Sand Dust Storms Source Identification and The Mineralogical and Micro-Organisms Effects of Regional Dust Storms - Middle East Region

Prof.Dr. Moutaz Al-Dabbas

Science college – University of Baghdad. (profaldabbas@yahoo.com)

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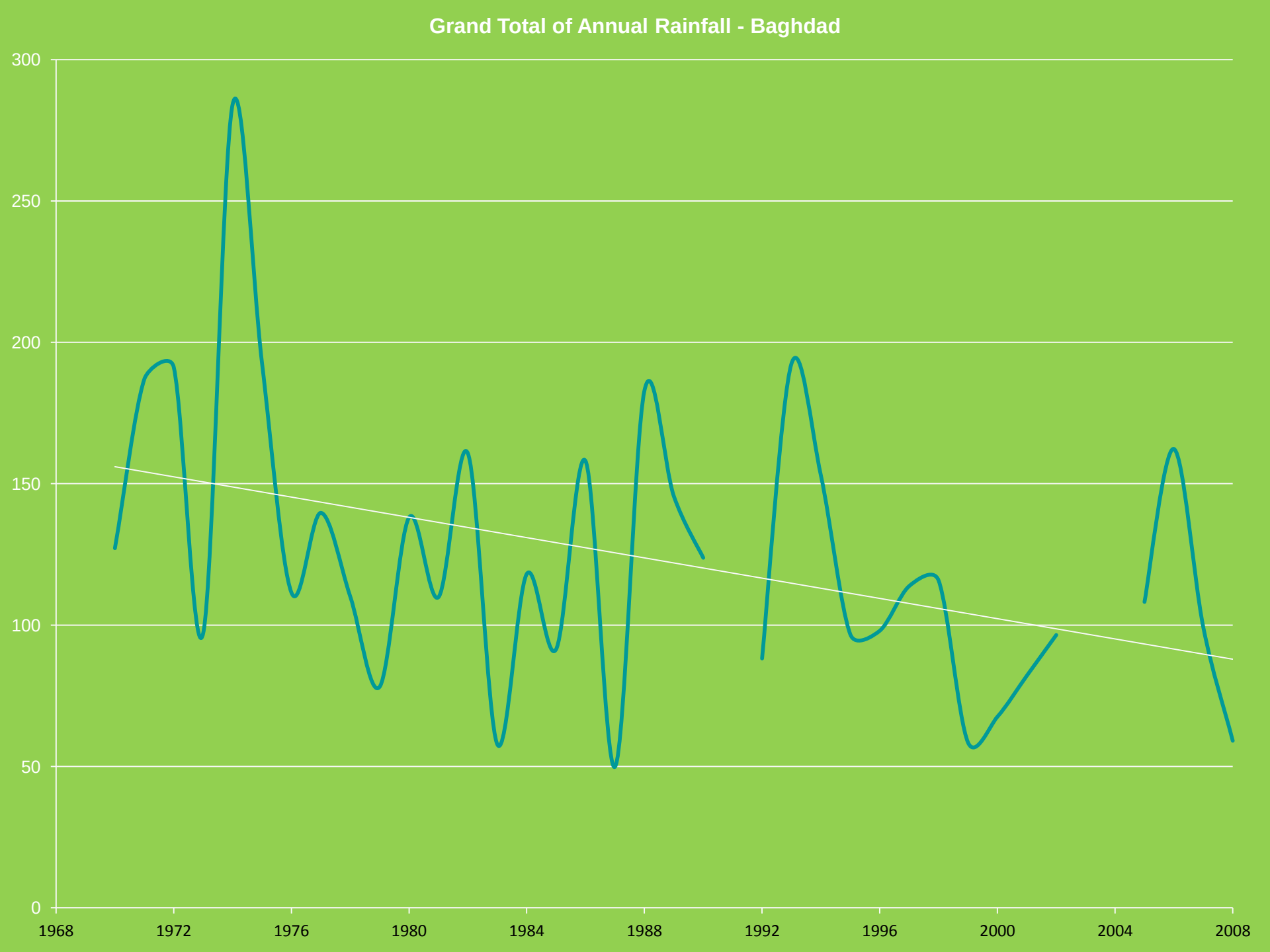
Preface

The frequency of the occurrence of sand and/or dust storm (SDS) has increased drastically in the last decade and it is increasing continuously (Figure 1). The climatic changes is one of the main reasons behind the development of sand and dust storms, especially the drastic decrease in the annual rate of rainfall, besides environmental changes, such as drying of the marshes in southern IRAQ , land degradation, and desertification . Due to the hot and dry climate in the region (arid and semi-arid) , soils are susceptible of being lifted to the atmosphere if winds are higher than the wind friction velocity, causing dust storms (wind speeds exceeding 14 Km/hr).


