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# Analysis of airborne pollen grains in Kırklareli

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**Abstract:** A continuous aeropalynological survey of the atmosphere of Kırklareli was carried out from January 2002 to December 2003 by means of the gravimetric method using Durham apparatus. Weekly pollen grains in per $cm^2$ were calculated. During these 2 years, a total of 11,758 pollen grains were recorded. Pollen fall in the years 2002-2003 comprised grains belonging 46 taxa. Of these taxa, 26 belonged to arboreal and 20 taxa non-arboreal plants. In 2002, 6011 pollen grains and, in 2003, 5747 pollen grains were recorded. Total pollen grains consisted of 71.02% grains from arboreal plants, 28.93% grains from non-arboreal plants, and 0.05% unidentified pollen grains. Pollen from the following taxa we also found to be prevalent in the atmosphere of Kırklareli: *Pinus* spp., Cupressaceae/Taxaceae, Gramineae, *Quercus* spp., Chenopodiaceae/Amaranthaceae, *Plantago* spp., *Platanus* spp., *Aesculus* spp., *Xanthium* spp., *Fagus* spp., *Robinia* spp., Urticaceae, *Betula* spp., and Oleaceae, *Artemisia* spp. A total of 64.95% pollen grains appeared during April to June. The pollen calendar for the region presented in this paper may be useful for allergologists to make an exact diagnosis.

**Key words:** Turkey, Kırklareli, pollen calendar, aeropalynology

## Kırklareli atmosferindeki polenlerin analizi

**Özet:** Kırklareli ilinde Ocak 2002 ve Aralık 2003 yılları arasında yapılan iki yıllık gravimetric yönteme dayalı aeropalinolojik araştırmada Durham Cihazı kullanılmıştır. Araştırmada haftalık olarak $cm^2$'ye düşen polen sayısı hesaplanmıştır. İki yıl boyunca toplam 11,758 adet polen tanesi kayıt edilmiştir. 2002 ve 2003 tarihleri arasında 46 aksona ait polen sayılmış ve bu taksonların 26 tanesi odunsu bitkilere, 20 tanesi ise otsu bitkilere ait olarak gözlenmiştir. 2002 yılında toplam 6011 adet polen ve 2003 yılında toplam 5747 adet polen kayıt edilmiştir. İki yıllık çalışmada toplam polen miktarının %71,02' si odunsu bitkilere, %28,93' ü otsu bitkilere ve %0,05' i ise tanımlanamayan bitkilere ait olarak gözlenmiştir. Kırklareli atmosferinde en yoğun görülen polen taksonları sıralanacak olursa; *Pinus* spp., *Cupressaceae/Taxaceae*, *Poaceae*, *Quercus* spp., *Chenopodiaceae/Amaranthaceae*, *Plantago* spp., *Platanus* spp., *Aesculus* spp., *Xanthium* spp., *Fagus* spp., *Robinia* spp., *Urticaceae*, *Betulaceae*, *Oleaceae*, *Artemisia* spp. dir. Maksimum polen sezonu ise %64,95 ile Nisan ve Mayıs aylarında görülmüştür. Bölgenin polen takviminin hazırlanması allerji uzmanlarına tanı koymalarında yardımcı olacaktır.

**Anahtar sözcükler:** Türkiye, Kırklareli, polen takvimi, aeropalinoloji

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## Introduction

Airborne pollen grains are important aeroallergens. When released by sources in sufficient amounts, allergenic pollen may evoke allergic responses in the sensitive patients, leading to allergic rhinitis and asthma. The highest risk to sensitized individuals is during the flowering periods of plants. Determining the pollen types and their concentration in the atmosphere of highly populated cities is therefore very important. These data prove helpful in the treatment of patients suffering from such diseases. It is a well known fact now that pollen grains of several plant taxa, such as *Alnus* spp., Cupressaceae, *Quercus* spp., *Platanus* spp., *Juglans* spp., Moraceae, *Pinus* spp., *Fraxinus* spp., *Acer* spp., *Corylus* spp., Gramineae, Chenopodiaceae/Amaranthaceae, Urticaceae, Compositae, *Plantago* spp., *Artemisia* spp., *Rumex* spp., and Umbelliferae have allergic effects (asthma, hay fever etc.) on humans (Levetin & Buck, 1980; Bousquet et al., 1984; Eriksson et al., 1984; D'Amato & Spieksma, 1990; Spieksma, 1990). For this reason, airborne pollen grains have been evaluated all over the world for several years by various studies to determine their dispersal (Koivikko et al., 1986; Romano et al., 1988; Kasprzyk, 1996; Bicakci et al., 1997-1999; Abreu et al., 2003; Ballero & Maxia, 2003; Puc, 2003; Carinanos et al., 2004; Celenk & Bicakci, 2005; Peternel et al., 2005; Bicakci, 2006; Garcia-Mozo et al., 2006; Rezanejad, 2008; Nautiyal et al., 2009; Celenk et al., 2010). In addition, pollen calendars are important for studies on phenology, ecology, pollination biology, etc.

