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SURVEY OF SOIL ALGAL FLORA OF SOME CULTIVATED SOILS IN BENI SUEF, EGYPT

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Abstract

The soil algal flora of some cultivated soils with different plants in addition to edaphic and physico-chemical characters of soils were studied at Beni Suef Governorate. A total of 117 species were identified, 52 of them belonging to Cyanophyta; 35 to Bacillariophyta; 27 to Chlorophyta; 2 to Euglenophyta and only one species of Xanthophyta. The cyanobacterial algae were more abundant being widely distributed at all the studied sites than the algal members. They represented 43% of the total algal population in all soil samples with predominance of *Oscillatoria amphibia* C.A. Agardh (2.95%); *O. granulata* (2.02%) and *O. angustissima* (1.75%).

Key words*:* Algae, Cultivated soils, Physico-chemical characters.

Introduction

Soil algae are present in all kinds of soils, both arable and virgin, in large amounts and in great diversity. These photosynthetic microorganisms, which are concentrated in the top few centimeters of the soil profile, are organized in a community structure that varies depending on soil type, farming methods and pesticide application (Berard *et al.*, 2004).

Soil habitats are the most important non-aqueous ecosystems for algae (Zenova *et al*., 1995). The activities of algae contribute to soil formation, to the stability of mature soils (Metting, 1981), and to the energy and matter fluxes in ecosystems (Kuzakhmetov, 1998). Another important aspect of soil algae is nitrogen fixation. Algae contribute to the nitrogen content of the soil through the process of biological nitrogen fixation (Goyal, 1997).

The study of microscopic algal flora of soil habitats has been stimulated by the assumption that any extra-terrestrial life which might exist probably develops under similar harsh conditions (Kobbia and Shabana, 1988). The isolation and identification of soil algae has been studied worldwide (Cameron and Devaney, 1970; Curl and Becker, 1970; Durrell, 1963). The importance of algae in soil has been discussed earlier (Lund, 1962; Schields and Durrell, 1964; Dommergues and Mangenot, 1970; Round, 1973). The Egyptian soil algal flora has been scarcely studied; El-Ayouty and Ayyad (1972) in a wheat field in the delta, Kobbia and El-Batanouny (1975) in Wadi El-Natroun; Salama and Kobbia (1982) in Lybian desert, Kobbia (1983) rhizosphere algae, Kobbia (1985) in

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gravel and limestone desert of Cairo-Suez road, Kobbia and Shabana (1988) in Bahariya Oasis, Ahmed (1994) in upper Egypt (Sohag) and Ibraheem (2003) in Wadi-Araba, eastern desert.

The present investigation is an attempt to survey the algal populations inhabiting cultivated and reclaimed soils in Beni Suef Governorate.

Materials and Methods

The study area and sampling:

Beni Suef governorate situated almost 120 Km south of Cairo (Figure 1). Seven study sites were selected and four samples were taken from different cultivated soils at Beni Suef and two samples from reclaimed soils and one from desert soil. Selection of these samples was based on the differences in the cultivated plants.