Grand Total of Annual Rainfall - Baghdad
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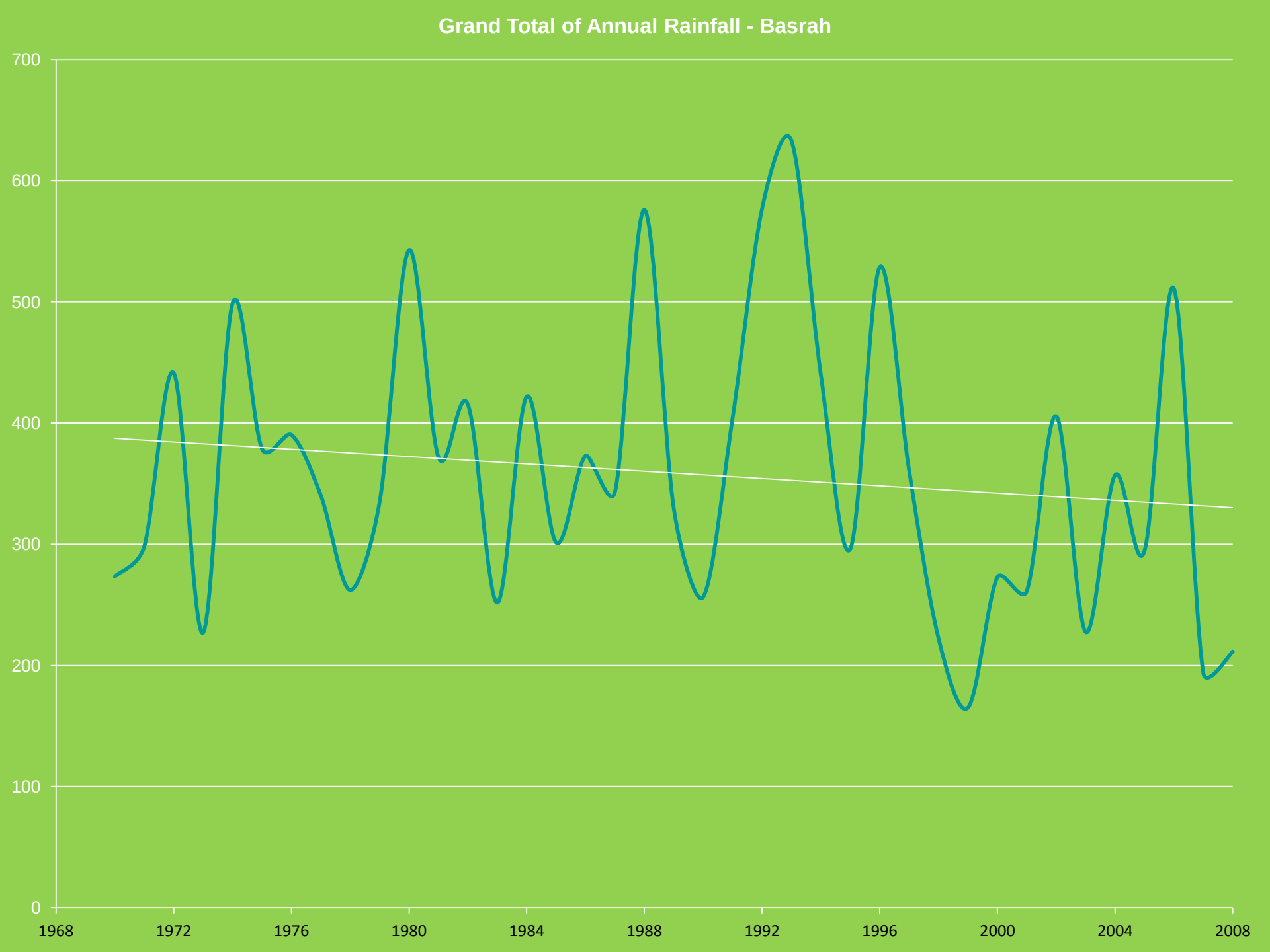
Grand Total of Annual Rainfall - Basrah
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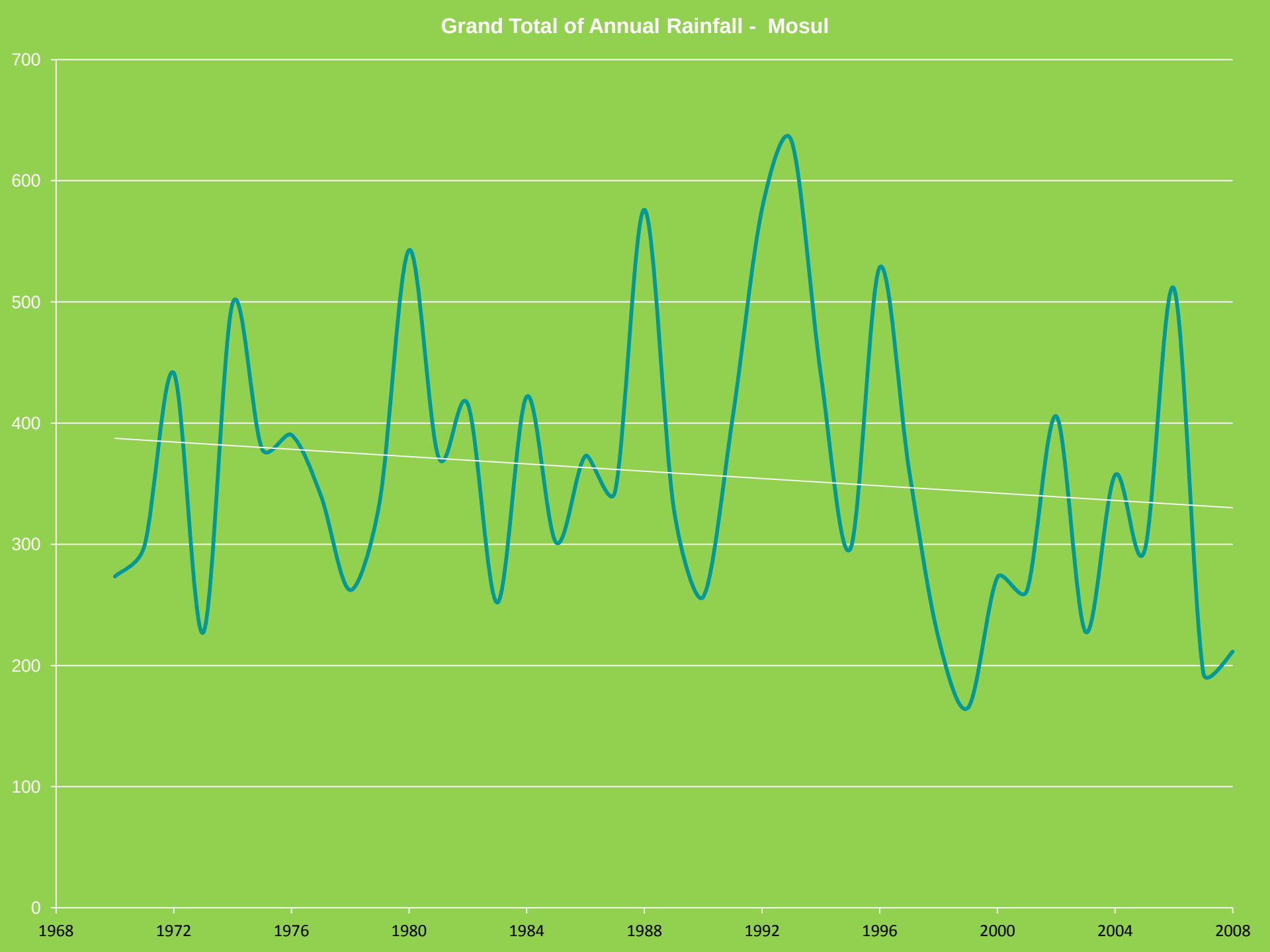
Grand Total of Annual Rainfall - Mosul