The aim of this study was to determine pollen grains and changes in pollen fall per $cm^2$ weekly, monthly, and annually. The pollen calendar for the region presented in this paper may be useful for allergologists to establish an exact diagnosis.

## Materials and methods

Kırklareli is situated at 41°14′-42°00′N and 26°53′-23°13′E in the north-west of Turkey at an altitude of 203 m above sea level. Kırklareli has both Mediterranean and Middle European climate generally. The most frequent winds are from the north-east with an average 0.85 m/s, an average annual mean temperature of 13.1 °C, a mean rainfall of 549 mm/year, and a mean humidity of 70.2%.

Vegetation north and east of the city is composed of large-leafed woods: *Quercus cerris* L. var. *cerris*, *Q. frainetto* Ten, *Q. pubescens* Wild., *Q. robur* L. subsp. *robur*, *Juglans regia* L., *Carpinus betulus* L., and *Tilia tomentosa*. In other regions, the most common trees and shrubs are *Abies bornmüelleriana* Mattf., *Acer regundo* L., *Aesculus hippocastanum* L., *Ailanthus altissima* (Miller) Swingle., *Alnus glutinosa* (L.) Gaertn., *Betula pendula* Roth., *Carpinus orientalis* Miller., *Cornus mas* L., *Corylus avellana* L., *Cupressus sempervirens* L., *Fagus orientalis* L., *Fraxinus ornus* L. subsp. *ornus*, *Morus alba* L., *Pinus nigra* L. subsp. *pallasiana* (Lamb.) Holmboe, *Pinus brutia* Ten., *Picea abies* (L) Karst., *Platanus orientalis* L., *Populus alba* L., *Robinia pseudoacacia* L., *Salix babylonica* L., *Salix alba* L., *Sambucus nigra* L., *Taxus baccata* L., *Tilia argentea* Desf. ex DC, and *Ulmus glabra* Huds.

In addition to the natural vegetation around Kırklareli, the following species are frequently seen in the parks, gardens, and streets of the city: *Pinus nigra* L., *Pinus pinea* L., *Platanus orientalis* L., *Populus* spp., *Robinia pseudoacacia* L., *Aesculus* spp., *Acer* spp., *Fraxinus* spp., *Salix* spp., *Tilia* spp., and *Forsythia* spp.

In this study, the gravimetric method was used. The Durham apparatus was placed on the office roof, at the height of 10 m above ground level. All sides of the roof were open to air flow, and surrounding the roof there are no high buildings blocking air flow. Slides placed on the Durham apparatus were changed weekly.

Before exposure, the slides were covered with glycerin jelly mixed with basic fuchsine (Charpin & Surinyach, 1974). The slides were examined under a light microscope weekly. The grains were identified and counted at genus level in most cases, and at family level in the rest. The grains that could not be identified were considered unidentified types. The number of pollen grains was expressed as grains per square centimetre of microscope cover glass (22 × 22 mm).

## Results and discussion

A total of 11,758 pollen grains from 46 taxa, 6011 in 2002 and 5747 in 2003, were identified in the atmosphere of Kırklareli during this 2-year period. The results of pollen count for both years are shown in Table 1. The counts include over 46 different pollen types (26 AP and 20 NAP). A total of 8350 pollen grains were found as AP (71.02%), 3402 as NAP (28.93%), and as 6 unidentified (0.05%). A total of 64.95% pollen grains appeared during April to June (Figure 1, Table 2).

