince in Kırıkkale (7), Bıçakçı et al. in Bursa (8), Mudanya, (9), Görükle (10) and Isparta (11), all using Durham samplers. İnceoğlu et al. carried out an aeropalynological study in Ankara, using the Hirst-Burkard trap, for a period of three years, from 1990 to 1993 (12).

In the present study, pollen grains in the atmosphere of Kütahya were identified, and changes in concentration were recorded weekly, monthly and yearly.

Methods

Kütahya, situated at 38° 70' N, 29° 00' E in central west anatolia at an altitude 1000-1200 m above sea level, is located in a plain flanked by mounts Gümüş and Yellice to the south and southwest. Kütahya has Irano-Turanian, Mediterrenean, Euro-Siberian vegetations and a generally Mediterranean climate (13).

Analysis of the flora of Mounts Gümüş and Yellice shows that Irano-Turanian elements are dominant at 15.7%, Euro-Siberian and Mediterranean elements account for 13.7 % and 12.2, respectively. The following species are found on both mountains: *Quercus cerris* L., *Fagus orientalis* Lipsky, *Carpinus betulus* L., *Castanea*

sativa Mill., Corylus avellana L., *Cretaegus monogyna Jacq., Berberis crataegina* L., *Prunus spinosa* L., *Pinus nigra* Am. subsp. *pallasiana* (Lamb) *Holmboe, Populus tremula L., Colutea cilicica Boiss.* & Bal., *Cistus laurifolius* L., *Pinus sylvestris* L., *Juniperus oxycedrus* L., *Juniperus communis* L., *Thymus* L., *Astragalus angustifolius* Lam. subsp. *angustifolius,* and *Acantholimon puberulum* Boiss. & Bal. (13).

In adidition to the natural vegetation around Kütahya, the following species are frequently seen in the parks gardens and streets of the town: *Acer sp., Betula sp., Corylus avellana* L., *Aesculus hippocastanum* L., *Juglans* sp., *Campsis radicans* (L.) Seem, *Buxus sempervirens* L., *Cotoneaster horizontalis* L., *Cercis siliquastrum* L., *Cornus mas* L., *Eriobotrya japonica* (Thumb.) Lindl., *Fraxinus* sp., *Gleditschia triancanthos* L., *Malus sylvestris* Miller., *Prunus cerasifera Ehrh. sub* sp. *divericata* (Ledeb.) *Schneider, Robinia pseudoacacia* L., *Spiraea* sp., *Syringa vulgaris* L., *Lonicera caprifolium* L., *Platanus orientalis* L., *Tilia* sp., *Ulmus* sp. *Vibirnum tinus* L., *Cupressus sempervines* L., *Populus alba* L., *Salix babylonica* L., *S. alba* L. (13).

Field studies were carried out in the central region of Kütahya during 1996. The Durham sampler (1, 8, 14) was placed 20 m above ground level at the center of the city. Before exposure, the slides were smeared with glycerine jelly stained with safranin (15). Slides were changed weekly. Identification and counting of pollen grains were accomplished at least up to family or genus levels, while some grains remained identified.

Result and Discussion

During the year of observation, 6,156 pollen grains/cm^2 belonging to 23 arboreal (82.88%) and 14 non-arboreal (14.24%) pollen types were found. Unidentified pollen types accounted for 2.88% (Table 1). Arboreal pollen types were dominant because they have a much higher production of pollen grains than herbs and grasses. According to other studies carried out in Europe, arboreal pollen types are also dominant in Finland (82%) (16), Perugia (71%) and Ascoli Piceno (55%) (17), Ankara (76%) (12) and Bursa (70.1%) (8).

The main pollen producers of arboreal plants in the atmosphere of Kütahya are *Pinus, Cupressaceae, Platanus orientalis, Quercus sp., Oleaceae, Fagus orientalis, Rosaceae, Juglans sp.* They form 76.02% of total pollen concentration (Table 1). Gramineae, Urticaceae, Chenopodiaceael Amaranthaceae, Compositae, Plantago sp., Rumex sp., Umbelliferae are responsible for the non-arboreal pollen production forming 13.09 % of total pollen concentration (Table 1).

The pollen season began in the atmosphere of Kütahya in March. In this month the main arboreal pollen

Table 1. Pollen taxa found in the atmosphere of Kütahya over the study period.