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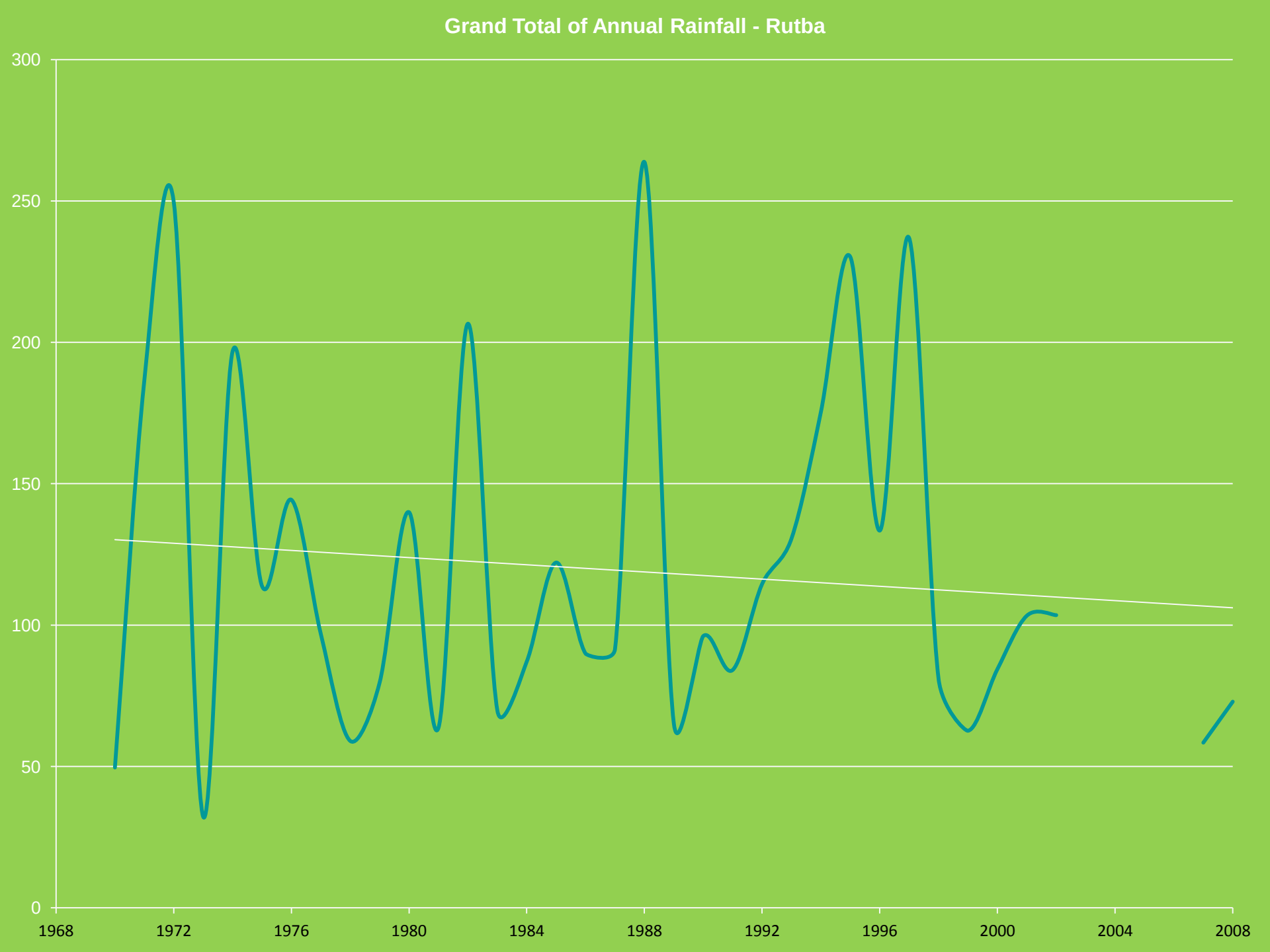
Grand Total of Annual Rainfall - Rutba
300
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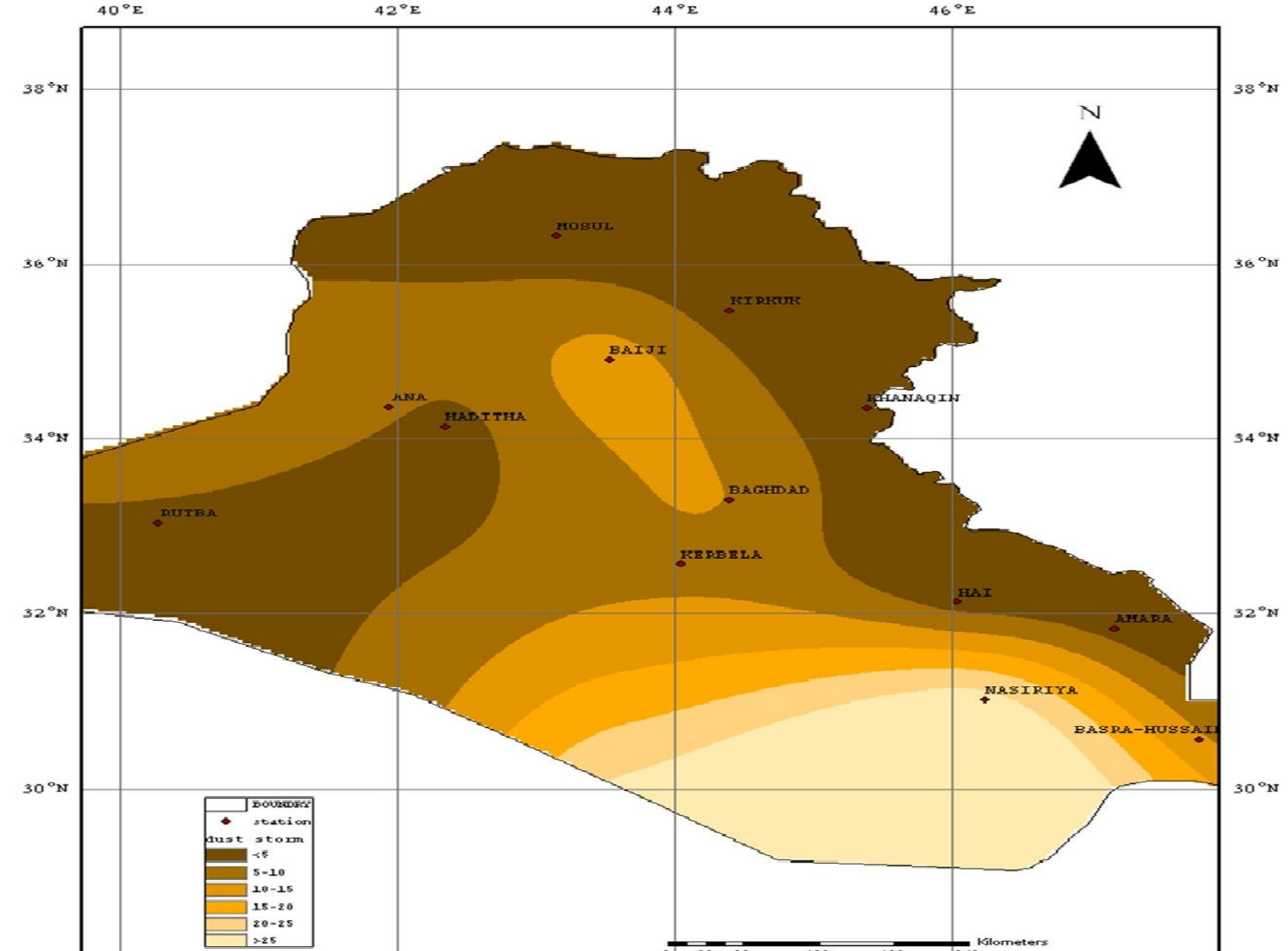
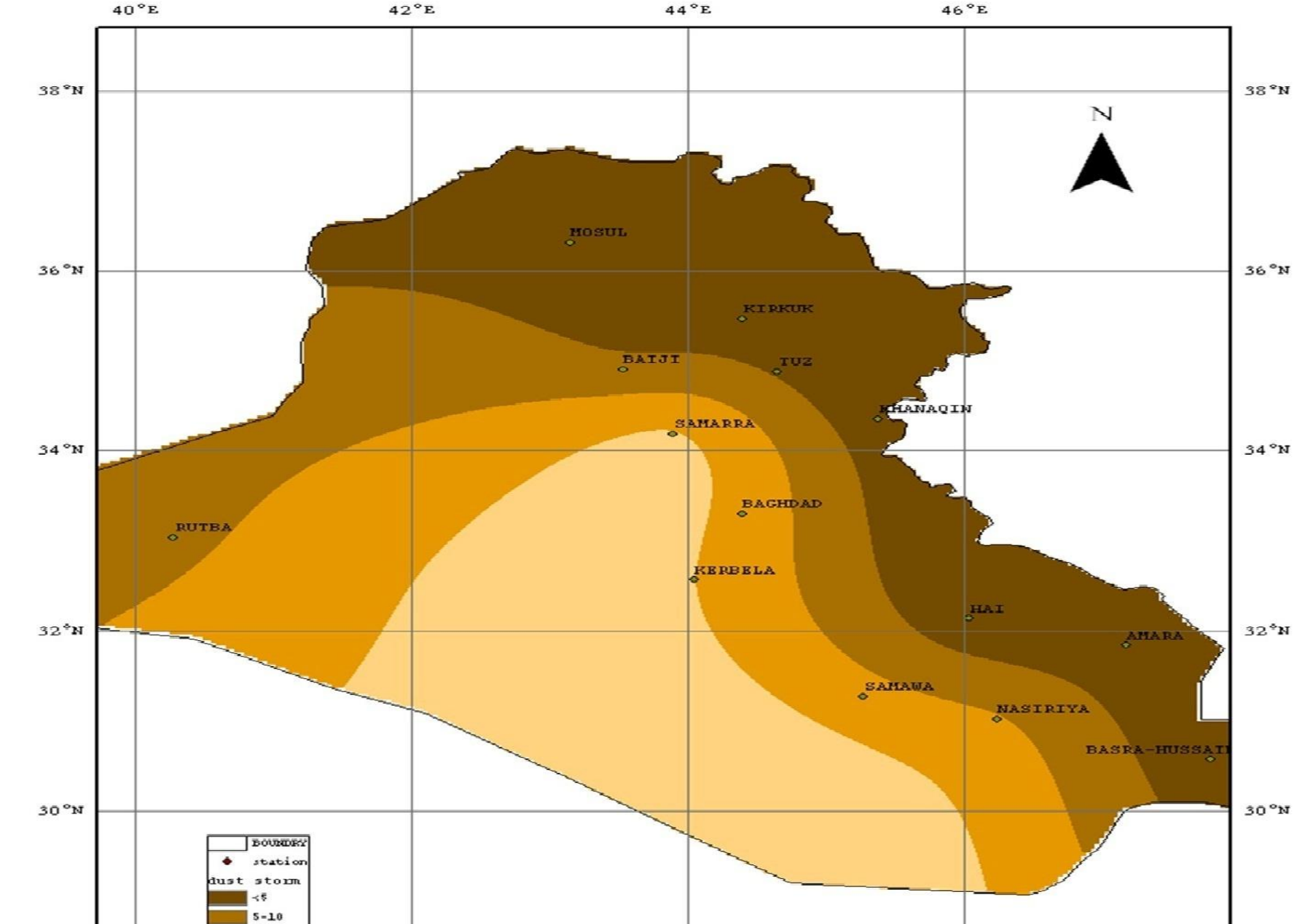
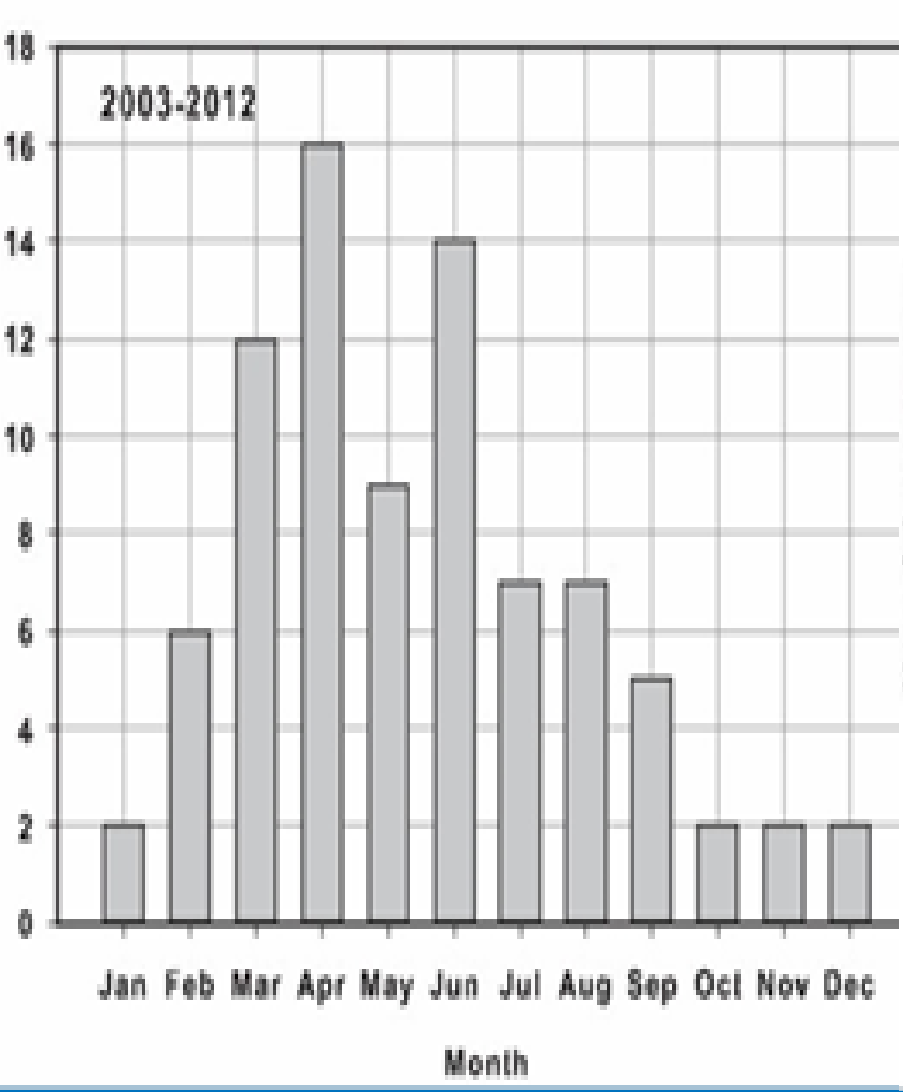
Mean Annual Number Of Days With Dust Storm
Seventey Years