In the atmosphere of Kırklareli, arboreal pollen types were dominant (Figure 1). At the investigated site, a smaller number of pollen grains belonging to arboreal taxa were counted in 2003 than in 2002 in February and March. This was a result of differences in pollen grain numbers of Cupressaceae/Taxaceae between these 2 years (Figure 1). The frequency of arboreal pollen grains generally depends on the distribution and density of the local vegetation and rate of pollen production. According to other studies carried out in Europe, arboreal pollen types are also dominant in Zonguldak, Turkey (94.00%) (Kaplan, 2004), Fethiye-Muğla, Turkey (89.62%) (Bilişik et al.,

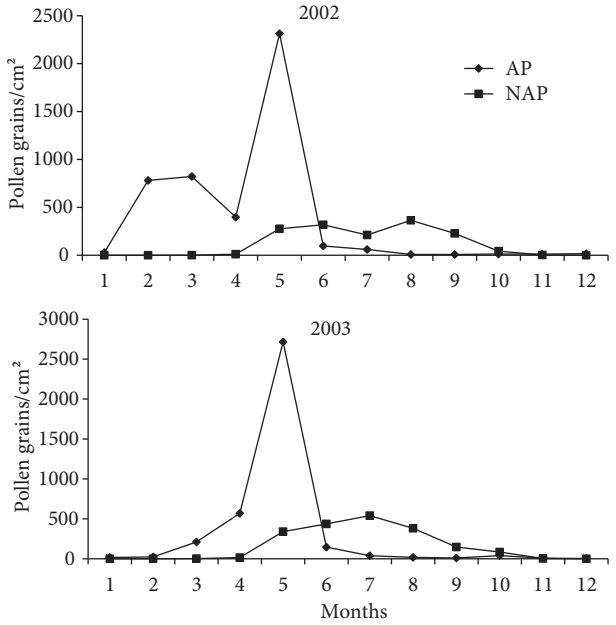


Figure 1. Monthly total variation in arboreal (AP) and non-arboreal pollen grains (NAP) in the atmosphere of Kırklareli (2002-2003).

Table 1. Annual totals of pollen counts for Kırklareli, 2002-2003.

| | 2002 | 2003 | 2002-2003 | % |
|---|---|---|---|---|
| *Acer* | 17 | 18 | 35 | 0.30 |
| *Aesculus* | 151 | 64 | 215 | 1.83 |
| *Ailanthus* | 42 | 54 | 96 | 0.82 |
| *Alnus* | 27 | 27 | 54 | 0.46 |
| *Betula* | 24 | 109 | 133 | 1.13 |
| *Carpinus* | 9 | 22 | 31 | 0.26 |
| *Castanea* | 0 | 2 | 2 | 0.02 |
| *Cedrus* | 15 | 24 | 39 | 0.33 |
| *Corylus* | 24 | 20 | 44 | 0.37 |
| Cup./Tax. | 1578 | 524 | 2102 | 17.88 |
| Ericaceae | 3 | 8 | 11 | 0.09 |
| *Fagus* | 110 | 72 | 182 | 1.55 |
| *Fraxinus* | 52 | 61 | 113 | 0.96 |
| *Juglans* | 30 | 20 | 50 | 0.43 |
| *Morus* | 3 | 29 | 32 | 0.27 |
| Oleaceae | 77 | 49 | 126 | 1.07 |
| *Ostrya* | 16 | 69 | 85 | 0.72 |
| *Pinus* | 1895 | 1298 | 3193 | 27.16 |
| *Platanus* | 50 | 196 | 246 | 2.09 |
| *Populus* | 14 | 6 | 20 | 0.17 |
| *Quercus* | 303 | 938 | 1,241 | 10.55 |
| *Robinia* | 55 | 93 | 148 | 1.26 |
| Rosaceae | 16 | 26 | 42 | 0.36 |
| *Salix* | 11 | 30 | 41 | 0.35 |
| *Tilia* | 16 | 22 | 38 | 0.32 |
| *Ulmus* | 16 | 15 | 31 | 0.26 |
| **Total (AP)** | **4554** | **3796** | **8350** | **71.02** |
| *Artemisia* | 41 | 79 | 120 | 1.02 |
| Cyperaceae | 7 | 6 | 13 | 0.11 |
| *Centaurea* | 6 | 8 | 14 | 0.12 |
| Che./Amar. | 269 | 247 | 516 | 4.39 |
| Compositae | 47 | 56 | 103 | 0.88 |
| Cruciferae | 36 | 66 | 102 | 0.87 |
| Gramineae | 574 | 1028 | 1602 | 13.62 |
| *Helianthus* | 12 | 10 | 22 | 0.19 |
| *Humulus* | 12 | 19 | 31 | 0.26 |
| Labiatae | 7 | 2 | 9 | 0.08 |
| Leguminosae | 5 | 8 | 13 | 0.11 |
| *Luzula* | 1 | 1 | 2 | 0.02 |
| *Plantago* | 120 | 186 | 306 | 2.60 |
| Rubiaceae | 7 | 3 | 10 | 0.09 |
| *Rumex* | 40 | 68 | 108 | 0.92 |
| *Taraxacum* | 11 | 10 | 21 | 0.18 |
| *Typha* | 12 | 21 | 33 | 0.28 |
| Umbelliferae | 19 | 25 | 44 | 0.37 |
| Urticaceae | 85 | 49 | 134 | 1.14 |
| *Xanthium* | 143 | 56 | 199 | 1.69 |
| **Total NAP** | **1454** | **1948** | **3402** | **28.93** |
| Unidentified | 3 | 3 | 6 | 0.05 |
| **TOTAL** | **6011** | **5747** | **11,758** | **100.00** |

