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Research Article

Airborne Allergenic Pollen Grains in Alexandria City, Egypt

Wafaa K Taia[1]* and Eman M Bassiouni[2]

[1]*Professor, Botany and Microbiology Department, Faculty of Science, Alexandria University, Alexandria, Egypt*

[2]*Professor, Faculty of Science, Department of Botany and Microbiology, Alexandria University, Alexandria, Egypt*

***Corresponding Author:** Wafaa K Taia, Professor, Botany and Microbiology Department, Faculty of Science, Alexandria University, Alexandria, Egypt.

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Abstract

This investigation concerning study of the trapped pollen grains in the aerosol of Alexandria city, Egypt throughout a full year from May 2019 to April 2020. To carry this work Hirst type volumetric trap was fixed in the roof of about 40 m above the ground building in El-Shatby district. A Tape removed after each week and segmented into 24 hours pieces and examined. The pollen counts are indicated the daily mean count per cubic meter of air. The data obtained indicated low annual pollen index with the dominant species belonging to the *Chenopodiaceae/Amaranthaceae* complex followed by *Casuarina, Arecaceae*, *Pinus* and *Urtica*. The maximum pollen incident was in both summer and spring while the lowest was during winter. There was no correlation between both the pollen incident and the different climatic factors. The study concluded that pollinosis in Alexandria city is not due to the pollen grain only, but it is due to combinations of factors beside the quantity of pollen in the air. The results have been discussed according to the works done in this concern.

Keywords: Aeropalynology; Allergy; Pollen Grains; Pollution

Introduction

The respiratory system is the first organ affected by air pollution. Particles carried by air inhaled by peoples causing severe symptoms and may cause death. These particles can be bio particles such as pollen grains, spores, feathers, mites, mold, virus, bacteria, plant fibers or insect debris or can be chemical pollutants and dusts. From the most widespread bio particles causing respiratory disorders are the pollen grains. Pollen grains are the male gametes within the most advanced categories of plants calling the gymnosperms and angiosperms. There are several ways of pollen transfer to the female organ within this group of plants, the most affected in air pollution are those transferred by air and called anemophilous plants. These pollen grains are major cause of allergy known as˶ hay fever or pollinosis" [1,2]. Anses (2014) announced that pollen grains are real cause in allergy, and they are a real contributor of the total bioaerosol mass [3]. Womiloju., *et al.* (2003) found that the air contents of pollen grains and fungal spores contribute from 4-11% of the total particulate matter less than 2.5 µm (PM2.5) mass and 12–22% of organic carbon in fine particulate matter (PM) [4]. Meanwhile the pollen grains are direct carriers to water and non-water soluble allergens and their fragments can cause irritation to the bronchitis and stimulate allergic symptoms. The small size pollen grains can easily enter the nose and start the reactions of allergy. In fact green spaces and ornamental trees improve the quality of life and provide many ecosystem services variables [5-7]. But some plants, especially grasses beside some trees and shrubs can affect the public health [8-12].

Dhyani., *et al.* (2006) as well as Mandal., *et al.* (2011), Mansouritorghabeh., *et al.* (2019) and others recognized that trees belonging to orders Fabales, Fagales, Lamiales, Proteales, and Pinales are recognized as the most potent allergen sources [13-15]. They recognized both *Prosopsis juliflora* and *Peltophorum pterocarpum* trees as the source of the important allergen. Whereas Asturias., *et al.* (2005) found that date palms produce clinically relevant pollen allergens [16]. Taia (2020) found that allergy is not restricted to certain trees, shrubs, or herbs, but it depends on the quantity of pollen grains released in the air beside several environmental factors [11].