Mean Anual Number Of Days With Dust Storm For Millennium



The maximum number of annual dust storms during 1951-1990 was about 24 days/year, whereas the predicted number of annual dust storms during 2013 is estimated to be 300 days (Figure 2). Therefore, the majority of the Iraqi territory is changed into Very High Potential for dust storm areas, except small part in the extreme northeastern part, where it shows Moderate Potential for dust storms.



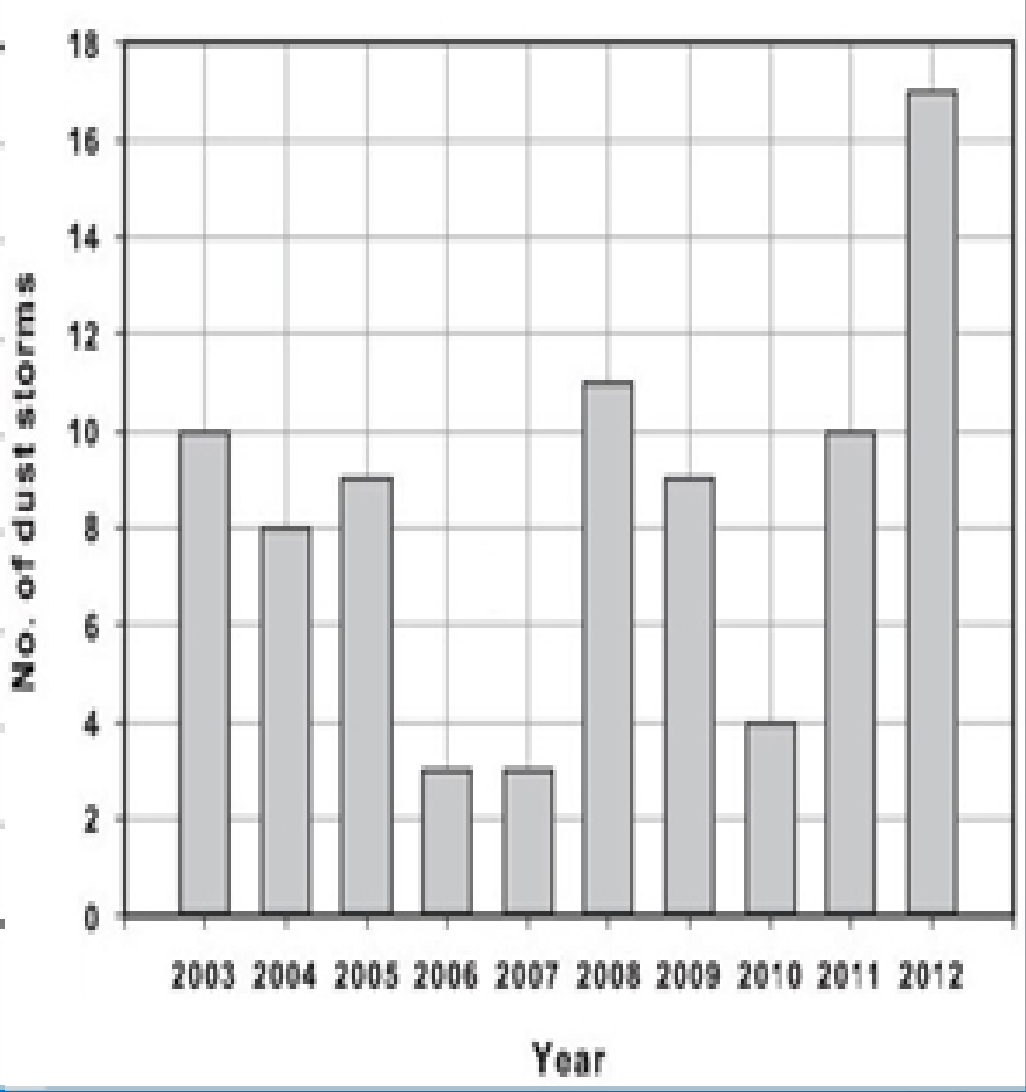


Figure 2: A-Number of dust storms per month in Iraq for the period 2003-2012, B-Total annual number of dust storms in Iraq (After Al-Jumaily and Ibrahim, 2013)

SAND DUST STORMS (SDS) HOTPOINT SOURCES

Maps of dust sources identification over Iraq performed by different authors using satellite imagery and other satellite remote sensing data are depicted in Fig. 3.

Three main dust hot point sources were recognized (Figures 3):

1. The Jazera area: This area located in the north west of Iraq and the east of Syria was specified as the main source of dust storms.
2. The Iraqi, Jordanian Syrian borders: that represents parts of Iraqi western desert, parts of Jordanian and Syrian eastern deserts.
3. The Mesopotamian plain of Iraq.

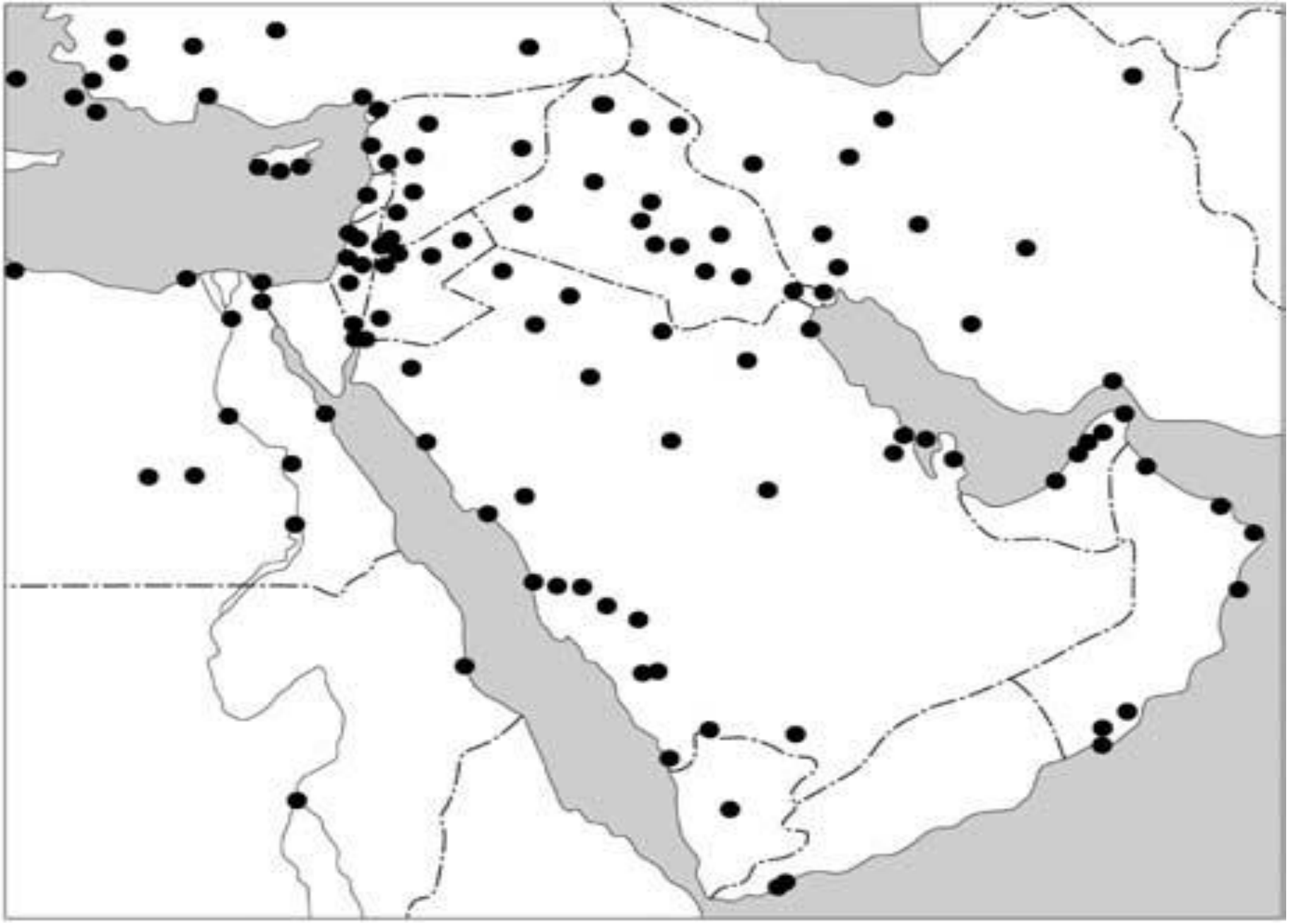
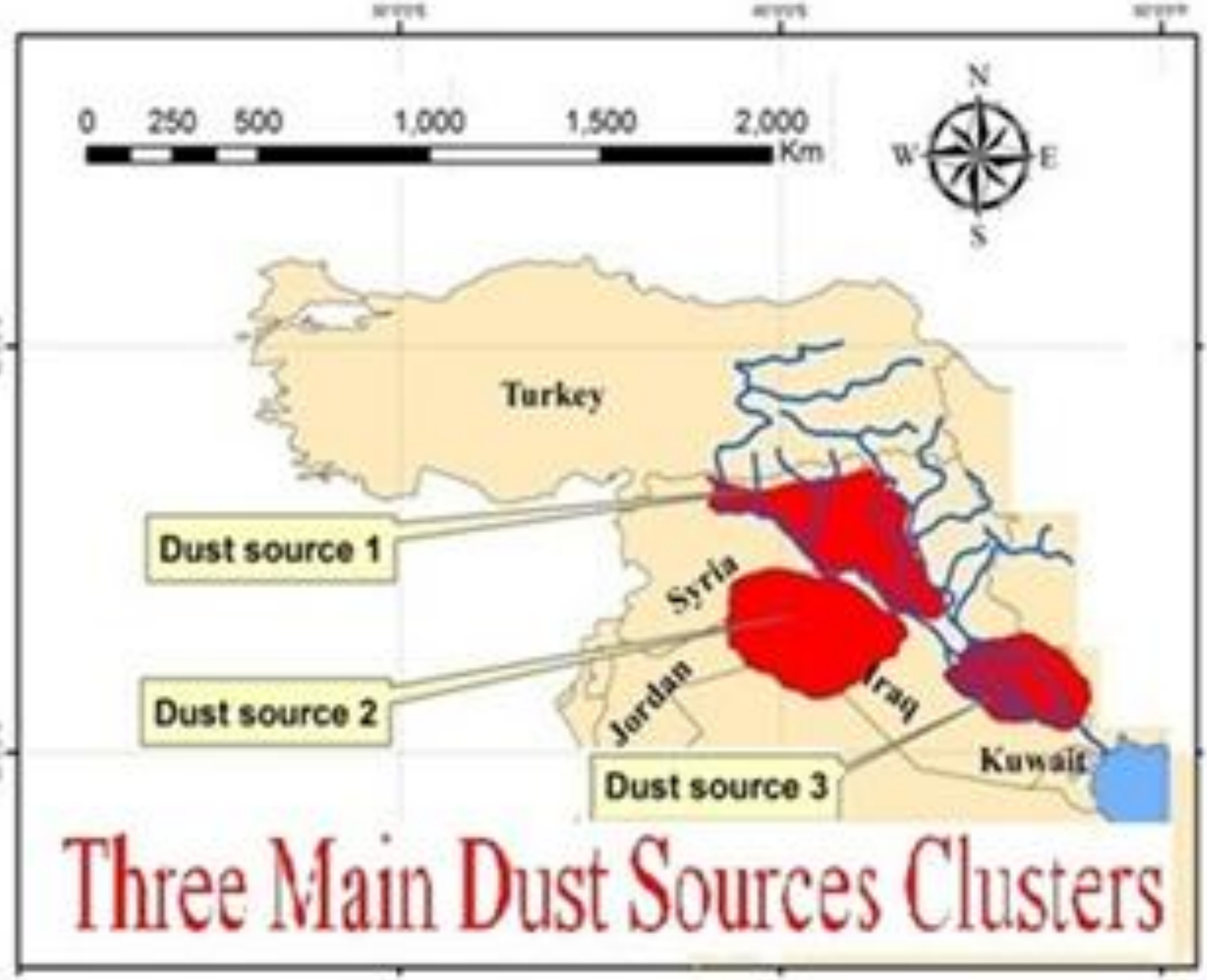


