ANADOLU ÜNİVERSİTESİ BİLİM VE TEKNOLOJİ DERGİSİ
ANADOLU UNIVERSITY JOURNAL OF SCIENCE AND TECHNOLOGY
Cilt/Vol.:7-Sayı/No: 2 : 357-362 (2006)

RESEARCH ARTICLE / **ARAŞTIRMA MAKALESİ**

SEASONAL VARIATIONS IN AIRBORNE *CLADOSPORIUM* AND *ALTERNARIA* SPP. CONIDIA IN ESKİŞEHİR

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ABSTRACT

The conidia of allergenic *Cladosporium* and *Alternaria* spp. were counted by using a Durham sampler at five sampling points during one year and the relationship between the numbers of conidia and meteorological data was investigated. The conidia of these fungi were present in the air of Eskişehir-Anatolia throughout the year. Temperature favoured conidial release for both species of *Cladosporium* and *Alternaria*. Rain precipitation was negatively correlated with conidial numbers of *Cladosporium* and *Alternaria* while no significant correlation was obtained with wind velocity.

Keywords: *Cladosporium* and *Alternaria*, Conidia, Seasonal variations

ESKİŞEHİR HAVASINDAKİ *CLADOSPORIUM* VE *ALTERNARIA* SPP. KONİDİALARININ MEVSİMSEL DEĞİŞİMİ

ÖZ

Allerjenik *Cladosporium* ve *Alternaria* spp. konidiası beş farklı örnekleme noktasında 1 yıl boyunca Durham örnekleyicisi kullanılarak sayılmış ve konidia sayıları ile meterolojik veriler arasındaki ilişki araştırılmıştır. Eskişehir havasında bu funguslara ait konidia yıl boyunca mevcut olarak tesbit edilmiştir. Sıcaklığın hem *Cladosporium* hem de *Alternaria* spp. türlerinin konidial salınımını arttırdığı saptanmıştır. Yağmur ile *Cladosporium* ve *Alternaria* spp. konidia sayısı arasında negatif etkileşim gözlenirken, rüzgar ile konidia sayıları arasında dikkate değer bir ilişki saptanamamıştır.

Anahtar Kelimeler: *Cladosporium* ve *Alternaria*, Konidia, Mevsimsel değişim

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Recieved: 24 December 2004; **Revised(I):** 31 August 2005; **Revised(II):** 10 February 2006; **Accepted:** 27 March 2006

1. INTRODUCTION

Airborne fungal conidia are important and of considerable economic significance because many species are pathogenic and can cause some diseases in humans, animals and plants. It has been known that inhalation of the conidia of moulds produce numerous allergies (Palmas and Cosentino, 1990). The species present and their concentrations in the air are dependent on several factors: geographical location, time of day, temperature, relative humidity, rainfall, wind velocity, seasonal climate factors, type of vegetation and human activities. Many investigations have been carried out on the airospora in many parts of the world (Abdel-Hafez and El-Said, 1989; Li and Kendrick, 1994; Lyon et al., 1984; Nussbaum, 1991, Çolakoğlu, 1996 a, b, c; Şen and Asan, 2001, Al-Subai, 2002)

In most aerobiological surveys, *Cladosporium* and *Alternaria* spp. have been reported to form the majority of airborne conidia in the temperate zones. They live as saprophytes or as parasites on many kinds of plants (Hjelmroos, 1993).

Eskişehir is an Anatolian city. Its altitude is 720 m and it has dry summers and cold winters. Rainfall occurs mainly in the springs. The city has a steppe vegetation and it is surrounded by agricultural areas producing cereals, chiefly wheat and barley. Because of its prevalent agricultural economy represents a particularly favourable environment for mould growth and dispersal. Atik and Tamer (1994) first studied the airborne microbial flora in Eskişehir by sedimentation method and they recorded that *Penicillium* spp., *Cladosporium* spp., *Aspergillus* spp., *Alternaria* spp., were the most prevalent fungi. Harmancı et al., (2000) examined 105 asthma patients living in Eskişehir using skin tests. They reported that *Cladosporium* and *Alternaria* spp. were common allergens. Therefore, this study was designed to give basic information on the seasonal variation of *Cladosporium* and *Alternaria* spp. in Eskişehir.

