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STUDY OF AEROBIOLOGY OF ALEXANDRIA, EGYPT

By

GAMAL EL-GHAZALY,* HASAN YUSEF,** MANAL AHMED**
and
POLIXENI KOTZAMANIDOU EL-GHAZALY***
* University of Qatar, Doha, Qatar. ** University of Alexandria, Faculty of Science, Alexandria, Egypt. *** Museum of Natural History, Palynological Laboratory S-10405 Stockholm, Sweden.

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ABSTRACT

The present study provides a survey of atmospheric pollen and fungal spores in the city of Alexandria with the aim of supplying information that may be useful in the treatment of aeroallergies. Considerable attention has been given to the correlation between pollen grain concentration in the atmosphere and concurrent values of meteorological variables. Air sampling using Burkard volumetric spore trap was undertaken daily for two years (1981, 1982). Fungal spores were counted weekly for one year (from April 1983 to April 1984) using culture plate technique. Pollen grains related to 18 families were identified and estimated. Those of Poaceae, Casuarinaceae, Chenopodiaceae, Asteraceae, Brassicaceae, Fabaceae, Rosaceae, Urticaceae, Cupressaceae, and Pinaceae were recorded in high frequency. The pollen peaks of common allergenic plants (Poaceae, *Casuarina, Artemisia,* and *Urtica*) and their distribution are presented in this study. They were correlated with frequencies of Spring catarrh. Twenty one genera of moulds and actinomycete were identified, of which only *Cladosporium, Alternaria,* and *Streptomyces* were frequently recorded.

INTRODUCTION

The study of the airborne pollen grains in the city of Alexandria was initiated by Saad (1958 a,b). Since that time the vegetation in Alexandria and its surroundings has been changed, mainly due to industrialization and urbanization.

The main purpose of the present study is to determine the airborne pollen grains and fungal spores in Alexandria, providing recent information that may be useful in treatment of aeroallergies. Another purpose is to correlate between pollen grains concentration in the atmosphere and concurrent values of meteorological variables.

MATERIALS AND METHODS

ı grains:

ırkard seven-days recording volumetric pollen trap was used. The trap was ied on the roof of the Botany Department, University of Alexandria (about 30 ›ve street level), at El-Shatby, Alexandria. The pollen grains, were sampled at ; flow of 10 liters per minute on a tape coated with a thin film of vaseline — 'in wax in toluene.

ıl spores in the air of the study area were counted weekly for one year (from 1983 to April 1984). The culture plate technique was used as it is impossible ntify the airborne moulds by the external feature of their trapped spores only, many fungi have similar spores.

nclature of pollen grains and fungal spores:

tempt has been made to relate the examined pollen and fungal spores to their ɔs, genera, or families on the basis of reference slides. In many cases it was ɔle to identify the pollen and fungal spores to the species or the genus level. In 's this could not be achieved because of the close similarity between the pollen s of different species and genera of the same family. The term "type" is thus where the described pollen has a structure similar to several genera of the family.

RESULTS

:entration of pollen grains in the air of Alexandria:

n grains related to 18 families were recorded in both 1981 and 1982 (Table 1). start, duration, end of pollen season, date of highest pollen count and :ntration of pollen (number of pollen/m^3 air) were reported. Pollen of 8 ıes: Poaceae, Asteraceae, Brassicaceae, Casuarinaceae, Chenopodiaceae, ıceae, Cupressaceae, and Pinaceae were recorded in high frequency (Figs. The concentration of pollen grains of the families: Poaceae, Casuarinaceae, opodiaceae, and Urticaceae were represented as 7 day running means. Other es were represented as 3 days running means as their incidence was relatively o high. The total number of pollen grains/day during the two years of tigation was recorded as 7 day running mean.

pollen concentration :

ɔollen season in 1981 generally started on February 11, two weeks later to that 32. However, they both ended in December. The total count of pollen grains

Table 1

Periods of prevalence of pollen grains of different families in the air of Alexandria, the date of highest pollen count for each family, and the pollen concentration (pollen/m^3 air) recorded during that day, in 1981 & 1982.

Families	Beginning of the pollen season		Duration (days)		End of the pollen season		Date of highest pollen count		Concentration /m^3 air	
	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982
Cyperaceae	23-03	06-07	16	6	30-06	06-10	14-05	28-06	4	6
Palmae	04-03	09-04	6	12	03-10	28-09	14-05	09-04	4	6
Poaceae	11-02	28-01	146	161	23-12	23-12	09-06	06-06	36	70
Asteraceae	06-04	15-04	30	37	06-10	06-10	11-09	11-04	32	92
Brassicaceae	04-03	01-04	46	76	23-07	07-08	23-05	29-05	50	620
Caryophyllaceae	06-03	09-05	15	25	30-09	06-11	25-09	18-05	8	20
Casuarinaceae	04-03	18-02	59	49	23-12	23-12	18-03	01-04	456	740
Chenopodiaceae	25-02	01-03	65	83	21-10	21-10	04-10	09-04	30	94
Labiatae	08-04	02-04	4	12	07-07	02-07	16-06	02-04	2	12
Leguminosae	22-03	06-04	56	75	25-08	25-08	30-04	06-07	66	60
Myrtaceae	13-05	29-04	4	12	20-07	06-07	07-05	01-05	2	25
Polygonaceae	08-04	14-04	13	37	06-09	31-08	26-04	06-07	8	20
Rosaceae	19-03	07-03	46	43	08-11	15-10	16-04	10-03	50	360
Umbelliferae	02-05	14-04	7	12	16-09	22-08	08-06	26-06	8	8
Urticaceae	25-02	04-03	66	62	04-11	04-11	18-03	06-04	16	60
Ephedraceae	05-05	22-04	2	3	28-06	22-09	28-06	22-04	2	4
Cupressaceae	04-03	03-04	44	43	14-07	08-07	30-05	16-04	60	46
Pinaceae	31-03	31-03	49	60	25-08	25-08	04-06	07-06	170	116

trapped in 1982 (15155 pollen/365 m³ air) was much higher than that in 1981 (5122 pollen/365 m³ air). Variations in the concentration of pollen count is presented in Fig. 9. More than 75% of the total pollen count in both years were recorded in March, April, June and July. The minimum counts were recorded in January, February and December.