Figure 3. Dust source locations according to Kutiel and Furman (2003)


0 250 500 1,000 1,500 2,000
Km
N
W
E
S
Turkey
Dust source 1
Syria
Dust source 2
Jordan
Iraq
Kuwait
Dust source 3
Three Main Dust Sources Clusters

Introduction

The identified regional dust storms by satellites images, that blowing over Iraq and the Middle East were studied ,from March 2007 to July 2010, the total studied dust storms were 47 (seven in 2007 , twenty in 2008,eleven in 2009 and nine in 2010). The collected dust samples, in the middle and south Iraq, were from Baghdad, Ramadi , Kut , Basra , Najaf , Karbala , Hilla and Sallahaldin. Grain size, shape and mineralogical analyses were determined. Analyses of the heavy elements were preformed to determine the heavy metals (Pb, Zn, Cd, Ni, Cu, Co, & Fe) concentration in the dust samples. Pollen analyses were preformed as well, to identify the pollen concentration in the dust samples. Microorganism's analyses methods for bacterial, fungal, and viral isolates were done.

As well as ,the aims of the present work were to study some geochemical, textural and Radioactive Characteristics of dust from sand storms that occurred over Baghdad and Ramadi cities, middle of Iraq, from February 2009 to July 2010. Dust samples were collected form dust storms at different places throughout Baghdad and Ramadi cities. The samples were thoroughly, mixed and analyzed for the heavy, light, clay minerals, trace metals, grain size analyses, as well as measuring of the Uranium concentration average absorbed dose and average external effective dose for dust of sandstorm for both cities Baghdad and Ramadi.

The Uranium concentration average absorbed dose and average external effective dose were calculated for dust of sandstorm at 2-4/7/2009 and 3-4/4/2010 for both cities Baghdad and Ramadi. The results for specific activity of uranium were in range of (5.43-9.56 Bg/kg) and the absorbed dose range (2.19- 5.46 nGy/h)for sandstorm at 2-4/7/2009 and the average specific activity of uranium was in range of (7.32- 18.96 Bg/kg) and the average absorbed dose (3.27- 8.98 nGy/h) for sandstorm 3-4/4/2010. All the results were lower than critical dose level, but the culmination of the dose of more than one sandstorm may have a damage effect.

Inhalation is the most important pathway for public exposure to radioactive elements such as uranium compounds. The estimated annual effective dose is less than the annual dose limit of the public recommended by the IAEA. The heavy metals of the most importance that designated as priority pollutants by USEPA and the Uranium concentration average absorbed dose were studied in this research.

Exposure to uranium and other heavy metals in large doses can cause changes in renal function, resulting in renal failure

The Laboratory work

Grain size & Shape analyses:- =

Mineralogy analysis:-

Analyses of the heavy elements :-

pH analyses :

Pollen analyses :-

Microorganisms Analyses methods for (BACTERIA, FUNGI & VIRUSES ANALYSES

Table (2- 3): shows the studied Regional over Middle and south Iraq (2007-2008)

No.	Date of dust storm	No.	Date of dust storm
1	17-3-2007	16	25-5-2008
2	18-4-2007	17	7-6-2008
3	11-5-2007	18	15-6-2008
4	16-5-2007	19	28-6-2008
5	8-7-2007	20	1-7-2008
6	16-7-2007	21	7-7-2008
7	7-9-2007	22	11-7-2008
8	19-2-2008	23	27-7-2007
9	3-3-2008	24	30-7-2007
10	15-3-2008	25	15-9-2008
11	30-3-2008	26	24-9-2008
12	4-4-2008	27	16-10-2008
13	17-4-2008		
14	27-4-2008		
15	16-5-2008		

17-2-2009 20-2-2009 27-2-2009

9-3-2009 9-6-2009 17-6-2009

28-6-2009 2-7-2009 4-7-2009

29-7-2009 30-7-2009 3-4-2010

4-4-2010 13-5-2010 14-5-2010

6-6-2010 23-6-2010 24-6-2010

19-7-2010 20-7-2010

Textural and mineralogical analyses:

Grain size analyses of the collected samples were performed using sieving and pipetting methods following Folk (13) ,to determine the sand, silt, and clay fractions . Microscopic examination by applying Carver(14) method to study the light minerals and heavy minerals, and X-ray diffraction method were used to identify the different minerals present.

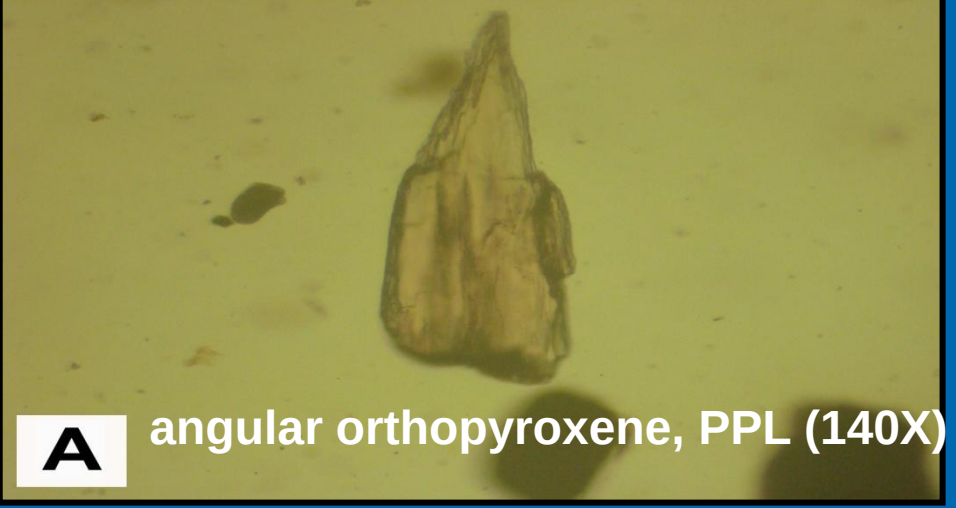
Heavy metal content:

The heavy metals: Pb, Zn, Cd, Ni, Cu, Co, and Fe were analyzed for all dust samples by using the Atomic absorption spectrophotometry.