Alexandria city is located in the western Mediterranean coastal region in Egypt, North Africa. It characterizes by its special weather, with high humidity all over the year, moderate rainfall and low temperature in the winter, and high temperature in summer (Table 1). The city exposed to several storms in the winter which make the peoples suffering from allergy. Taia (2020) studied the effect of road trees pollen grain on stimulating allergy in Alexandria city [11]. Meanwhile Taia and Zayed (2021) showed the effect of some road trees pollen grains widely cultivated in Alexandria city on stimulating allergic reactions [12]. This work aims to establish the potential allergenic value in Alexandria city aerosol through the whole year, so that the allergenic risk generated in the city can be easily estimated. It is considered as step forward in the study of aeropalynological and identification of allergenic significant pollen grains in Alexandria.

Month	May.19	Jun.19	Jul.19	Aug.19	Sep.19	Oct.19	Nov.19	Dec.19	Jan.20	Feb.20	Mar.20	Apr.20
Max.T (C∘)	33.2	30.2	34.1	31.9	30.6	28.8	27.2	19.1	16.7	19.4	23.4	28.3
Min.T (C∘)	17.5	23.2	24.3	23.5	22.2	20.5	16.7	12.2	10.8	10.8	12.3	14.9
Av.T (C∘)	25.35	26.7	29.2	27.7	26.4	24.65	21.95	15.65	13.75	15.1	17.85	21.6
R.Hum. (%)	50.0	64.0	61.0	65.0	55.0	62.0	61.0	64.0	72.0	67.0	59.0	55.0
T.Rain (mm/ month)	0.0	0.0	0.0	0.0	0.0	63.2	0.0	106.5	163.3	36	39.6	1.3

Table 1: Climatology (from May 2019 to April 2020).

Materials and Methods

Study area

Alexandria city extends about 40 km at the northern coast of Egypt along the Mediterranean Sea, It is the second city in Egypt, along the Mediterranean Sea. It is located between latitudes 31°12'56.30" N and longitudes 29°57'18.97" E. It is the largest city on the Mediterranean coast, the fourth-largest city in the Arab world, the ninth-largest city in Africa, as well as the 79th largest urban area by population on Earth. Alexandria has desert climate, the summers are long, warm, muggy, arid, while it is clear and cool in winters, with few to moderate rainfall, windy, and mostly clear. Over the year, the temperature typically varies from 50°F to 86°F and is rarely below 44°F or above 89°F (Figure 1).

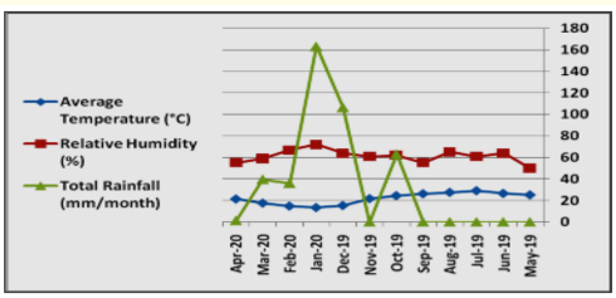

Figure 1: Average temperature, relative humidity and total rainfall in the studied area in Alexandria From May 2019 till April 2020.

The study depends on capturing the air borne pollen grains from the air of El-Shatby district in Alexandria. El-Shatby is surrounded by road trees and near El-Nozha and the zoo public gardens. Meanwhile it is near the seashore.

Method

Field trips were carried monthly to identify the local plant species and cultivated trees around the area of study (Table 2). Pollen index of these plants was done by the acetolyses method [17].

A Hirst type volumetric seven-day recording trap supplied by Burkrad Scientific (UK) was used in capturing the airborne pollen grains (Figure 2). The pollen trap was fixed on the roof of the Faculty of Science building on the seventh floor, about 40m high. The trap contains a vacuum pump that draws 10 l/min airflow via mobile orifice which is oriented towards the wind all the time. Pollen grains and other particles present in the surrounding air were impacted on an adhesive coated transparent plastic tape. The Melinex tape is fixed on a drum which is driven by a 7-jewel clockwork movement. Its mechanism involves that the drum rotated past the orifice at 2 mm/hour, and it is changed weekly [18]. In this study, the sampling method used by Hirst (1952) was followed [19]. The plastic tape is firstly coated with 10% gelvatol and after that the adhesive mixture (Vaseline and wax) is added. Then it fixed in a drum with a known circumference.

