ALGAL FLORA OF RICE FIELDS AT EL-KHARGA OASIS, EGYPT

Mohamed A. El-Naghy, Ahmed M. El-Shahed, Adel A. Fathi, and Gamal El Din G. Ahmed
Botany Department, Faculty of Science, Minia University, Minia 61519, Egypt

Abstract
Algal flora as well as the physicochemical characteristics of rice fields at El-Kharga Oasis was investigated. A total of 99 taxa were identified of which, 23 were Cyanophytes that belong to 11 genera; 19 Chlorophytes belonging to four genera; 52 Bacillariophytes belonging to 15 genera and five Euglenophytes belonging to three genera. Community structure differed among the studied sites diatoms being the most dominant. Taxa that attained high percent of frequency of occurrence (more than 66.6% i.e. being recorded four times during the study period) include; the blue green algae *Osdcillatoria chlabea*, *O. mougeotii*, *O. principes, O. raoi*, *O. simplissima*; the green algae *Cosmarium lavae* var. *Lavae*, *C. pseudopyramidatum* and the diatoms *Anomoeoneis sphaerophora* and *Nitzschia thermalis*. Taxonomic description for the rarely recorded taxa to the algal flora of rice fields is given. The paper also includes illustrations of 78 recorded algal taxa presented in 6 plates.

Key words*:* Aquatic algal flora, rice fields, El-Kharga Oasis, Egypt.

Introduction
El-Kharga Oasis belongs to the New Valley governorate which occupies about 67% of the Western desert and about 45.8% of Egypt's total area. The New Valley extends over a vast groundwater basin called Dakhla basin which is the main source of water for domestic and agricultural purposes in this area. The climate of the Oasis is extremely arid with an average rainfall below 3.6 mm/year and temperature range of 16.1 to 26.3^{o}C in winter months and 29 to 39 ^{O}C in summer months (El-Younsy *et al.*, 1991).

Generally, few studies have been performed on algal flora of the Oases in Egypt. Shabaan and El-Habibi (1978) worked on El-Kharga; Shabaan (1985) on Siwa and Kobbia and Shabana (1988) on Bahariya Oasis. Similarly, studies on algae of the whole Egyptian deserts are relatively few. Kobbia and El-Batanouny (1975) studied algal flora of soils from Wadi El-Natroun; El- Awamri *et al.*, (1996) reported on the region of Saint Catherine; and Shaaban and Hamed, (1997) investigated water bodies at El- Arish valley.

Rice fields were chosen for this study since they are considered favourable places for algal growth (De, 1939). Studies on the algal flora in rice fields dealt mostly with the importance of cyanophytes as nitrogen fixers (Brammer, 1983; Hung and Chow, 1988). Such role of algae in soil fertility in rice fields gains more importance and attracts more attention when such fields are

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located in the nitrogen poor desert soils. (Mayland and McIntosh, 1966). Algal crusts of desert range lands may fix about 4 gm N/ha after a rainfall (McGregor and Johnson, 1971). The nitrogen fixed by the blue green algae is liberated and then reassimilated by higher plants (Stewart, 1970).

The present work aims at studying the algal flora of rice fields at El-Kharga Oasis in an attempt to give information on the role played by these organisms in increasing soil fertility and providing a record on algal flora in this arid region of Egypt, in comparison with that in the Nile valley.

Materials and Methods

1- Area of Study:

El-Kharga Oasis is located about 230 km south of Assiut and 200 km south west of Qena. The studied area lies between the latitudes 24^{o} 30’ and 25^{o} 00’ N and the longitudes 30^{o} 15’ and 30^{o} 28’ E (Figure 1).

Sampling Sites:

The studied rice fields were chosen at sites 1, 2, 3 indicated on the map (Fig. 1) and each was divided into quadrates of 16x16 m. These fields were submerged with water supplied from water wells through a network of channels. Sites 1, is located in the city, 2 about 10 km north of the city whereas site 3 lies 15 km north of the city (Fig.1).

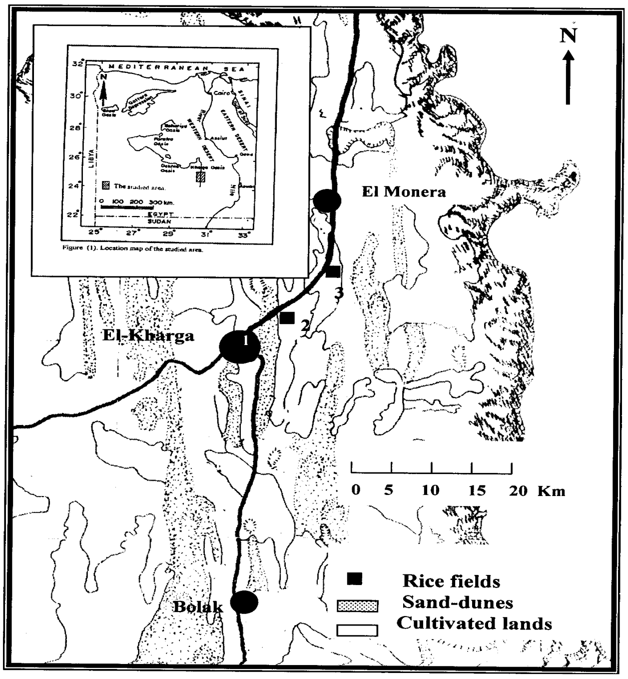

Figure (1): Map Showing the Study Area and the Sampling Sites.

