

Pollen Spectrum of Gonen (Balıkesir) Atmosphere

Aycan Tosunoglu¹*, Hanife Akyalcin², Adem Bicakci¹

¹Uludag University, Faculty of Science, Department of Biology, 16059, Gorukle, Bursa, Turkey.

²18 Mart University, Faculty of Science, Department of Biology, Canakkale, Turkey.

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Abstract: In this study, pollen amounts and variations were monitored in the atmosphere of Gonen-Balıkesir annually by using gravimetric method. A total of 38 taxa and unidentified pollen grains were recorded and from these, 22 of them belong to arboreal plants (AP), 16 to non-arboreal plants (NAP). During the sampling period 4916 pollen counted per cm², of which 73.13% pertain to arboreal plants, 26.08% to non-arboreal plants and 0.79% to unidentified. Dominating taxa in the air of sampling cite were *Pinus* (19.08%), *Poaceae* (16.94%), *Cupressaceae/Taxaceae* (10.50%), *Quercus* (9.62%), *Juglans* (9.52%), *Olea europaea* (8.58%), *Platanus* (6.20%), *Amaranthaceae* (3.32%), *Asteraceae* (2.71%), *Alnus* (1.59%), *Acer* (1.14%) and *Morus* (1.14%); all of dominated pollen types previously reported as allergenic in the literature. In the study period, the pollen amount reached its highest level in May.

Gönen (Balıkesir) Atmosferinin Polen Spekturumu

Anahtar Kelimeler

Aerobioloji,
Gravimetrik örnekleme,
Polen takvimi

Özet: Bu çalışmada Gönen-Balıkesir atmosferinde görülen yıllık polen miktar ve değişimi gravimetrik metod kullanılarak araştırılmıştır. Toplam 38 takson ve tanımlanamayan polenler kaydedilmiştir ve bunlardan 22 tanesi odunsu bitkilere (AP), 16 tanesi otsu bitkilere (NAP) aittir. Örnekleme süresi boyunca cm²'de 4916 polen kaydedilmiş olup, bunların %73.13'ü odunsu bitkilere, %26.08'i otsu bitkilere %0.79'u ise tanımlanamayan polenlere aittir. Örnekleme sahası atmosferindeki dominant taksonlar; *Pinus* (%19.08), *Poaceae* (%16.94), *Cupressaceae/Taxaceae* (%10.50), *Quercus* (%9.62), *Juglans* (%9.52), *Olea europaea* (%8.58), *Platanus* (%6.20), *Amaranthaceae* (%3.32), *Asteraceae* (%2.71), *Alnus* (%1.59), *Acer* (%1.14) ve *Morus* (%1.14) olup; literatürde tüm dominant polen tiplerinin allerjik olduğu rapor edilmiştir. Çalışma süresinde polen miktarı Mayıs ayında en yüksek seviyede görülmüştür.

*İlgili yazar: aycanbilisik@uludag.edu.tr

1. INTRODUCTION

Gonen (Balıkesir) is situated in the North-West of Turkey (40° 06' N - 27° 38' E) along the Marmara Sea and has a 33 m altitude. Gonen is an agricultural region in both dry and irrigated lands, a great variety of crops grow during the year because of the particular

climate. The most important yield of Gonen is rice. In addition to this, Gonen is a well-known center of health tourism in Turkey and famous with thermal springs.

The studied area has Mediterranean climate and some species appear in the study area as follows; *Quercus coccifera* L., *Olea*