2. MATERIALS AND METHODS

2.1 Study area

The study was performed over a 12-month period, from February 1999 to January 2000 at five sampling points in the city of Eskişehir. Two of the sampling sites were located in the center of the city, and three were in its rural regions.

2.2 Sampling Method

Durham or gravity slide samplers (Ogden et al., 1974) was used in five sampling point to trap the conidia. The traps were installed 1.5 m above the ground level. The slides were coated with glycerin-jelly and then positioned on the samplers. The slides were removed from the samplers at weekly intervals. The numbers of conidia of the *Cladosporium* and *Alternaria* spp. were counted under a light microscope. Identification of the conidia was based on microscopic morphology, using the mycologic literature (Hasenekoğlu, 1991a,b). Weekly conidial counts/cm^2 were converted to montly mean values for each sampling site and then a mean *Cladosporium* and *Alternaria* spp. conidial numbers were determined.

Daily meteorological data were obtained from the city's Meteorological Office and the meteorological data were processed as montly averages.

2.3 Statistical Analysis

Regression analysis was made by Statview, by using *Cladosporium* and *Alternaria* conidial counts and weather variables (mean temperature, mean wind velocity and mean precipitation) recorded at the time of sampling.

3. RESULTS AND DISCUSSION

Our survey revealed that both the *Cladosporium* and *Alternaria* spp. were present in the air of Eskişehir throughout the year. Table 1 gives the montly average number of conidia. The conidia of the *Cladosporium* spp. appeared were dominant through out the year.

Table 1. Monthly average conidial numbers (conidia/cm^2) of the *Cladosporium* and *Alternaria* spp.

Months	**Conidial Number (conidia/cm^2)**	
	Cladosporium spp.	***Alternaria*** spp.
February 1999	119	111
March	220	206
April	453	341
May	612	423
June	942	614
July	813	563
August	663	568
September	584	497
October	574	455
November	436	308
December	444	246
January 2000	310	195

The maximum average temperature (C^o) was recorded in June and July while the minimum average temperature was in December and January. The average precipitation (mm) was highest in January and lowest in Aprily and the summer months. The wind velocity (m/s) was high in May and June and was the lowest in September (Figure 1-a).

The number of conidia increased in parallel with temperature and the wind velocity. The peak values for both *Cladosporium* and *Alternaria* spp. were found in June and July. Rain precipitation was high in February and March but the *Cladosporium* and *Alternaria* conidial numbers were lower (Figure 1-b). The smallest conidial counts for both the *Cladosporium* and *Alternaria* spp. were recorded in February 1999 although the precipitation had the highest value (Figure 1-a).

