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THE RELATIONSHIP BETWEEN THE ANALYSIS OF AIRBORNE POLLEN AND METEOROLOGICAL PARAMETERS, THE CASE OF BARTIN

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Abstract

The study was performed in Bartın in 2003 and it was aimed to help physicians with the diagnosis and treatment of airborne pollen grains causing allergic diseases. The samples were collected from two different stations (Yalı and Balamba) in Bartın and analyzed by Durham-gravimetric method. The plant taxa of the pollen grains in Bartın atmosphere was determined and after their identifications were morphologically made, their microphotographs were taken. The amount of the pollen grains in Bartın atmosphere was measured as cm^2 units with respect to the specified area within weekly and monthly periods by the help of the microscope slides placed in Durham instrument. It was found that pollens belong to 20 taxa of tree and bush, and 14 taxons of herbaceous forms. 69% of tree and bush taxa pollens, 14% of Poaceae pollens, 15% of other herbaceous taxa pollens and 2% of unidentified pollens make up the total pollen quantity. The results were compared with the meteorological factors and the monthly pollen calendar.

Keywords: Pollen, meteorology, analysis, pollen calendar.

1. Introduction

During the last two decades clean evidence emerged that there was an increase in the incidence of pollen allergy in most European countries (D'Amato & Spieksma 1990). Atmosphere concentration of different pollen types varies enormously from country to country or from city to city, because pollen emission depends on environmental conditions and vegetation (Ribeiro et al., 2003). Most of the microorganisms such as pollens, spores, bacterium and viruses in the air might be the agents of an illness. These spores and pollens provoke allergic reactions on some sensible bodies. This allergic illness caused by pollens and spores is called "polinosis". It is needed to determine the diagnosis of allergic pollens and spores sweeping through the air, find out the type of the plant they belong to. It's also needed to frame pollen calendars indicating the changes in the concentrations in terms of monthly, in order to be successful in the treatment and diagnosis of the "polinosis illnesses". In most of the cities, both the names and the numbers of the pollens are announced to the public daily and hourly by means of media (Pehlivan, 1995). In addition to having a knowledge of quantity and pollen morphology, it is urgent to determine, classify and be familiar with the vegetation around so as to be victorious in diagnosis and treatment of some allergic illnesses like asthma and hay fever. Thus, a pollen calendar of a particular area is important for ecological and allergically uses (Badya & Pusha,, 1991, Mullins & Emberlin, 1997, Docampo et al., 2007). Airborne pollen studies were initiated by Aytuğ et al. (1974) in Turkey and pollen calendar for 1966-1968 was prepared. There are many studies about relationship between pollens and meteorological factors such as Istanbul (Aytuğ, 1973), Ankara (Özkaragöz & Karamanoğlu ,1967; İnceoğlu et al., 1994; Kızılpınar et al., 2010), Samsun (Yurdukoru, 1979), Kütahya (Bıçakçı, 1999), Bartın (Kaya, 2004), Zonguldak (Kaplan, 2004), Sydney, Australia (Stennet & Beggs, 2004), Germany (Estrella, 2006), Lugo, Spain (Rodrigues-Rajo, 2003), Tenerife, Canary Island (Izquierdo et al., 2010).

During the year 2003, an atmospheric study was held in different stations in order to create the pollen calendar of Bartın by applying a gravimetric method.

2. Material and methods

2.1. Sampling location

Bartın is located in West Black Sea Region, between 41º 53º North Latitude and 32 º 45 º East Longitude. The city measures 2143 sq. km. Altitude changes between sea level and 55 m. Bartın has mild climate (Black Sea Climate) with very warm summers and cool winters. Its closeness to the sea and the parallel mountain ranges

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lead to the decrease of temperature differences in the coast, the increase of humidity and the effect of air mass from Balkan.

The studies were carried out in 2003 in Bartın city. In this study, a gravimetric method and a Durham sampler were used (Figure 1). The Durham sampler was located at 1.50 m. height above ground level. Slides placed in the Durham sampler were changed weekly before exposure and the slides were covered with petroleum jelly. The slides were examined weekly under the light microscope. Slides were covered by two cover slips of 24 x 24 mm size and hence pollen grains were determined on an 1152 mm. square area.