europa L., *Phillyrea latifolia* L., *Spartium junceum* L., *Cercis siliquastrum* L., *Crataegus monogyna* Jacq., *Laurus nobilis* L., *Erica arborea* L., *Paliurus spina-christi* Miller., *Pinus brutia* Ten., *Platanus orientalis* L., *Fraxinus excelsior* L., *Fraxinus ornus* L., *Fagus orientalis* Lipsky. and *Castanea sativa* Miller.. On the slopes of mountains at higher altitudes *Pinus brutia* Ten. and *Pinus nigra* Arn. are dominate. Pollen allergy is a common disease caused by a hipertensivity allergic reaction of the respiratory system and the eye conjunctivae to pollen grains. During the pollination season sensitive individuals shows the symptoms like; allergic rhinitis, allergic conjunctivitis, allergic bronchial asthma and urticaria. Determination of pollen type and concentrations of pollen grains will be useful for patients' complaining from pollen allergy. For this reason, pollen calendars have been prepared in many countries in the world (Bicakci *et al.*, 2000a; Bicakci *et al.*, 2002; Giner *et al.*, 2002; Bicakci *et al.*, 2003; Peternel *et al.*, 2003; Gioulekas *et al.*, 2004).

The aims of the study were; to expose the pollen types present in the atmosphere, their actual conditions and to establish a pollen calendar for Gonen-Balikesir region.

2. MATERIALS AND METHODS

From 1 January to 31 December 2012, a Durham gravimetric pollen trap located at the top of the structure, 10 m above the ground level. Weekly slides were covered with glycerin jelly mixed with basic fuchsine (Charpin and Surinyach, 1974). Light microscopy was used for identification of pollen grains and pollen counting was done on 22 × 22 mm area of the slide, which was calculated to one cm². Weekly pollen amounts of plant taxa were calculated and weekly pollen calendar was prepared.

3. RESULTS AND DISCUSSION

A total of 4916 pollen from 38 taxa were identified in the atmosphere of Gonen. Of

these, 22 taxa were belong to arboreal plants and the others from non-arboreal plants. 3595 pollen found to be arboreal (73.13%), while 1284 as non-arboreal (26.08%) and 39 as unidentified (0.79%) (Table 1).

The main pollen producers were arboreal plants such as *Pinus*, Cupressaceae/Taxaceae, *Quercus*, *Juglans*, *Olea europaea*, *Platanus*, *Alnus*, *Acer*, *Morus* and they constituted 67.28% of the annual pollen index (API). Most frequented herbaceous plants were; Poaceae, Amaranthaceae and Asteraceae (22.97% of API) in Gonen atmosphere (Table 1).

Monthly values of variation, recorded in the atmosphere were shown in Figure 1. In the sampling period, the highest pollen amounts was recorded in May with 1673 pollen (34.03% of the API) and the less concentration recorded in December with 2 pollen (0.04% of the API) (Figure 1, Table 2). During the January-June term and in December; pollen grains of woody taxa dominated and during July-November term; non-arboreal ones. No arboreal pollen were recorded in October-November term and non-arboreal pollen grains were not represented in the months January-February and December in Gonen-Balikesir atmosphere (Figure 1, Table 2).

The earliest airborne pollen grains recorded at the beginning of the year from the following species; *Alnus* (0.51%), Cupressaceae/Taxaceae (0.37%), *Betula* (0.10%) and *Ulmus* (0.02%). In January 51 pollen recorded and that was 1.04% of the API (Figure 1-2, Table 2).

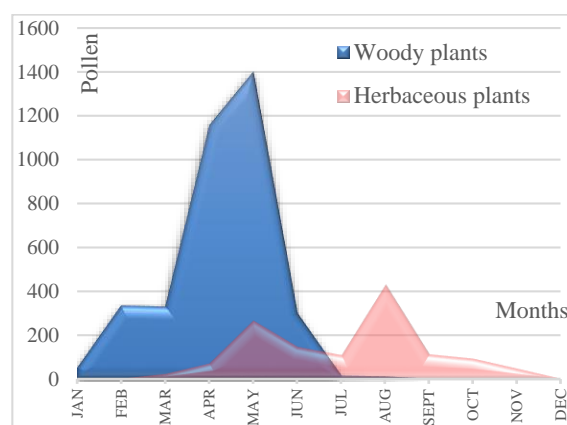
In February, number of plant species that recorded are increased, with the pollen originated from Cupressaceae/Taxaceae (4.13%), *Alnus* (0.96%), *Salix* (0.81%), *Fraxinus* (0.28%), *Betula* (0.22%), *Acer* (0.14%), *Populus* (0.08%), *Ulmus* (0.08%), *Corylus* (0.04%), Oleaceae (0.02%) and Rosaceae (0.02%). In addition, 338 pollen counted in February (6.88% of API) (Figure 1-2, Table 2).

