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ALGAL FLORA OF AIN HELWAN
II. THE SOIL ALGAE

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Abstract

Seasonal soil samples were collected, from soils on both sides of the spring passage, during the period of April 2004 to January 2005 and physico-chemical analyses have been performed for investigation. Isolation and identification of the different algal species were carried out. Concerning the physical soil characteristics, fluctuations of environmental temperature were seasonally recorded which ranged 15 - 44 ºC, pH values ranged from slightly acidic to moderately alkaline (6.5 – 8.6) and soil moisture content ranged 20.3- 30.6%. Seasonal fluctuations in chemical soil characteristics were recorded (anions, cations and micronutrients). The total identified algae in the soil samples were 86 genera and 165 species belonging to four algal divisions; Cyanobacteria (98 species), Chlorophyta (34 species), Bacillariophyta (32 species) and only one species belonging to Chrysophyta. Autumn soil sample recorded the maximum number of algal population followed in descending order by spring, summer, and winter soil samples. It seemed that the diversity of algal community in soil samples was mainly correlated with some physico-chemical characteristics of the soil samples.

Key Words: Ain Helwan, Physico-chemical analyses, Soil algal flora.

Introduction

Soil photoautotrophic algae are significant component of many terrestrial ecosystems. Many algae inhabiting soils play an important role in improving the fertility and texture of the soil and any change in the quality of soil will exert a certain effect on its algal population.

The isolation and identification of soil algae have been studied worldwide including Antarctic, Tropics and Desert regions (Curl and Becker, 1970; Shields and Durell, 1964; Friedman *et al*., 1967).

In Egypt, soil algal flora has been investigated by many authors. Most of their studies concerned with algal populations inhabiting cultivated soils in different localities (El-Ayouty and Ayyad, 1972; Abou El-Kheir and Mekky, 1987; Kobbia and Shabana, 1988; El-Gamal, 1990; Kobbia *et al*., 1991; Atia, 1993; Ahmed, 1994; El-Sheekh *et al*., 1998; Hifney, 1998), while few studies were delt with soil algal flora of the desert habitats (Hamouda, 1981; Salama and Kobbia, 1982; El-Otify and Mahalel, 2000).

Helwan area since long time was known by its natural worm springs which have different therapeutic effects. Algal flora of these springs were studied by Abou-El Kheir and Mekky, 1986; Hamed, 1995; El-Gamal and Salah El Din, 1999 and recently by Shanab, 2006 (in press), but algal flora of the soil on both sides of the spring passage was longtime neglected. So the main objective of this investigation was to study the seasonal algal vegetation and the physico-chemical

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characteristics of the soil extended on both sides of the water passage of Ain Helwan worm spring.

Material and Methods

1. Collection of Soil samples

Soil samples were seasonally collected from the soil (at depth 1-3 cm) from both sides of the water passage (site 3) of the spring. Each soil sample was air dried, sieved through mesh number 30. Each of the fine granulated soil samples was stored in refrigerator in clean glass bottle and marked S1 (spring), S2 (summer), S3 (autumn) and S4 (winter). Each soil sample was divided into two parts:

The 1^{st} part was used for physico-chemical analyses.

The 2^{nd} part of the soil was used for algal isolation and identification.

2. Physical parameters

Soil samples were used for the determination of the following physical analyses:

a- pH values were carried out in the laboratory Using soil suspension (1 g / 100 mL dist. H_2O, stirred regularly for 20-30 min) and measured by digital pH meter (ORION) model 230 A portable pH/ISE Meter Instruction Manual.

b- Light intensities received by the soil surfaces were measured *in situ* using LT Lutron Lx-101 digital Lux Meter Operation Manual Digital Lux Meter.

c- Air temperatures were measured *in situ* using thermometer.

d- Moisture content of the soil was estimated by oven drying (at 100 ºC for 3 hrs.) of an air dried known weight of each soil sample.

3. Chemical analyses

Different methods of chemical analysis were performed for soil samples using soil extract (at 1:5 wt/vol). Soluble anions, cations, macro- and micronutrients and heavy metals (Cu, Ni, Zn, Co, Cd and Pb) were also measured according to Doeck and Tracy (1956), Jackson (1960), (1977), Boyed (1984), and APHA (1985).