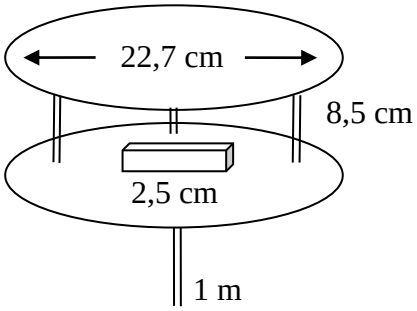
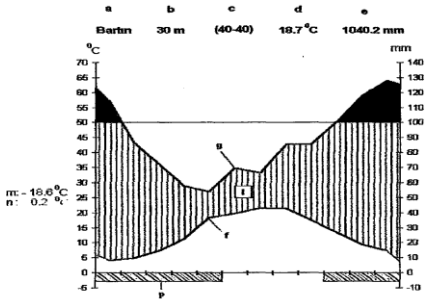


Figure 1. Durham sampler

The identification of pollen taxa was done with the help of reference slides which were prepared from the plants of Bartın at different periods of the year according to the Wodehouse method (1965). The reference slides were deposited at the Palynology Department of Gazi University. Identification was also followed using the books on palynology (Erdtman, 1952-1966; Louveaux, 1970; Nilsson et al., 1977; Moore et al., 1991, Pehlivan, 1995).

2.2. Meteorological data

Meteorological parameters obtained from Bartın Meteorological Directorate in 2003 are shown in Table 1 and Figure 2.



a: Weather station
b: Height of weather station (m.)
c:Temperature and precipitation observation year
d: Average annual temperature (ºC)
e: Average annual precipitation (mm.)
f: Temperature curve
g: Precipitation curve
I: Humid season
m: The lowest temperature average of the coolest month
n: Absolute minimum temperature (ºC)
r:Possible frost months

Figure 2. Bartın's climate diagram (2003)

Table 1. Meteorological parameters Bartın in 2003

Values/ Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Average
Avg. Temperature (mm)	6.6	2.8	3.5	9.4	16.3	20.2	22.2	22.1	17.2	14.4	9.2	5.1	12.4
Avg. Total Precipitation (mm)	123.9	112.4	68.1	54.6	8.3	0.0	71.3	6.5	89.3	119.1	100.7	109.6	863.8
Daily the highest precipitation amounts (mm)	45.0	17.7	17.7	11.4	5.2	0.0	32.7	3.6	14.9	43.6	23.8	41.0	45.0
Average humidity %	85.6	82.1	79.9	77.5	75.8	64.1	73.2	72.9	83.4	81.6	85.0	85.2	78.9
Avg. Wind Speed	1.0	1.8	1.5	1.7	1.7	1.9	1.7	1.7	1.4	1.6	1.0	0.9	1.5

2.3. Statistics

The Khi-kare test was applied to the pollen quantities found in Balamba and Yalı stations. It helped us to evaluate the pollen quantities statistically.

35 terms were used while applying the test. It was aimed to compare both two stations with the help of the test (Balamba and Yalı). Although both of the stations had 35 terms, it was found 35-1= 34 with the formula; n-1, while trying to find the range of scattering of the places to be compared.

Khi-kare result was found $x^2 = 1.77$
Range of scattering; df = 34

Two hypotheses were stated as H_0 and H_1. It was aimed to accept one and deny the other according to the results of the Khi kare test.

Ho : There is no difference in the pollen quantities between the stations.
H_1 : There is a difference in pollen quantities between the stations.

The most suitable *a* number was accepted as $a = 0.01$ and the result 1.77 was seen higher than the number 0.01. That is why H_0 was denied. The result of this study showed us that the places have a great importance to find out the pollen quantities

3. Results

The studies were held in 2003 by means of the Durham sampler placed in two different study areas. In the atmospheric study of Bartın, it was found that pollens belong to 20 taxa of tree and bush, and 14 taxons of herbaceous forms. 69% of tree and bush taxa pollens, 14% of Poaceae pollens, 15% of other herbaceous taxa pollens and 2% of unidentified pollens make up the total pollen quantity (Table 2, Figure 3). The quantities of the taxa according to the months were given Figure 4.