Figure 2: Burkard Scientific (UK) trap.

Division	Subdivision	Class	Scl	Order	Family	Species	LF
Embrophyta	Angiosperm			Glumiflorae	Poaceae	*Arundo donax* L.	H
						Bromus rubens Justl.	
						Digitaria Sanguinalis (L.) Scop.	
						Eleusine indica (L.) Gaertn.	
						Setaria verticillata (L.) P. Beauv.	
				Principes	Arecaceae	*Phoenix dactylifera* L.	T
				Verticellateae	Casuarinaceae	*Casuarina* sp.	T
				Urticales	Moraceae	Morus *sp.*	T
					Urticaceae	*Urtica urens* L.	H
				Polygonales	Polygonaceae	*Polygonum salicifolium* Brouss. ex Willd	H
						Rumex crispus L.	
				Centrospermae	Chenopodiaceae	*Atriplex* sp.	H
						Chenopodium murale L.	H
						Chenopodium album L.	
					Amaranthaceae	*Amaranthus lividus* L.	H
					Nyctaginaceae	*Bougainvillea glabra* Choisy	L
					Caryophyllaceae	*Silene rubella* L.	H
				Rhoedales	Brassicaceae	*Brassica rapa* L.	H
						Diplotaxis harra (Forssk.) Boiss	
						Mathiola longipetala (Vent.)DC.	
						Sisymbrium irio L.	
				Rosales	Cicerdeae	*Bauhinia galpinii* N.E. Br.	T
						Bauhinia variegate L.	
						Cassia javanica L.	
						Parkinsonia aculeate L.	
						Delonix regia (Bojer) Rafin	
					Papillionaceae	*Melilotus indica* (L.) All.	H
					Mimosaceae	*Mimosa* sp.	T
				Geraniales	Geraniaceae	*Erodium gruinum* (L.) L'Hér	H
						Erodium hirtum Willd.	
					Euphorbiaceae	*Croton cotinifolia* L.	T
						Ricinus communis L.	
		Dicotyledoneae	Archichlamydeae	Malvales	Malvaceae	*Hibiscus arboreus* L.	H
						Malva parviflora L.	
				Parietales	Tamaricaceae	*Tamarix nilotica* (Ehrenb.) Bge	T
				Myrtiflorae	Myrataceae	*Psidium guajava* L.	T
				Umbelliflorae	Apiaceae	*Daucus* L.	H
				Gentianales	Apocyanaceae	*Carissa macrocarpa* (Echlr.)A.Dr.	S
			Sympetalae			*Catharanthus roseus* (L.)G.Don	
						Nerium oleander L.	
					Asclepiadaceae	*Crystostegia grandiflora* R.Br.	C
				Tubiflorae	Convolvulaceae	*Convolvulus althaeoides* L.	Tw
						Convolvulus arvensis L.	
						Ipomoea cairica (L.) Sweet	
					Solanaceae	*Nicotiana glauca* Graham	T
						Solanum nigrum L.	
					Lamiaceae	*Ocimum basilicum* L.	H
				Campanulatae	Asteraceae	*Conyza dioscoridis* (L.) Desf.	H
						Conyza linifolia (Wild.) Täckh.	H
						Onopordum alexandrinum Boiss.	S
						Senecio desfontainei Druce	H
						Sonchus oleraceus L.	H
						Urospermum picroides (L.) scop.	H

Table 2: List of the dominant plants collected from Alexandria classified according to Engler and Prantl's system.
Tw: Twinner; C: Climber; S: Shrub; L: Liana; T: Tree; H: Herb; LF: Life Form; Scl: Subclass