	Total	%
Aesculus hippocastanum	34	0.55
Alnus	1	0.02
Carpinus betulus	6	0.09
Castanea sativa	31	0.50
Cistus	3	0.05
Corylus avellana	10	0.16
Cupressaceae	1147	18.63
Ericaceae	18	0.29
Fagus orientalis	97	1.58
Fraxinus	10	0.16
Juglans	81	1.32
Moraceae	17	0.27
Oleaceae	141	2.29
Pinus	2205	35.82
Platanus orientalis	660	1072
Populus	62	1.01
Quercus	266	4.32
Robinia pseudoacacia	77	1.25
Rosaceae	83	1.34
Salix	71	1.15
Sambucus	54	0.88
Tilia	10	0.16
Ulmus	18	0.30
TOTAL A.P.	5102	82.88
Caryophyllaceae	5	0.06
Centaurea	3	0.05
Cheno./Amaranthaceae	145	2.36
Compositae	70	1.14
Cruciferae	6	0.09
Cyperaceae	10	0.16
Gramineae	309	5.02
Papaveraceae	5	0.08
Plantago	56	0.91
Rubiaceae	15	0.24
Rumex	41	0.67
Typha	20	0.32
Umbelliferae	33	0.54
Urticaceae	159	2.58
TOTAL N.A.P.	877	14.24
Unidentified	177	2.88
TOTAL	6156	100.00

Table 2. Pollen grains (per cm^2) of taxa by month, Kütahya.

Months	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.
Aesculus hippocastanum	-	6	28	-	-	-	-	-
Alnus	1	-	-	-	-	-	-	-
Carpinus betulus	-	2	4	-	-	-	-	-
Castanea sativa	-	-	-	24	7	-	-	-
Cistus	-	-	2	1	-	-	-	-
Corylus avellana	5	4	1	-	-	-	-	-
Cupressaceae	16	307	773	26	14	11	-	-
Ericaceae	3	5	6	2	-	-	1	1
Fagus orientalis	-	20	77	-	-	-	-	-
Fraxinus	4	6	-	-	-	-	-	-
Juglans	-	10	71	-	-	-	-	-
Moraceae	-	7	10	-	-	-	-	-
Oleaceae	-	26	69	39	7	-	-	-
Pinus	2	85	1607	478	22	11	-	-
Platanus orientalis	-	52	608	-	-	-	-	-
Populus	10	45	7	-	-	-	-	-
Quercus	2	51	213	-	-	-	-	-
Robinia pseudoacacia		-	41	32	4	-	-	-
Rosaceae	1	38	42	2	-	-	-	-
Salix	-	30	41	-	-	-	-	-
Sambucus	-	-	4	20	12	18	-	-
Tilia	-	2	6	2	-	-	-	-
Ulmus	-	18	-	-	-	-	-	-
TOTAL A.P.	44	714	3610	626	66	40	1	1
Caryophyllaceae	-	-	-	-	-	2	3	-
Centaurea	-	-	-	-	-	-	2	1
Cheno/Amaranthaceae		-	17	10	17	64	33	4
Compositae	-	4	12	14	8	14	12	6
Cruciferae	-	1	-	5	-	-	-	-
Cyperaceae	1	1	4	3	1	-	-	-
Gramineae	-	7	90	136	37	21	14	4
Papaveraceae	-	-	-	5	-	-	-	-
Plantago	-	3	4	12	9	13	13	2
Rubiaceae	-	2	5	3	5	-	-	-
Rumex	-	-	12	12	6	9	2	-
Typha	-	-	-	1	8	7	3	1
Umbelliferae	-	-	6	12	8	7	-	-
Urticaceae	-	4	55	49	18	22	9	2
TOTAL N.A.P.	1	22	205	262	117	159	91	20
Unidentified	3	19	79	35	24	6	11	-
TOTAL	48	755	3894	923	207	205	103	21

grains were observed. Seven hundred fifty-five pollen grains/cm^2 were recorded in April, and the maximum value was reached in (3,894 pollen grains/cm^2). *Pinus sp.*, *Cupressaceae*, *Platanus orientalis* and *Quercus sp.*, releasing high amounts of pollen into the atmosphere troughout their pollination period, were responsible for