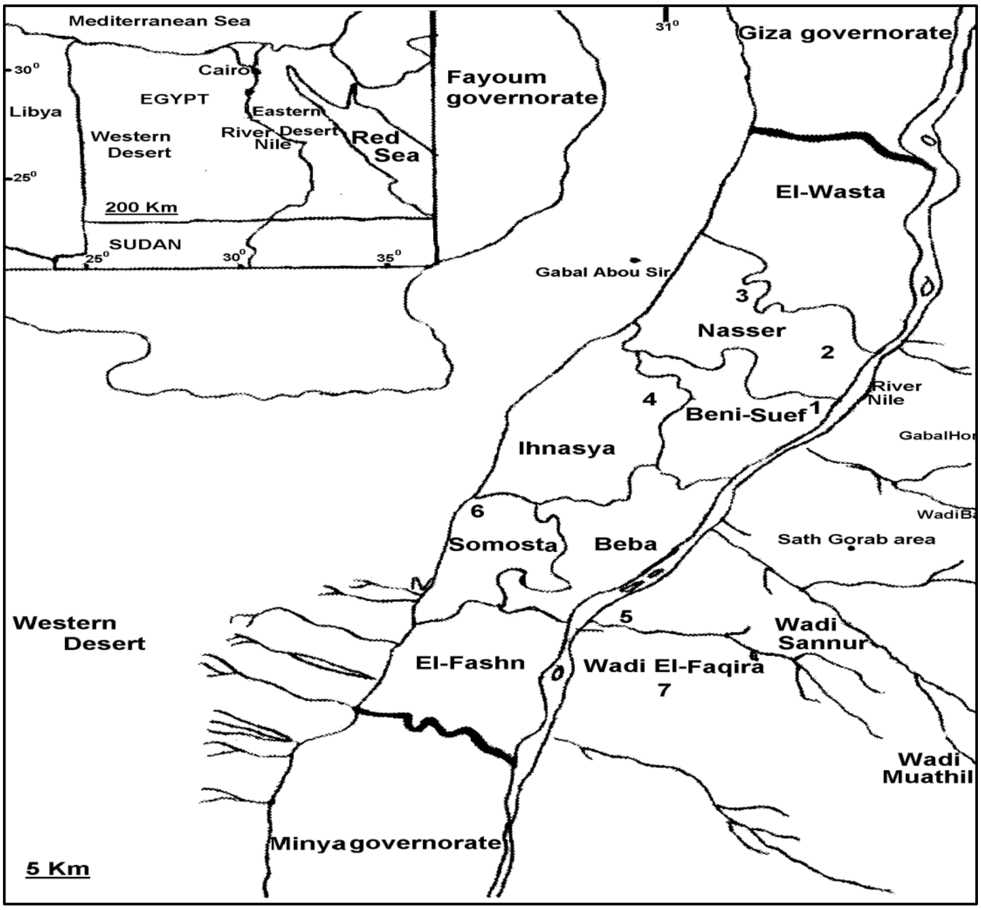

Figure (1): Map of Beni Suef Governorate showing the sampling sites

Each soil sample was a composite of four random samples from each site. The samples were collected only once during October 2004, under aseptic conditions following the method adopted by Salama and Kobbia (1982).

Soil samples were taken by cores (5cm diameter) from representative habitats at a depth of zero to 5 cm, then kept in pre-sterilized plastic bags and returned to the laboratory for analysis.

Chemical and physical analysis of soil samples:

Soil texture analysis was carried out using the sieving method in which the percentage of gravel, coarse and fine sand, silt and clay were estimated. The hygroscopic moisture content of the soil was estimated by oven drying air samples. Total organic matter was determined according to Jackson (1960).

Soil water extracts at 1:5 were prepared for determination of electric conductivity (EC) and soil pH. Conductivity was evaluated by a direct conductivity bridge (mmohs/cm). Soil PH was estimated using a glass electrode pH meter. The estimation of chloride was performed according to the method described by Jackson (1960). Bicarbonates were determined by titration with a standard acid using phenolphthaline and methyl orange as indicators. The versene titration method (Schwarzenback and Biederman, 1948) was employed for both calcium and magnesium determinations. Soluble silicon contents of soil samples were determined by gravimetric method according to APHA (1985). All other analysis was done according to Allen *et al*. (1974).

Isolation and culturing of algae:

For identification of live cells, 2.5gm aliquot of each sample was subsequently blended in 20 mL dist. water. Moist plate method recommended by Jurgensen and Davey (1968) was applied for the culturing of algae. One gram of each soil sample was placed in 99 mL of sterile water and then placed in a shaker for 15 min. Five replicate petri-dishes were inoculated each with 1 mL of the appropriate dilution and 25 mL of nutrient agar medium (45˚C) were added. Meyer's C medium incubated at 35 ± 1˚C was used for isolation of blue green algae. Allen's free nitrogen medium was applied for nitrogen fixing species (Allen and Stanier, 1968). The green algae were isolated in Beijrinck medium (Stein, 1966) at 20 ± 1˚C, Chu 10 medium was used for isolation of diatoms. All were incubated at 16/8 hr light/dark cycle with a light intensity of 3500-4500 lux. Soil suspension introduced into a flask containing sterile nutrient were also used for algal culturing (Bold, 1970).

The surveyed areas comprised the cultivated lands of the following plants:

1. Wheat (*Triticum vulgare*)
2. Onion (*Allium cepa*)
3. Potato (*Solanum tuberosum*)
4. Clover (*Trifolium alexandrinum*)
5. Guava (*Pisidium guava*) reclaimed land.

6. Barley (*Hordium vulgare*) reclaimed land.
7. Non cultivated soil arid.

Statistical analysis: Data were analyzed using SPSS program package version 11.

Results

Data in Table (1) show that the maximum moisture content of all soil samples was recorded at site 1 cultivated with wheat (38.3%) followed by site 2 cultivated with onion (36.6%), whereas site 7 (Non cultivated soil) and site (5) (cultivated with guava) were the lowest in moisture contents (19.5%) and (21.8%) respectively. Soil texture analysis showed that the percentage of gravel, coarse sand, fine sand, silt and clay fractions varied remarkably from one site to another. Site 7 (non cultivated soil) exhibited the highest percentages of gravel and coarse sand (28.4% and 35.3%, respectively). The highest percentage of fine sand was recorded at site 6 (35.7%) followed by site 5 (34.8%) (reclaimed soil cultivated with barely and guava, respectively). Site 1 exhibited the highest silt content (34.2%), while site 2 exhibited the highest clay content (25.3%). The pH in all the sites was slightly alkaline with its maximum (8.1) at sites 2, 3 and 4, whereas its lowest value (7.6) was recorded at site1.

Table (1): Average values of some physico-chemical characters of soils collected from different cultivated lands at Beni Suef Governorate during October 2004 (1. Beni-Suef; 2 and 3. Nasser; 4. Ihnasya; 5. Wadi Sannur; 6. Somosta; 7. Wadi El Faqira).