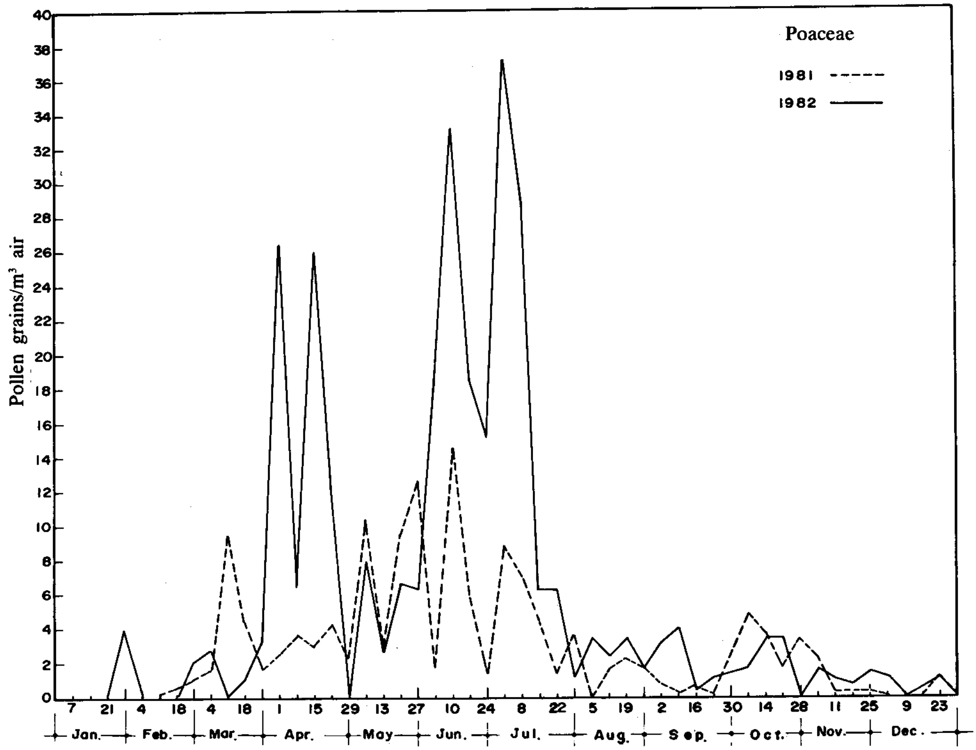

Fig. 1: Variations in the concentration of pollen grains of family Poaceae during 1981 and 1982.

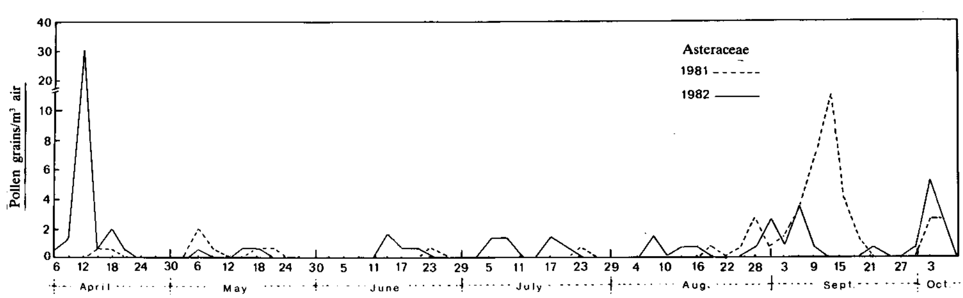

Fig. 2: Variations in the concentration of pollen grains of family Asteraceae during 1981 and 1982.

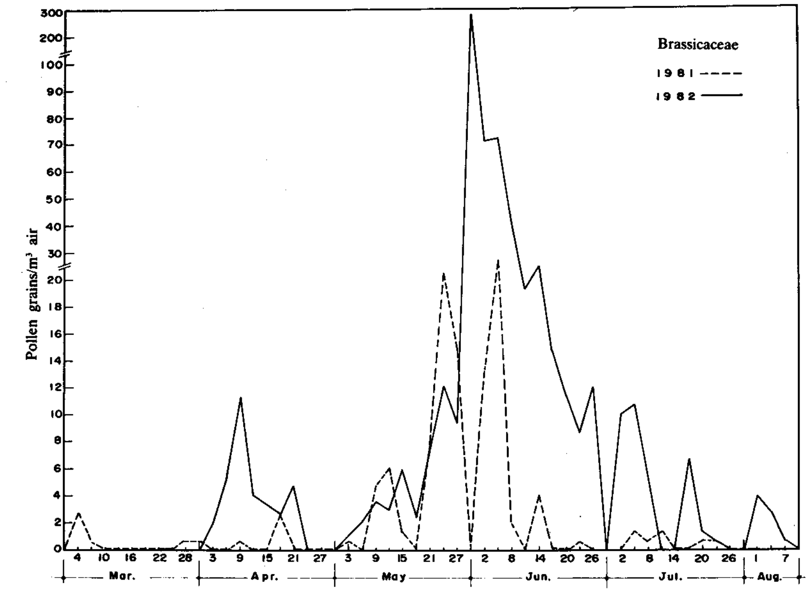

Fig. 3: Variations in the concentration of pollen grains of family Brassicaceae during 1981 and 1982.

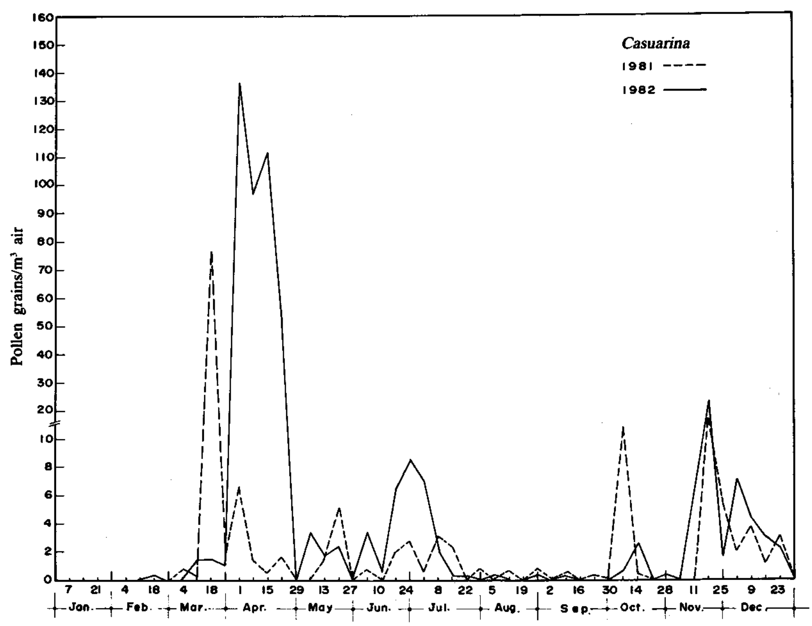

Fig. 4: Variations in the concentration of pollen grains of *Casuarina* sp. during 1981 and 1982.

