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OBSERVATION ON THE SUCCESSION AND PERIODICITY OF SOIL ALGAE IN CULTIVATED LANDS

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ABSTRACT

Little is known about the succession and periodicity of soil algae. So, the present investigation is carried out to study the succession fluctuations and periodicity of soil algae of cultivated land in El-Khanka district, Qaliolbyia governorate.

The study showed that algal folra for this region consists of 33 species of Cyanobactria (blue green algae) and 4 species of green algae. The results revealed the ranges of monthly variations of moisture and nutrient content in soil samples.Organic carbon, carbonates and total nitrogen in the soil crust seemed to be major controlling factors affecting the fluctuations of the isolated algae.

INTRODUCTION

Some phycologists investigated the types, abundance and frequency of soil algae (Chantanachat and Bold, 1962; Friedmann, 1964; Friedmann et al., 1967; Evenari et al., 1975 and komaromy, 1976).They reported that edaphic factors and soil characters togther

with some specific features within the algal organisms themselves constitute the main factors responsible for the existence of the algae in the soils.

In Egypt, the study of soil algal flora has been scarcely studied: El-Ayouty and Ayyad (1972) in a wheat field in the Delta; kobbia & El-Batanony (1975) in wadi El-Naturoun; Salama & kobbia (1982) in Lybian deserts; kobbia (1983) on rhizospheric algae; kobbia (1985) in gravel and lime stone deserts of Cairo-Suez road; kobbia & Shabana (1988) on soil algal flora of Egyptian Bahariya Oasis.

As far as we aware, the periodicity of soil algae are scarce. So, we shall discuss our results in the light of the available literatures concerning the periodicity of water algae.

The distribution, growth, and periodicity of algal flora in a wide variety of ecological situations in Egypt, have recieved comparatively little attention by a few workers (Nosseir & Abou El-Kheir, 1970, and Nosseir & Abou El-Kheir, 1972). Also the factors controlling the distributions and periodicity of fresh water algae, were discussed by some investigators : organic nutrients (Ketchum, 1951); Oxygen concentration in water (Rao, 1955); Dissolved nutrients in water (Abou El-Kheir & El-shimi, 1973); water temperature (El-Hag & Fogg. 1986), and organic cabon & carbonates (kobbia & Shabana, 1988).

Hart (1935) stated that the general pattern of seasonal fluctuation is influenced by the physical and chemical factors of light, temperature, and availability of nutrient salts mainly nitrate and phosphate. Finally, Lund& Talling (1957) stated that there is no ultimate factor responsible for algal mass productivity and periodicity. But some workers added that seasonal flutuation af algae may be due to the sum of the nutritional and environmental conditions (Fritsch, 1906; Patrick, 1945; Jorgensen, 1957; and Nosseir & Abou El-Kheir, 1970 a, b, c, &1972).

The main object of this work is the study of sucession, fluctuation and periodicity of soil algae inhabiting the soil crust under the cultivated crops and trees in El-Khanka district.

MATERIALS AND METHODS

Five fields situated in El-Khanka district, Qaliobyia governorate, were chosen for this study. These fields were cultivated with *Psidium guajava (Guava), Corchorus Olitorius* (Jew's mallow), *Trifolium alexandrinum* (Egyptian clover), *Zea mays* (Maize), *Triticum vulgare* (wheat), and *Hibiscus esculentus* (Okra). Crop rotation was followed in the third (*Trifolium/ Zea/ Trifolium*) and the fourth (*Triticum/ Zea/ Triticum*) fields. The two fields were left uncultivated during November, while the fifth field was left uncultivated during July, 1988- January, 1989 period.

Soil Analysis: Samples of soil curst (each was a composite of

4 randum samples) were transferred immidiately to the laboratory for determination of soil moisture content according to Piper (1950). Samples were air dried and stored in plastic bags.

Chemical analysis: The contents of total nitrogen, exchangeable ammonium and nitrate (Black et al., 1965), total organic carbon (Piper, 1950) were determined. Measurements of soil pH and carbonates& bicarbonates determination were carried out as described by Jackson (1977).

Isolation of algae: The methods used by El-Ayouty and Ayyad (1972) were applied on the dry samples for cultivation and isolation of algae. The algal taxa were identified according to the standard identification methods.