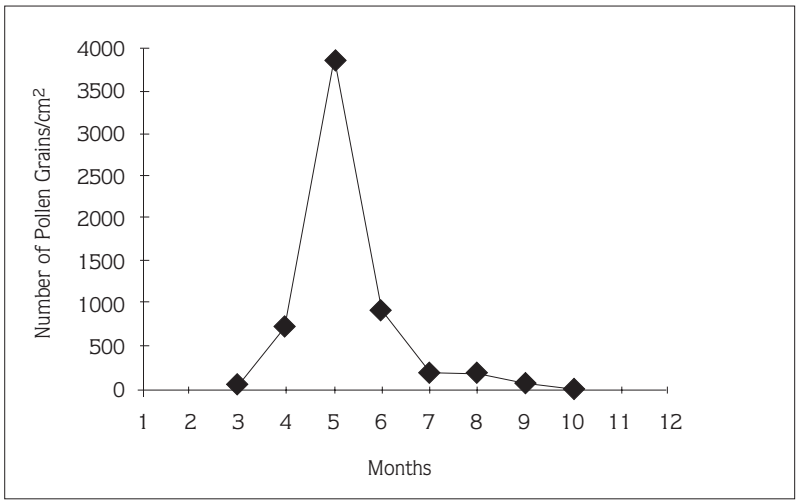

Figure 1. Total monthly variation in atmospheric pollen in 1996.

70.90% of the total pollen grains in May (Table 2). Arboreal pollen concentration, began to decrease in June, whereas the maximum number of non-arboreal pollen grains were found. The decrease in the of pollen beween July and September was minimum in October, as the pollination period of many plants ended, no pollen was recorded in November, December, January and February (Table 2, Fig. 1). According to previous studies carried out in Turkey, the highest numbers of pollen grains were observed during the March-May period in Ankara (12), in April Bursa (8) and Görükle (10), in May in Kırıkkale (7) and Mudanya (9) and from May to June in Samsun (6). The pollen grains of *Cupressaceae, Platanus orientalis, Pinus* sp.,*Quercus* sp.*and Gramineae* were found dominantly in the atmosphere of Kütahya, and pollen grain density was highest April, May, June. In Turkey, the other studies on the same taxa *Cupressaceae, Gramineae, Quercus* sp., *Betula* sp. in Kırıkkale (7), *Gramineae, Cupressaceae, Moraceae* in Ankara (12), *Gramineae, Quercus* sp., *Platanus orientalis, Fagus orientalis* in Bursa (8). As for; South Europe *Gramineae, Urticaceae, Olea* sp., the Central and Northen Europe *Betula* sp., *Gramineae* were also found as dominatically (18).

The increases in temperature and wind velocity lead to an increase in the amount of pollen grains in the atmosphere (19). Humidity at high temperatures also increases the amount of pollen grains. Steady rain and humidity at low temperatures decrease the density of pollen in the atmosphere. An increase in temperature after short-term rain increases the amount of pollen grains (5).

Following the aeropalynological study in Kütahya, it was concluded that the amount of pollen grains in the atmosphere had changed according to blossoming term of plants and meterological factors. Both meteorological factors and monthly pollen variation were shown in Fig. 2. The research showed there to be an increase of pollen grains from March to the end of May. The reason for this three-month increase in three months is the pollination season of taxa which produce a great deal of pollen grains, such as *Pinus* sp. *Cupressaceae Platanus orientalis, Quercus* sp., *Gramineae, Oleaceae, Robinia pseudoacacia, Fagus orientalis Salix sp., Rosaceae, Populus* sp and *Juglans* sp. In the same year from January to July there was an increase of weather temperature. There is a correlation between the increase in temperature in March, April and May and the number of pollen grains. In these months, proportional humidity, rain and wind velocity didn't change much, and these conditions were the most suitable for pollen grains. In May the total amount of pollen reached the maximum level, though in this month it rained much. These are short-term rains. The reason for this decrease after May was not meteorological factors in the atmosphere of Kütahya, but rather the end of the pollination periods of woody plants and the high production of pollen that enters the atmosphere. Beginning from June, the pollen grains of weeds became dominant, but the amount of pollen was lower than in spring. The maximum amounts of pollen grains for *Gramineae, Urticaceae, Umbelliferae* and *Rumex* sp.were recorded in June, while those of *Chenopodiaceae/Amaranthaceae Compositae,* and *Plantago* sp. were recorded in August. Low amounts of pollen grains were recorded as the pollination periods of many plants finished in September and November, as has been the case in other comparative studies in Turkey that