Table 1. Pollen types recorded in Gonen-Balikesir atmosphere, their annual total and annual percentages

Taxa	Number of pollen	%
<i>Pinus</i>	938	19.08
Cupressaceae/Taxaceae	516	10.50
<i>Quercus</i>	473	9.62
<i>Juglans</i>	468	9.52
<i>Olea</i>	422	8.58
<i>Platanus</i>	305	6.20
<i>Alnus</i>	78	1.59
<i>Acer</i>	56	1.14
<i>Morus</i>	56	1.14
<i>Fraxinus</i>	48	0.98
<i>Salix</i>	45	0.92
<i>Betula</i>	36	0.73
<i>Fagus</i>	29	0.59
<i>Castanea</i>	23	0.47
Ericaceae	20	0.41
<i>Populus</i>	19	0.39
Rosaceae	16	0.33
<i>Olea europaea</i>	15	0.31
<i>Carpinus</i>	14	0.28
<i>Corylus</i>	7	0.14
<i>Ulmus</i>	7	0.14
<i>Tilia</i>	4	0.08
WOODY PLANTS	3595	73.13
Poaceae	833	16.94
Amaranthaceae	163	3.32
Asteraceae	133	2.71
<i>Xanthium</i>	47	0.96
<i>Plantago</i>	20	0.41
Urticaceae	20	0.41
Apiaceae	11	0.22
<i>Artemisia</i>	9	0.18
Cyperaceae	9	0.18
Fabaceae	8	0.16
Campanulaceae	6	0.12
Caryophyllaceae	6	0.12
Lamiaceae	6	0.12
<i>Taraxacum</i>	5	0.10
Brassicaceae	3	0.06
<i>Typha</i>	3	0.06
HERBACEOUS PLANTS	1284	26.08
Unidentified	39	0.79
TOTAL	4916	100.00

In March, pollen grains belonging to dominating plant taxa recorded in Gonen atmosphere; *Juglans* (2.18%), Cupressaceae/Taxaceae (1.63%), *Fraxinus* (0.67%), *Platanus* (0.43%), Poaceae (0.33%),

Betula (0.26%), *Quercus* (0.24%), *Populus* (0.20%), *Acer* (0.18%), *Carpinus* (0.14%), *Alnus* (0.12%), *Pinus* (0.12%), *Salix* (0.10%) and Oleaceae (0,10%). In March 352 pollen counted and that was 7.16% of the API (Figure 1-2, Table 2).

**Figure 1.** Monthly variation in pollen amounts belonging to woody and herbaceous taxa in Gonen-Balikesir, Turkey

In April, nearly similar taxa composition was found with March, but number of pollen grains increased and second highest pollen concentration was in this month. Dominated pollen types in April were; *Juglans* (5.92%), *Pinus* (5.57%), *Quercus* (4.88%) and *Platanus* (3.66%). In April 1231 pollen recorded and that was 25.04% of the API (Figure 1-2, Table 2).

In the sampling period the highest concentration was in May, with the pollen originating from *Pinus* (12.29%), *Olea europaea* (4.96%), Poaceae (4.60%), *Quercus* (4.41%), Cupressaceae/Taxaceae (2.32%), *Platanus* (2.12%) and *Juglans* (1.36%) (Table 2, Figure 1). The pollen grain that found most frequently in Gonen atmosphere in May was the pine pollen and number of pollen grains belongs to this taxon represents 36.10% of counted pollen grains in this month. Total number of pollen grains recorded in May constituted 34.03% of API (Figure 1-2, Table 2).