Samples / Soil Chemicals	1	2	3	4	5	6	7
Moisture content	38.3	36.6	29.5	24	21.8	23	19.5
Gravel %	21.7	13.6	17.4	8.5	11.5	10.6	28.4
Coarse sand %	13.5	17	18.5	18.4	32.6	31.8	35.3
Fine sand %	22	15.4	20.4	20.2	34.8	35.7	20.8
Silt %	34.2	21.2	24.3	19.9	9.6	10.3	6.8
Clay %	8.6	25.3	19.4	33	11.5	11.6	6.7
pH	7.6	8.1	8.1	8.1	7.8	7.7	8
EC ms/cm	1.2	0.9	0.75	1.1	1.05	0.95	3.5
Organic matter %	7.16	7.5	6.7	6.8	6.5	6.9	6.5
Silicon	4.2	4	3.8	4.5	5.6	5.8	6.1
CO_3	5.8	6.3	6.8	7.4	7.5	6.4	7
HCO_3	38	46	44	43	39	38.5	40
SO_4	12	10	11	9.5	13.5	13.2	15.2
Ca	12.5	11.4	9.5	11.8	9.5	12	18.5
Mg	2	3.1	1.6	2.3	2.6	3.3	6.5
Mn	0.09	1.1	0.9	1.2	1.4	1.5	2.3
Na	10.5	8.6	9.4	9	8.6	11.2	14.5
K	6.8	5.3	6	5.9	5.2	7.2	8.3
Cl	9	7.5	8.2	8.8	8.5	8.3	10.2

Data in Table (1) also show that all soil samples were characterized by high contents of organic matter. However, the maximum content of organic matter (7.5%) was detected at site 2, whereas sites 5 and 7 recorded the lowest value (6.5%). Site 7, 6 and 5 recorded the highest silicon content 6.1, 5.8 and 5.6% respectively, while the minimum content was found at site 3 (3.8%). The highest alkalinity (as HCO_3) was observed in soil cultivated with onion (site 2), while the lowest was recorded in soil cultivated with wheat (site 1). The highest carbonate content was recorded at site 5, while the lowest was in site 1. The non cultivated soil (site 7) recorded the highest percentages of Ca (18.5%); Mg (6.5%); Mn (2.3%); Na (14.5%); K (8.3%) and Cl (10.2%).

Algal distribution:

The major algal groups enumerated either by direct observation or by culture method include the blue green algae (Cyanobacteria), the green algae (Chlorophyta), diatoms (Bacillariophyta) the yellow green algae (Xanthophyta) and the euglenoids (Euglenophyta) in all the soil samples. The data in table 2 revealed that the total number of species recorded was 117; out of these 52 belongs to Cyanobacteria; 35 to Bacillariophyta; 27 to Chlorophyta; 2 Euglenophyta and only one to Xanthophyta.

Cyanobacteria algae frequently appeared constituting about (42.8%) of the total algal flora of all soil samples. The dominant species was *Oscillatoria amphibia* (2.95%); followed by *O. granulata* (2.02%), *O. angustissima* (1.75%), *Lyngbya aestuarii* (1.66%) and *L. limnetica* (1.56%). All the dominant species were filamentous oscillatorioid forms (Table 2). Diatoms followed the blue green algae with percentage occurrence of 32.1%. The dominant species of diatoms were *Melosira granulat*a; *Navicula cryptocephala* and *N. gracilis* (2.53, 2.21 and 2.02% respectively). Chlorophyta recorded 23.9% of the total isolates count. The dominant species of Chlorophyta were *Chlorella vulgaris* (3.32%); *Scenedesmus obliquus* (2.39%) and *S. bijuga* (1.66%). The occurrence of Euglenophyta was only 0.92% divided equally between *Euglena gracilis* and *Phacus longicauda*. Only one species of Xanthophyta (*Botrydium granulatum*) represented 0.18% of the total isolates count.

The reclaimed land cultivated with guava harboured the greatest number of species (79), representing 67.5% of all species recovered, followed by the soil cultivated with clover which harboured 77 species representing 65.8%. While the least number of species (59) was recorded in the reclaimed soil cultivated with barely. A different situation was monitored concerning the total number of algal isolates. The highest number of isolates (218) was recorded in site number 1 (soil cultivated with wheat) which represent 20.1% of the total count (Fig 2). Site 2 cultivated with onion harboured 207 isolates which represent 19.03% of the total number of isolates. The lowest number of isolates (90) was also recorded in the reclaimed soil cultivated with barley.

Site 1 cultivated with wheat recorded the highest number of Cyanophycean isolates (103) representing 22.1% of the total number of Cyanophycean isolates and the highest number of Chlorophycean isolates (55 spp.) which represent 21.2% of the Chlorophycean isolates. The highest number of diatoms isolates 79 spp. was recorded at site 2 cultivated with onion and represent 22.7% of the total diatom isolates. The Xanthophyta species was only recorded twice in sites 1 and 5.