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

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AU. | SEP. | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pinus* | - | - | 0.04 | 0.67 | 25.16 | 0.84 | 0.23 | 0.13 | 0.09 | - | - | - | 27.16 |
| Cupress./Taxa. | 0.35 | 6.02 | 7.78 | 2.52 | 0.56 | 0.10 | 0.06 | 0.03 | 0.03 | 0.15 | 0.12 | 0.15 | 17.88 |
| Gramineae | - | - | 0.02 | 0.10 | 3.23 | 3.91 | 3.51 | 1.70 | 0.74 | 0.36 | 0.05 | - | 13.62 |
| *Quercus* | - | - | 0.09 | 1.74 | 8.64 | 0.05 | - | - | - | - | - | - | 10.52 |
| Cheno./Amaranth. | - | - | - | - | 0.07 | 0.07 | 0.72 | 2.43 | 0.95 | 0.14 | - | - | 4.39 |
| *Plantago* | - | - | - | - | 0.31 | 1.15 | 0.69 | 0.41 | 0.04 | - | - | - | 2.60 |
| *Platanus* | - | - | 0.01 | 0.05 | 1.98 | 0.05 | - | - | - | - | - | - | 2.09 |
| *Aesculus* | - | - | - | 1.11 | 0.72 | - | - | - | - | - | - | - | 1.83 |
| *Xanthium* | - | - | - | - | - | - | 0.02 | 0.94 | 0.69 | 0.05 | - | - | 1.69 |
| *Fagus* | - | - | - | 0.20 | 1.34 | 0.01 | - | - | - | - | - | - | 1.55 |
| *Robinia* | - | - | - | - | 1.18 | 0.08 | - | - | - | - | - | - | 1.26 |
| Urticaceae | - | - | - | 0.01 | 0.67 | 0.24 | 0.13 | 0.02 | 0.07 | 0.01 | - | - | 1.14 |
| *Betula* | - | 0.13 | 0.08 | 0.14 | 0.78 | - | - | - | - | - | - | - | 1.13 |
| Oleaceae | - | - | - | 0.08 | 0.05 | 0.42 | 0.48 | 0.05 | - | - | - | - | 1.07 |
| *Artemisia* | - | - | - | - | - | 0.02 | 0.43 | 0.26 | 0.24 | 0.08 | - | - | 1.02 |
| **Total** | 0.35 | 6.15 | 8.01 | 6.63 | 44.70 | 6.93 | 6.27 | 5.95 | 2.85 | 0.79 | 0.17 | 0.15 | 88.95 |
| *Others* | 0.02 | 0.69 | 0.79 | 1.81 | 3.31 | 1.55 | 0.95 | 0.60 | 0.48 | 0.73 | 0.05 | 0.01 | 11.00 |
| Unidentified | - | - | - | - | - | 0.02 | 0.02 | 0.01 | - | 0.00 | - | - | 0.05 |
| **TOTAL** | **0.37** | **6.84** | **8.80** | **8.44** | **48.01** | **8.50** | **7.24** | **6.57** | **3.33** | **1.52** | **0.22** | **0.16** | **100.00** |