4. Isolation of soil algae

Isolation of the soil algae which might be persisting in the form of spores, hormogonia, akinetes or any other perennating stages were carried out using the moist plate method recommended by Jurgensen and Davey (1968).

One gram of each soil sample was mixed with 99 mL of distilled water and then shaked for 2 hrs. Four replicate Petri-dishes (9 cm diameter) were inoculated each with 1 mL of the soil extract and 20 mL of the molten nutritive medium (45 ºC) were added. Incubate the Petri-dishes at 30 ± 1 ºC for prokaryotic algae and at 20 ± 1 ºC for eukaryotic ones, both were incubated at light intensity of 3000-4000 Lux during 16/8 hrs light/dark cycles.

For isolation of Cyanobacteria, the medium of Rippka and Herdman (1993) was used, while Chu 10 medium (Chu, 1942) was used for isolation of diatoms and Bold's basal medium was utilized for eukaryotic and green algae (Bischoff and Bold, 1963).

5. Algal identification and Photography

The microscopically examined algal species were photographically recorded using Nikon Labo-Photo (AFX-II) microscope combined with camera (Nikon Fx-35, Japan). Identification of the algal species were carried out according to Desikachary (1959), Bourrelly (1968, 1970 and 1972), Prescott (1978 and 1982), Foged (1980) and Cox (1996). Most photos were magnified by (x 400) except otherwise cited in the plate..

Results and Discussion

The population density and distribution of soil algae in different habitats were controlled by various environmental factors (not to any specific one) and correlated with edaphic factors, since each taxon varied independently of others (Metting, 1981, Davey and Rothery 1993, El-Otify and Mahalel, 2000; Abdel Rahman *et al*, 2004).

Physico-chemical soil characteristics during the period of study, illustrated in Table (1), revealed that the seasonal air temperatures ranged 15 – 44 ºC, pH values ranged 6.5 – 8.6, moisture content valued 20.3 – 30.6 % and light intensities received by the soil surface ranged 26.4–115 Klux and values of anions, cations, macro- and micronutrients were seasonally fluctuated.

The algal biomass and distribution could be mainly correlated with alteration in soil temperature. Maximum algal flora was obtained during autumn season (S3) which was characterized by its optimum temperature (30 ºC) as illustrated in Tables 2 and 3. These results were in harmony with the findings of Trainer (1962), who suggested that soil algae are able to tolerate high temperatures under dry conditions, but very high ones may be lethal.

The pH values of the investigated soils were slightly acidic to moderately alkaline during the period of study. Shields and Durell (1964) as well as Starks *et al*. (1982), reported that neutral and alkaline soils are more favourable for the development of Cyanobacteria while Chlorophyta was better represented in neutral to slightly acidic soils. These were in conformity with the obtained results where Cyanobacteria dominated in autumn and spring soil samples (S3 and S1) and Chlorophyta grow well in summer and winter seasons (S2 and S4).

Soil algae grow better in partially dry soil (30-60%), while soil moisture exceeding 75-100 % of water holding capacity resulting in high growth of soil protozoa and nematoda which fed on algae and consequently a destruction and lysis of soil algae occurs. All the seasonal soil samples in this study were considered as dry soils due to their moisture contents (20.3-30.6 %) which positively correlated with seasonal algal growths (S3 > S1 > S2 > S4). It was reported that seasonal succession,which occur in aquatic systems, is not apparent in soil (Hunt *et al*., 1979) where seasonal changes in soil algal vegetation are generally quantitative due to fluctuation in the availability of water, while species composition remain constant allover the year (Metting, 1981).

Table (1): Seasonal physico-chemical analyses of soil samples (Site 3) of Ain Helwan during 2004 –2005.