Materials

After one week of exposure, the tape was cut into 48 mm or 24 hours segments. Each segment representing one day was put on a slide, and glycerin jelly stained with basic fuchsin was used as a mounting medium. Light microscope fitted with camera and computer software was used for examination. The methodology followed by Spanish Aerobiology Network, REA [20] was used as four longitudinal horizontal sweeps per slide were counted at magnification of 400 x. Pollen counts are indicated as the daily mean count per cubic meter of air. The examined slides were prepared and preserved in Botany and Microbiology Department, Faculty of Science, Alexandria University. Throughout one full year, approximation to pollen calendar was designed by following Spieksma's model [21]. Such a model expresses 10-day mean pollen concentrations into a series of classes indicated by columns of increasing height. In the present study, only those dominant pollen grains with minimum 10-day mean equal to or greater than 0.1 pollen grains/m^3 of air are included.

Results

Species identified within the study area

The plant species identified within the study area are listed and classified according to Engler and Prantl's system (Table 2). The species recorded are mostly cultivated ornamental trees belonging to different families and taxonomic categories. Fifty-three trees, Herbs, lianas, twinners and shrubs are collected, identified and used to do the pollen index.

Pollen grains

The counts of pollen grains obtained show annual pollen index throughout the study year was 378. The maximum monthly pollen count recorded in May, June 2019 and April 2020 (99, 62 and 64 pollen grains/m^3 respectively, Figure 3). The lowest pollen count was recorded in October 2019 and January 2020 (4 pollen grains/m^3, Figure 3). The dominant pollen grains in the aerosol of Alexandria city were belonging to *Chenopodiaceae/Amaranthaceae* complex, *Casuarina*, *Arecaceae*, *Pinus* and *Urtica* species with records of 9.6% for the *Chenopodiaceae/Amaranthaceae* complex, 8.7% for *Casuarina* sp., 6.7% for *Arecaceae*, 5.5% for *Pinus* and 4.9% for *Urtica* sp. (Table 4). *Apiaceae* and *Myrtaceae* considered the rare families (Plate 1, Photos. 1 and 8). An approximation to a pollen calendar is set up for the eight dominant taxa during the year of study as shown in figure 4.

Figure 3: Monthly pollen index during the period from May 2019 to April 2020 in Alexandria, Egypt.

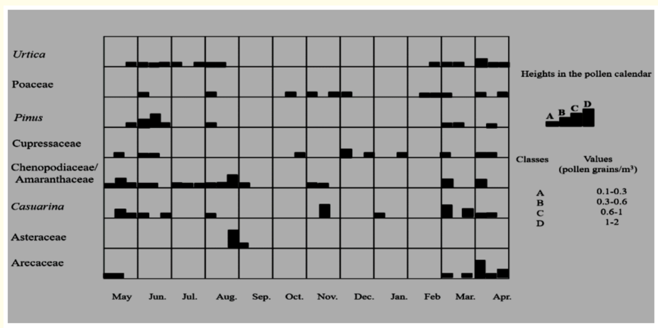

Figure 4: An approximate pollen calendar for Alexandria, using data from May 2019 to April 2020. Classes and pollen concentration values are represented in the calendar.

Taxa↓, Month→	May	June	July	Aug.	Sep.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Y.influx	%
Apiaceae	1	1	0	0	0	0	0	0	0	0	0	0	2	0.6
Arecaceae	4	0	0	0	0	0	0	0	0	0	2	17	23	6.7
Asteraceae	0	0	0	11	1	0	0	0	0	0	0	0	12	3.5
Casuarina	5	2	0	1	0	0	6	0	1	0	12	3	30	8.7
Chenod/Amar.	9	1	2	10	1	0	2	0	0	0	4	4	33	9.6
Cupressaceae	1	2	0	0	0	1	0	6	1	0	1	3	15	4.4
Myrtaceae	2	0	0	0	0	0	0	0	0	0	0	2	4	1.2
Pinus	2	13	0	1	0	0	0	0	0	0	1	2	19	5.5
Poaceae	0	1	0	1	0	2	2	1	0	2	1	1	11	3.2
Utrica	1	5	1	1	0	0	0	0	0	1	1	7	17	4.9
Unidentified	74	37	22	15	0	1	15	1	2	4	11	25	212	61.6
Monthly influx	99	62	25	40	75	4	25	8	4	7	33	64	378	