2008), İzmir, Turkey (84.05%) (Güvensen & Öztürk, 2003), Finland (82%) (Koivikko et al., 1986), Yalova, Turkey (80.50%) (Altunoğlu et al., 2008), Bursa, Turkey (78.61%) (Bıçakçı et al., 2003), İstanbul European part, Turkey (77.72%) (Çelenk et al., 2010), Ankara, Turkey (76.00%) (İnceoğlu et al., 1994), Burdur, Turkey (76.1%) (Bıçakçı et al., 2000), İstanbul Asian part, Turkey (75.61%) (Çelenk et al., 2010), Bartın, Turkey (72.81%) (Kaya & Aras, 2004), Edirne, Turkey (71.81%) (Bıçakçı et al., 2004), Balıkesir, Turkey (70.92%) (Bıçakçı & Akyalçın, 2000), Perugia (71%) and Ascoli Piceno (55%) (Romano et al., 1988), Tekirdağ, Turkey (64.08%) (Erkan et al., 2010), Afyon, Turkey (69.67%) (Bıçakçı et al., 2002), and Sakarya, Turkey (69.45%) (Bıçakçı, 2006).

The main pollen producers in the atmosphere of Kırklareli were the following arboreal plants: *Pinus* spp., Cupressaceae/Taxaceae, *Quercus* spp., *Platanus* spp., *Aesculus* spp., *Fagus* spp., *Robinia* spp., *Betula* spp., and Oleaceae. They form 64.52% of the total pollen fall (Table 1, Figure 2).

From herbaceous plants, Gramineae, Chenopodiaceae/Amaranthaceae, *Plantago* spp., *Xanthium* spp., Urticaceae, and *Artemisia* spp. were found frequently in the atmosphere of Kırklareli making up 24.46% of the total pollen fall (Table 1, Figure 2).

The earliest pollen grains in the atmosphere of Kırklareli were noted in January (Figure 1, Table 2). In January, pollen grains of Cupressaceae/Taxaceae, *Alnus* spp., and *Corylus* spp. were recorded. The number of pollen grains increased from February to April and reached its maximum level in May (48.01%) (Table 2). *Pinus* spp. (25.16%), *Quercus* spp. (8.64%), Gramineae (3.23%), *Platanus* spp. (1.98%), *Fagus* spp. (1.34%), and *Robinia* spp. (1.18%) produced high amounts of pollen in the atmosphere throughout their pollination period and formed 40% of the total pollen grains in May (Table 2).

From June, the pollen grains of weeds became dominant, but the amount of pollen was lower than in springtime. The reason for this decrease was

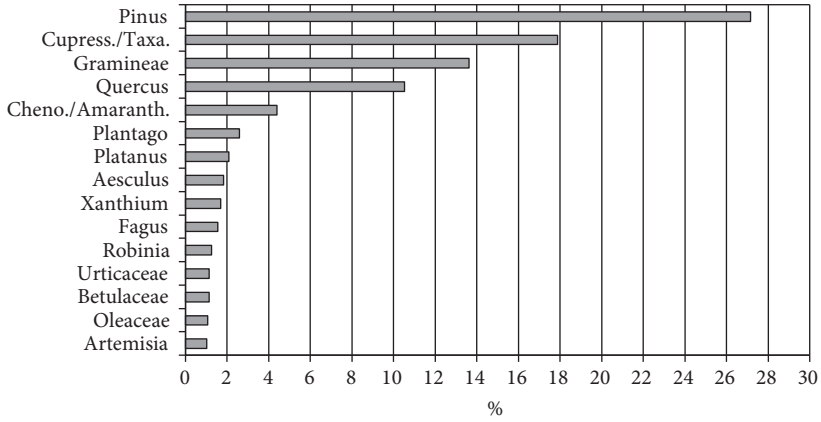


Figure 2. Total biannual percentage values of the main pollen types in the atmosphere of Kırklareli.

associated with the end of the pollination periods of many arboreal plants which produced and released high amounts of pollen grains into the atmosphere (Figure 1, Table 2). In June Gramineae, *Plantago* spp., *Pinus* spp., and Oleaceae; in July Gramineae, Chenopodiaceae/Amaranthaceae, *Plantago* spp., and Oleaceae; in August and September, Chenopodiaceae/Amaranthaceae, Gramineae, and *Xanthium* spp.; in October, Gramineae, Cupressaceae/Taxaceae, and Chenopodiaceae/Amaranthaceae; in November, Cupressaceae/Taxaceae and Gramineae; and in December, Cupressaceae/Taxaceae were recorded as dominant taxa (Table 2).