Parameters		Soil Samples			
		S1 (Spring)	S2 (Summer)	S3 (Autumn)	S4 (Winter)
Physical Analysis	Temperature (ºC)	37	44	30	15
	pH	8.6	6.5	7.77	6.5
	Light intensity (klux)	60	115	46.3	26.4
	Moisture content (%)	28.0	25.2	30.6	20.3
Chemical Analysis	**Anions (mg/mL)**				
	PO_4-P	0.040	0.186	0.920	0.155
	NH_4-N	0.235	0.114	0.020	0.065
	NO_3-N	0.0172	0.008	0.0005	0.007
	SiO_3^{-2}	0.019	0.092	0.084	0.015
	Cl^-	15.265	1.892	22.038	20.661
	SO_4^{--}	10.291	3.888	8.040	12.028
	CO_3^{--}	0.00	0.00	0.00	0.00
	HCO_3^-	0.994	0.293	0.836	0.915
	Cations (mg/mL)				
	Ca^{2+}	2.060	3.95	12.44	16.98
	Mg^{2+}	1.309	2.11	6.8	9.14
	Na^+	10.267	7.73	60.76	58.28
	K^+	0.176	0.12	0.20	0.36
	Macro and Microelements (µg/mL)				
	N	29.7	8.20	5.50	38.60
	Fe	47.96	49.96	30.60	28.34
	Mn	22.00	16.62	16.81	16.62
	P	11.27	17.81	4.33	1.19
	Si	1.93	3.14	3.32	5.70
	Zn	0.009	0.24	0.02	0.04
	Pb	0.08	0.22	0.13	0.01
	Cu	0.05	0.04	0.01	0.16
	Ni	0.21	0.00	0.00	0.45
	Co	0.00	0.00	0.00	0.00
	Cd	0.00	0.00	0.00	0.00

The total algal flora recorded during the period of study was 86 genera including 165 species belonging to the four algal divisions; Cyanobacteria, Chlorophyta, Bacillariophyta and Chrysophyta as presented in Table (2) and some of them were illustrated in Plate (I). These results were in accordance with the findings of Metting (1981); Kobbia and Shabana (1988); Ahmed (1994), who reported that members of Cyanobacteria, Chlorophyta and Bacillariophyta are the main constituents of soil algal flora.

Table (2): Seasonal algal composition of the soil samples during 2004-2005.

Algal Species	Seasonal Soil Samples			
	S1 (Spring)	S2 (Summer)	S3 (Autumn)	S4 (Winter)
Cyanobacteria				
***Alternantia geitleri* Schiller**	—	—	—	+
***Anabaena iyengari* Bharad**	—	—	—	+
***Anabaena spiroides* Klebahn**	+	+	—	—
***Aphanothece caldariorum* Richter #**	+	+	+	+
***Aphanothece castagnei* (de Bréb.) Rabenhorst #**	+	+	+	+
***Aphanothece elabens* (de Bréb.) Elenkin #**	+	+	+	+
***Aphanothece nidulans* Richter**	+	—	+	+
***Aphanothece elachista* (West and West) Starmich**	+	+	+	—
***Aphanothece gelatinosa* (Henn.) Lemmermann**	+	+	—	+
***Aphanocapsa elachista* var. planctonica G.M. Smith**	—	+	—	—
***Borzia trilocularis* Cohn**	+	—	—	—
***Chroococcus limneticus* Lemmermann**	—	+	+	—
***Chroococcus minor* (Kütz.) Naegeli**	+	—	+	—
***Chroococcus turgidus* (Kütz.) Naegeli**	—	+	+	—
***Cyanoptyche gloeocystis* Pascher fo. minor Starmach**	—	—	—	+
***Dactylococcopsis acicularis* Lemmermann #**	+	+	+	+
***Dactylococcopsis raphidioides* Hansgirg**	+	—	—	—
***Dactylococcopsis fascicularis* Lemmermann**	—	+	+	+
***Desmocarpa kerneri* Hansgirg**	+	—	—	—
***Gomphosphaeria aponina* (Umger.) Lemmermann**	+	+	—	—
***Gomphosphaeria naegeliana* (Umger.) Lemmermann**	—	—	+	—
***Isocystis messanensis* Borzi**	+	—	—	—
***Johannesbaptistia pellucida* (Dickie) Taylor**	—	+	—	—
***Lithococcus schizodicwarmomum* Copeland**	+	—	—	—
***Lyngbya turidum* Gomont #**	+	+	+	+
***Lyngbya lucidum* Kütz.**	+	+	+	—
***Lyngbya putealis* Montague #**	+	+	+	+
***Lyngbya lagerheimii* (Moebius) Gomont #**	+	+	+	+
***Lyngbya perelegans* Lemmermann #**	+	+	+	+
***Lyngbya autumnale* (Ag.) Gomont**	+	+	—	—
***Lyngbya valderianum* Gomont #**	+	+	+	+
***Lyngbya bipunctata* Lemmermann**	+	+	+	—
***Lyngbya taylorii* Drouet and Strickland**	+	—	—	—
***Lyngbya limnetica* Lemm.**	+	+	+	—
***Lyngbya birgei* G.M.Smith**	—	+	+	—
***Lyngbya favosa* Bory**	—	+	—	—
***Lyngbya aerugineo-caerulea* (Kütz.) Gomont**	—	+	+	—