Table 3: Monthly pollen index from May 2019 to April 2020 in Alexandria, Egypt.

Taxa	Pol	Sym	PA L. µm	EA L. µm	P/E	Shape	Aperture		Exine	
							Ty	St	Th µm	Orn
Apiaceae	Ip	BSym	33.2	12.8	2.5	PP	Tcol	SF	1.2	Trug
Arecaceae	Ip	RSym	22.8	22.8	1	Sp	Tsu	S	1.25	Tpun
Asteraceae	Ip	RSym	30.3	30.3	1	Sp	Tcol	LF	2.6	Tec
Casuarina	Ap	BSym	20.5	28.5	0.72	So	Tp	Sm	1.0	Tgr
Ch/Am	Ap	RSym	27.5	27.5	1	Sp	Ppo	Sm	1.1	Tgr
Cupressaceae	Hp	RSym	44.2	44.2	1	Sp	Mpo	S	0.8	Tgr+Or
Myrtaceae	Ip	BSym	16.8	16.8	0.65	So	Tcol	SF	1.8	Tsc
Pinus	Ap	BSym	26.8	33.5	0.8	Ob	In	--	3.1	Tsc
Poaceae	Hp	BSym	12.8	12.8	1	Sp	Mpo	S	1.1	Tmrug
Urtica	Ap	BSym	14.2	14.2	1	Sp	Dp	S	0.6	Tgr, Tec

Table 4: Pollen grain characters of the trapped species.

Abbreviations used in the table↓, Grey color: Small Pollen Taxa, Blue color: Medium Pollen Taxa.

Pol: Polarity; Apol: Apolar; Ip: Isopolar; Hp: Heteropolar; Sym: Symmetry; BSym.: Bilateral Symmetric; Rad.Sym.: Radially Ymmetric; PA L: Polar Axis Length; EA L: Equatorial Axis Length; Ob: Oblate; PP: Perprolate; So: Suboblate; Sp: Spherical; Ty: Type; Dp: Diporate; In: Inaperturate; Mpo: Monoporate; PPo: Pantoporate; Tcol: Tricolpate; Tsu: Trisulccate; St: State; LF: Long Free; S: Short; SF: Short Free; Sm: Small; Th: Thickness; Orn: Ornamentation; Or: Orbicules; Tec: Tectate Echinate; Tgr: Tectate Granulate; Tmrug: Tectate Microrugate; Tpun: Tectate Punctate; Trug: Tectate Rugate; Tsc: Tectate Scabrate.

The quantity of the captured pollen grains varied between the studied months. In May the pollen incidence was 99 to all the studied taxa, and starts to decrease in June to become 62 and in July it reaches 25 only. In August the pollen incidence increased and reaches 40 while it was sparse in September and October to be 7 and 4 respectively. In November the pollen incidence increased gradually to be 25 and decrease again to be sparse in December, January and February to be 8, 4 and 7 respectively. Sudden increase happened in the following two months, March and April to reach 33 and 64 in the two months (Table 4 and Figure 3).

Full morphological description of the most dominant taxa arranged alphabetically are given below and summarized in table 2. Terminology followed Punt., *et al.* (2007) [22].