The types of pollen grains present in the atmosphere of Kırklareli are shown in the form of a pollen calendar based on the counts made in 2002-2003 (Figure 3). The following taxa (15 taxa) produced the greatest amounts of pollen grains in the atmosphere of Kırklareli (Figure 2, Table 2).

***Pinus* spp.** Pollen season started in the 3rd week of March (12th week), maximum between 18th week and the 22nd week of the year, and continued to occur in the last week of September (39th week). The total number in 2002 was 1895 while it was 1298 in 2003. Pollen grains of this genus constituted 27.16% of total pollen in the atmosphere of Kırklareli (Tables 1-2, Figures 2-3).

**Cupressaceae/Taxaceae** Pollen grains of these taxa constituted 17.88% of total pollen in the atmosphere of Kırklareli. Pollen grains were recorded during all months of the year. The total number in 2002 was 1578 and 524 in 2003 (Tables 1-2, Figures 2-3).

**Gramineae** Pollen production continued from the 3rd week of March (12th week) to the last week of the November (48th week). Pollen grains of this family constituted 13.62% of total pollen in the atmosphere of Kırklareli. The highest value was noted in the 3rd week of May and 2nd week of June, 3rd and 4th weeks of June, 2nd and 3rd weeks of July, and 1st and 2nd weeks of August. The total number in 2002 was 574 while it was 1028 in 2003 (Tables 1-2, Figures 2-3).

***Quercus* spp.** Pollen season started in the 2nd week of March (11th week) and ended in the 3rd week of June (25th week). The highest count was recorded between the 17th week and the 21st week. The total number in 2002 was 303 while it was 938 in 2003. Pollen grains of this genus constituted 10.55% of total pollen in the atmosphere of Kırklareli (Tables 1-2, Figures 2-3).

**Chenopodiaceae/Amaranthaceae** Pollen grains of these taxa constituted 4.39% of total pollen in the atmosphere of Kırklareli. Pollen production continued from the 1st week of May and the last week of October (44th week). The highest count was recorded between the 32nd week and the 37th week. The total number in 2002 was 269 while it was 247 in 2003 (Tables 1-2, Figures 2-3).

***Plantago* spp.** Pollen season started in the 1st week of May (18th week) and ended in the 3rd week of September (38th week). The highest values were noted between the 21st week and the 22nd week.