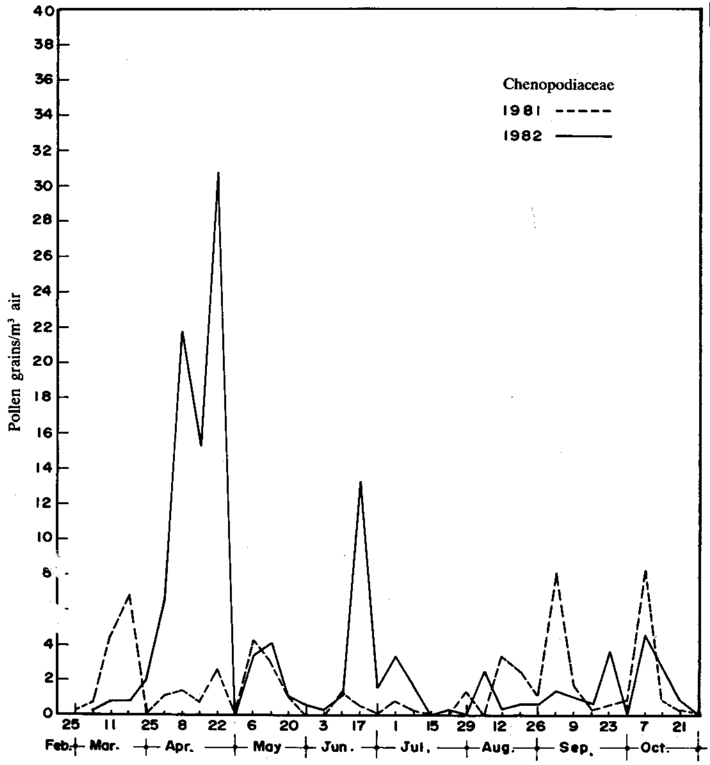

Fig. 5: Variations in the concentration of pollen grains of family Chenopodiaceae during 1981 and 1982.

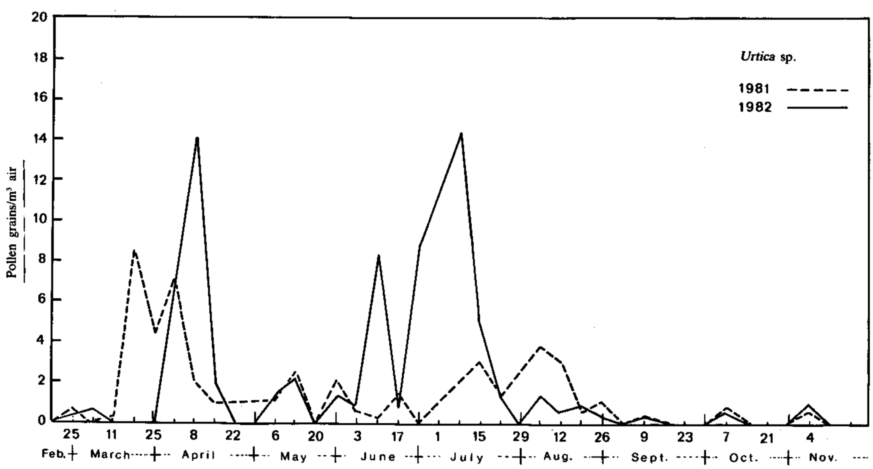

Fig. 6: Variations in the concentration of pollen grains of *Urtica* sp. during 1981 and 1982.

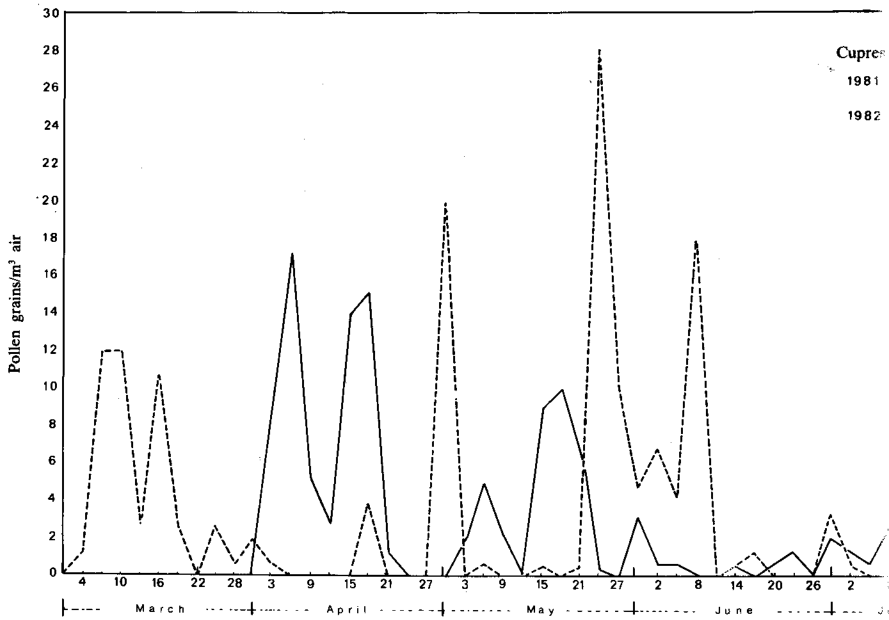

Fig. 7: Variations in the concentration of pollen grains of *Cupressus* sp. 1981 and 1982.

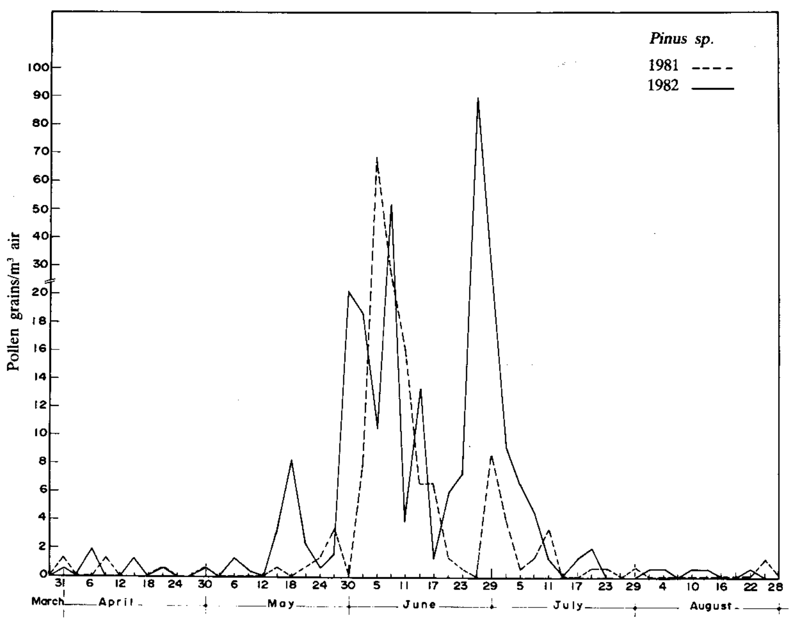

Fig. 8: Variations in the concentration of pollen grains of *Pinus* sp. durin 1981 and 1982.