***Lyngbya major* Meneghini**	—	—	+	—
***Lyngbya tenue* Gomont**	+	+	+	
Microcoleus acutissmus Gomont Gardner	—	+	+	—
Microcoleus vaginatus (Vaucher)	+	—	+	+
***Microcystis aeruginosa* (Küetz.) Kuetzing**	+	+	—	—
***Microcystis biformis* (A. Br.) Rabenhorst**	+	—	—	—
***Microcystis elabens* var. minor Nygaard**	—	—	—	+
***Microcystis elachista* (West and West) Starmach**	+	—	+	—
***Microcystis viridis* (A. Braun) Lemmermann**	—	+	+	—
***Microcystis wesenbergii* fo. polymorpha (G.S. West) Kuetz. emend Elenkin**	—	—	+	—
Monocilia viridis Gerneck	—	—	+	—
***Myxosarcina dubia* Ercegovic #**	+	+	+	+
***Myxosarcina spectabilis* Geitler and Ruttner**	—	—	+	—
***Nodularia spumigena* Mertens**	—	—	—	+
***Nostoc linckia* (Roth) Bornet**	—	—	+	—
***Nostoc paludosum* Kütz.**	+	—	+	+
***Oscillatoria acuminata* Gomont**	+	+	+	—
***Oscillatoria okeni* Agardh**	+	+	+	—
Oscillatoria putealis	+	—	—	—
***Oscillatoria janthiphora* (Fior. Mazz.) Gomont**	+	—	+	—
***Oscillatoria hamelii* Frémy**	+	+	+	—
***Oscillatoria chalybea* Mertens**	+	+	+	—
***Oscillatoria limnetica* Lemmermann**	—	+	+	—
***Oscillatoria rubescens* De Cand.**	—	+	+	—
***Oscillatoria platensis* (Nordstedt) Geitler**	+	+	—	—
***Oscillatoria agardhii* Gomont**	—	+	—	—
***Oscillatoria tenuis* C.A. Agardh**	+	+	+	—
Oscillatoria birgie	—	—	+	—
***Oscillatoria bormetii* Zukal**	+	—	—	—
***Oscillatoria limosa* (Roth) C.A. Agardh.**	—	—	+	—
Oscillatoria magnifolia	—	—	+	—
***Oscillatoria granulata*Gardner**	—	—	+	—
***Oscillatoria margaritifera* Kütz.**	—	—	+	—
***Oscillatoria lacustris* (Klebahn) Geitler**	+	—	+	—
***Oscillatoria sancta* (Küetz.) Gomont**	—	—	+	—
***Phormidium mucicola* Naumann**	—	—	+	—
***Phormidium retzii* (C.A. Agardh) Gomont**	—	+	+	—
***Phormidium tenue* (Menegh.) Gomont**	—	—	+	—
***Phormidium ambiguum* Gomont**	+	+	—	+
***Pilgeria brasiliensis* Schmidle**	—	—	+	—
***Plectonema notatum* Schmidle #**	+	+	+	+
***Plectonema nostocorum* Bornet #**	+	+	+	+
***Plectonema malayense* Biswas**	+	—	—	—
***Plectonema purpureum* Gomont**	—	—	—	+
Pseudanabaena catenata Lauterb.	—	+	—	—
***Raphidiopsis curvata* Fritsch**	—	—	+	+
***Schizothrix friezii* Gomont**	—	+	—	+
***Schizothrix thelephoroides* (Montagne) Gomont**	—	—	—	+
***Schizothrix lacustris* A. Braun**	—	+	—	+
***Schizothrix muelleri* Naegeli**	+	—	—	+
***Spirulina nordstedtii* Gomont**	—	—	—	+
***Spirulina laxa* G.M. Smith**	—	—	—	+
***Spirulina major* Kütz.**	+	—	—	—
***Spirulina subsalsa* Oersted**	+	—	—	—
***Stigonema mamillosum* (Lyngb) C.A. Agardh**	+	—	—	—
***Stigonema minutum* (Agardh) Hassall**	+	—	—	—