Table 2. Monthly variation of airborne pollen grains in Gonen-Balikesir atmosphere

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
<i>Acer</i>	-	0.14	0.18	0.49	0.33	-	-	-	-	-	-	-	1.14
<i>Alnus</i>	0.51	0.96	0.12	-	-	-	-	-	-	-	-	-	1.59
<i>Betula</i>	0.10	0.22	0.26	0.14	-	-	-	-	-	-	-	-	0.73
<i>Carpinus</i>	-	-	0.14	0.10	0.04	-	-	-	-	-	-	-	0.28
<i>Castanea sativa</i>	-	-	-	-	0.02	0.43	0.02	-	-	-	-	-	0.47
<i>Corylus</i>	-	0.04	0.10	-	-	-	-	-	-	-	-	-	0.14
Cupressaceae/Taxaceae	0.37	4.13	1.63	0.94	2.32	1.08	0.02	-	-	-	-	0.02	10.50
Ericaceae	-	-	0.06	0.20	0.10	0.02	-	-	0.02	-	-	-	0.41
<i>Fagus</i>	-	-	0.04	0.37	0.18	-	-	-	-	-	-	-	0.59
<i>Fraxinus</i>	-	0.28	0.67	0.02	-	-	-	-	-	-	-	-	0.98
<i>Juglans</i>	-	-	2.18	5.92	1.36	0.06	-	-	-	-	-	-	9.52
<i>Morus</i>	-	-	0.06	0.81	0.26	-	-	-	-	-	-	-	1.14
<i>Olea europea</i>	-	-	-	-	4.96	3.56	0.06	-	-	-	-	-	8.58
Oleaceae	-	0.02	0.10	0.18	-	-	-	-	-	-	-	-	0.31
<i>Pinus</i>	-	-	0.12	5.57	12.29	0.79	0.18	0.16	-	-	-	-	19.08
<i>Platanus</i>	-	-	0.43	3.66	2.12	-	-	-	-	-	-	-	6.20
<i>Populus</i>	-	0.08	0.20	0.10	-	-	-	-	-	-	-	-	0.39
<i>Quercus</i>	-	-	0.24	4.88	4.41	0.08	-	-	-	-	-	-	9.62
Rosaceae	-	0.02	-	0.08	0.10	0.08	-	0.04	-	-	-	-	0.33
<i>Salix</i>	-	0.81	0.10	-	-	-	-	-	-	-	-	-	0.92
<i>Tilia</i>	-	-	-	0.06	0.02	-	-	-	-	-	-	-	0.08
<i>Ulmus</i>	0.02	0.08	0.04	-	-	-	-	-	-	-	-	-	0.14
WOODY PLANTS	1.00	6.79	6.69	23.54	28.52	6.06	0.28	0.20	0.02	-	-	0.02	73.13
Amarathaceae	-	-	-	-	0.02	0.08	0.37	1.89	0.73	0.16	0.06	-	3.32
<i>Artemisia</i>	-	-	-	-	-	-	0.02	0.10	0.06	-	-	-	0.18
Campanulaceae	-	-	-	0.02	-	-	0.02	0.08	-	-	-	-	0.12
Caryophyllaceae	-	-	0.02	0.08	0.02	-	-	-	-	-	-	-	0.12
Asteraceae	-	-	0.04	0.06	0.28	0.18	0.26	1.53	0.18	0.10	0.06	-	2.71
Brassicaceae	-	-	-	0.02	0.04	-	-	-	-	-	-	-	0.06
Cyperaceae	-	-	-	0.02	0.06	0.06	0.02	0.02	-	-	-	-	0.18
Poaceae	-	-	0.33	0.83	4.60	2.32	1.22	4.13	1.18	1.55	0.79	-	16.94
Lamiaceae	-	-	-	-	0.02	0.02	0.08	-	-	-	-	-	0.12
Fabaceae	-	-	0.04	0.02	0.02	0.02	0.02	0.04	-	-	-	-	0.16
<i>Plantago</i>	-	-	-	0.02	0.14	0.10	0.06	0.06	-	0.02	-	-	0.41
<i>Taraxacum</i>	-	-	-	0.04	0.02	-	0.04	-	-	-	-	-	0.10
<i>Typha</i>	-	-	-	-	-	0.04	0.02	-	-	-	-	-	0.06
Apiaceae	-	-	-	-	0.02	0.10	0.04	0.06	-	-	-	-	0.22
Urticaceae	-	-	-	0.28	0.10	0.02	-	-	-	-	-	-	0.41
<i>Xanthium</i>	-	-	-	-	-	-	-	0.81	0.10	0.02	0.02	-	0.96
HERBACEOUS PLANTS	-	-	0.43	1.40	5.39	2.95	2.18	8.73	2.26	1.85	0.94	-	26.08
Unidentified	0.04	0.08	0.04	0.10	0.16	0.04	0.04	0.12	0.06	0.06	0.02	0.02	0.79
TOTAL	1.04	6.88	7.16	25.04	34.03	9.05	2.50	9.05	2.34	1.91	0.96	0.04	100.00