RESULTS AND OBSERVATIONS

Results presented in Table 1 indicated that soil reaction in all the studied fields is alkaline. Data obtained also revealed that the maximum moisture content of soil sample was recorded for field No.1 (19. 19%) durinh Dec. - Feb. period under Psidium gujava cultivation, whereas the minimum content was recorded during Mar.- Jan period in field No 2 under *Corchorus olitorius* culativation. The total nitrogen content of soil sample in field No.1 (during Jan. -Nov. period) exceeded that of the other fields while in field No.3 (during Nov.- Dec. period) it represents the lowest one. The highest value of nitrates (51 Kg / ha) was attained in

Table (1) Ranges of monthly variations of moisture content (M.C.%), total nitrogen, nitrates,ammonia nitrogen, organic carbon, carbonates and bicarbonates (kg/ ha).

Fidld No.	Period	M.C.%	Total N_2	No_3	NH_4	Organic Carbon	Co_3	Hco_3	pH
1	Mar-Jun	2.83-6.10	476-865	9-51	0.27-0.54	793-1430	1697-1983	129-189	8.43-8.71
	Jul-Nov.	3.60-10.34	540-1100	7-21	0.30-0.72	640-1631	1432-3504	116-278	8.29-9.62
	Dec-Feb	11.12-19.19	276-1000	5-25	0.22-0.45	591-1003	1120-1540	24-116	8.54-8.73
2	Mar-Jun	1.58-4.14	379-607	7-18	0.29-0.59	631-1008	2093-2152	290-390	8.2-8.5
	Jul-Nov.	4.20-13.16	316-584	6-11	0.31-0.49	491-975	1131-1417	410-450	8.25-8.51
	Dec-Feb	5.5-7.92	210-500	4-8	0.19-0.33	400-1100	1230-1410	480-512	8.49-8.66
3	Mar-Jun	4.38-8.91	487-686	10-17	0.39-0.62	816-1417	1755-2321	278-377	8.34-8.62
	Jul-Nov.	1.83-7.67	100-710	6-12	0.28-0.40	430-1183	1417-1807	128-260	8.01-8.61
	Dec-Feb	11.86-13.96	211-490	6-12	0.37-0.43	780-1317	1119-1570	120-300	8.63-8.68
4	Mar-Jun	1.81-6.05	553-761	7-13	0.31-0.52	919-1350	1755-2291	248-410	8.31-8.67
	Jul-Nov.	2.43-11.16	326-501	6-28	0.31-0.62	546-839	1417-2262	218-525	8.45-8.72
	Dec-Feb	4.24-13.39	109-480	5-10	0.22-0.44	940-1200	980-1200	200-401	8.45-8.75
5	Mar-Jun	1.80-3.65	522-767	6-11	0.50-0.71	871-1247	1836-2291	231-337	8.2-8.41
	Jul-Nov.	5.30-12.78	200-567	4-10	0.28-0.51	600-949	1403-1699	605-872	8.42-8.61
	Dec-Feb	2.73-5.76	196-503	3-10	0.25-0.49	680-1350	1197-1600	299-494	8.42-8.67

Table2: periodicity of the isolated algae during the present study

List of algae	Field1	Field2	Field3	Field4	Field5
	Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.	Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.	Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.	Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.	Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.
1 Chroococcus minutus			———		
2 Gloecapsa stegophila			———	———	
3 Calothix parielina			———	———	
4 C. thermclis		———			
5 Nostoc calciola		———			———
6 N. commune			———		
7 N. entophytum	———		———		
8 N.minutm	———				
9 N. paludosum	———	———	———	———	———
10 N. passerianum	———				
11 N.pruniforme			———		
12 N. puncliforme		———	———		
13 N.sphaericum	———	———	———	———	———
14 N.spongiaeforme			———		
15 N.verrocosum		———		———	———
16 N. sp.	———		———	———	
17 Nodularia harvenyana	———		———		
18 Anabaena ambigue	———				———

Table2: periodicity fo the isolated lgae during the pesent study (cont.)