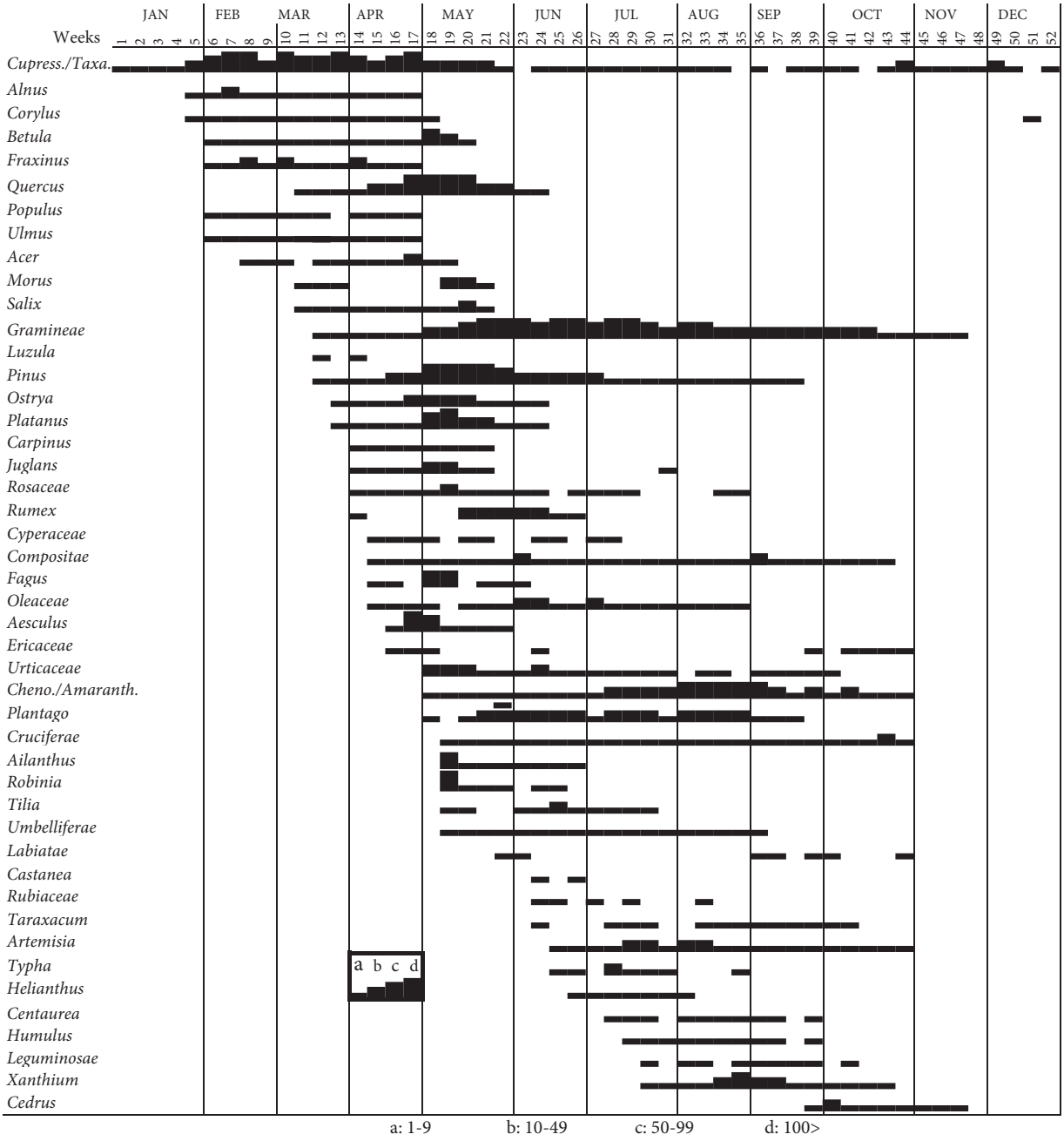


Figure 3. Pollen calendar for Kırklareli (2002-2003).

Pollen grains of this genus constituted 2.60% of total pollen in the atmosphere of Kırklareli. The total number in 2002 was 120 while it was 186 in 2003 (Tables 1-2, Figures 2-3).

***Platanus* spp.** Pollen production continued from the 4th week of March (13th week) to the 2nd week of the June (24th week). The highest count was recorded in the 2nd and 3rd week of May. Pollen grains of this

genus constituted 2.09% of total pollen in the atmosphere of Kırklareli. The total number in 2002 was 50 while it was 196 in 2003 (Tables 1-2, Figures 2-3).

***Aesculus* spp.** Pollen grains of this genus constituted 1.83% of total pollen in the atmosphere of Kırklareli. Pollen season started in the 3rd week of April and ended in the 1st week of June. The highest value was noted in the last week of April. The total number in 2002 was 151 while it was 64 in 2003 (Tables 1-2, Figures 2-3).

***Xanthium* spp.** Pollen season started in the 4th week of July (30th week) and ended in the 4th week of October (43rd week). The highest count was recorded in the last week of August (35th week). Pollen grains of this genus constituted 1.69% of total pollen in the atmosphere of Kırklareli. The total number in 2002 was 143 while it was 56 in 2003 (Tables 1-2, Figures 2-3).

***Fagus* spp.** Pollen production continued from the 2nd week of April and ended in the 2nd week of June (24th week). The highest counts were recorded in the 1st and 2nd week of May. Pollen grains of this genus constituted 1.55% of total pollen in the atmosphere of Kırklareli. The total number in 2002 was 110 while it was 72 in 2003 (Tables 1-2, Figures 2-3).