Isolates recorded at site 1 were 218 comprising the five different algal groups. Cyanobacteria recorded 103 isolates representing 47% of the total isolates at site 1, followed by Bacillariophyta (58 isolates) representing 26%, Chlorophyta (55 isolates) representing 25%. Euglenophyta and Xanthophyta recorded one species each. The dominant species at site 1 were *Oscilattoria amphibia*, *Chlorella pyrenoidosa*, *Melosira granulate* and *Navicula cryptocephala*. They were all represented by 9 isolates.

Site 2 cultivated with onion recorded 348 isolates. Cyanobacteria and Bacillariophyta recorded equal numbers of isolates (79) which represent 38% each. Chlorophyta recorded 46 isolates representing 22% of the total isolates at site 2. Euglenophyta were represented by only 3 isolates. The dominant species were *Chlorella pyrenoidosa* (11 isolates), *Navicula gracilis* (9 isolates).

Site 3 cultivated with potato recorded only 125 isolates. Cyanophyta was represented by 58 isolates representing 46%, followed by Bacillariophyta (38 isolates representing 30%), and Chlorophyta (27 isolates representing 21%). Euglenophyta recorded only 2 isolates. The dominant species was *Oscilattoria amphibia* (6 isolates).

The number of isolates recorded at site 4 was 173, dominated by Cyanophyta (75 isolates representing 43%), followed by Chlorophyta (49 isolates representing 28%) and Bacillariophyta (47 isolates representing 27%). *Oscilattoria amphibia* and *O. angustissima* West and West were the dominant species (7 isolates each).

The total number of isolates in site 5 reached 175 spp. Cyanobacteria was represented by 66 isolates (37%), Bacillariophyta by 64 isolates (36%) and Chlorophyta by 44 (25%). Only one isolate of Xanthophyta was recorded. The dominant species was *Chlorella pyrenoidosa* (7 isolates).

Site 6 cultivated with barely recorded the lowest number of isolates (90 isolates). Cyanobacteria were the dominant group and accounted for 48% (43 isolates) followed by Bacillariophyta 33% (30 isolates) and Chlorophyta 18% (17 isolates). *Nodularia harvenyana* was the dominant species (4 isolates).The arid land (site 7) recorded 96 isolates. Again Cyanobacteria was the highest group of algae (43%) of the total count at site 7, followed by Bacillariophyta (33%) and Chlorophyta (22%).

Ranking the habitats by diversity index (H) is shown in figure (2), these were: site 6 (2.58) > site 5 (2.53) > site 4 (2.52) >site 7 (2.31) > site 2 (2.26) > site 3 (1.99) > site 1 (1.87).

Table (2): Number of isolates of the soil algal species and their relative distribution in soil samples collected from different sites at Beni Suef Governorate during October 2004.

Site / Algal species	1. Beni-Suef	2 . Nasser	3. Nasser	4. Ihnasya	5. Wadi Sannur	6. Somosta	7. Wadi El Faqira	Total number of species	Occurrence (%)
Cyanobacteria									
Anabaena acqualis Lemmermann	2	-	-	1	2	2	-	7	0.64
A. ambigua Rao, C.B. A Drwsh.	1	2	-	1	2	1	1	8	0.73
A. circinalis var. Macrospore (Wittr.) Detoni.	2	2	1	-	-	2	2	9	0.83
A. helicoidea Bernard.	-	1	2	-	-	-	-	3	0.27
A. spiroides Klebahn.	-	2	-	2	1	-	1	6	0.55
A. subtropica Gardner	1	-	1	2	-	1	-	5	0.46
A. variabilis kütz.	3	-	-	2	3	-	-	8	0.73
Aphanotheca microspora (Menegh.)	-	2	1	-	3	2	-	8	0.73
Aph. nodulans P. Richter	2	-	-	2	3	-	1	8	0.73
Aphanizomenon flos-aquae (L.) Ralf.	1	-	1	2	3	1	2	10	0.92
Calothrix contarenii Zanard.	1	3	2	3	-	-	1	10	0.92
C. scopularum Weberet Mohr.	-	2	1	-	2	2	2	9	0.83
C. parietina (Nageli) Thirret.	2	-	1	-	-	1	1	5	0.46
Chroococcus minor (kűtz.) Naegeli	4	2	-	-	-	-	1	7	0.64
Gloeocapsa aeruginosa kutzing	2	1	-	3	1	-	-	7	0.64
G. turgida (kütz) Hollerb.	-	2	3	-	2	2	-	9	0.83
Lyngbya aestuarii (Mert.) Liebmann	6	4	2	4	-	-	2	18	1.66
L. limnetica Lemmermann	6	4	2	3	1	-	1	17	1.56
L. major Meneghini	1	2	-	3	2	-	-	8	0.73
L. versicolor (wartmann) Comont.	-	1	-	1	2	1	-	5	0.46
Merismopedia elegans A. Braun	2	-	1	1	2	-	2	8	0.73
Microcoleus vaginatus (Vauch.)Gomont	-	-	-	2	1	3	3	9	0.83
Nodularia spumigena Mertens.	3	-	2	-	1	2	1	9	0.83
N. harvenyana (Thw.) Thuret	-	-	2	2	-	4	1	9	0.83
Nostoc ellipsosporum (Desmaz) Rabenhorst	5	2	1	-	-	-	-	8	0.73
N . calcicola	-	1	-	1	3	1	-	6	0.55
N. microscopicum Carmichael	4	-	2	1	-	-	-	7	0.64
N. punctiforme (kűtz.) Hariot	4	1	-	-	2	2	1	10	0.92
N. verrucosum Vaucher	1	-	-	-	2	1	1	5	0.46
Oscillatoria amphibia C.A. Agardh	9	8	6	7	1	-	1	32	2.95
O. angustissima West and West	4	6	2	7	-	-	-	19	1.75
O. articulate Gardner	-	1	2	2	1	1	-	7	0.64
O. bornetii Zukal	-	1	-	2	3	1	-	7	0.64
O. chalybea (Mertens) Gomont.	2	-	-	-	2	-	2	6	0.55
O. formosa Bory.	5	2	-	-	4	2	2	15	1.38
O. fragilis Bocher.	-	1	2	-	1	-	2	6	0.55
O. granulata Gardner	8	6	4	2	1	-	1	22	2.02
O. limosa	-	2	-	1	1	-	1	5	0.46