List of algae	Field1 Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.	Field2 Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.	Field3 Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.	Field4 Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.	Field5 Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb.
19 A. anomala			—	—	—
20 A.doliolum		—			
21 A. naviculoides		—			—
22 A. subtropica			—		
23 A. variabilis		—	—		—
24 A. varibilis var ellipsospora		—	—		—
25 A. variabilis var kashiensis		—			
26 Oscillatoria acuta		—			
27 phormidium corium	—	—	—	—	
28 ph. tenue	—	—	—	—	—
29 Lynbya dendrobia		—			
30 L. gracilis	—				
31L.martensiana			—		
32 L.scotti			—	—	—
33 Microcolaus aculissimus	—				
1 chlamydomonas altera		—	—	—	
2 Ch. leptobasis	—				
3 Chlorella pyrenoidosa		—			
4 Chlorococcum botryoides			—	—	—

Table (3) Ranges of pH., Moisture content and nutrients in the soil samples supported the isolated predominating taxa (Kg/ha) in all the studied fields.

Peredominant algal taxa	Stand No.	pH	M.C.	Total N_2	No_3	NH_4	Organic Carbon	Co_3	Hco_3
Notoc sp.	1,3,4,5	8.01 8.75	2.43-19.19	109-1000	3-25	0.22-0.72	546-1631	980-3504	24-872
N. entophytum	1,3	8.34 8.71	2.83-8.91	476-865	9-51	0.27-0.62	793-1430	1697-2231	129-377
N. paludosum	1,2,3 4,5	8.01 8.72	1.58-13.16	100-1100	4-51	0.27-0.72	340-1631	1131-540	116-872
N. punctiforme	2,3	8.01 8.62	1.58-13.16	100-710	6-18	0.28-0.62	430-1417	1131-2321	128-450
N. sphaericum	2,3,4.5	8.01 8.75	2.43-13.39	109-584	3-28	0.19-0.62	400-1450	980-2262	200-872
N. verrocosum	2,4	8.20 8.72	1.58-13.16	100-686	6-18	0.28-0.62	430-1417	1131-2321	128-450
Anabaena ambigua	1,5	8.29 8.73	2.73-19.19	196-1000	3-25	0.22-0.72	591-1631	1120-3504	24-872
A. anomala	2,4,5	8.25 8.72	1.83-13.96	100-710	3-28	0.22-0.62	430-1350	980-2262	120-872
A. naviculoides	2,5	8.20 8.50	1.58.4.14	379-767	6-18	0.29-0.71	631-1247	1836-2291	231-390
A. variabilis	2,3,5	8.20 8.62	1.58-8.91	379-676	6-18	0.29-0.71	631-1417	1755-2321	231-390
A. variabilis var ellipsosporis	2,3,5	8.20 8.62	1.58-8.91	379-767	6-18	0.29-0.71	631-1417	1755-2321	231-390
Chlamydomanas altera	2,3,4	8.01 8.72	1.83-13.16	100-710	6-28	0.28-0.62	430-1183	1131-2262	128-525
Chlorococcum	3,4,5	8.20	1.80-8.91	487-686	6-17	0.31-0.71	816-1417	1755-2321	231-410

filed No.1 (during Mar.-Jun.period) while the minimum value (3kg/ ha) reached during Dec.-Feb period in filed No. 5. The maximum value of ammonia nitrogen, organic carbon, and carbonates was recorded in field No.1 during Jul-Nov. period, while the minimm value of these parameters was attained during Dec.- Feb. period in fields No.1,2& 4 respectively. Bicarbonates reached their maximal value in field No.5 during Jul.- Nov. While the minimum one was during Dec.- Feb. period in field No.1.

For further details concerning the range of each studied paramater throughout the present investigation in each field see Table1.

It was observed that at least one or two species of both *Phromidium* and Lyngbya were recorded throughout the whole period of investigation in addition to the alga *Nodularia harvenyana* that predominated throughout the whole period of investigation only in field No.1 Anyhow, these species were found as follows:

These species are considered to be highly adaptable to the extreme and severe variations in the climatic and edaphic factors of these regions.

Field No.1

1- *Nodularia harvenyana.*
2- *Phormidium corium.*
3- *Ph. tenue.*
4- *Lyngbya gracilis.*
5- *L. martensiana.*

Filed No.2

1- Phormidium corium.
2- Ph. tenue
3-Lyngbya dendrobia

Field No. 3

1- Phormidium corium
2-ph. tenue.
3-Lyngbya martensiana.
4- L. scotti.