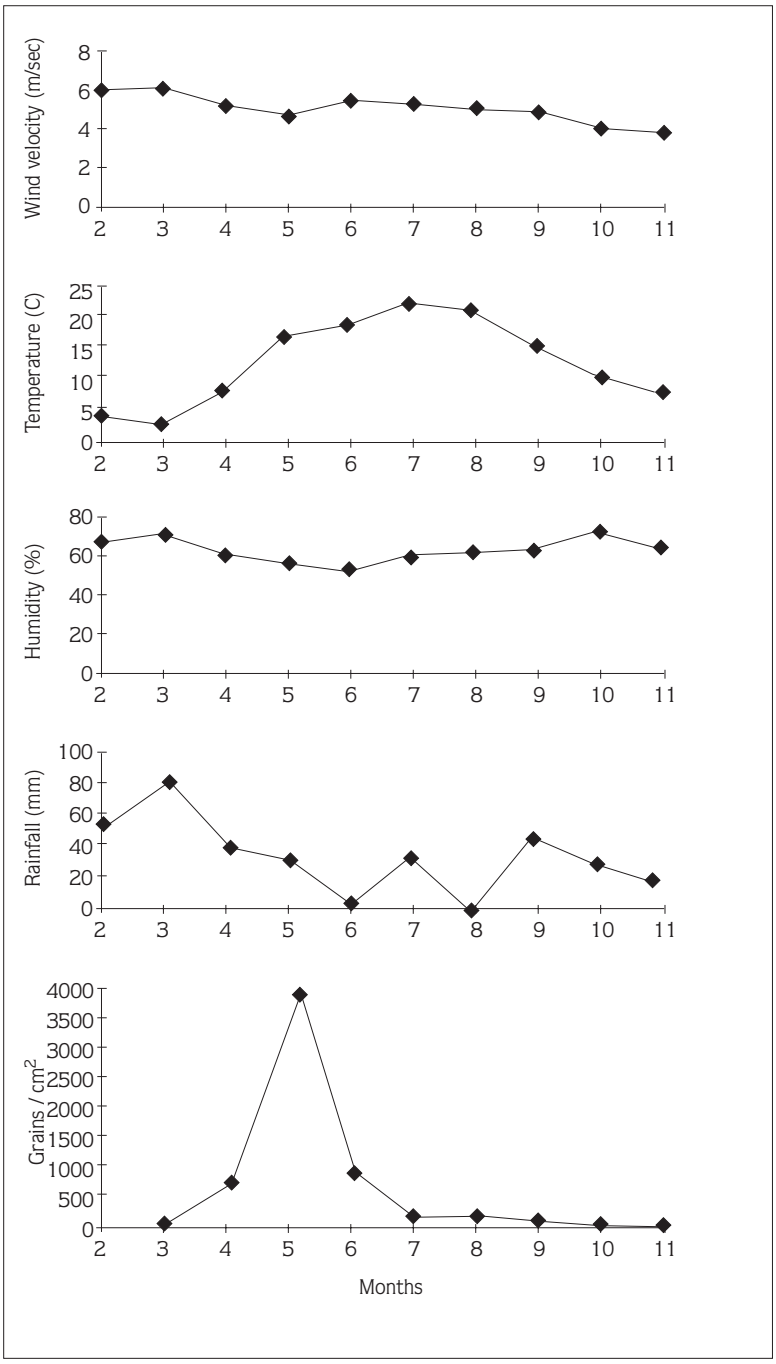

Figure 2. Monthly variations in atmospheric pollen and weather conditions

have taken meteorological factors into consideration (8, 11, 12).

The types of pollen present in Kütahya's atmosphere are shown in the form of a pollen calendar (Fig.3) based on the counts for 1996.

Finally, the arboreal pollen grains *Pinus* sp.,*Cupressaceae*, *Platanus orientalis Quercus* sp. and *Oleaceae*, and the non-arboreal pollen grains *Gremineae Urticaceae*, *Chenopodiaceae/Amaranthaceae*, *Compositae*, *Plantago* were recorded in high concentrations as the dominant allergenic pollen grains in Kütahya. Similar