***Synechococcus cedrorum* Sauvageau**	+	—	—	—
***Synechococcus vantieghemi* Pringsheim**	+	+	+	—
***Synechocystis aquatilis* Sauvageau**	+	+	+	—
***Symploca muscorum* (C.A.Ag.) Gomont**	+	+	+	—
***Tubiella elenkinii* Hollerbach.**	+	+	—	—
Chlorophyta				
***Actinastrum hantzschii* Lagerheilm**	—	+	—	+
***Ankistrodesmus falcatus* (Corda) Ralfs**	+	—	—	—
***Chlorococcum humicola* (Naegeli) Rabenhorst**	—	—	—	+
***Chlorella vulgaris* Beyerinck**	+	+	—	+
***Chlamydomonas debaryana* Gorosch.**	+	—	—	+
***Chlamydomonas sanguinea* Lag. Zygospore**	—	—	+	+
***Chlamydomonas polypyrenoideum* Prescott**	+	—	—	—
***Chlamydomonas globosa* Snow**	+	—	—	—
***Chloronomala palmelloides* Mitra**	—	+	—	+
***Chlorosarcina consociate* (Klebs) G.M. Smith**	—	—	—	+
***Crucigenia tetrapedia* (Kirchner) West and West #**	+	+	+	+
***Ctenocladus circinnatus* Borzi**	+	—	—	—
***Dactylococcus infusionum* Naegeli**	—	+	+	+
***Desmococcus viridis* (Agardh) Brand**	—	—	—	+
***Dictyosphaerium pulchellum* Wood**	—	—	+	—
***Kirchneriella elongata*G.M. Smith**	+	—	+	+
***Kirchneriella lunaris* (Kirch.) Moebius #**	+	+	+	+
***Kirchneriella contorta* (Schmidle) Bohlin**	—	—	—	+
***Mougeotia floridama* Trans**	—	+	—	—
***Mougeotia scalaris* Hassall**	—	+	+	—
***Mougeotiopsis calospora* Palla**	—	+	—	—
***Muriella terrestris* Petersen**	+	+	—	+
***Murielliopsis pyrenigera* Reisigl**	—	+	—	—
***Neochloris aquatica* Starr**	—	+	—	+
***Oedogonium hazenii* Lewis**	—	—	—	+
***Planktosphaerella terrestris* Reisigl**	—	—	—	+
Pseudochlorococcum typicum Archibald	+	+	—	—
***Trochiscia obtusa* (Reinsch) Hansgirg**	—	+	+	—
***Tetraedron pentaedricum* West and West**	—	—	+	—
***Tetraedron minimum* (A. Braun) Hansgirg**	—	—	+	—
***Tetracus ilsteri* Skuja**	+	—	—	—
***Ulothrix subtilissima* Rabenhorst**	—	+	+	—
***Ulothrix variabilis* Kütz.**	+	+	—	—
***Ulothrix tenuissina* Kütz.**	—	+	—	—
Bacillariophyta				
***Actinocyclus sp*. Ehrenberg #**	+	+	+	+
***Achnanthes exigua* Grunow**	—	—	+	—
***Achnanthes pseudoswazi* Carter**	—	—	+	—
***Amphipleura pellucida* (Küetz.) Kuetzing**				
***Amphora veneta* Kütz.**	—	+	—	—
***Aneumastus pseudotusculus* (Ehrenberg) Mann and Stickle**	—	—	+	—
***Biddulphia laevis* Ehrenberg**	+	—	—	—
***Coscinodiscus lacustris* Grunow #**	+	+	+	+
***Cocconeis pediculus* Ehrenberg**	—	—	+	—
***Denticula elegans* Kütz.**	+	—	+	—
***Denticula Kuetzingii* Grunow**	—	—	+	—
***Denticula tenuis* Kuetzing**	—	—	+	—