Field No.4

1- phormidium corium.
2- ph. tenue.
3- Lyngbya scotti.

Field No.5

1- phormidium tenue.
2- Lyngbya dendrobia.
3- L. scotti.

Concerning the perioditity of the remaining isolated algae throughout this investigation, one can condlude the following:

Algal taxa	period	Field No.
Chroococcus minutus	Mar.- June., 1988	3
Gloeocapsa stegophila	Mar.- June., 1988	3
	June.-Sep., 1988	4
Nostoc calcicola	Jul. 1988-jan. 1989	2 & 5
N. spaericum	Mar. 1988-May 1989	1
	Jul. 1988-Jan, 1989	2-5
N. paludosum	Mar.-Nov., 1988	1-5
N. entophytum	Mar.-June., 1988	1 & 3
N. verrocosum	Mar.-Oct., 1988	2 & 4
Anabena ambigua	Jul. 1988-Jan., 1989	1 & 5
A. anomala	Jul. 1988-Jan. 1989	3,4,5
A. variabilis		
&	Mar.-July, 1988	2 & 5
A. naviculoides		
A. variabilis var. ellipsospaora	Mar.-May, 1988	2, 3, 5
	Jul.-Sep., 1988	3,4
Chlamydomonas altera	Jul.-Nov., 1988	2
Ch. tepasis	Jul.-Nov., 1988	1
Chlorella pyrenoidosa	Jul.-Feb., 1989	2
Chlorococcum botryoides	Mar.-Aug., 1988	3,4

Regarding the succesion of isolated algae in each field, one can notice the following:

Field No.	Mar. 1988	Jul. 1988
1	Notosc entophytum N. minutum N. paludosum N.passerianum N. sphaericum	Nostoc sp. Anabaena ambigua Microcoleus acutissimus Chlamydomonas Leptobasis
2	Nostoc paludosum N.punctiforme N. veroxosum Anabaena naviculoides A. variabilis A. variabilis var. ellipsopora A. variabilis var. kashiensis O. acuta	Calothrix thermalis Nostoc calcicola N.sphaericum Anabaena doliolum Chlorella pyrenoidosa Chlamydomonas altera
3	Chroococcus minutus Gloecapsa stegophila Calothrix parietina Nostoc paludosum N. commune N.entophytum N.punctiforme N. spongiaeforme Nodularia harvenyana Anabaena subtropica A. variabilis A.varibilis var. ellipsospora Chlorococcum botryoides	Nostoc sp. N. pruniforme N. sphaericum Chlamydomonas altera
4	Nostoc paludosum N. verocosum Chlorococcum botryoides	Gloeocapsa stegophila Calothrix parietina Nosstoc sp. N. sphaericum Anabaena anomala Chlamydomonas altera
5	Nostoc paludosum Anabaena naviculoides A. variabilis A.variabilis var. ellipsospora Chlorococcum botryoides	Nostoc sp. N. calcicola N. sphaericum Anabaena ambigua A. anomala

DISCUSSION

The algae isolated - throughout the whole investigation period from soil crusts of all fields (Table 2) were almost mainly blue-green ones, especially the filamentous forms. These were dominated by Nostoc spp. which constituted 46.2, 35.7, 40.40 and 33.3% of the whole blue-green algae encountered in the five fields uneder-study (1-5) respectively; followed by Anabaena spp. comprising 7.7, 33.3, 20, 10 and 41.7% of the blue green algae in the fields (1-5), respectively. This is cofirmed by the findings of Allison et al. (1937) who found that all culitivated lands and grass lands support a rather abundant flora of blue green algae and also in agreement with those of Ashely et al (1985) and Roger et al. (1987) who found that *Nostoc* was the most dominant genus, followed by *Anabaena* in samples from rice fields (from philippines, India, Malysia and portgal). They also found that the incidence of *Nostoc* was higher in dry soils than in wet soils.