Dominating pollen grains and their percentages in June were; *Olea europaea* (3.56%), Poaceae (2.32%), Cupressaceae/ Taxaceae (1.08%), *Pinus* (0.75%) *Castanea sativa* (0.43%), Asteraceae (0.18%), *Plantago* (0.10%) and Apiaceae (0.10%). In June 445 pollen grains recorded and this number is calculated as 9.05% of API (Figure 1-2, Table 2).

In July 123 pollen/cm² were counted and that was 2.50% of the total pollen concentration in the year. Pollen grains belonging to dominating plant taxa recorded and their percentages were; Poaceae (1.22%), Amaranthaceae (0.37%), Asteraceae (0.26%), *Pinus* (0.18%), Lamiaceae (0.08%), *Olea europaea* (0.06%), *Plantago* (0.06%), *Taraxacum* (0.04%) and Apiaceae (0.04%) (Figure 1-2, Table 2).

In August, dominated pollen grains as follows; Poaceae (4.13%), Amaranthaceae (1.89%), Asteraceae (1.53%), *Xanthium* (0.81%), *Pinus* (0.16%) and *Artemisia* (0.10%). 445 pollen counted in this month and it was 9.05% of total pollen content (Figure 1-2, Table 2).

In September 115 pollen counted and that was 2.34% of the API. Dominated plant taxa and their percentages were; Poaceae (1.18%), Amaranthaceae (0.73%), Asteraceae (0.18%), *Xanthium* (0.10%) and *Artemisia* (0.06%) (Figure 1-2, Table 2).

In October, 94 pollen grains that all of them belonged to non-arboreal plants counted and this number calculated as 1.91% of total pollen grains recorded whole year. Dominating pollen types recorded in October; Poaceae (1.55%), Amaranthaceae (0.16%), Asteraceae (0.10%), *Plantago* (0.02%) and *Xanthium* (0.02%) (Figure 1-2, Table 2).

In November and December, recorded pollen grains' annual percentages were not above 1%, Poaceae is the most frequent pollen in November. In December, the only recorded

pollen was belong to Cupressaceae/Taxaceae (Figure 1-2, Table 2).

Airborne pollen grains of arboreal plants were found to predominate in the atmosphere of Gonen-Balikesir with percentages of 73.13%. That was due to the vegetation, climate and geographical location of Gonen. Arboreal pollen types also found as dominant in Ostrawiec Swietokrzyski-Poland (73%) (Kasprzyk, 1996), Balikesir-Turkey (70.92%) (Bicakci *et al.*, 2000c), Izmir (Guvensen *et al.*, 2003), Koycegiz-Turkey (Tosunoglu *et al.*, 2009), Yalova-Turkey (Altunoglu *et al.*, 2008), Kastamonu-Turkey (Ceter *et al.*, 2011), Denizli-Turkey (Guvensen *et al.*, 2013), Buyukorhan-Turkey (Tosunoğlu *et al.*, 2013), Kayseri-Turkey (Acar *et al.*, 2015).

Arboreal pollen grains as *Pinus*, *Quercus*, *Juglans*, *Platanus*, *Alnus*, *Acer*, *Morus* and non-arboreal pollen grains such as Fabaceae, Amaranthaceae and Asteraceae families occupy a place, which encountered to have more than 1% of the total pollen content were recorded in high concentrations as the important allergenic pollen grains (Levetin and Buck, 1980; Bousquet *et al.*, 1984; Eriksson *et al.*, 1984; Chapman, 1986; D'Amato and Spieksma, 1990; Gioulekas *et al.*, 1991) in Gonen-Balikesir atmosphere.