Diurnal variations of pollen concentration:

Diurnal variations in the average number of total pollen catch through the period from June 1 up to and including June 30, 1982 are presented in Fig. 10. The highest peak of pollen concentration was observed at 2 p.m. (14.3 pollen/m^3 air). A relatively small peak was observed at 9 a.m. (7.4 pollen/m^3 air). The minimum pollen concentration was observed at 9 and 10 p.m. (2.7 pollen/m^3 air) and at 7 a.m. (2.4 pollen/m^3 air).

Figure 11, shows, the diurnal variations in the average number of trapped pollen grains of some selected predominant families.

Variations in the weekly average of pollen concentration in relation to variations in some meteorological factors:

Variations in the weekly average number of total pollen grains/m^3 air in relation to variations in the weekly averages of some meteorological data during 1981 and 1982 are presented in Fig. 12. The highest pollen peaks were recorded at average air temperature 18°C, relative humidity 66% and wind speed 11-14 knots. Rainy days were characterized by very low pollen counts.

Relationship between pollen counts of some selected families and records of spring catarrh:

The concentrations of pollen grains of Poaceae, Casuarinaceae, Urticaceae and *Artemisia* from Asteraceae, in relation to the number of patients of spring catarrh were recorded for both years of investigation (Figs. 13, 14). The highest number of patients for 1981 was recorded on November (1600 patients) and September (1400 patients). The increase in number of patients was concomitant with the increase in the pollen concentration (Figs. 13, 14).

Concentration of fungal spores in the air of Alexandria:

Twenty-one genera of moulds and actinomycete were detected on the exposed plates during the period from April 1983 till April 1984. They are represented alphabetically in Table 2, along with the periods of their prevalence in the atmosphere.

The frequencies of the predominant airborne genera of *Alternaria, Aspergillus, Cladosporium* and *Streptomyces* are graphically represented in Fig. 15.

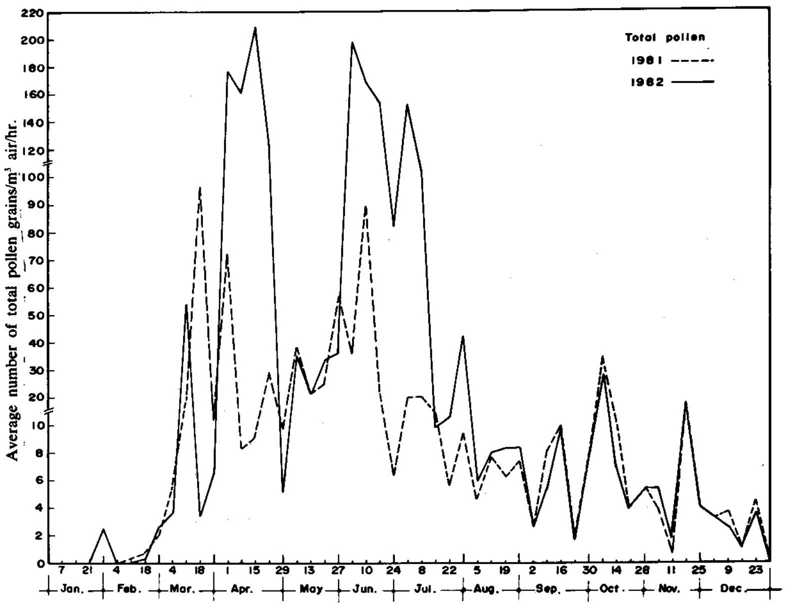

Fig. 9: Variations in the concentration of total pollen count during 1981 and 1982.

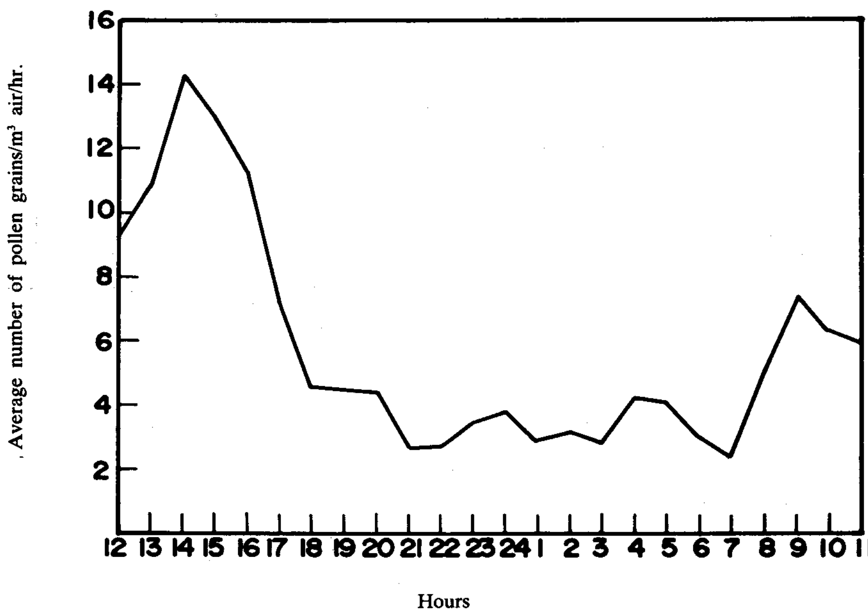

Fig. 10: Diurnal variations of the average number of total pollen/m³ air in June 1982.