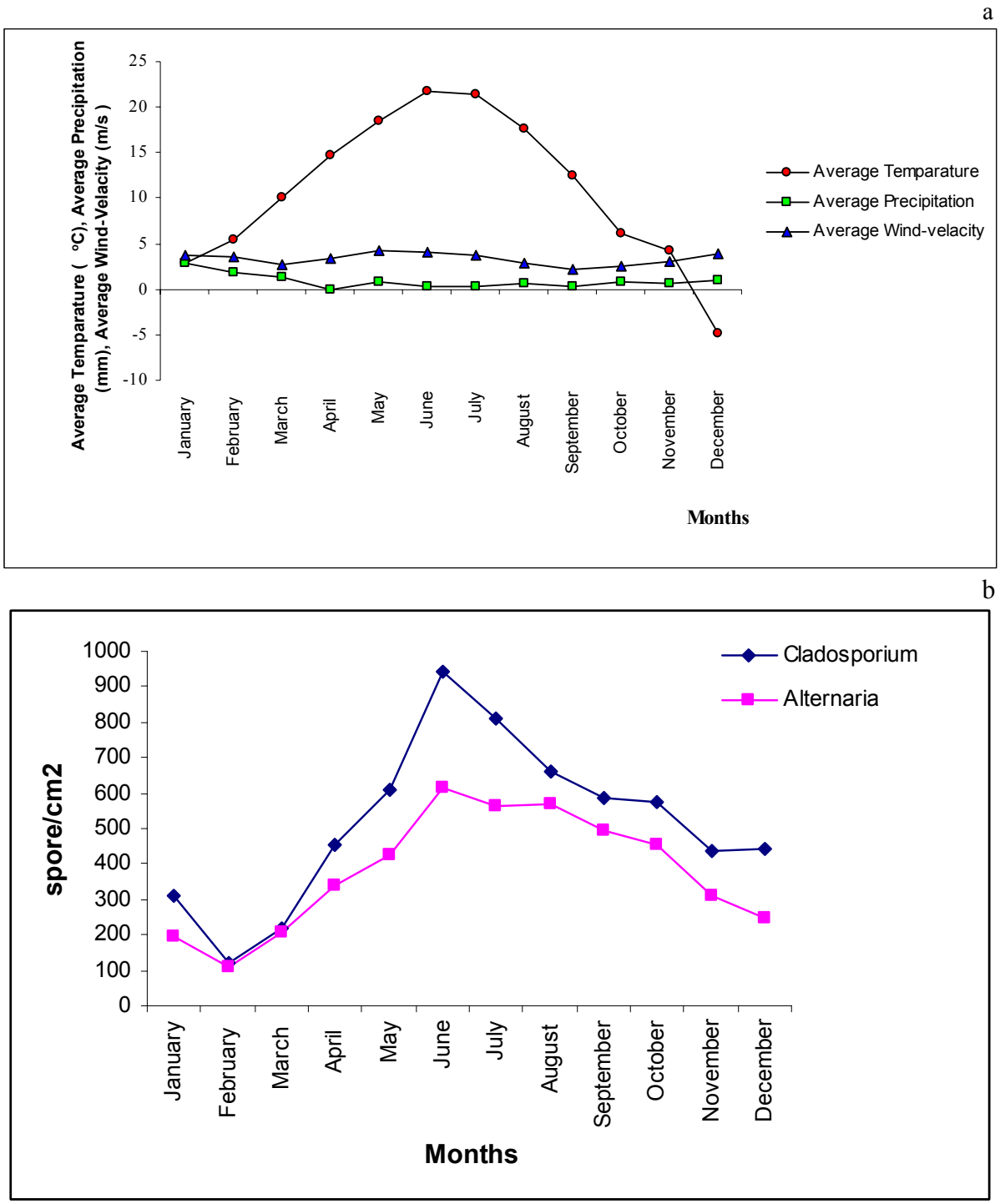

Figure 1. Comparison of conidial numbers of *Cladosporium* and *Alternaria* spp.and the meteorological data for one year (**a)** meteorological data **b)** conidial numbers).

Coefficients of determination (r^2, F and p) calculated for conidial deposits of *Cladosporium* and *Alternaria* against the meteorological variables (mean temperature, mean wind velocity and mean precipitation) are shown in Table 2. Average temperature was significantly correlated with the concentrations of *Cladosporium* and *Alternaria* conidia.

Average precipitation was negatively correlated with the conidial numbers of *Cladosporium* and *Alternaria* while no significant correlation was obtained between the average wind velocity and the conidial numbers.

When comparing results of aerobiological surveys, the difference in methods being applied by various authors leads to problems in the interpretation of results. Many different types of conidial traps have been used, each with its specific advantages and disadvantages (Ebner and Haselwandter, 1989). The Durham sampler has been one of the standards recommended by the American Academy of Allergy for many years (Ogden et al., 1974).

Table 2. Statistical determinants obtained in regression analysis of conidial concentration data against meteorological data.