Apiaceae Plate 1 Photo. 1 a and b

The incidence pollen grains of the *Apiaceae* were restricted in the two months; May and June 2019; with very low percentage, 0.6%. The pollens are isopolar, bilateral symmetric, medium in size (33.2 × 12.8 µm), perprolate (PA/EA = 2.5), tricolporate, with short free colpi and wide bridged elongate endoaperture, exine thin, 1.2 µm with tectate rugate ornamentation.

Arecaceae Plate 1, Photo. 2 a and b

Family *Arecaceae* pollen type considered the third largest pollen captured in this study with 6.7% incidence (Table 2). From figure 3, it is appeared that *Arecaceae* pollen restricted only in March, April and May with the highest peaks in the first and last decades of April. The pollens are isopolar, radial symmetric elliptic to spherical (PA/EA = 1), medium in size (22.8 µm), triaperturate, zonosulcate, and thin exine about 1.25 µm with tectate punctuate ornamentation.

Asteraceae Plate 1, Photo. 3 a and b

The pollen grains count of *Asteraceae* was moderate in comparison to the other pollen taxa, it records (3.5%) which is deposited in the last period of August. The pollens are isopolar, radio symmetric, spherical (PA/EA = 1), small in size (25-36 µm) 30.3 µm, from the tricolporate type within the family, with long colpi, but not syncolpate and wide lolongate endoaperture and exine thick 2.6 µm with tectate echinate ornamentation.

Casuarina Plate 1, Photo. 4 a and b

This type of pollen grains recorded on the trap throughout eight months from the year, with no incidence at all in July, September, October, December and February (Figure 3), its annual pollen index was 8.7%, which is considered the second largest pollen taxa in Alexandria city. The greatest incidence of the *Casuarina* pollen grains was in mid November and the beginning of March. The pollens are apolar, bilateral symmetric, suboblate (PA/EA = 0.72), small in size (20.5 x. 28.5 µm), triporate with small pores and thin exine 1.0 µm and tectate granulate ornamentation.

Chenopodiaceae/Amaranthaceae complex Plate 1, Photo. 5, 6 a and b

This type of pollen grains was the most incident ones in this study, the greatest amounts of pollen grains come from *Chenopodiaceae/Amaranthaceae* complex with 9.6%. It was trapped in the hot months from March until August with the highest peak in the third decades of August (Figure 3). The pollen grains of the *Chenopodiaceae/Amaranthaceae* complex are apolar, radiosymmetric, spherical (PA/EA = 1), small in size (25-32 µm) 27.5 µm, pantoporate with small hooked pores and thin exine 1.1 µm and tectate echinate or tectate granulate ornamentation.

Cupressaceae Plate 1, Photo. 7 a and b

Cupressaceae pollen grains contributed with a few incidents throughout the studied period, it was 4.4%. This pollen taxon was very few in the recorded months and gives its highest record in the first decade of December (Figure 3). The pollens are heteropolar, radiosymmetric, spherical (PA/EA = 1), big in size (36-48 µm) 44.2 µm, monoporate aperture with small operculate pore in its distal surface, and thin exine 0.8 µm with tectate granulate ornamentation with numerous orbicules attached to its surface.

Myrtaceae Plate 1, Photo. 8 a and b

The *Myrtaceae* pollen grains were few throughout the studied period, it recorded in two months only, May 2019 and April 2020, by very few incidences, it represents 1.2%. The pollens are isopolar, bilateral symmetric, suboblate (PA/EA = 0.65), very small in size (13 X 20 µm) 16.8 µm, tricolporate with short colpi unreached to the poles and lolongate endoaperture. Exine thickness 1.8 µm with tectate scabrate ornamentation.

Pinus Plate 1, Photo. 9, 10 a and b

The *Pinus* pollen grains considered from the moderate quantity in the aerosol of Alexandria city, it recorded 5.5% in relation to the other taxa. It starts in May 2019 with very low record (2) and increased in June with high record (13), while in August and March it was very few (1) and in April it was (2). There was no record of this type in the rest of the months. The *Pinus* pollen grains have their characteristic features; it has two large oval sacci and central corpus. The corpus is oblate (PA/EA= 0.8) moderate in size (26.8 X 33.5 µm), mostly inaperturate with thick exine 3.1 µm and reticulate exine in both the sacci, while the colpus is tectate scabrate.