As mentioned above, 69% of the total pollen quantity is covered by pollens of 20 taxa in the form of tree and tree-like. The percentage shows some changes in some of the studies held in some other cities of Black Sea Region, that is, 84% for Zonguldak (Kaplan, 2004) and 72.33% for Bartın (Kaya, 2004).

While having a study in a different station in Bartın between the 1995 and 1997, we came across with a new type Geranium, apart from the study we held in 2003. But in 2003, we came across with Aceraceae, Cyperaceae, Polygonaceae and Moraceae families as new types.

Table 2. The percentages and the quantity of the pollens belonging to tree and tree-like types, Poaceae and other herbaceous plants.

Plant group	Total Pollen Quantity (fg)	Percentage
Tree	61343	69
Poaceae	11971	14
Herbaceous	13478	15
Other	1635	2

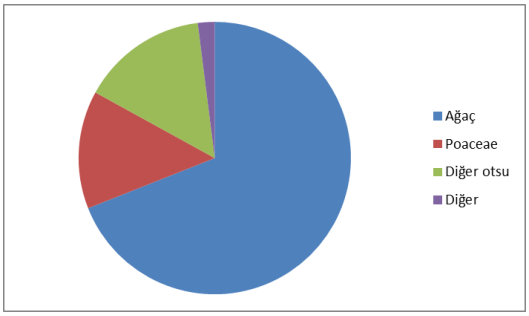
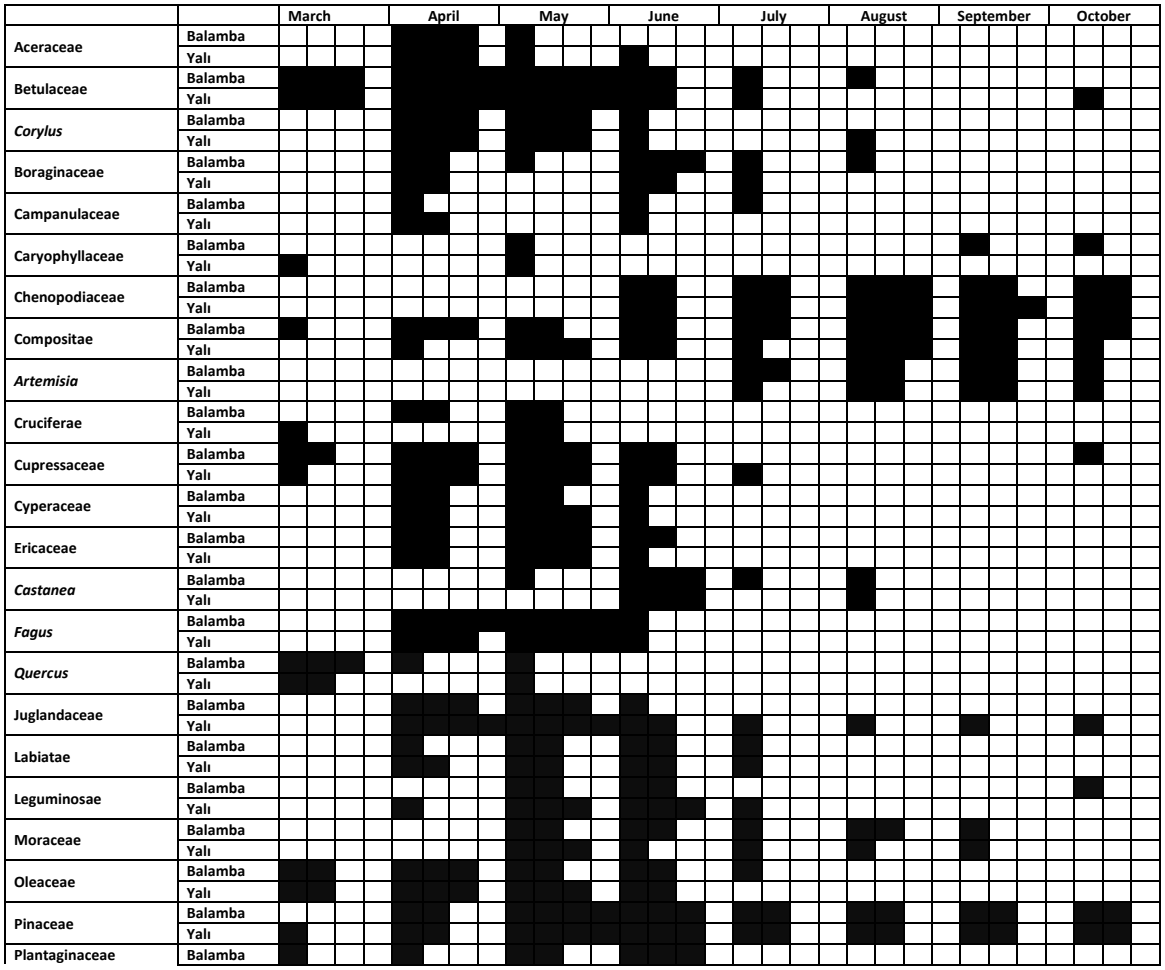
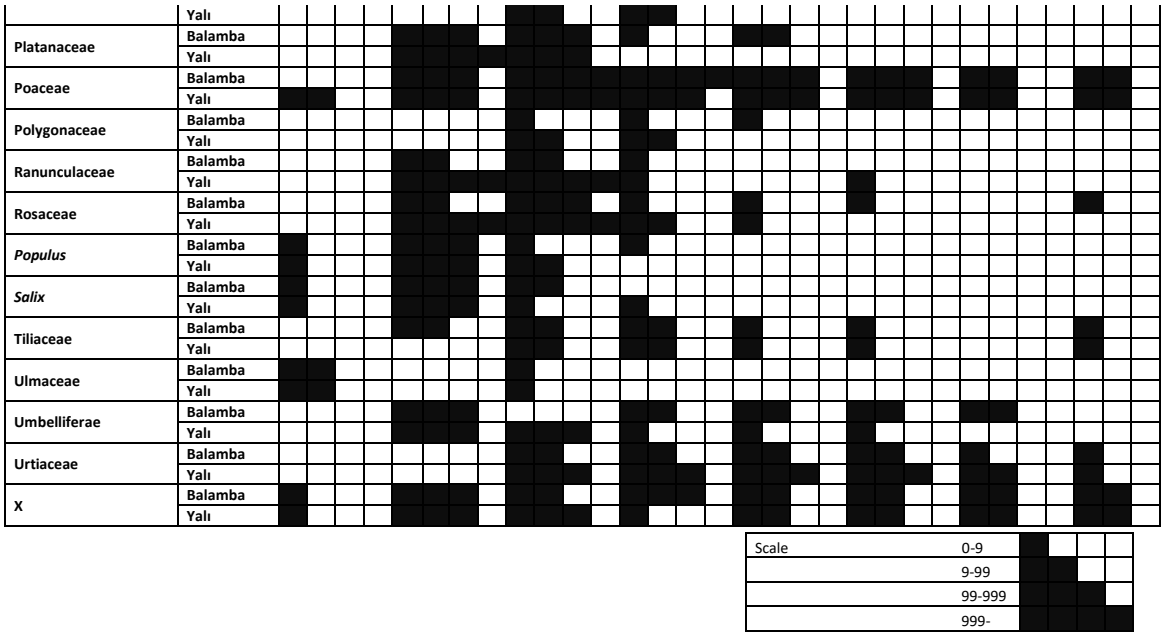


Figure 3. The percentages of the pollens belonging to tree and tree-like types, Poaceae, other herbaceous taxa and unidentified ones