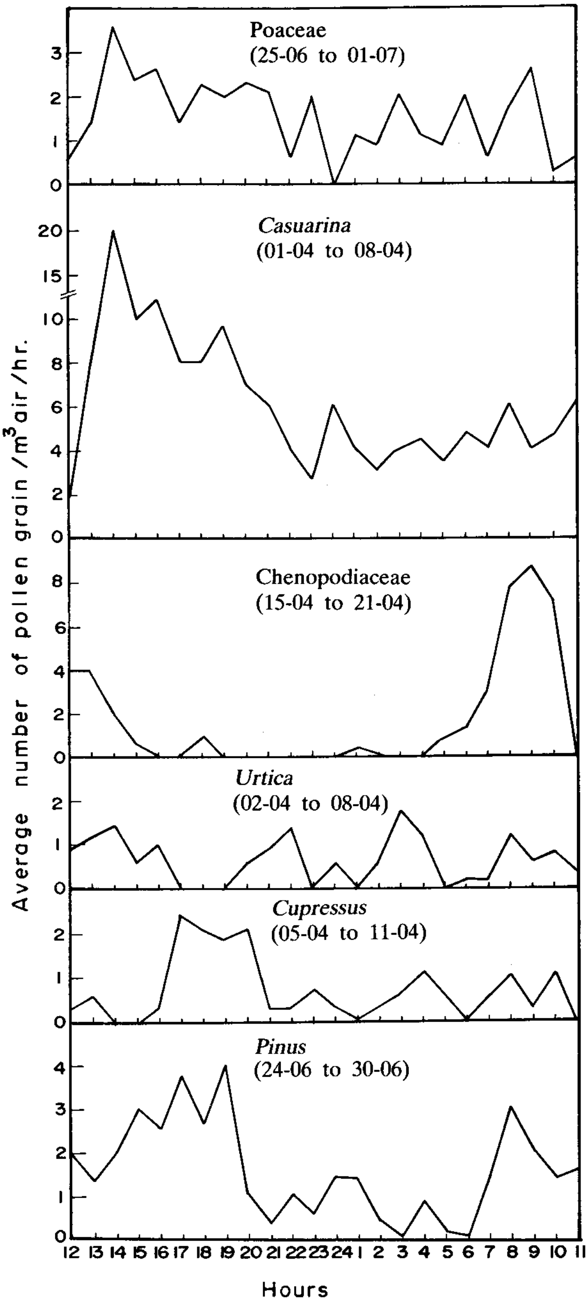

Fig. 11: Diurnal variations in the average number of trapped pollen grains of the predominant families and genera /m³ air/hr/week in 1982.

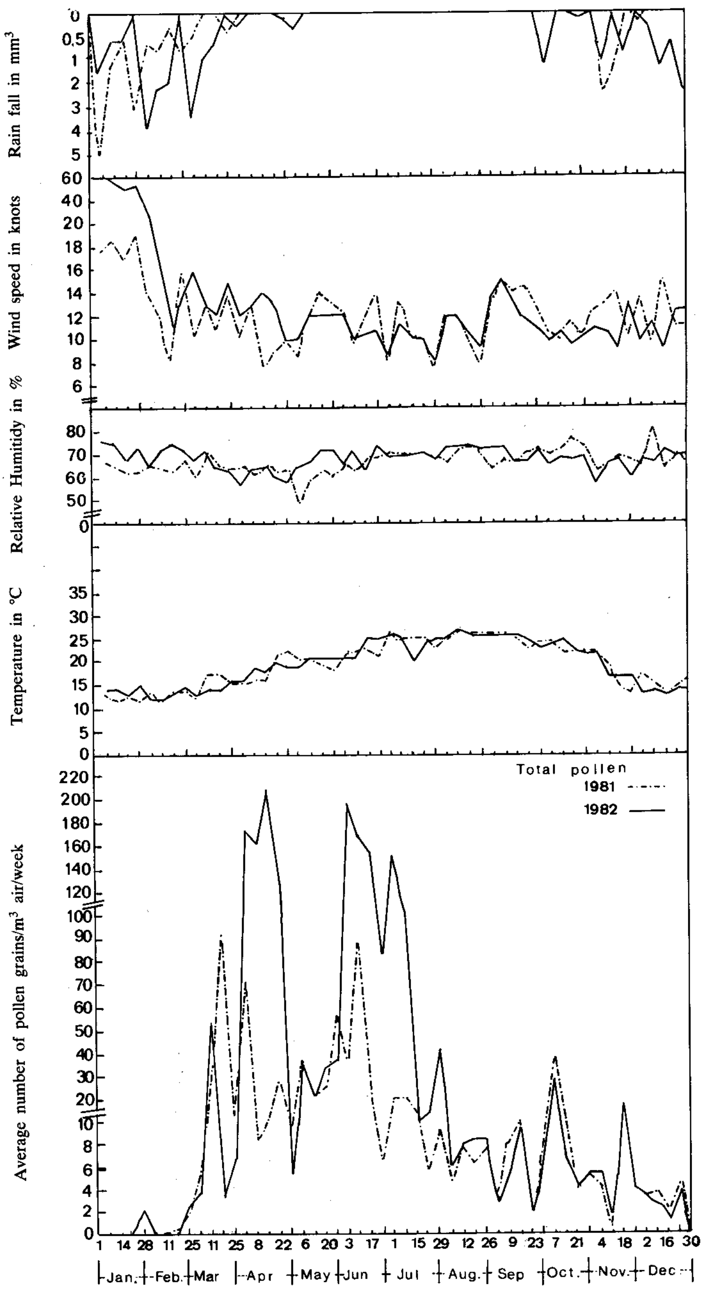

Fig. 12: Variations in the average number of total pollen catch/m³ air/week in relation to variations in the weekly average of some meteorological factors during 1981 and 1982.