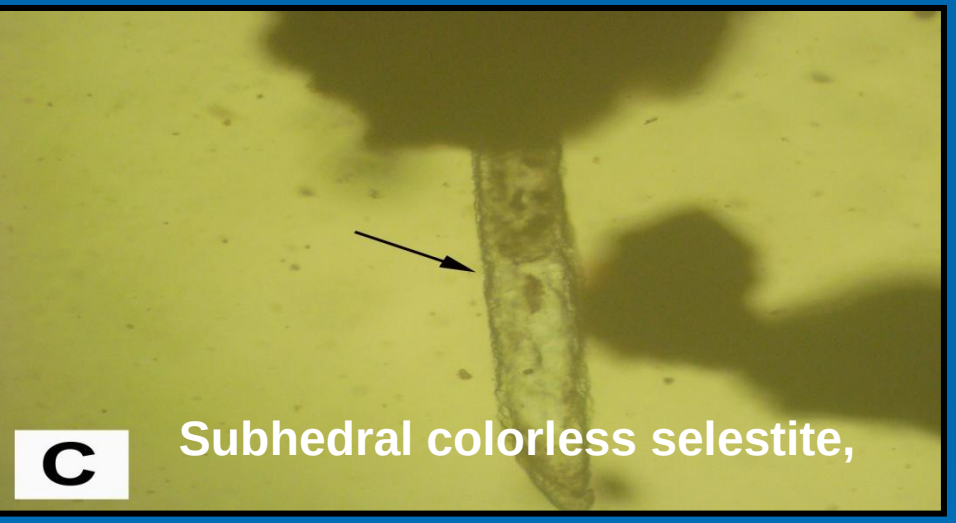
Radioactive Characteristics

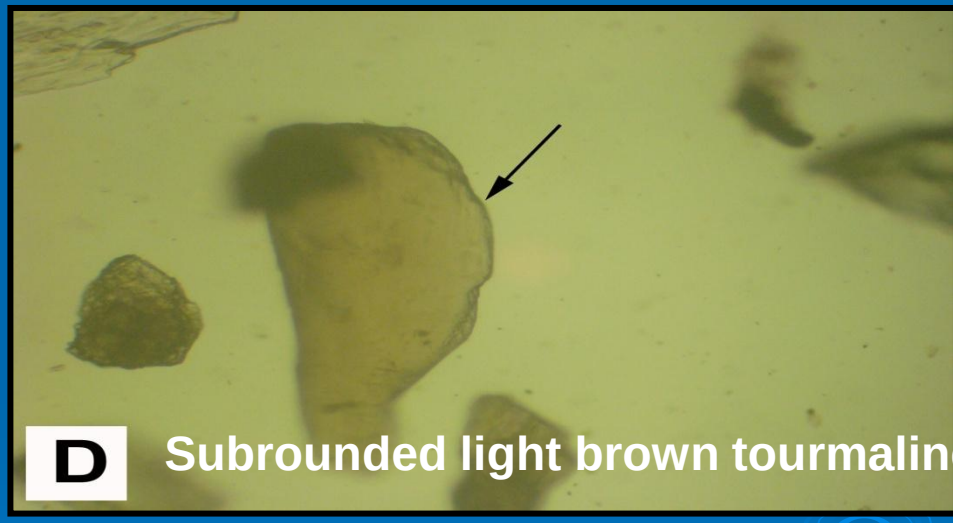
The Uranium concentration average absorbed dose and average external effective dose were calculated for dust of sandstorm at 2-4/7/2009 and 3-4/4/2010 for both cities Baghdad and Ramadi according to Mahdi ,et al, (15) and Marouf (6) methods.

The results of particle size analyses indicate the texture most of samples are ranging from sandy clayey silt (72 %), and clayey sandy silt (28 %). The result of roundness of quartz grains, (20 % rounded, 80 % sub rounded), reflect that they were transported over long distances. Moreover, the dust samples were analyzed and identified by using XRD analyses. The results reflect the following minerals, quartz, feldspars, calcite, with small amount of gypsum. The clay minerals (Chlorite, Illite, Montmorillonite, Palygorskite and Kaolinite) were recognized. The analyses of heavy minerals percentages by using the microscope were done.

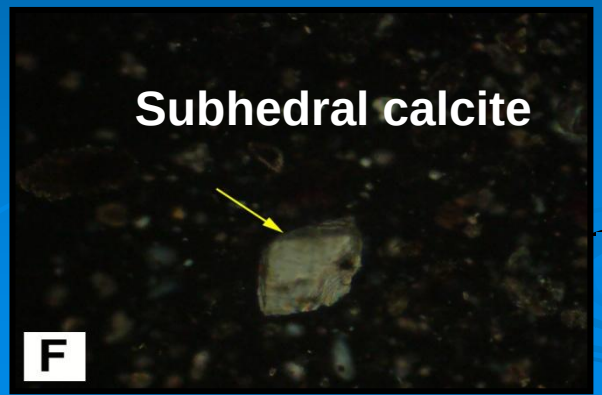

A
angular orthopyroxene, PPL (140X)


B
: Rounded colorless zircon


C
Subhedral colorless selestite,


D
Subrounded light brown tourmalin


E
Angular quartz


Subhedral calcite
F


Angular alterd orthoclase
G

The results of pollen distribution, in descending order, were Chenopodiaceous, Graminea, Pine, Artemisia, Palmae, Olea & Typha, (reach 83%,70%, 65%,50%,15%,10%,&5% of the counted pollen grains, respectively). The results of microorganis (i.e. isolated bacteria and fungal), in descending order, were the gram – positive Bacillus species (40.6 %), Aspergillus species pl Candida albicans (14.5%) and (7,7%) respectively, the gram-negative rods, Escherichia coli (8.4%), the gram-positive Cocci streptococcus pneumonia (7.4%), than the gram-negative rod Enterobacter Cloacae (5.8%), Staphylococcus epidermidis and Staphylococcus (4.2%) & (2.6%), respectively. The remaining Gram -negative microorganisms were Pseudomonas aeruginosa (2.9%). Regarding the viral etiology; there is no any viral isolate among the work results. The allergens commonly associated wit dust storms include fungal spores, plant and grass pollens and organics represent an agricultural area pollens grains.

Identified Pollen Grains	Number of Samples	Range percentages
Chenopodiaceae	21	3-83 %
Graminea	19	5- 70 %
Pine	14	10- 65%
Artemisia	8	0-50%
Palmae	6	0.0- 15%
Olea	4	0- 10%
Typha	3	0-5%

Spores , Fungi , Algae,& Micro Spines		
Cuticle	32	10 – 80 %
Fungi	26	3- 60 %
Algae	5	0- 20 %
Lycopodium	10	5- 75%
Sphagnum	3	0-8 %
Unnamed spores	2	0-6 %
Micro Spines	2	0-20%

Palynological Analysis:

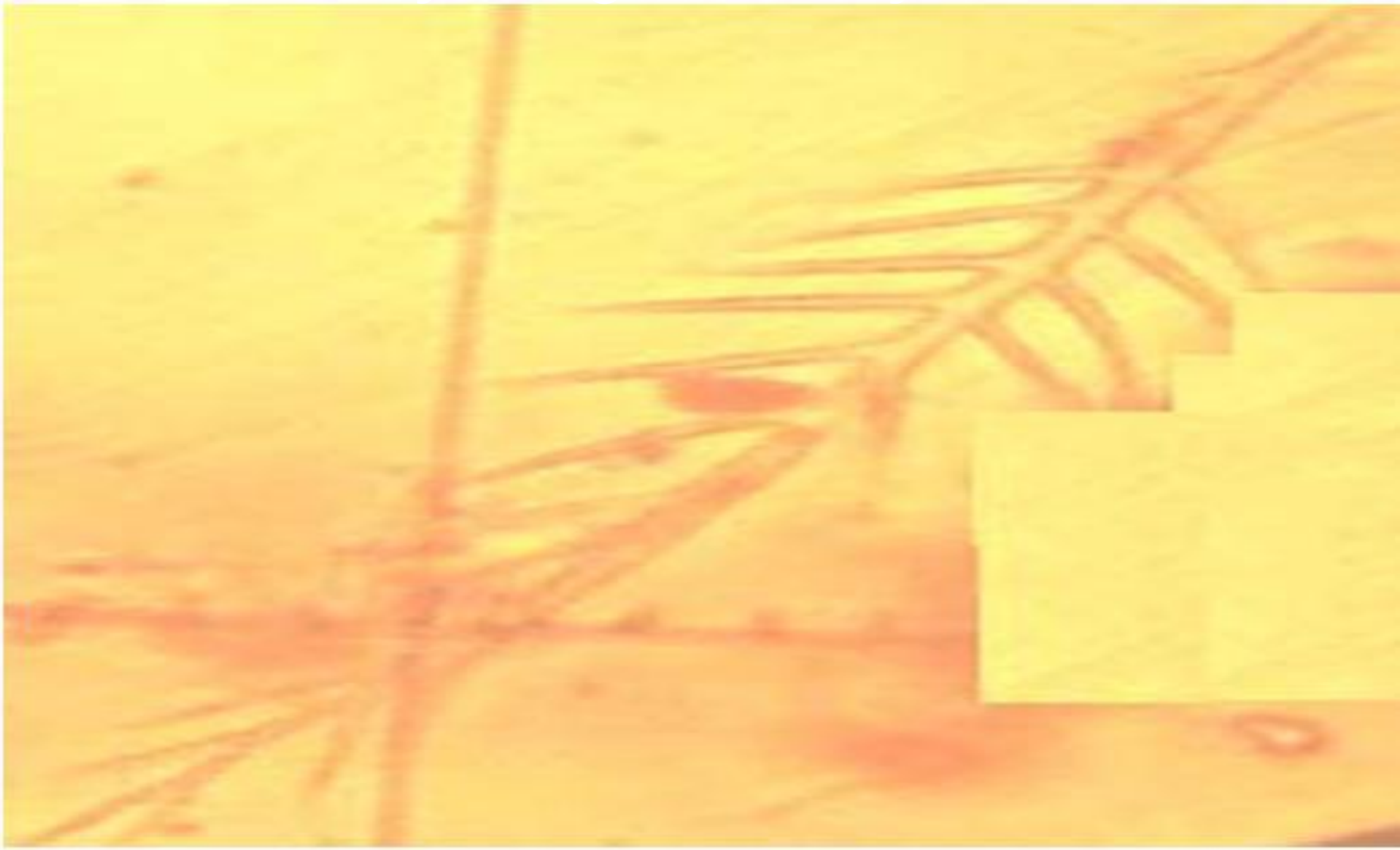


Figure 5- 1: Micro Spine in the studied dust storms samples of Baghdad, (relatively small at 18 to 25 µm).