***Diatoma hiemale* var. mesodon (Ehrbg.) Grunow**	—	—	+	—
***Diatomella hustedtii* Manguin**	+	+	—	—
***Diploneis ovalis* (Hilse) Cleve**	—	+	—	—
***Fragillaria capucina* Desmazières**	—	—	+	+
***Gomphonema clevei* Fricke**	—	—	+	—
***Gyrosigma acuminatum* (Kuetzing) Rabenhorst**	—	+	—	—
***Hantzchia virgata* (Roper) Grunow**	—	—	+	—
***Hydrosera triquetra* Wall.**	+	—	—	—
***Mastogloia smithii* Thwaites**	—	—	+	—
***Melosira dickiei* (Thwaites) Kütz.**				
***Navicula schoenfeldii* Hustedt**	—	—	+	—
***Navicula menisculus* Schumann**				
***Neidium magellanicum* Cleve**	+	+	—	—
***Neidium iridis* (Ehrenberg) Cleve**	—	+	—	—
***Nitzschia recta* Hantzsh ex Rabenhorst**	—	—	+	—
***Nitzschia intermedia* Hantzsch**				
***Nitzschia ovalis* Arnott**				
***Opephora martyi* Herib.**	—	—	+	+
***Pinnularia sudetica* (Hilse) Peragallo**	—	—	+	—
***Stephanodiscus miagarae* Fhr.**	+	—	+	+
***Surirella ovalis* Bréb**	+	+	—	+
***Synedra acus* Kütz.**	—	—	+	—
Chrysophyta				
***Chrysamoeba radians* Klebs**	—	—	—	+

+ = presence of algal species; — = absence of algal species; # = Persisting species in the four seasonal samples.

Cyanobacteria recorded the greatest number of identified algal genera and species allover the year (98 species and 33 genera) which represented 59.39 % and 38.37 % of the total identified algae/year, with maximum production in spring (S1) and autumn (S3).

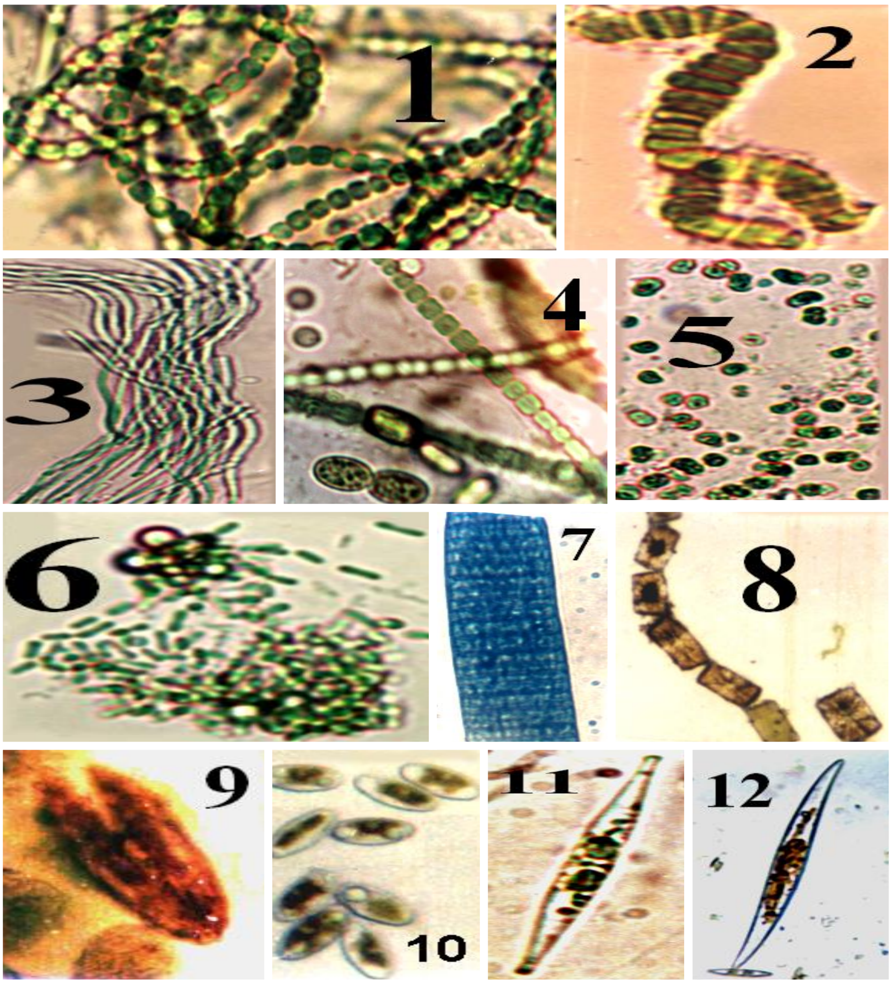
Chlorophyta subdominated Cyanobacteria with 34 species and 25 genera represented 29.07 % and 20.61 % respectively and it flourished more in summer and winter than in spring and autumn, followed by Bacillariophyta with 32 species and 27 genera represented 19.39 % and 31.46 % with greater production in autumn season (S3). The least number of identified soil algal flora was (only one species and one genus) belonging to division Chrysophyta and represented 0.61 % and 1.16 % of the total soil algae/year as shown in Tables 2 and 3.