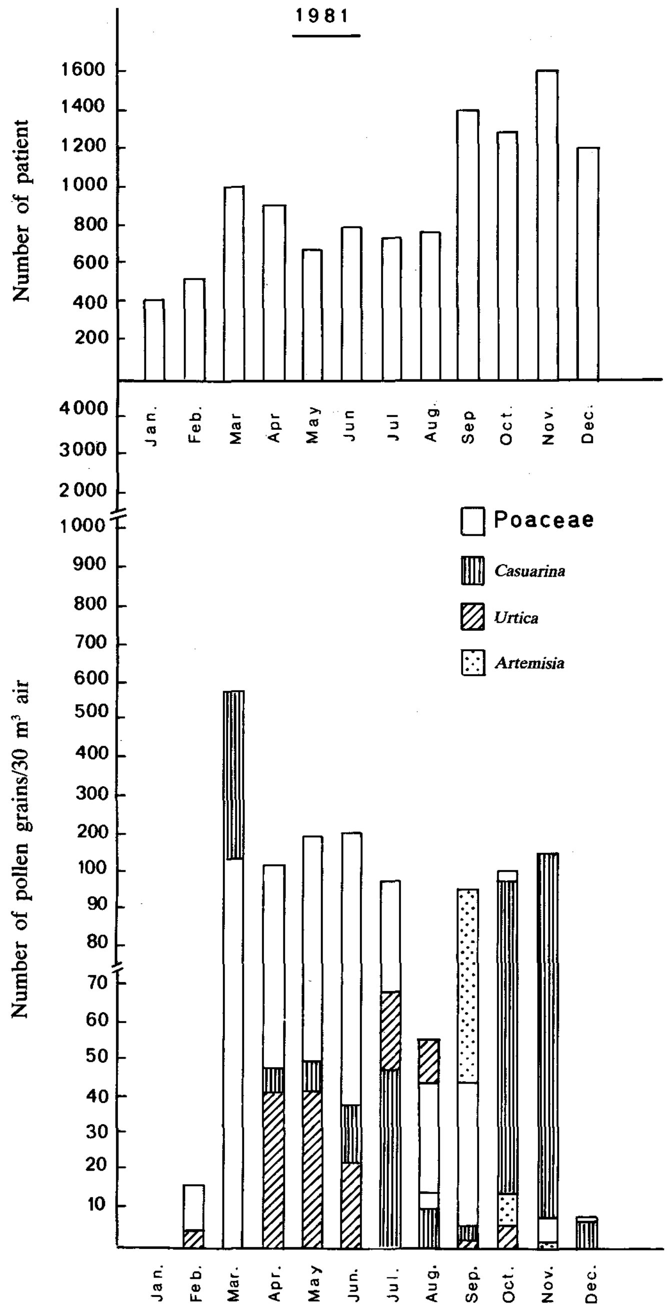

Fig. 13: Correlation between the concentration of pollen grains of common allergenic plants and the number of patients of spring catarrh during 1981.

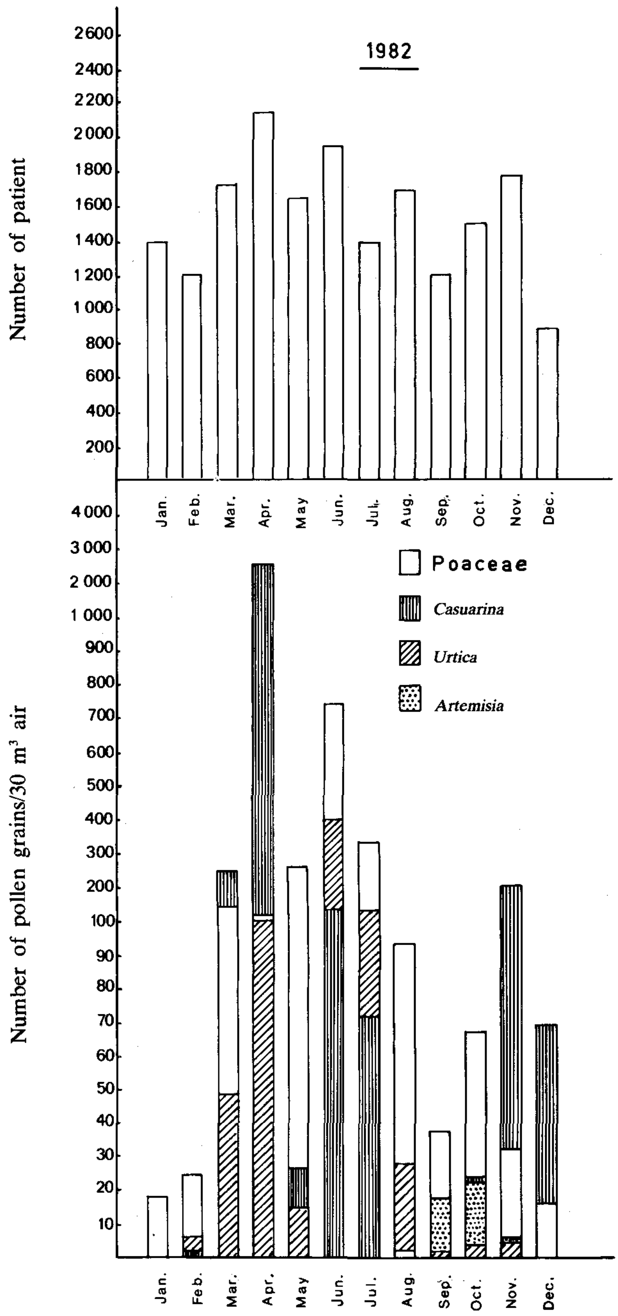

Fig. 14: Correlation between the concentration of pollen grains of common allergenic plants and the number of patients of spring catarrh during 1982.

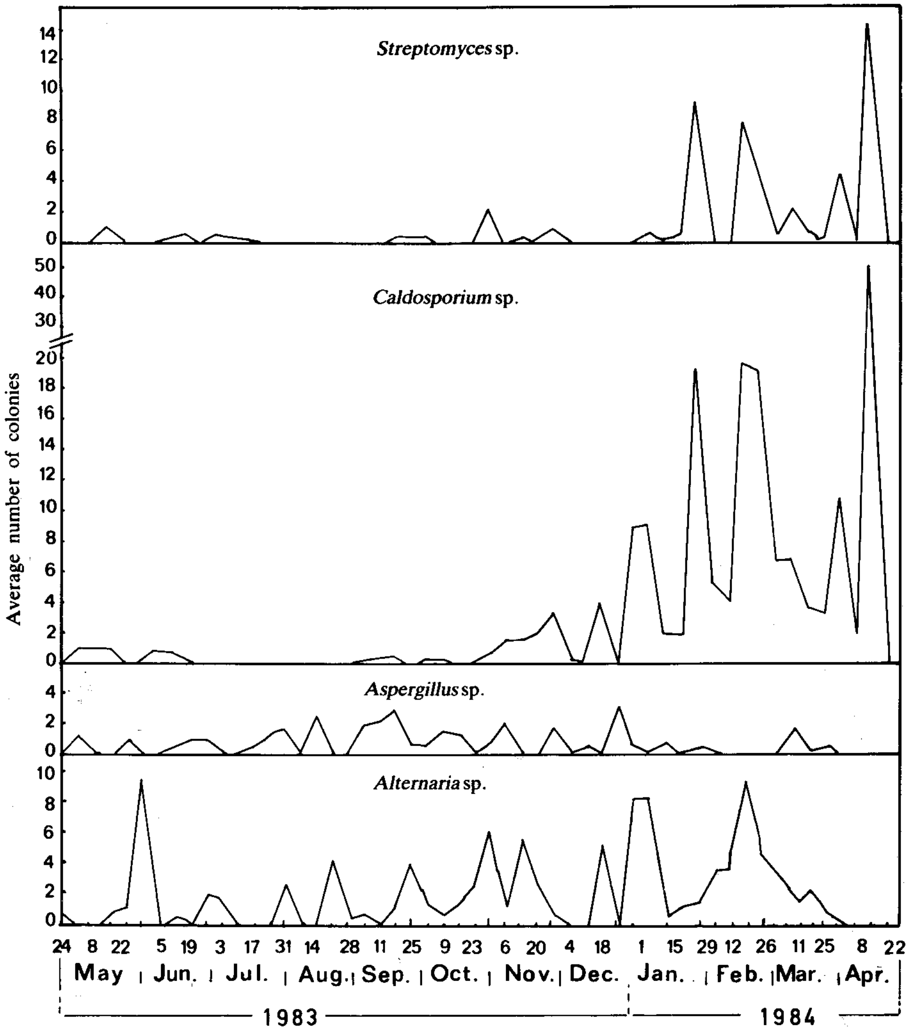

Fig. 15: Variations in weekly mean counts of fungal and Streptomyces colonies growing on the exposed plates during the period from April 1983 till April 1984.