Table 4. The pollen calendar of Bartın





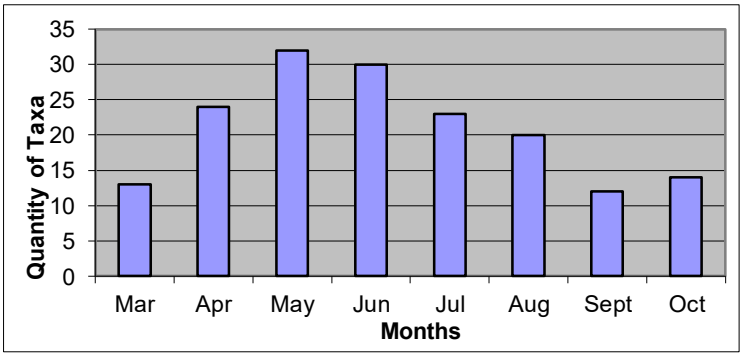


Figure 4. The changes in the quantity of taxa of pollens monthly

The types of pollen presented in the atmosphere of Bartın are shown in the form of pollen calendar (Figure 5) based on the counts made in 2003. The following taxa produced the greatest amounts of pollen in the atmosphere of Bartın.

Aceraceae : The pollens were first met in second week of April. The second week of June was the last period of that type to be seen.
Betulaceae : The quantity of this type showed an increase after March and reached its peak in May because of the gradual increase in temperature and decrease in the amount of rain. *Corylus* pollens planted around was also seen in the atmosphere after the third week of March.
Boraginaceae : The pollens belonging to this family were seen after the first of April. The last week of September was the last period to meet with this type.
Caryophllaceae : The pollens of this family seen rarely in the atmosphere were first met at the first week of May, and lastly at the first week of October.
Campanulaceae : The family which is met rarely in the atmosphere was first seen at the first week of May and lastly at the third week of July.
Chenopodiaceae : The pollens belonging to this family were mostly observed in August. This difference in the quantity between the stations is not just because of the nature of this region but also because of some types that were planted in the gardens around. That is why we met more pollen in Yalı station.
Compositae : The pollens, being a part of this family, were both seen in two stations between March and October.
Cruciferae : The pollens of this family were mostly observed in May.
Cupressaceae : The pollens of this family were met in April when the speed of the wind showed an increase.
Cyperaceae : The pollens were met between April and June.

Ericaceae : Being in the northern slopes and facing the sea in the natural vegetation of Bartın, the pollens of this family were in sight during a long period starting from April to the third week of October.
Fagaceae : The pollens belonging to this family were observed starting from April to the end of August and reached at the percentage of 20.42 of total pollen quantity both in two stations.
Since being close to the natural vegetation, the pollens of *Fagus* family found in the highest quantity in Balamba Station are not so considerable when it comes to its allergic effects. It only covered 4.83% of total pollen quantity and that of 2.76% was seen in Balamba Station. But *Quercus* pollens covering 14.96% of total pollen quantity was mostly seen in Balamba Station with the percentage of 9.60. As a result of the data, it was classified as the most dangerous when it is thought in terms of allergic effects.
Juglandaceae : Although the pollens of this family showed some differences in both stations, they were mostly in sight in Yalı Station. Planting *Juglans* around the gardens near the station might be considered as a reason of this. The allergic effect of these pollens is stated as medium.
Labiatae : The pollens were seen at the maximum level in both stations during May.
Legüminosae : The pollens of this family were observed during a period between the third week of April and October. Since they are planted nearby, the pollens of the family which are entomogam were mostly seen in Yalı Station and covered 0, 59% of total pollen quantity.
Moraceae : The pollens were observed between the first weeks of May and September. But they were mostly observed in May because of the increase in the temperature and a considerable decrease in the amount of the rain when it was compared to April.
Oleaceae : The pollens were seen during the period between the third week of March and the last week of June.
Pinaceae : The pollens were in sight between the last weeks of March and October. Being the first in Bartın atmosphere when it comes to the pollen concentration, they were mostly observed in May. During the months mentioned above, the quantity of the pollens showed an increase since the temperature and speed of wind were high and the amount of rain was low. Not only the reasons mentioned but also having trees belonging to Pinaceae family and spreading many types of pollen increased the quantity that they covered in total pollen quantity.
Plantaginaceae : The pollens were seen between the last week of March and the second week of October.
Platanaceae : The pollens were in sight between the first week of April and the last week of July.
Poaceae : The pollens of this family were first observed in the third week of March. Polinization continued until the end of October. The quantity of the pollens reached their maximum level in the third week of May both in two stations.
Polygonaceae : The pollens belonging to this family were seen during the period starting at the second week of May and having an end in the third week of July.
Ranunculaceae : However the pollens were seen between the first week of April and the fourth week of August, the pollens were mostly observed in Yalı Station. The reason of having the pollens more in Yalı Station was finding the samples more in the gardens around the station.
Rosaceae : The pollens of this family were first in sight in the first week of April and lastly in the last week of October. The reason of observing this type of pollen during a long period might be growing this type as a plant for decoration and also having lots of fruit trees.
Salicaceae : *Populus* L. pollens from Salicaceae family were first seen at the third week of March. It was last in sight in the second week of June in the atmosphere. *Salix* L. pollens were seen between the third week of March and the first week of June.
Tiliaceae : The pollens belonging to this family were seen between the fourth week of April and the last week of October. Because of having no rain and the highest speed, the pollens reached their maximum level in June compared to whole year.
Ulmaceae : The pollens were observed between the third weeks of March and May.
Umbelliferae : They were seen between the first week of May and the second week of September
Urticaceae : The pollens belonging to this family were in sight between the second weeks of May and October. Being also a period of blossoming, the speed of the wind together with rain had a great effect in the quantity of pollens to be seen in June.