The dominance of Cyanobacteria in all seasonal soil samples, of the present study, might be attributed to the tolerance of its prokaryotic cells and its adaptability to survive under variable, even adverse conditions (Shields and Durell, 1964; Brock, 1973). Such observation justified the findings of Kobbia and Shabana (1988), Ahmed (1994), Abdel Rahman *et al*. (2004) and Zancan *et al*. (2006).

In accordance with these results members of Cyanobacteria were the most abundant individuals in desert soils as in the Western Libyan Desert of Egypt (Salama and Kobbia, 1982), Saudia Arabia (Arif, 1992), Wadi Allaqi Biosphere Reserve Area in the south eastern desert of Egypt (El-Otify and Mahalel, 2000).

Plate I

Certain species of Cyanobacteria, Bacillariophyta and Chlorophyta inhabiting soil of Ain Helwan (Site 3) at different seasons during 2004-2005.



<u>1-7 Cyanobacteria</u>

1. *Nostoc linckia* (Roth) Bornet and Flah **2. *Nodularia harveyana* Thuret**

3. *Microcoelus vaginatus* (Vaucher) Gomont **4. *Anabaena Iyengari* Bharad.**

5. *Microcystis aeruginosa* (Kütz.) Kuetzing **6. *Aphanothece caldariorum* Richter**

7. *Oscillatoria limosa* C. A. Agardh

<u>8-12 Bacillariophyta</u>

8. *Buddulphia laevis* Ehrenberg **9. *Neidium magellanicum* Cleve**

10. *Amphora veneta* Kütz. **11. *Nitzschia recta* Hantzsch ex Rabenhorst**

12. *Gyrosigma acuminatum* (Kuetz.) Rabenhorst

<u>13-15 Chlorophyta</u>

13. *Chlamydomonas debaryana* Gorosch. **14. *Chlorella vulgaris* Beijer**

15. *Pseudochlorococcum typicum* Archibald

Table (3): Seasonal isolated algal genera and species belonging to different divisions from soil samples (Site 3) during 2004-2005.

Algal Taxa	Water Samples					
	S1 Spring	S2 Summer	S3 Autumn	S4 Winter	Total algae per year	% per total algae
Cyanobacteria						
Species	56	50	58	31	**98**	**59.39**
Genera	24	20	18	16	**33**	**38.37**
Chlorophyta						
Species	13	17	11	17	**34**	**29.07**
Genera	10	14	9	14	**25**	**20.61**
Bacillariophyta						
Species	9	9	20	6	**32**	**19.39**
Genera	9	8	17	6	**27**	**31.40**
Chrysophyta						
Species	—	—	—	1	**1**	**0.61**
Genera	—	—	—	1	**1**	**1.16**
Seasonal Isolated Algal Species	**78**	**76**	**89**	**55**	**165**	**—**
Seasonal Isolated Algal Genera	**43**	**42**	**44**	**37**	**86**	**—**

It was reported by many authers that the greatest numbers of Diatoms were recorded in alkaline pH, high moisture, bicarbonate and silicate contents (Bock, 1963; Kobbia and Shabana, 1988). These factors were presented and characterized the autumn soil sample (S3) in this study where Bacillariophyta (20 species and 17 genera) flourished and subdominated the Cyanobacteria (58 species and 18 genera).

Chlorophyta (in this study) grow more in Summer and Winter soil samples than in spring and autumn ones, these findings was in harmony with those obtained by Starks *et al*. (1982), Arif (1992) and Kobbia *et al*. (1993), who reported that members of Chlorophyta were better represented in neutral or slightly acidic soils containing suitable levels of phosphate and nitrate contents and can tolerate variable seasonal temperatures and light intencities.