	Regression Coefficient	Constant	Determinative Coefficients		
	A_1	A_0	r^2	F	p
Wind-*Alternaria*	36,95	254,86	0.02	0.21	0.654
Temp.- *Alternaria*	22.87	110.22	0.92	119.72	0.0001*
Precip.- *Alternaria*	-149.41	513.66	0.50	10.16	0.0097*
Wind-*Cladosporium*	81.04	245.66	0.503	0.52	0.4836
Temp.- *Cladosporium*	29.53	169.36	0.76	33.35	0.0002*
Precip.- *Cladosporium*	-219.63	714.61	0.54	11.96	0.0061*

*the level of significance=0.05. Wind:average wind velocity, Temp.:average temperature, Precip.: average precipitation

Lyon et al. (1984) studied the vertical variation of airconidial concentrations in the atmosphere and found that *Cladosporium* conidial numbers were significantly more than at the 9 or 30 m heights while the *Alternaria* spp. did not exhibit a correspondingly larger number. In our study we placed the Durham samplers at the 1.5 m level which is an average nose level.

Many surveys of the occurrence of *Cladosporium* spores in different regions of the world clearly show their dominance in comparison with other spores (Tamer et al., 1994; Çolakoğlu, 1996 b; Şimşekli et al., 1997; Stepalska et al., 1999; Şen and Asan, 2001; Al-Subai, 2002). The conidia of the *Cladosporium* spp. appeared were dominant through out the year in our survey in agreement with above studies.

Fungal airoconidia are known to incite respiratory allergic reactions in sensitized indiviuals. The most common moulds implicated in fungal allergies include *Cladosporium*, *Alternaria*, *Aspergillus*, *Helminthosporium*, *Epicoccum*, *Fusarium*, *Penicillium*, *Geotrichum*, *Rhizopus*, *Mucor* and numerous ascomycete and basidiomycete. The species of these genera are among the most common and most cosmopolitan contributors to airoconidia. Therefore, understanding the microenvironments that produce these moulds, noting their diurnal periodicities, and becoming aware of weather conditions that promote their abundance may assist patients and clinicians in their attempts to lessen the severity of respiratory allergies (Nussbaum, 1991).

Cladosporium species live, like those of *Alternaria*, as saprophytes or as parasites on many kinds of plants. Species of *Cladosporium* and *Alternaria* are considered to be the most prevalent of aeroallergens (Çolakoğlu, 1996 b). *Alternaria* spp. are often found growing together with *Cladosporium* spp. (Ebner and Haselwandter, 1989; Hjelmroos, 1993). *Cladosporium* conidia was the most frequent airborne conidia at low altitudes (582-827 m) of alpine sites. *Alternaria* conidia were also present in the air throughout the year. We also recorded both *Cladosporium* and *Alternaria* throughout the year.

Meteorological conditions clearly have profound influences on the production, dispersal and deposition of fungal conidia. Rain, wind speed, wind direction, humidity temperature and flora and fauna in the testing area are among the major factors that affect the concentration of airborne fungal conidia. The influence of meteorological factors on the airborne fungal conidial concentration appears to be additive and not independent (Li and Kendrick, 1994).

Low temperatures were found to depress conidium release in *Cladosporium* and *Alternaria* spp. (Halwagy, 1989; Li and Kendrick, 1994). It was reported that winter in temperate and cold regions is a dormant season for most fungi. We also found maximum conidial counts of both moulds at high temperatures in the summer months.

Various factors, such as the type of collection medium, the identification process, the period of the day in which the collection of fungi takes place, the sampling frequency and duration influence the airborne fungi monitoring (Takahashi, 1997). However, we are in agreement with Atik (1993) who recorded that *Cladosporium* spp. was the most prevalent in summer months in Eskişehir by sedimentation method.

The effect of rain on airborne conidial concentrations can be simultaneously positive and negative, and is related more on droplet size and droplet frequency than amounts (Stephen and Dowding, 1990). We found that precipitation was significantly negatively correlated with conidial counts of *Cladosporium* and *Alternaria* spp. in Eskişehir. Similar findings were reported in Sanluri, Italy (Palmas and Cosentino, 1990).

Wind is the most unpredictible agent in the dispersal of fungal conidia and *Cladosporium* and *Alternaria* conidia are released by wind (Li and Kendrick, 1994). We, however did not find any significant correlation between wind velocity and conidial numbers.

This preliminary study gives the information that *Cladosporium* and *Alternaria* spp. were present in the air of Eskişehir throughout the year giving peaks in June and the summer months. A long term study involving different sampling techniques should be carried out to provide a detailed conidial calender for the allergy sufferers in this area.

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