O. splendida Greville	-	2	1	2	-	2	1	8	0.73
O. subtilissma kütz	2	-	-	3	-	-	-	5	0.46
O. tenuis C.A. Agardh	-	5	-	2	2	1	-	10	0.92
Phormidium autumnale (C. A .Ag) Gomont.	4	-	-	2	1	-	1	8	0.73
Ph. favasum (Bory) Gomont	-	-	2	1	-	-	1	4	0.35
Ph .inundatum Kuetzing	-	2	1	2	2	-	2	9	0.83
Ph. mucicola Hub. Pest et. Naum.	-	3	-	1	2	-	-	6	0.55
Ph. nostocorum Born ex Gram	6	2	-	1	-	2	-	11	1.01
Ph. tenue (Menegh.) Gomont	-	1	3	-	-	1	1	6	0.55
Schizothrix rivularis (Wolle) Drouet	-	1	2	1	-	2	1	7	0.64
Spirulina laxa G. M. Smith G.W. Prescott.	5	-	-	2	3	1	-	11	1.01
S. major kütz.	2	-	5	-	3	1	-	11	1.01
Symploca muscorum (C. A. Ag.) Gomont	-	2	1	-	1	1	-	5	0.46
Synechococcus aeruginosus	3	-	2	1	-	-	-	6	0.55
Chlorophyta									
Ankistrodesmus convolutus Corda.	2	-	-	2	1	-	1	6	0.55
A . falcatus	-	1	-	2	1	-	1	5	0.46
A . falcatus var. acicularis (A. Braun)	1	3	2	-	1	-	-	7	0.64
A. fusiformis	-	1	2	2	-	1	1	7	0.64
Chlamydomonas debargara Gor.	2	-	-	2	1	-	-	5	0.46
Chlorella ellipsoidea Gerneck	-	2	-	1	2	1	-	6	0.55
C. pyrenoidosa Chick	5	1	-	2	3	-	2	13	1.19
C. vulgaris Beyerinch	9	11	3	5	7	1	-	36	3.32
Chlorococcum infusionum (Schrank) Meaneghiai	3	-	1	1	1	2	1	9	0.83
Collastrum strigosum Breb	-	-	2	-	1	-	-	4	0.35
Crucigenia quadrata Morren	-	1	-	2	-	-	-	3	0.27
Dictyosphaerium pulchellum	4	2	1	-	-	2	-	9	0.83
Gloeocystis planctonica (West & West) Lemmermann	-	2	1	-	3	-	2	8	0.73
Kirchneriella obesa (W. West) Schmidle	2	-	1	-	2	1	2	8	0.73
Pandorina morum	3	-	1	-	2	-	3	9	0.83
Planktisphaeria gelatinosa G. M. Smith.	-	3	-	2	-	1	-	6	0.55
Scenedesmus acuminatus (Lagerh.) Chodat	1	-	1	2	-	-	-	4	0.35
S. bijuga var. *alternans* (Reinsch).	5	-	-	1	-	1	1	8	0.73
S. bijugatus (Turp.) Lag.	-	5	-	5	6	1	1	18	1.66
S. dimorphus (Turp) Kuetzing	3	2	-	4	2	-	-	11	1.01
S. longus var. *Naegelii* (de Bréb) G. M. Smith.	-	3	2	2	2	1	-	10	0.92
S. obliquus (Turp.) kuetzing	8	6	2	5	4	1	-	26	2.39
S. opoliensis P. Richter.	4	-	2	1	3	2	2	14	1.29
S. quadricauda var. westii G. M.Smith	3	-	2	3	-	-	2	10	0.92
Selenastrum gracile Reinsch	-	2	1	-	-	-	1	4	0.35
S. minutum (Naeg.) Collins	-	1	1	2	-	2	-	6	0.55
Stichococcus bacillaris Naegeli	-	-	2	3	2	-	-	7	0.64
Bacillariophyta									
Achnanthes hungarica Grun	-	1	-	1	1	1	-	4	0.35
Amorpha coffeaeformis (Ag.) Kütz	2	2	-	1	1	-	-	6	0.55
A. ovalis var. *gracilis* (E) Cl	-	2	1	-	1	-	2	6	0.55
Asterionella formosa Hass.	1	-	1	-	1	1	1	5	0.46
Cyclotella meneghiniana kütz.	5	8	2	-	-	-	2	17	1.56
Cymbella affinis kütz.	3	4	4	-	-	2	2	15	1.38
C. lanceolate Ehrenb.	-	3	-	4	4	-	-	11	1.01