According to the other studies in the world; *Platanus*, Poaceae, *Acer*, *Cupressus*, Chenopodiaceae, Urticaceae, *Morus*, *Plantago* and Oleaceae in Santiago-Chile (Villegas and Nolla, 2001); *Betula*, *Corylus*, *Ambrosia*, Urticaceae in Zagreb-Croatia (Peternel *et al.*, 2003); Cupressaceae, *Quercus*, Urticaceae, Oleaceae, Pinaceae, Poaceae, Platanaceae, *Corylus*, Chenopodiaceae and *Populus* in Thessaloniki-Greece (Gioulekas *et al.*, 2004); Cupressaceae, Poaceae, *Platanus*, *Quercus*, *Artemisia*, Chenopodiaceae/ Amaranthaceae and Urticaceae in Isparta-Turkey (Bicakci *et al.*, 2000b); *Pinus*, *Olea*, *Platanus*, Poaceae, Cupressaceae/Taxaceae, *Quercus*, *Acer*, *Morus*, *Xanthium*, *Castanea*, Amaranthaceae, *Corylus*,

Artemisia, *Urtica* and *Fraxinus* in Bursa-Turkey (Bicakci *et al.*, 2003); Pinaceae, Cupressaceae, *Fraxinus*, *Cedrus*, *Artemisia*, Poaceae, Chenopodiaceae and *Populus* in Eskişehir Sivrihisar (Potoglu Erkara, 2008); *Pinus*, *Fraxinus*, Cupressaceae, *Ailanthus*, Chenopodiaceae/ Amaranthaceae, *Sophora*, *Acer*, Poaceae, *Populus*, *Ostrya*, *Quercus*, *Salix*, Urticaceae, *Abies*, *Ulmus* and *Juglans* in Konya (Altunoglu *et al.*, 2010); *Pinus*, *Fagus*, *Ostrya*, *Quercus*, *Pistacia*, Brassicaceae, Poaceae, Cupressaceae/Taxaceae, *Salix*, Chenopodiaceae/ Amaranthaceae, *Abies*, *Carpinus*, *Juglans* and *Phillyrea* in Karabuk (Kaplan and Ozdogan, 2015) were reported as predominated taxa.

Pine was recorded as the most frequent pollen during the investigation period with 19.08%, probably the result of excessive pollen production of pine forests of the study area and its surroundings. Pine pollen recorded as the first dominating type before many times from Western Turkey; Burdur (Bicakci *et al.*, 2000a), Afyon (Bicakci *et al.*, 2002), Fethiye (Bilisik *et al.*, 2008a), Koycegiz (Bilisik *et al.*, 2009) and Didim (Tosunoglu *et al.*, 2008b).

Gramineae pollen was recorded as the most frequent non-arboreal type in Gonen atmosphere and their long presence was showing a similar pattern with other Mediterranean cities (Bicakci *et al.*, 2002, Giner *et al.*, 2002), which was probably due to the due to intense rice farming in the area. In addition, Gramineae pollen grains were also reported as a predominant pollen type in Bursa (Bicakci *et al.*, 2003), in Kayseri (Ince *et al.*, 2004), in Thessaloniki (Gioulekas *et al.*, 2004), and in Zagreb (Peternel *et al.*, 2003), Koycegiz (Tosunoglu *et al.*, 2009), Bodrum (Tosunoglu and Bicakci, 2015), Kagızman (Yalcin *et al.*, 2017) and Usak (Uguz *et al.*, 2018).

In conclusion, Airborne pollen grains of 38 taxa, 22 of them arboreal and 16 of them non-arboreal were recorded annually in Gonen-Balikesir, Turkey. Pollen grains on slides seen without deductions during the investigation period. The airborne pollen calendar prepared for Gonen-Balikesir (Figure 2). We hope the calendar designed by us will be useful for medical treatment of patients' complaining from pollen allergy in Gonen-Balikesir province and its surroundings.