A very important factor for the distribution of soil algae is the pH value of the soil crust, which was alkaline throughout the whole investigatin period. It is generally accepted that neutral or alkaline soils are more favourable to the development of blue-green algae (Durrel, 1964; Shields & Durrel, 1964; Cameron and Blank, 1966; Holm-Hansen, 1968; Stewart, 1969; Brock, 1973; Friedmann& Galun, 1974; Shubert, 1980.

The presence of numerous cyanophycean members as compared to other types of soil algae is a matter of tolerance and adaptability (Brock, 1973). However, the widespread of cyanophycean members in the present study than the other groups, may be due mainly to the cellular structure of such organisms. Such assumption is in confirmity with the findings of Fay & Fogg (1962) and Trainor (1978) who reported that the ability of blue greens to survive under variables is due to the properties of prokaryotic cells.

It was found that the majority of *Nostoc* spp. were recorded during Mar.-Oct. period while some of them were observed during Jul. 1988-Jan., 1989 period. This is in partial agreement with the finding of Abou El-Kheir& El-Shimi (1973) who recorded *Nostoc* spp. in El-Zomor and El-Mansoriya Canals, Giza during Oct- Jan. Period.

It was also observed that *Anabaena* spp. were recorded during Mar - Jul period (5 spp.) , Jul - Nov. period (2 spp.) and one species during Jul - jan period. This in partial accordance with the findings of some workers as follows : Rzoska et al. (1955) in White and Blue Nile. Sudan, during the perods May - Dec. and Jan - Apr. respectively; Abou El - Kheir & El - Shimi (1973) in El - Zomor and El - Mansoriya Canal, Giza, A. R. E during Aug - Nov. period, and Shabban et al. (1987) in El - Tawila Drain, Dakhlia, A. R. E. during Jun-Oct period .

Four Lyngbya spp. were recorded throughout the whole investigation period, *L. scotti* in fields No. 3, 4 &5; *L. dendrobia* in fields No. 2 &5; *L. martinsiana* in fields No. 1 & 3, and L. gracilis in the first field. Rzoska et al. (1955) recorded Lyngbya sp. in he white and Blue Nile, Sudan, during Oct-Jan period while Abou E. Kheir& El-Shimi (1973) recorded Lyngbya spp. In El-Zomor and El-Mansoriya Canals, Giza, Egypt, during Aug-Oct. period.

Oscillatoria acuta was recorded during Mar-Jul period-in the present study-only in the second field. In this respect, *Oscillatoria* spp. were recorded by Nosseir and Abou El-Kheir (1972) in El-khashab Canal during Dec-Mar and Jun-Dec. period; Abou El-Kheir & El-Shimi (1973) in El-Zomor and El-Mansoriya Canal Giza during Aug.-Dec. period, and by Shaaban et al. (1987) in El-Tawila Drain, Dakahlia governorate, during Apr., Aug& Oct.

Chroococcus minutus was recorded only in the second field during Mar-Jun period, while it recorded by Abou El - Kheir & El-Shimi (1973) in El - Zomor and El - Mansoriya Canals in Aug, Sep & Nov.

Concering the periodicity of green algae in this study, *Chlamydomonas* altera was recorded in the second field during Jul-Jan. period and Jul-Sep. period in fields No. 3&4. *Chlorella pyrenoidosa* also recorded in the second field during Jul-Jan period while *Chlorococcum botryoides* was recorded in field No. 3,4& 5 during Jul-Nov.

period. Similarly, Abou El-Kheir& El-Shimi (1973) recorded *Chlamydomonas* spp., *Chlorella* spp., *Chlorococcum* spp. during Aug-Nov. period in El-Zomor and El-Mansoriya Canals, Giza. Our results - rconcerning Chlorococcum - is not in hamony with that of Nosseir & Abou El-Kheir (1972) who recorded *Chlorococcum* spp. during Mar-Jun. period.

According to the ranges of the studied parameters in the samples of soil crust (Table 3), the frequent algae can be segregated into three classes:

1- Moisture content:

a- wide range:

Nostoc sp., N. paludosum, N. punctiforme, N. sphaericum, N. verocosum, Anabaena ambigua, A. anomala and Chlamydomonas

altetra.

b- Medium range:

Nostoc entophytum, Anabaena variabilis, A. variabilis var. ellipsospora and Chlorococcum.

c- Narrow range:

Anabaena naviculoides.