Fragilaria infata var. *venter* (Ehr.) Grun.	2	-	-	2	-	2	-	6	0.55
Gomphonema gracile Ehr.	2	4	1	2	2	2	-	13	1.19
G. lanceolatum genuinum A. Cl.	-	1	3	2	3	-	1	10	0.92
Gyrosigma attenuatum (Kr.) Cl.	7	8	-	-	4	-	2	21	1.93
G. elongatum W. Smith	-	1	1	2	2	1	-	7	0.64
Hanzschia amphioxys pusilla Dipp.	3	-	1	4	5	-	-	13	1.19
Melosira granulata (Ehr.) Ralfs	9	5	-	6	5	2	1	28	2.53
Navicula cryptocephala exilis Grun	9	7	3	1	2	2	-	24	2.21
N. gracilis (Kütz.) Grun	1	9	3	1	4	2	2	22	2.02
N. lanceolata (Ag.) Kz. Genuina A. Cl.	-	1	3	-	3	-	2	9	0.83
N. oblonga kütz.	-	-	2	-	-	1	1	4	0.35
N. mutica ventricosa (Kz.) Grun	-	-	2	1	-	1	1	5	0.46
Nitzschia acicularis W. Smith	2	-	-	2	2	-	-	6	0.55
N. angustata (W. Sm.) Grun	-	2	-	2	2	-	2	8	0.73
N . communis Rabenh.	-	1	1	2	3	1	-	8	0.73
*N . palea (*kütz.) W. Smith.	3	1	1	-	-	-	1	6	0.55
N. punctata (W. Sm.) Crun	2	2	1	-	1	1	-	7	0.64
N . sigma (Kuetz.) W. Sm.	-	2	-	-	2	-	2	6	0.55
Pinnularia appendiculata	-	3	-	2	-	2	3	10	0.92
P . viridis (Nitzsch) Ehr.	2	1	-	-	-	2	1	6	0.55
Pleurosigma macrum	-	1	-	3	2	2	2	10	0.92
Stauroneis anceps Ehr. Cleve.	1	-	2	-	2	-	-	5	0.46
Suirella ovalis Ehrenb.	-	2	1	2	1	2	-	8	0.73
S. ovata typica (A.S.) A. Cl.	2	-	2	4	2	2	-	12	1.1
Syndera acus radians (kütz.) A. Cl.	-	2	2	1	4	-	1	10	0.92
S. ulna lanceolata Grun.	1	5	-	-	2	-	1	9	0.83
S. ulna splendens (Kütz.) A. Cl.	-	1	-	-	1	-	-	2	0.18
Xanthophyta									
Botrydium granulatum (L.) greville	1	-	-	-	1	-	-	2	0.18
Euglenophyta									
Euglena gracilis Klebs	-	2	2	-	-	-	1	5	0.46
Phacus longicauda (Ehr.) Duj	1	1	-	2	-	-	1	5	0.46
Number of isolates	**218**	**207**	**125**	**173**	**175**	**90**	**96**	**1084**	
Number of species	**67**	**76**	**69**	**77**	**79**	**59**	**65**	**117**	
Diversity index	**1.87**	**2.26**	**1.99**	**2.52**	**2.53**	**2.85**	**2.31**		

It is clear from the data in table (3) that there are high significant correlations between number of algal isolates and moisture content; pH; coarse sand; silt; organic matter; and manganese content of soil.

Discussion

The role of physico-chemical characters and edaphic factors of the soil is very important in distribution of microorganisms. Soil pH is an important factor in determining the composition of algal communities (Zancan, *et al*., 2006). In all sites, the soil pH varied little, from 7.6 to 8.1, so all the main algal groups were represented. In this study the majority of algal isolates from all sites are related to Cyanophyta (Cyanobacteria). Out of 117 identified species, 52 species belong to Cyanophyta; 35 species belong to Bacillariophyta; 27 species belong to Chlorophyta; 2 species belong to Euglenophyta and 1 to Xanthophyta.