Poaceae Plate 1, Photo. 11 a and b

The trapped pollen grains have 3.2% pollen grains of the *Poaceae* family without any specific period for their incident; they were recorded in eight months from the year while there was no record of them during July, September, October, December and February. The pollen grains of *Poaceae* are heteropolar, bilateral symmetric, spherical, folded or irregular (PA/EA = 1), small in size (10-21 µm) 12.2 µm, monoporate with very small annulate and centrally plugged pore with smooth unornamented rim. Exine thin 1.1 µm with tectate microrugulate.

Urtica Plate 1, Photo. 12

Pollen grains of *Urtica* contribute 4.9% from the total pollen assemblage in Alexandria city. It is recorded during spring and summer months; May, June, July and August and there was no record of it during the autumn and winter months and it return again from the end of February, March and April. The pollen grains bilateral symmetric, apolar, oblate-spheroidal (PA/EA = 1), very small (12.0-16.0 µm) 14.2 µm. The pollen grains have from two to four circular annulate plugged pores, mostly triporate with elevated annulus. Exine very thin 0.6 µm with tectate granulate or tectate echinate ornamentation.

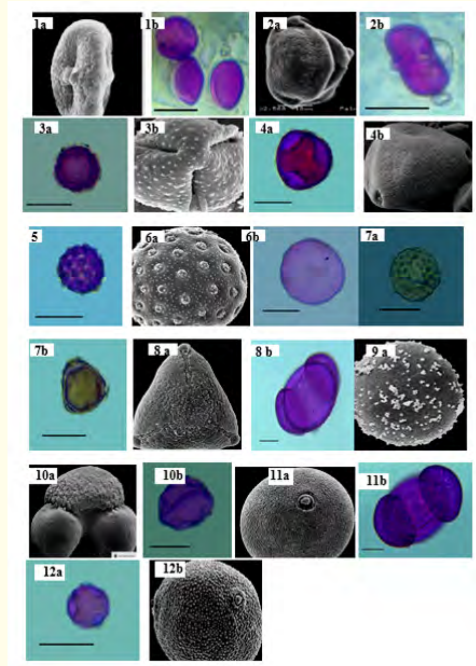

Plate 1: Pollen grains of the captured taxa. (Scale bar = 20 µm; SEM photos under 2000X magnification) a= light microscope, b= SEM photographs, 1. *Apiaceae*; 2. *Arecaceae*; 3. *Asteraceae*; 4. *Casuarina sp.*; 5, 6. *Chenopodiaceae/Amaranthaceae*; 7. *Cupressaceae*; 8. *Myrtaceae*; 9, 10. *Pinus sp.*; 11. *Poaceae*; 12. *Urtica sp*.

Relation between major climatic data and pollen incidence

To estimate the relation between the monthly pollen grain incidences in Alexandria city, graphic illustrations have been constructed to evaluate the correlation between the pollen quantities in aerosol of the city with the average temperature, relative humidity and total rainfall as shown in figure 5. The highest records of the pollen grain were during May 2019 and April 2020, with another lower peak during August and November 2019. This result is in negative correlation with the rainfall and did not affect by both temperature and air relative humidity. In contrary, during the rainy months; October and December 2019, and January and February 2020; the pollen grain counts were very few or without any record.