The maximum production of algal flora in autumn soil sample (89 species and 44 genera) characterized by favourable physical factors for the growth and maximum production of all algal taxa belonging to the three main algal divisions constituting the soil flora. These results were confirmed by the marked decrease in most of the anions, cations and micronutients (NH_4-N, NO_3-N, SiO_3, N, Fe, P, Zn and Cu) which were consumed by the great algal population in this season. These findings were in harmony with the results obtained by Brock (1967), Kobbia and El-Batanouny (1975), Shields and Durell (1964), Salama and Kobbia (1982), Kobbia and Shabana (1988) and Kobbia *et al*. (1995).

On the other hand the adverse physical soil characteristics in Summer (S2) and the fluctuations in its chemical properties, drastically inhibited algal growth especially members of Bacillariophyta. However, the winter soil sample (S4) with its low moisture content, low air temperature, slightly acidic pH and minimum seasonal light intensity received by the soil surface, led to a marked retardation of algal growth especially to Bacillariophyta. These results were justified by the observed increase in the values of most soil chemical analyses.On the contrary these winter characteristics might be suitable for the occurrence of Chrysophyta (one species and one genus).

In all soil samples certain algal species, belonging to the three main divisions constituting the soil algal flora, could withstand the fluctuated physico-chemical soil characteristics and persisted allover the year. Most of these resistant species were belonged to Cyanobacteria (12 species), Chlorophyta (2 species) and Bacillariophyta (2 species) recorded in Table (2) and marked (#),

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الفلورا الطحلبية لعين حلوان
2- طحالب التربة المحيطة بمجرى العين

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تم جمع العينات الموسمية للتربة على جانبى مجرى العين خلال مدة الدراسه من أبريل 2004 حتى يناير 2005 و تم اجراء التحاليل الفيزيقوكيميائية لكل عينه, كما تم عزل و التعرف على الأنواع الطحلبيه المختلفه. بالنسبه لدرجات حرارة الجو التى تأثربها سطح التربه فقد تراوحت بين 15-44 °م خلال فترة الدراسة، و الأس الهيدروجينى للتربه تراوح بين تربه قليلة الحامضيه إلى متوسطه القاعديه (6.5 – 8.6). ومحتوى التربة من الرطوبة تراوح بين 20,3-30,6 أما الخواص الكيميائيه للتربه (الأيونات, الكاتيونات, العناصر الكبرى و الصغرى) فكانت قيمها متفاوته و متذبذبه فى الفصول المختلفه. العدد الكلى للفلورا الطحلبية التى تم التعرف عليها فى عينات التربه شمل 86 جنس و 165 نوع منتمية الى أربعه أقسام طحلبية هى السيانوبكتريا, الطحالب الخضراء, الدياتومات و الطحالب البنية-الذهبية. كان العدد الأكبر من الأنواع الطحلبية ممثلا فى السيانوبكتريا 98 نوع (33 جنس) تليها الطحالب الخضراء 34 نوع (25 جنس) فالدياتومات ممثلا فى 32 نوع (و27 جنس) ثم الطحالب البنيه-الذهبيه التى شملت أقل الأجناس و الأنواع الطحلبية التى تم التعرف عليها فى عينات التربه (شملت نوع واحد و جنس واحد فقط). شملت عينة التربة فى فصل الخريفٍ على أكبر عدد من الفلورا الطحلبية تنتمى إلى السيانوبكتريا , الدياتومات و الطحالب الخضراء, تليها عينة الربيع فالصيف وتأتى عينة الشتاء فى المؤخرة حيث تم رصد أقل عدد من الطحالب فيها. ظهر واضحا ازدهار السيانوبكتريا وسيادتها فى كل الفصول تليها الطحالب الخضراء ثم الدياتومات والتى ظهر واضحا نموها المتميز خلال فصل الخريف حيث احتلت المركز الثانى بدلا من الطحالب الخضراء فى هذا الفصل. تم التعرف على جنس واحد ونوع واحد من الطحالب البنية –الذهبية فى عينة تربة الشتاء. و لقد ظهر من نتائج هذه الدراسه وجود علاقة بين التركيب النوعى والكمى للفلورا الطحلبية وبعض الخصائص الفيزيقوكيميائية لعينات التربة .