DISCUSSION

A noteworthy characteristic in this study is the higher pollen count in 1982 than in 1981. Variations in the frequency of pollen grains in the air from year to year have been noted by other studies (Hyde, 1952; Davis and Smith, 1973; Fuckerieder, 1976; Tauber, 1977; McDonald, 1980 and Jager, 1989). These variations are explained by differences in flowering intensity and pollen productivity due to

Table 2
Streptomycetes and moulds developing on the exposed plates, and periods of their prevalence in the atmosphere.

Genera	Date of the first appearance on the plates	Duration (weeks)	Date of the last appearance on the plates
Alternaria	04-4-83	8	15-11-84
Aspergillus	01-5-83	29	1-4-84
Botryotrichum	05-6-83	4	11-8-84
Cephaliophora	01-1-84	4	11-3-84
Chaetomium	29-5-83	4	19-2-84
Cladosporium	01-5-83	33	15-4-84
Cuvularia	17-7-83	23	18-3-84
Diplodia	28-8-83	1	—
Drechslera	22-5-83	28	18-3-84
Epicoccum	11-9-83	4	15-1-84
Fusarium	08-5-85	29	1-4-84
Mucor	24-4-83	8	11-3-84
Nigrospora	14-8-83	9	15-1-84
Penicillium	01-5-83	32	15-4-84
Rhizopus	04-12-83	12	29-4-84
Scopulariopsis	26-6-83	6	25-4-84
Stachypotrys	01-5-83	8	20-11-83
Streptomyces	15-5-83	20	15-4-84
Trichoderma	09-4-83	4	20-11-83
Trichothecium	15-1-84	1	—
Ulocladium	24-4-83	21	8-4-84
Verticillium	01-5-83	22	1-4-84

climatic variations (Hyde, 1952; Fuckerieder, 1976). Anderson (1980) was able to evaluate the influence of climatic variations on annual pollen deposition on the basis of ten year records. The effect of climatic factors on pollen deposition in the present study will be discussed later. The present study provides evidence that the duration of pollen-free atmosphere in Alexandria is short and that it occurs only in January and part of February. In these months, the precipitation is at its maximum and the rain may wash down the pollen content of the atmosphere. Saad (1958 a,b) observed a much longer pollen-free time, he mentioned that pollen grains were nearly absent from the air during summer (July - September) and winter (December - February). In this study the main pollen season started from the first week of March and continued till the second week of July. During this period airborne pollen grains related to more than twenty species were recorded. Pollen grains of common tree species are those of the genera *Casuarina, Pinus* and *Cupressus*. The greatest amounts of these pollen grains are recorded in the middle of March till the first week of July. A minor pollen season started from the middle of July till the end of December.

Diurnal variations:

In the present study, the largest count of the daily pollen catch was sampled between 8 a.m. and 4 p.m., with a high peak at about 2 p.m. This timing of high peak has been mentioned also by other studies (e.g. Assem, 1973 in the Netherland, and Kapyla, 1981 in Finland). The high pollen catch at 2 p.m. can be ascribed to the remarkable increase of verticial and horizontal mixing processes of the air at that time when the air temperature is at its maximum (Trewartha, 1954). Chenopodiaceae was the only case where maximum pollen concentration occurred at 9 a.m. Saad (1958 b) working on the diurnal variations of pollen in the atmosphere of Alexandria, came to the conclusion that the morning hours between 8 and 11 a.m. were the hours of maximum deposition of all pollen grains. This discrepancy between our observations and Saad's conclusion may be due to difference in methodology. The gravity slide method used by Saad does not seem to provide for quantitative estimations; this is especially related to the imperfect control of slow air movements and the high selectivity in favour of large spores. Pollen grains are generally at their lowest concentration between 5 and 6 p.m. However, pollen grains of *Pinus* and *Cupressus* exhibited a different pattern of distribution. Their maximum concentration in the air occurred at 7 and 8 p.m. respectively. The *Pinus* pollen increased again at 8 a.m. Urticaceae pollen grains were characterized by maximum liberation at 3 a.m. These variations in pollen liberation during different hours of the day and night are dependent on the natural pollen release rhythm of the plant species. The rhythm is modified largely by the preceding and prevailing weather conditions (Kapyla, 1981). There are several phases in the anthesis (Liem, 1967), each of which is affected differently by weather conditions (Liem and Groat, 1973). These phases have not yet been properly analyzed for most species. The phase of emission of pollen into the air is also affected by weather conditions, especially wind. Far from the source, the movement of air masses is more important than pollen release in determining diurnal fluctuations of pollen in the air (Ogden *et al,* 1975). The rather stable climatic factors in Alexandria during long periods of the year makes it possible to some extent to reveal the critical threshold values of meteorological factors for the pollen release and the combination of these factors favourable to high pollen occurrence.

Airborne pollen grains and meteorological conditions:

The major factor that might influence the annual pollen deposition is probably the amount of rain and its distribution with time. In 1981 in Alexandria, a large amount of monthly rainfall (8 mm) was recorded in January; followed by only 0.5 mm in February, while the period from March till November was almost dry. However, in 1982, the monthly rainfall was nearly regularly distributed from January till the end of March (average 3 mm). It is generally recognised that for successful vegetation growth there should be a shower every fortnight (Saad 1958 b). This might be the reason for a better vegetation cover in 1982 than in 1981, and consequently higher amounts of atmospheric pollen were recorded in 1982. The only exception was that *Cupressus* pollen had a higher amount of pollen grains in 1981 where pollen productivity was stimulated by rain-fall that coincided with the pollen season. This conclusion is supported by the ten-years study of Anderson (1980) on the influence of climatic variations on pollen season in which he asserts that flowering intensity and pollen productivity of many plants are apparently stimulated by good water supply before and during flowering.