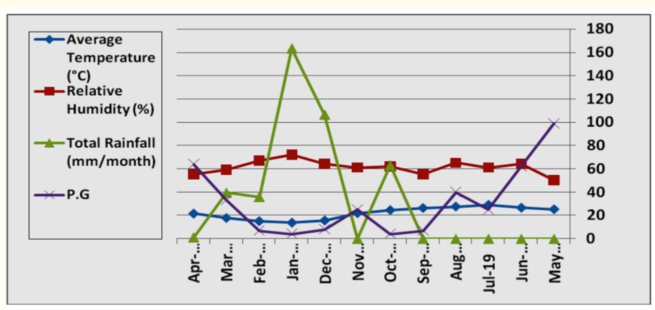

Figure 5: Variations in the monthly pollen grain incidences in relation to the average temperature, relative humidity and total rainfall.

Discussion

Measuring the quantity of airborne pollen over time is commonly used as a proxy for monitoring the anemophilous plants in certain regions as well as in allergological studies [23]. Hirst-type volumetric method (Hirst 1952) is the widespread method for quantification of airborne pollen throughout the day [24]. With the increase of air pollution by both biological remains and chemical constituents, peoples suffering from allergic symptoms. Accordingly, the study of the aerosol in different countries or even districts become an important issue. D`Amato., *et al*. (1998) announced that it is essential to know the airborne pollens in each country and region due to the increase in mobility and business activity [25]. At the same time, they warned from planting some allergenic trees species in the subtropical climate. Mansouritorghabeh., *et al.* (2019) mentioned that pollens play an important role in the onset of allergy and more than 40% of allergic patients are due to pollen grains [15]. As the result of global climate change in the world and especially the Mediterranean area and Middle East, the periodical study of the type of vegetation in response to the fluctuation in the climate must be done.

Alexandria city from the affected cities by the global climate change, the climate in the city has been faced with major changes in the last three years. Thus, the study of the type of vegetation and allergen trees become a serious topic. This work can give good information about how much the vegetation in the city can affect the people health. The results obtained revealed that the aerosol of the city can consider from the unpolluted air by pollen grains. The total incidence of the pollen throughout the whole year is very low (378). This incidence was concentrated in the summer and spring, May 2019 (99), June 2019 (62), July 2019 (25), and August 2019 (40). Then the incidence of the pollen grains was very low or even scarce in September 2019 and October 2019. In November it becomes 25 and become few in the December, January and February, then it increases in March to be 33 and April 64. This means that there is long duration in which Alexandria aerosol is pollen-free and this notification has been mentioned in the work done before by [26-28]. In spite of the rarity of the pollens in Alexandria air, the dominant type of pollens were that of the *Chenopodiaceae/Amaranthaceae* complex and *Urtica* sp.. Those types were recorded before as being allergenic and they are widely distributed in Alexandria streets, roadsides, railways and disturbed areas. The pollens of *Casuarina* (8.7), *Arecaceae* i.e. palm trees (6.7); *Pinus* (5.5) and *Cupressaceae* trees (4.4) are the great quantities in the aerosol of Alexandria. These trees pollinated by air and have light small pollen grains. The ornamented trees have not recorded by the trap as they are mostly insect pollinated trees. This conclusion has been mentioned by [2,29-32].

The overall view to the quantity of the pollen grains trapped and the different climatic factors, we found that there was no correlation between both of them. This is not agreed with Sabo., *et al*. (2015) who correlate between the quantity of pollen grains in the air by both the richness of the anemophilous species and temperature, meanwhile the correlation was negative between the quantity of air-pollen and humidity [33]. In the rainy periods in Alexandria the trapped pollen grains were scarce and we can attribute this data to the draining and washing effect of the pollen.

Conclusion

This study showed that the aerosol of Alexandria city can be described by being pure air without pollen contaminants throughout the whole year. It has few amounts of pollen grains which consider within the safe limits, and the present types are mostly of anemophilous trees beside both *Amaranthaceae-Chenopodiaceae* type and *Urtica* sp. The density of the pollen counts throughout the whole year doesn't correlate with any climatic factors. We can conclude that symptoms of allergy in Alexandria city are not due to the high contents of pollen grains in the air, but it might be due to the high humidity and other factors.

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