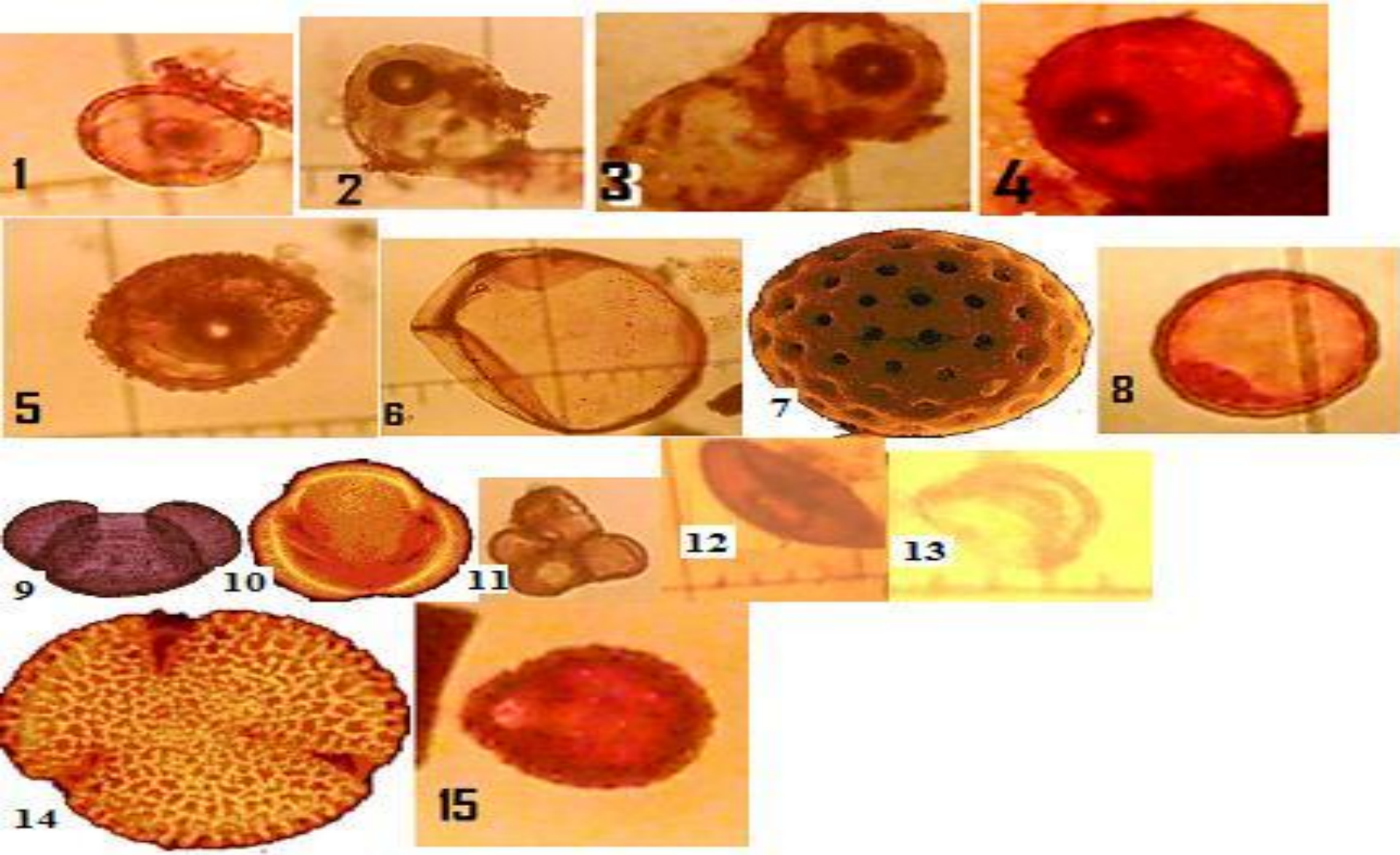


Figure 5-2: (1-5),cultivated Graminea .6-wildGraminea, (7-8)-Chenopodea,9- bisacate Pinus, 10- Artemisia,11- Typha,(12-13)- Palmae,(14- 15)-Olea.

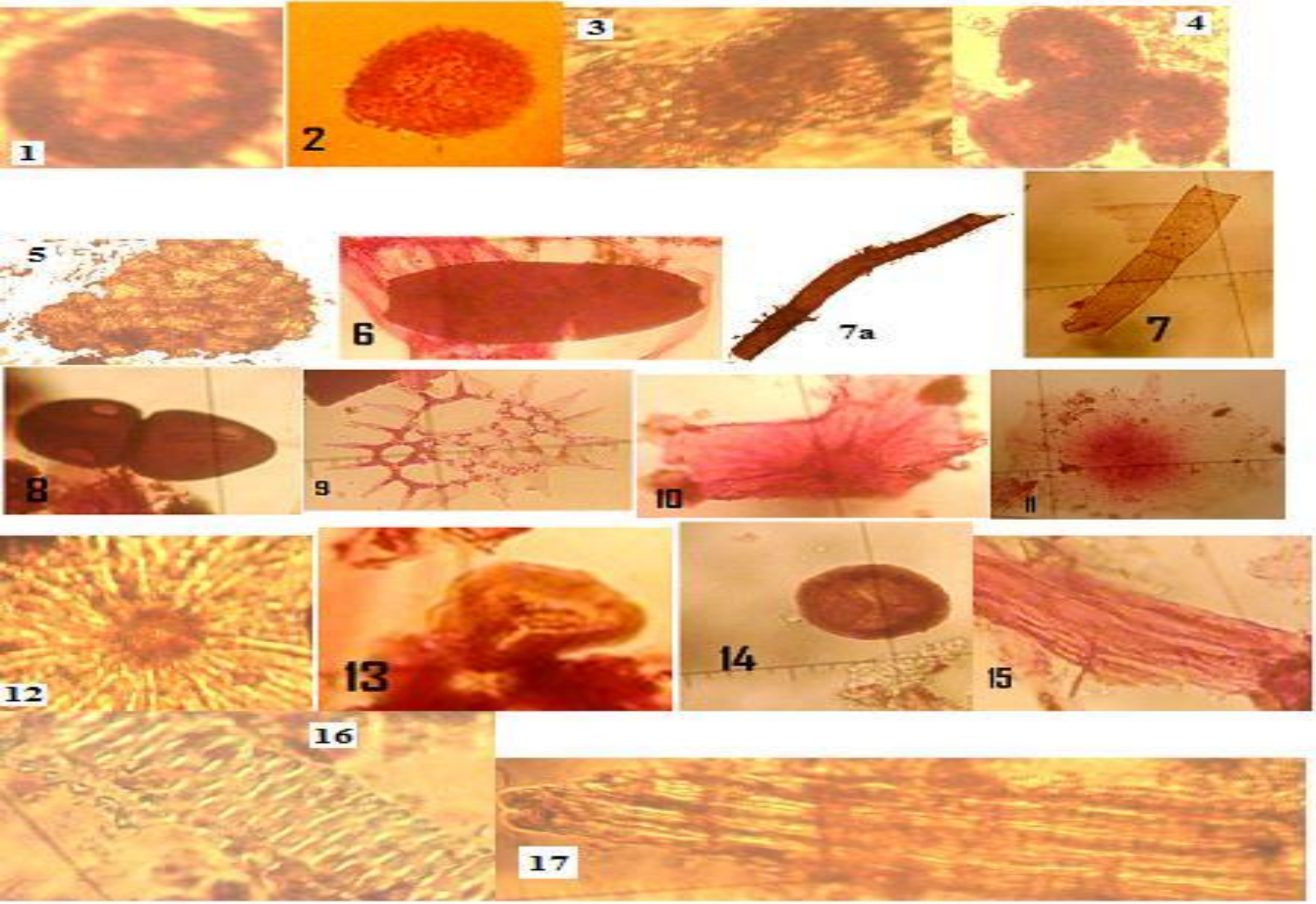


Figure 5-3: (1) -Sphagnum, (2) -Lycopodum,(4-8)- Fungi,(9-12)Algae,(13-14)- Unname
spores.(15-17)-Cuticle.