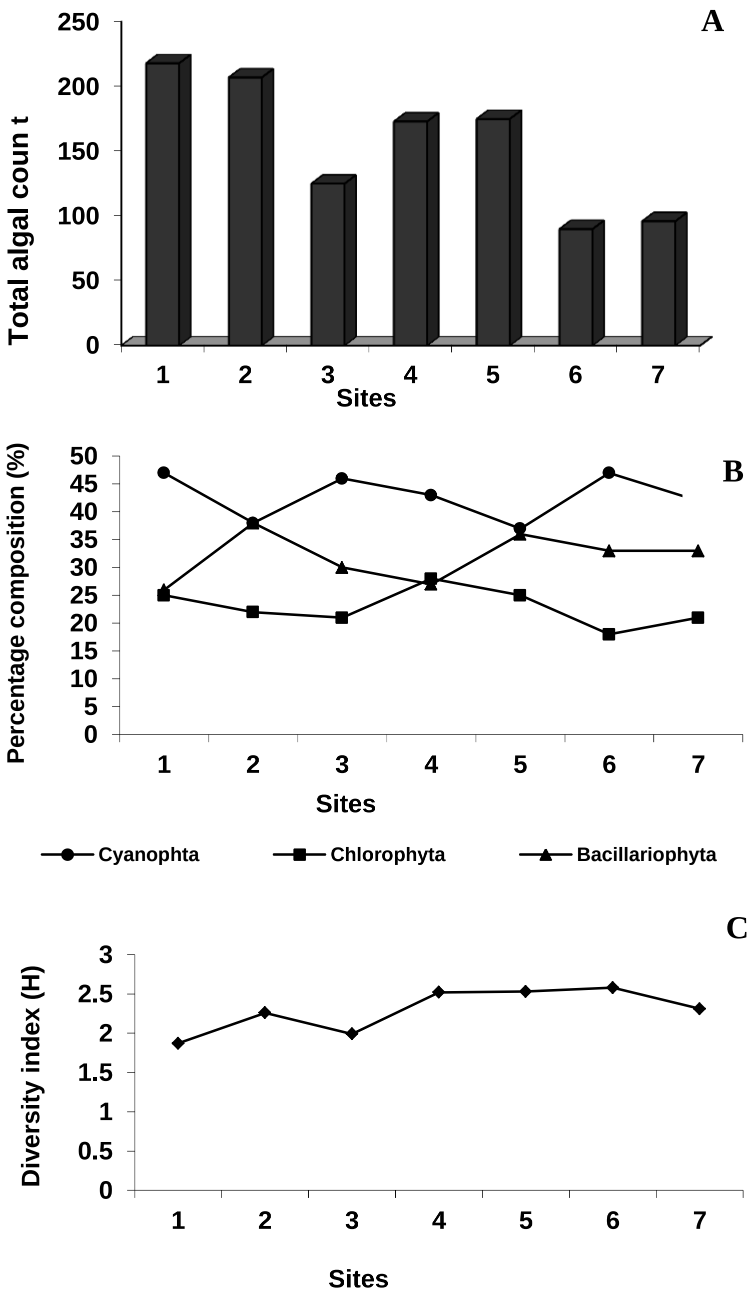

Figure (2): A- Variation in standing crop, B- percentage distribution of soil algae and C- species diversity index (H) in seven sites at Beni Suef Governorate (October 2004)

Table (3): Correlation coefficient matrix showing the relationship between algal count and physico-chemical characters of soil.

	Algae	Moist.	Gravel	Coarse sand	Fine sand	Silt	Clay	pH	EC	Organic matter	Si	CO_3	HCO_3	SO_4	Ca	Mg	Mn	Na	K	Cl
Algal	1																			
Moist	.73**	1																		
Gravel	-.08**	.24**	1																	
Coarse	-.68**	-.84**	-.024	1																
Fine	-.35**	-.57**	-.26**	.70**	1															
Silt	.65**	.86**	.25**	-.93**	-.51**	1														
Clay	.17**	.02	-.66**	-.40**	-.50**	.05**	1													
pH	-.69**	-.19**	-.29**	-.055**	-.55**	-.26**	.74**	1												
EC	-.41**	-.39**	.68**	.47**	-.07**	-.38**	-.41**	.01	1											
O. matter	.63**	.86**	.012	-.709**	-.6**	.58**	.27**	.02	-.37**	1										
Si	-.58**	-.79**	.047**	.94**	.72**	-.82**	-.48**	-.26**	.57**	-.66	1									
CO_3	.47**	-.85**	-.47**	.58**	.35**	-.71**	.32**	.45**	.12**	-.75**	.47**	1								
HCO_3	-.56**	.209**	-.32**	-.35**	-.69**	.022	.79**	.89**	-.26**	.42**	-.56**	.10**	1							
SO_4	.81**	-.46**	.51**	.77**	.63**	-.50**	-.87**	-.5**	.62**	-.57**	.81**	.09**	-.72**	1						
Ca	.38**	-.14**	.67**	.22**	-.26**	-.15**	-.30**	-.03*	.91**	-.055**	.38**	-.16**	-.20**	.42**	1					
Mg	.64**	-.42**	.42**	.61**	-.03**	-.62**	-.27**	.16**	.88**	-.20**	.64**	.14**	-.04**	.56**	.82**	1				
Mn	.71**	-.81**	-.11**	.82**	.23**	-.94**	.067**	.47**	.54**	-.51**	.71**	.66**	.15**	.39**	.36**	.76**	1			
Na	.51**	-.25**	.76**	.38**	.027	-.19**	-.58**	-.24**	.87**	-.28**	.51**	-.18**	-.44**	.63**	.89**	.74**	.33**	1		
K	.39**	-.15**	.71**	.22**	.019	-.020	-.54**	-.34**	.73*	-.214**	.39**	-.29**	-.50**	.55**	.83**	.56**	.15**	.96**	1	
Cl	.51**	-.40**	.601**	.32**	.14**	-.1**	-.48**	-.3**	.80**	-.57**	.51**	.14**	.63**	.60**	.72**	.46**	.19**	.78**	.77**	1