2- Total Nitrogen:

a- Wide range:

Nostoc sp., N. paludosum, Anabaena ambigua.

b- Medium range:

Nostoc punctiforme, N. verrocosum, Anabaena anomala and Chlamydomonas altera.

c - Narrow range:

N. entophytum, N. sphaericum, Anabaena naviculoides, A. variabilis, A. variabilis var. ellipsospora and Chlorococcum.

3- Organic carbon:

a- Wide range:

Nostoc punctiforme, N. sphaericum, N. verocosum, and Anabaena anomala.

c- Narrow range:

N. entophytum, A. naviculoides, A. variabilis, A. variabilis var. ellipsospora, Chlamydomonas altera and Chlorococcum.

4- Carbonates:

a- Wide range:

Nostoc sp., N. paludosum, Anabaena ambigua.

b- Medium range:

N. punctiforme, N. sphaericum, N. verocosum and Anabaena anomala and Chlamydomonas.

c- Narrow rgane:

N. entophytum, A. naviculoides, A. variabilis, A. variabilis var. ellipsospora, and Chlorococcum.

5 - Bicarbonates:

a- Wide range:

Nostoc sp., N. paludosum, N. sphaericum, A. anomala and A. ambigua.

b- Medium ragne:

N.entophytum, N. punctiforma, N. verrocosum, and Chlamydomonas.

c- Narrow range:

A. naviculoides, A. variabilis, A. variabilis var. ellipsospora, and Chlorococcum.

The associations obtained from the preivious classification in case of total nitrogen, organic carbon and carbonates may explain the similar behavior in fluctuation and periodicity fo these species (see Table 2) and ascertain that edaphic factors seem to be an im-

portant determing factor in the fluctuation and periodicity of the predominating species forming the basis of this study. This conclusion is confirmed by the finding of Kobbia & Shabana (1988) who found that organic carbon and carbonate content in the soil samples are the major controlling factors affecting the growth and distribution of algae in Egyptian Bahariya Oasis.

It was found that some algal species were recorded only in one field (NO.1,2 & 3) while they not exist in the other fields, these species are as follows; Nostoc minutum, N. passerianum, Microcoleus acutissimus, and Chlamydomonas Leptobasis in field No. 1, Calothric thermalis, Anabaena doliolum, A. variabilis var Kashiensi, Oscillatoria acuta and Chlorella pyrenoidosa in field No. 2, and Chroococcus minutus, Nostoc commune, N. pruniforme, N. spongiaeforme and Anabaena subtropic in field No. 3.

The presence of these species in one field in the present study and their absence in the other fields may due to the type of the plant vegtation dominated in each field. This is in accordance with the findings of Evenare et al. (1975) and Salma & Kobbia (1982) who mentioned that the desert plant vegetation has a direct effect in selecting and determing the types of algal organisms and although there are similarities in the edaphic factors and physco-chemical characters of some sites, yet dissimilarities between the abundance and type of algal population exist. In the authors' opinion that these species may be incapable of living except under specific conditions since they were represented in only one field.

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ملاحظات على التعاقب والموسمية لطحالب التربة فى الأراضى المنزرعة

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.تهدف الدراسة الى القاء الضوء على تعاقب وموسمية مجموعة طحالب التربة التى عزلت من الطبقة السطحية للتربة التى تنمو بها بعض الأشجار والمحاصيل بمنطقة الخانكة بمحافظة القليوبية.

وقد تم عزل ٣٣ نوعاً من الطحالب الخضراء المزرقة و٤ أنواع من الطحالب الخضراء كما تم تعيين المحتوى الرطوبى وبعض مكونات التربة شهرياً.

وقد صنفت الدراسة هذه الأنواع الى ثلاثة مجموعات: المجموعة الأولى سجلت طوال الدراسة والمجوعة الثانية ظهرت في بداية الدراسة وحتى شهر يوليو ثم المجموعة الثالثة التى استمرت الى الشهور الأخيرة من الدراسة كما أوضحت الدراسة أن عوامل التربة لها دور هام فى التعاقب والموسمية بالإضافة الى العوامل الأخرى التى لم تطرق بالدراسة.