4. Discussion

During the studies held in Bartın atmosphere, the pollens belonging to 20 taxa of tree and bush forms and 14 of herbaceous forms were observed.

At the end of aeropolinological study, it was seen that the pollen quantity was variable every time. This is because of the changes in the blossoming period of the plants and meteorological factors. In addition to this, the choice of the place to fix the device is so important to identify the pollen, in other words, taxa quantities.

Metrological factors affect growing and flowering of plants, along with the amount, distribution and carriage of pollen in the atmosphere. Among these factors, daily temperature has an effect on the vegetative growth, formation and maturation of the organs and fertility of plants (Thuzar et al. 2010).

Meteorological factors, temperature and moisture showed an increase in May. The increase in pollen quantity proves that these meteorological factors had a positive effect on the pollen quantity. This is because of creating an atmosphere for the anters to mature and blossom.

Since these were an increase in the amount of rain, as in September, the pollens were blocked to go out of anter and spread around. So, there occurred a decrease in the quantity of pollens.

In October, the amount of the rain was always high. That is why it has got the least pollen quantity. Low temperature and high amount of rain decreased the pollen quantity in September and March.

The total pollen quantity was mostly seen in May. High temperature and taxa blossoming in this period were the main reasons of this result. Although the temperature and speed of the wind were so high in June, low level of moisture when compared to May decreased the pollen quantity. Although the moisture was so high, the temperature was so low. In addition to this, having a great amount of rain in May caused a decrease in the pollen the quantities.

The temperature, moisture and the amount of rain were so high in july That is why not so many pollens were observed. After August, the decrease in the amount of rain caused an increase in pollen quantity when compared to June. In several studies, including ours, humidity and rainfall exerted a negative influence on tree, grass and weed pollen counts (Stach, 2000; Puc & Puc, 2004; Alwadie, 2008; Sahney & Chaurasia, 2008).

With the study held in Bartın, it was shown that meteorological parameters have a significant, mild-to-moderate influence on the occurrence and distribution of pollen grains in the atmosphere. Additionally, this study gives an indication of the airborne pollen types present in the atmosphere in Bartın and provides also an indication of their main flowerig seasons. Pollens are important because they affect human health. The pollen calendar of the city was formed and it was seen that the most important taxa in terms of their allergic effects and quantities were Poaceae (13.54%), *Quercus* (14.96%), Juglandaceae (5.49%), Oleaceae (3.88%), Chenepodiaceae (1.93%) *Corylus* (1.44%), Plantaginaceae (0.95%). The pollens of Pinaceae family (16.02%) were the ones seen mostly in the city. The pollen calendar and the association with meteorological factors may be useful to physicians helping to diagnose and treat allergic patients, and advise precautions.

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