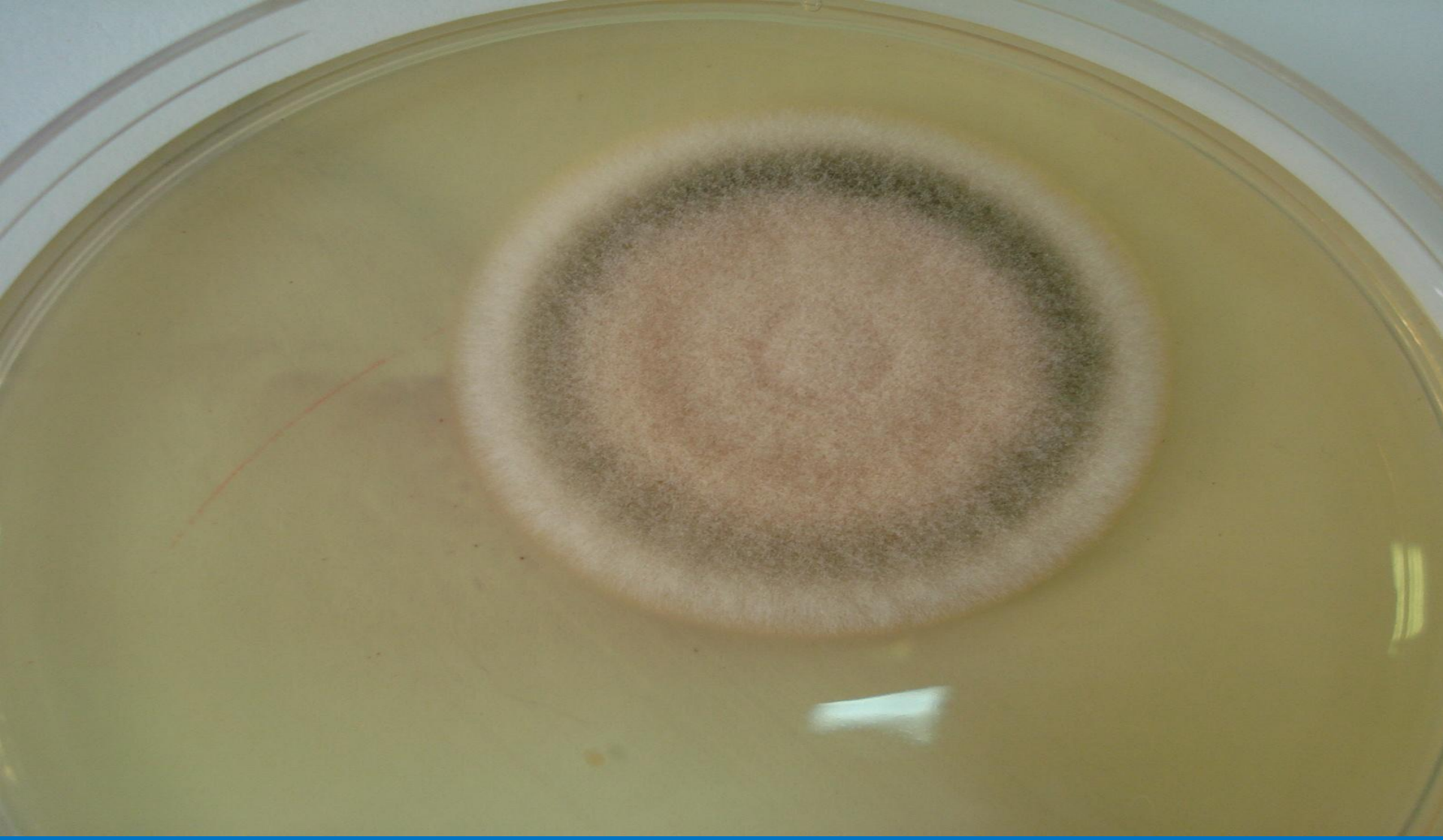
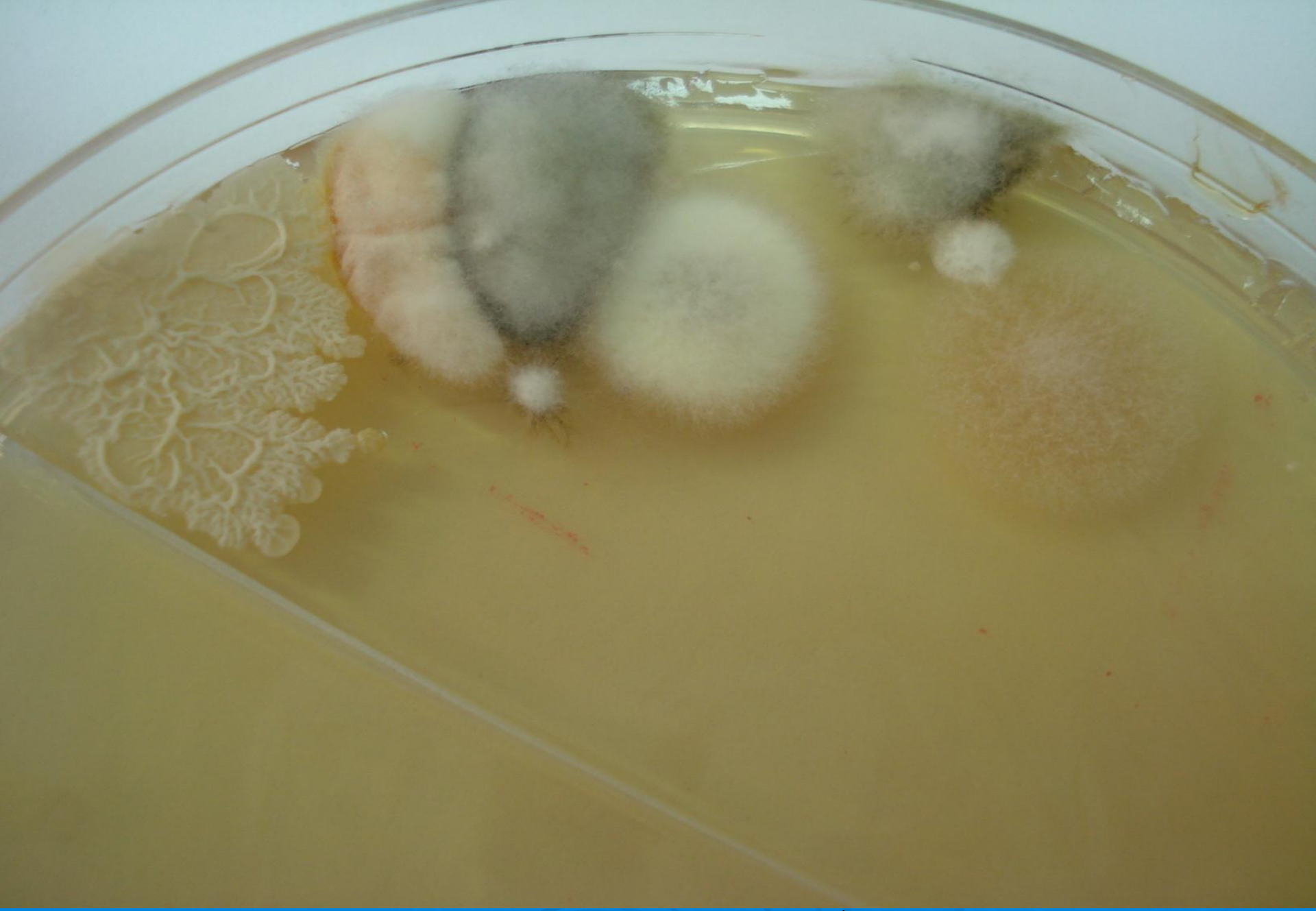


Figure : revealed a colony of the mold *Aspergillus* species

revealed different *Aspergillus* species colonies

shows colonies of *Pseudomonas aeruginosa* (oxidase positive),

circular colonies of *Escherichia coli* which isolated from dust sample



Observe that this plate support fungi growth and inhibit most of bacteria.

The results of the studied pollens reflect a wet - moist climate as indicated by the pollen grains. Such findings may give good evidence of the regional dust storms that originated in far away places as shown by the pine pollens, as they could be from northern Syria, Turkey or transported from the countries near to Iraq which have the same climate. The allergens commonly associated with dust storms include fungal spores, plant and grass pollens, and organic detritus represent an agricultural area pollens grains. Some of the fungi & algae may grown, increasing in soil and transportation with regional dust storms that carrying them. The highest values of isolates regarding the bacterial and fungal etiology were among the late spring season months and early summer season due to increased dust storms incidence.

Conclusions

The present study has given rise to the following conclusions:

1- The results of particle size analyses indicated that the main texture of most dust samples were sandy clayey silt, and to less extent clayey sandy silt, that depend on the energy and velocity of the wind from the regional dust storm which carries these grains. Also, the result of roundness of quartz grain reflects that they were transported over long distances.

2- The studied pollens reflect a wet - moist climate as indicated by the pollen grains. Such results may give good evidence of the regional dust storms that originated in faraway places as shown by the pine pollens that have sacs to keep pollen afloat and carried to great distances by the wind, as it could be from northern Syria , Turkey or transported from the countries near to Iraq which have the same climate. The allergens commonly associated with dust storms include fungal spores, plant and grass pollens, and organic detritus represent an agricultural area pollens grains. Some of the fungi & algae may grow, increasing in soil and transportation with regional dust storms which carrying them.

3- Regarding the bacterial isolates; Bacillus species were more common than others, followed by E.coli, S.pneumoniae, E.cloacae, S.epidermidis, P.aeruginosa, equal values is shared between P.mirabilis and K.pneumoniae, least value reported by P.vulgaris.

4 -Regarding the fungal isolates; Aspergillus species was the common, followed by C.albicans.

5-Regarding the viral etiology; there is no any viral isolate among the work results.

6- The highest values of isolates regarding the bacterial and fungal etiology were among the late spring season months and early summer season due to increased dust storms incidence.

7- During the strong dust storm affected Baghdad, and other Iraqi countries, reports from the Iraqi ministry of health and statistical analyses that have been done by researchers for many cases in many hospitals in Baghdad and the governorates indicated that many people were taken to hospitals after sustaining breathing problems ,asthma, bronchitis and lung diseases.


Thank You
Babylon Iraq