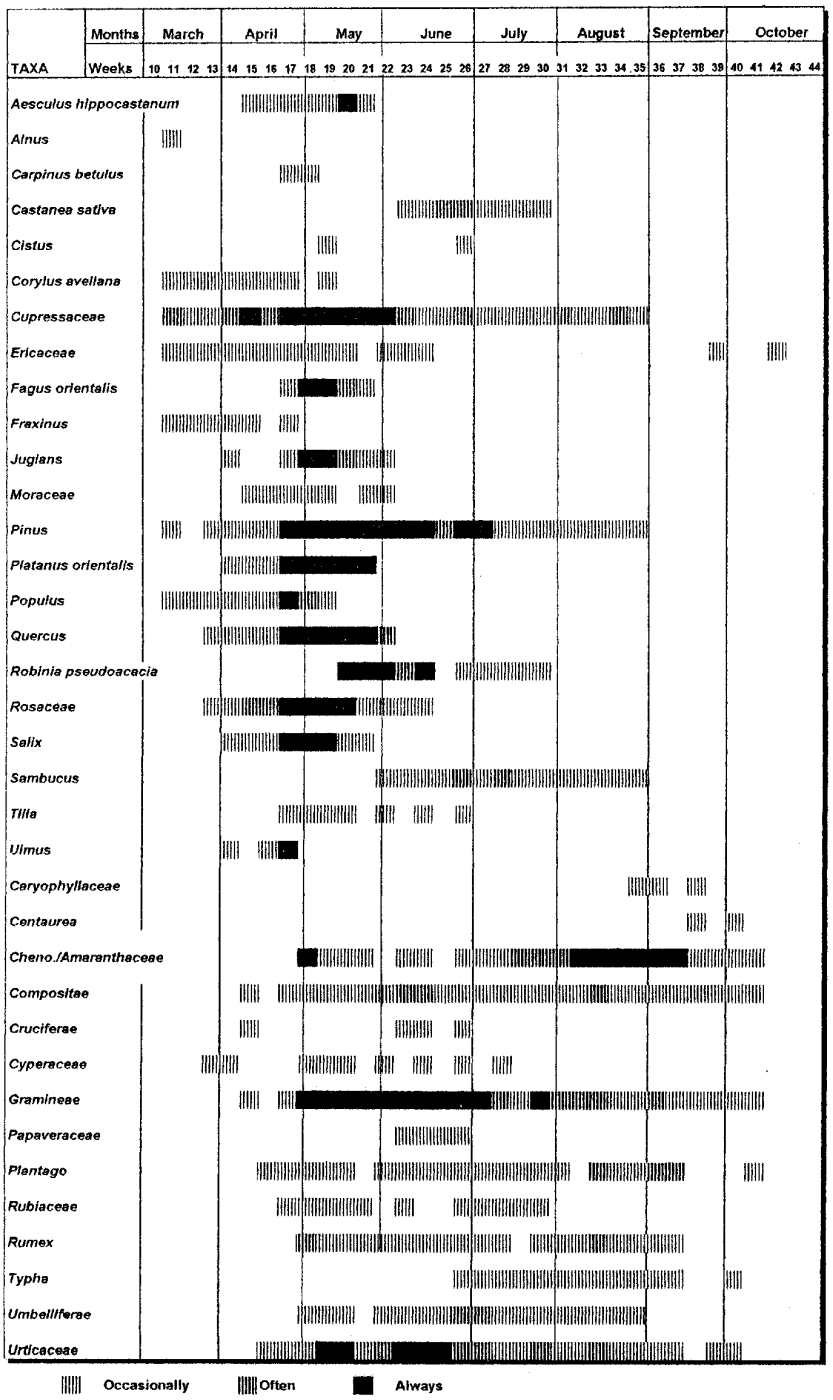

Figure 3. Annual pollen calendar of Kütahya.

studies have been done in Turkey, the dominant pollens being *Pinus* sp., *Gramineae* and *Cupressaceae* in Kırıkkale (7); *Cupressaceae/Taxaceae*, *Pinaceae, Gramineae, Betula* sp. *Moraceae, Platanus* sp., *Populus* sp., *Acer* sp., *Quercus* sp., *Chenopodiaceae/Amaranthaceae*, *Plantago* sp. and *Rumex* sp. in Ankara (12); *Gramineae*, *Pinus* sp. *Cupressaceae/Taxaceae, Abies nordmanniana* and *Urticaceae* Abies nordmanniana, Platanus orientalis in Bursa (8); and *Pinus sp.*, *Cupressaceae/Taxaceae*, *Platanus orientalis, Quercus sp., Gramineae, Artemisia, Chenopodiaceae Amaranthaceae* and *Urticaceae* in Isparta (11). In Europe, the dominant airborne pollen species

have been determined to be *Gramineae, Alnus* sp., *Artemisia* sp., *Urtica* sp. and *Betula* sp. in Leiden, the Netherlends (20);*Gramineae, Urticaceae, Oleaceae* and *Artemisia* sp. in Ascoli Piceno, Italy (21); *Betula* sp., *Pinus* sp. *Alnus* sp. and *Gramineae* in Eskilstuna, Sweden (22).

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