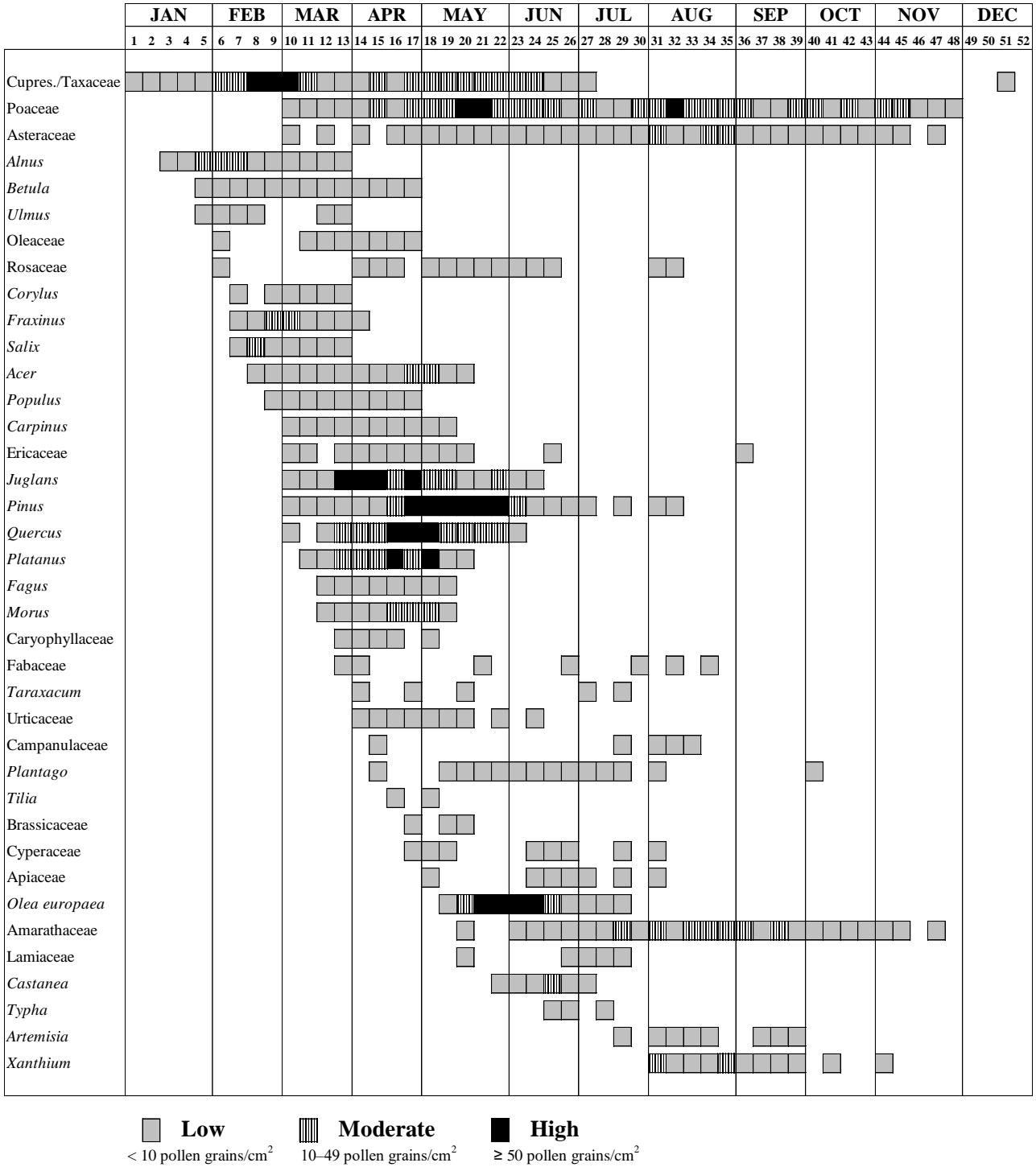


Figure 2. Annual pollen calendar of Gonen-Balikesir, Turkey.

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