Clear negative correlation was observed in the present study between the daily average of relative humidity and the concentration of most pollen types. Generally, pollen attained their lowest concentration shortly after midnight, when the temperature and wind velocity were low and the relative humidity was high. Maximum concentration was usually recorded in the afternoon when the relative humidity was low. This was clearly observed for the pollen grains of Poaceae and *Casuarina,* where their maximum concentration was usually attained when the relative humidity was minimum (about 50% for *Casuarina* and 55% for Poaceae). In contrary *Pinus* and *Cupressus* pollen concentration attained its maximum in days of high relative humidity (70 - 78%). Some families such as Chenopodiaceae and Urticaceae include several species that have different flowering seasons and have no obvious correlation with relative humidity. Chenopodiaceae pollen grains had two high peaks in October 1981 and April 1982. The first peak coincided with low relative humidity (about 65%), while the second coincided with comparatively high relative humidity (about 75%). These peaks probably indicate pollen production of two different genera or species of Chenopodiaceae flowering at different seasons and behaving differently with relative humidity. Pollen production by Urticaceae also had two high peaks, one in March 1981, and the other in July 1982. The first peak coincided with low relative humidity (55%), and the second with comparatively high relative humidity (70%).

Wind direction seems to be important in the interpretation of the appearance and disappearance of some pollen types in the atmosphere of Alexandria. Obvious examples of pollen grains that are affected by the wind direction are those of *Ephedra,* Palmae and *Casuarina. Ephedra* does not occur around the site of the trap in the study area. Its pollen was presumably blown for long distance by wind into the trap from their place of origin. *Ephedra* plants occur in El-Bosaily about, 50 km to the east of Alexandria. Whenenver *Ephedra* pollens were recorded, the wind direction was east. In the present study, Palmae pollen grains were observed in very small concentrations during the high season (April - May). Most Palmae plantations are found to the south-east of Alexandria. The low concentration of Palmae pollen recorded may be due to wind direction which was north to north-west during the flowering season. The Palmae pollen grains were recorded mainly when the wind came from the east, at the very beginning or at the end of the flowering season. *Casuarina* plantations are common both in the east and west of Alexandria, their pollen was recorded when the wind was easterly or westerly.

However, high peaks were noticed mainly when wind came from the east, probably because the eastern plantations are denser and closer to the trapping site. In the present study, it was generally observed that the eastern winds were the most heavily contaminated with pollen grains. This is in agreement with observations mentioned by Saad (1958 b).

The amount of pollen grains in the atmosphere may also vary due to variations in wind speed, as clearly demonstrated in *Cupressus, Casuarina* and Chenopodiaceae.

Pollen concentration and frequencies of spring catarrh:

In both 1981 and 1982, when pollen peaks of Poaceae, *Casuarina, Artemisia* and *Urtica* were correlated with frequencies of spring catarrh, notable positive correlations were observed with *Artemisia* in September and *Casuarina* in November. In 1982, a high number of allergic conjunctivitis patients coincided with high peak of Poacae pollen that occurred in June. Alia (1978) observed that during winter, the asthma cases exhibited high percentage of positive skin test for *Casuarina,* but her pollen curves did not show *Casuarina* pollen in the air of Alexandria during that time. In the present study, relatively high peaks of *Casuarina* pollen grains were recorded in winter of both 1981 and 1982; which explains Alia's observation.

Fungal spores:

Out of twenty-one genera of moulds and actinomycete that were identified, only *Cladosporium, Alternaria,* and *Streptomyces* were frequently recorded (more than 10 colonies/week in their maximum peaks). *Cladosporium* and *Alternaria* were also common in the air of El-Minya Southern Egypt (Mazen and Shaban 1983) and Wadi Qena, Eastern Desert, Egypt (Sobhy *et al.* 1989). *Cladosporium* contributed 64% of the total aerospora and represented the most dominant constituent of the aerospora of Alexandria. This fungus was reported to be dominating airborne fungal spore from many parts of the world, as London (Davis, 1957; Hamilton, 1959), Jamaica (Meredith, 1962), and India (Vittal and Krishnamoorthy, 1981 and Santra and Chanda, 1989).

Several species of mould genera reported in this study are pathogenic to man and animals. Some others cause diseases to plants. The allergic effect of *Cladosporium* and *Alternaria* have been mentioned by Hirst, 1953; Hyde and Williams, 1953; Schlueter *et al.* 1973 and recently Vijay *et al.* 1985, 1988. It has been asserted that one of the reasons of causing allergic problems is their high abundance in air. Alia

(1978) mentioned that the increase of asthma attacks in Alexandria during winter is related to climatic factors, and to the possibility of fungal spores. In the present study, high *Cladosporium* concentration that was recorded in winter, may explain the increase of asthma attacks during that time.

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دراسة عن حبوب اللقاح والأنواع الفطرية بهواء مدينة الاسكندرية - جمهورية مصر العربية

جمال عبدالمجيد الغزالي و حسن محمد يوسف
منال فوزي أحمد و بوليكسيني الغزالي

درست حبوب اللقاح والأنواع الفطرية الموجودة بهواء مدينة الاسكندرية بهدف الحصول على معلومات قد تفيد في علاج أمراض الحساسية التي تنتج عن وجود هذه الجسيمات في الهواء ، وتهتم الدراسة على وجه الخصوص بالعلاقة بين تركيز حبوب اللقاح في الهواء وقيم المتغيرات المناخية كما أنها توفر معلومات أساسية قد يكون لها فائدة في الأبحاث المستقبلية عن الكساء الخضري والفلورا في منطقة ساحل البحر المتوسط بمصر .

استخدمت مصيدة بركارد لحبوب اللقاح لأخذ عينات يومية من الهواء لمدة عامين (١٩٨١ ، ١٩٨٢) فأمكن رصد ثمانية عشر نوعاً من حبوب اللقاح بدرجة عالية وهي تابعة لثمانية عشر فصيلة نباتية .

أوضحت النتائج التركيزات العالية لحبوب لقاح النباتات المسببة للحساسية وتوزيعها خلال عامي الدراسة مثل ما يتبع الفصيلة النجيلية وهذه النتائج تساعد المختصين في علاج بعض حالات الحساسية . كما أتضح أن هناك علاقة طردية ملحوظة بين تكرارية حبوب اللقاح التابعة لهذه النباتات ومعدلات الاصابة بالرمد الربيعي .

وتم حصر وتعريف واحداً وعشرين جنساً من الفطريات وجنساً واحداً من الاكتينوميسيتات وظهرت الأجناس «الترناريا» وكلادوسبوريم و «ستربتوميسين بنسب عالية . ويتبع العديد من أجناس الفطريات المسجلة في هذه الدراسة أنواعاً تسبب أمراضاً للإنسان والحيوان والنبات .