Correlation was based on 20 samples ; *, ** indicate correlation was significant at 0.05 and 0.01 probability levels, respectively

The presence of numerous Cyanophycean members as compared with other types of soil algae is a matter of tolerance and adaptability (Brock, 1973). These organisms were found to flourish under pH value of more than 7 and are unable to survive in acidic conditions (Bold, 1970; Brock, 1973 and Doeley and Houghton, 1973), while abundant and diverse green algae have been recorded in acid soils (Lukesova and Hoffmann, 1995). The pH values at all sites under investigation were more than 7 and this might partially explain the wide spread of cyanophycean members in the different sites studied. Metting (1981) and Lukesova (2001) reported that neutral conditions support the growth of algal communities representing all the main taxonomic groups, which agree with the data recorded in this study.

The moisture content of the soil is considered as a prime factor in abundance of algae in soils. Sites of high moisture content appeared with the highest algal populations (site 1 and 2).

The soil texture may also interfere in selecting and distributing soil algae. Salama *et al*., (1971) indicated that the importance of this effect arise from the fact that the presence of fine particles in one type of soil more than the other leads to the availability of more total exposed surface in such soil over that possessing coarse soil particles. In this study, the site 1 and 2 which recorded the highest algal populations recorded high percentages of silt and clay.

At all the sites, Cyanophyta were represented with the largest number of species, followed by Bacillariophyta and Chlorophyta. Euglenophyta were found in five sites only, while only one species of Xanthophyta was detected in two sites.

Though critical comparisons with published data are often hindered by different experimental conditions and quantitation methods, often linked to the difficult and tedious nature of species identification (Round, 1981; Stellmacher and Reisser, 1999). Our findings confirm that *Chlorella vulgaris* Beijerinck, *Oscillatoria amphibian* C.A. Agardh, *Scenedesmus obliquus* (Turp.) Kuetzing, *Melosira granulate* (Her.)Ralfs, *Navicula cryptocephala exilis* Grun ,*Navicula gracilis* (Kz.) Grun and *Oscillatoria granulata* Gardner can be considered cosmopolitan and widespread in different soils. They were found widely distributed in at least six of the seven soil samples analyzed and they were the quantitatively dominant species in the soil algal communities. The results revealed that members of coocoid green algae and blue green represented the predominant forms. Such observation agrees with the findings of other investigators (Salama and Kobbia, 1982 and Kobbia and Shabana, 1988).

The presence of the high relatively number of species belonging to Cyanobacteria may be due to the presence of lower amounts of carbonate (Kobbia and El-Batanouny, 1975) or high amount of calcium (Gorham *et al*., 1974).

All the cultivated soils are subjected to treatment with fertilizers, herbicides and pesticides. Pesticides are known to affect algae in vitro and in vivo, with algal species varying considerably in their sensitivity to various pesticide concentrations (Megharaj *et al.*, 1999 and Mostafa and Helling, 2002). In this study the main concern was studying the relation between edaphic factors; physico-chemical parameters and the algal content of soils.

There is a general need to improve our knowledge of soil algae in relation to intensive ploughing, planting, herbicide, fungicide and pesticide applications, fertilization and harvesting associated with farming. Zancan *et al*., (2006) reported that soil algae community structures are affected more by soil usage than by physico-chemical parameters. This task should be addressed in my next study.

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مسح للفلورا الطحلبية في بعض الأراضي المزروعة في بني سويف, مصر

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تم دراسة الفلورا الطحلبية لبعض مواقع التربة المزروعة بنباتات مختلفة بالإضافة إلي الخواص الفيزيائية والكيميائية للتربة. أمكن تعريف 117 نوعا ينتمي 52 نوعا منها إلي الطحالب الخضراء المزرقة (السيانوبكتريا) و35 نوعا الي الطحالب العصوية (الدياتومات) و 27 الي الطحالب الخضراء ونوعان للطحالب اليوجلينية ونوع واحد للطحالب الصفراء. وكانت الطحالب بدائية النواة هي الأكثر انتشارا في كل الأماكن المدروسة بالنسبة للطحالب حقيقية النواة. ومثلت الطحالب الخضراء المزرقة نسبة 43% من مجموع التجمعات الطحلبية الموجودة في عينات التربة وكانت السيادة للأوسيلاتوريا امفيبيا (2.95%), أوسيلاتوريا جرانيولاتا (2.02%) و أوسيلاتوريا انجوستيسيميا (1.75%).