***Robinia* spp.** Pollen grains of this genus constituted 1.26% of total pollen in the atmosphere of Kırklareli. Pollen season started in the 2nd week of May and ended in the 3rd week of June. The highest value was recorded in the 2nd week of May. The total number in 2002 was 55 while it was 93 in 2003 (Tables 1-2, Figures 2-3).

**Urticaceae** Pollen season started in the 1st week of May (18th week) and ended in the 1st week of October (40th week). The highest count was recorded between 18th week and the 20th week. Pollen grains of this family constituted 1.14% of total pollen in the atmosphere of Kırklareli. The total number in 2002 was 85 while it was 49 in 2003 (Tables 1-2, Figures 2-3).

***Betula* spp.** Pollen production continued from the 1st week of February and ended in the 3rd week of May (20th week). The highest value was recorded in the 1st week of May (18th week). Pollen grains of this family constituted 1.13% of total pollen in the atmosphere of Kırklareli. The total number in 2002 was 24 while it was 109 in 2003 (Tables 1-2, Figures 2-3).

**Oleaceae** Pollen grains of this family constituted 1.07% of total pollen in the atmosphere of Kırklareli. Pollen season started in the 2nd week of April (15th week) and ended in the last week of August (35th week). The highest count was recorded in the 1st and 2nd weeks of June and in the 1st week of July (27th week). The total number in 2002 was 77 while it was 49 in 2003 (Tables 1-2, Figures 2-3).

***Artemisia* spp.** Pollen season started in the 3rd week of June (25th week) and ended in the last week of October. The highest count was recorded in the 3rd and 4th weeks of July (29th and 30th weeks) and in the 1st and 2nd week of August (32nd and 33rd weeks). Pollen grains of this genus constituted 1.02% of total pollen in the atmosphere of Kırklareli. The total number in 2002 was 41 while it was 79 in 2003 (Tables 1-2, Figures 2-3).

Some important allergenic pollens such as *Pinus* spp., Cupressaceae/Taxaceae, *Platanus* spp., *Salix* spp., *Juglans* spp., *Fraxinus* spp., *Fagus* spp., *Ulmus* spp., *Ailanthus* spp., *Alnus* spp., Gramineae, Chenopodiaceae/Amaranthaceae, *Plantago* spp., *Artemisia* spp., and *Xanthium* spp. were also found in high concentrations in Kırklareli (Levetin & Buck, 1980; Bousquet et al., 1984; Eriksson et al., 1984; Chapman, 1986; D'Amato & Spieksma, 1990; Spieksma, 1990; Gioulekas et al., 1991; Spieksma et al., 1991; Obtulowicz et al., 1996; Anand & Pawan, 2003). In Europe, the dominant airborne species have been determined to be Gramineae, *Alnus*, *Artemisia*, *Urtica*, and *Betula* in Leiden, the Netherlands (Spieksma, 1990; Jager et al., 1991); Gramineae, Urticaceae, Oleaceae, and *Artemisia* in Ascoli Piceno, Italy (Romano et al., 1988); *Betula*, *Pinus*, *Alnus*, *Platanus*, and *Plantago* in Brussels, Belgium (Spieksma, 1990; Jager et al., 1991); Cupressaceae, Gramineae, *Quercus*, and *Plantago* in Montpellier, France (Spieksma, 1990); Pinaceae, *Alnus*, *Betula*, *Quercus*, Gramineae, and *Artemisia* in Jyvaskylan, Finland (Koivikko et al., 1986); *Alnus*, *Betula*, Gramineae, and *Corylus* in Ostrowiec Swietokrzyski, Poland (Kasprzyk, 1996); and *Betula*, *Quercus*, Gramineae, and Urticaceae in Vienna, Austria (Jager et al., 1991). The airborne pollen types mentioned above are responsible for many cases of pollinosis in Europe.

## Conclusion

Pollen grains of 46 taxa were identified during the years 2002-2003 in the atmosphere Kırklareli, of which 15 formed about 88.99% of the total pollen spectrum (Tables 1-2, Figure 2). In the region investigated, pollen grains were recorded all year round and reached their maximum levels in May (Table 2, Figure 1). The pollen calendar for the region presented in this paper may be useful for prospective visitors in timing their visit to the city, and may also help allergologists in establishing an exact diagnosis.

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