Sample Collection:

Samples for physicochemical and algal investigations were collected monthly from good illuminated places in the period June 1998- September 1999 during the cultivation season which extends from June to September. Water samples for physicochemical analysis were collected in one liter polyethylene bottles. Samples for algal investigations were collected, in 0.5 l polyethylene bottles from water, water-submerged parts of plants and solid objects embedded in water according to the standard method of Prescott (1982).

2- Physicochemical Characteristics of Water:

Water Temperature was measured in the field and water samples were transported to the laboratory in a frozen state, kept frozen for later analysis of the rest of parameters. pH was measured using a pH meter (Sargent Welch, Scientific Company, London, UK). Conductivity was measured using a conductivity meter (WPA, Saffron Waden, England). Total alkalinity was estimated according to Mackereth *et al*., (1978) and the chemical oxygen demand was determined according to Golterman *et al.*, (1978). Inorganic soluble orthophosphates and nitrates were measured spectrophotomertically according to Moore and Chapman (1986) using a UV- VIS spectrophotometer (Perkin Elmer mod. 55B, USA). Chlorides were determined according to Jackson, (1960) and silicates according to Mullin and Reily, (1955). Sodium and potassium, were determined according to Golterman *et al.*, (1978) using a flame photometer (M410 Ciba Corning Diagnostics, UK). Ca^{2+} and Mg^{2+} were determined by compleximetric methods according to Eaton *et al*. (1995).

3- Algal Investigations:

Algal taxa were identified using a Phase contrast Carl Zeiss Med 2 microscope according to the keys of Smith (1950); Desikachary (1959); Rüžička (1977), Komarek and Fott (1983) and Krammer and Lange- Bertalot (1986, 1988, 1991a,b). Illustrations of most of the recorded taxa were performed using a Carl Zeiss Camera Lucida 10X. Diatoms were identified in permanent slides prepared according to Barber and Haworth (1981). Abundance of species was estimated according to the following scale:

\+ = rare; less than 20 specimens/ 10 microscopic fields,

++ = subdominant, 20- 40 specimens/ 10 microscopic fields,

+++ = dominant more than 40 specimens/ 10 microscopic fields.

Results and Discussions

I- Physicochemical Characteristics of Water:

Physicochemical variables of water of the studied rice fields are presented in table (1). The mean annual temperature seems comparatively high than that of water bodies of other parts in Egypt reflecting probably climatic characteristics as located in extremely arid part of Egypt. Water pH was alkaline (above 8) throughout the period of study, although the pH in wells which supplied these fields was lower and ranged between 6 and 7 (Elnaghy *et al*, in press).

Table (1): Range of change in some physicochemical characteristics of water sample from the studied rice fields during the period June - September of the years 1998 and 1999. COD is the chemical oxygen demand n= 8.

Parameters	Temp. °C	pH	E.c. (x 10^4 mhos)	Total alkalinity (mg l^{-1})	COD (mg l^{-1})	N (ug l^{-1})	P (ug l^{-1})	Cl^- (mg l^{-1})	Si-$Si_2O_3^{2-}$ (mg l^{-1})	Na^+ (mgl^{-1})	K^+ (mgl^{-1})	Ca^{2+} (mgl^{-1})	Mg^{2+} (mgl^{-1})
Mean	31.0	8.6	1.9	100.0	4.7	336.0	96.2	22.0	1.9	22.5	17.2	15.9	8.8
Range	24.0-36.0	8.24-8.82	1.6-2.3	100.0-100.0	4.0-6.5	237.0-434.0	87.0-104.0	16.0-36.0	1.3-2.4	13.4-50.0	13.6-26.2	9.2-28.8	17.2-20.6
S.D.±	5.0	0.6	0.2	0.0	0.4	100.0	10.0	4.0	0.5	10.4	10.0	8.2	7.1

This can be attributed to the metabolic activities of the rice plants grown and to the agricultural practices followed such as fertilization with organic and inorganic fertilizers. The other physicochemical parameters of rice fields water were relatively low when compared with that of the river Nile (Ibrahim, 1997).

II- Structure of The Algal Community at The Study Sites:

During the period of study, a total of 99 taxa were recorded among which 23 were cyanophytes that belong to 11 genera, 19 chlorophytes that belong to four genera, 52 bacillariophytes that belong to 15 genera and five euglenophytes that belong to three genera (Tab.2). Illustrations of most of these taxa are given in Plates I- VI.

Bacillariophytes were the most dominant group whereas cyanophytes and chlorophytes were the subdominant algae in the area of study. Salama and Kobbia (1982) recorded 51 species of algae from desert soils near Cairo-Alexandria desert road in relation to the edaphic and climatic factors and emphasized that the prokaryotic algae were more abundant and widely distributed in the studied sites (42 species) than eukaryotic members especially diatoms which were recorded as only two species. Kobbia and Shabana, (1988) also reported the dominance of cyanophytes in the algal flora of some cultivated soils at Bahariya Oasis, describing sixty species among which 25 species were cyanophyta with *Oscillatoria, Phormidium, Lngbya* and *Rivularia* the dominant genera. Also an account on algal flora of the Mediterranean coast in Egypt was given by El-Sheekh *et al*. (1998). Fifty species of algae were identified from which 42 cyanophyte species among which; *Lyngbya hieronymusii, Aphanotheca microspora, Lyngbya birgei, Phormidium inundatum* and *Oscillatoria tenuis* were the most frequent.

During the two seasons of study the total number of taxa was nearly similar except that it was slightly larger in the second season (June, 1999-September 1999). Site 3 was richer in number of taxa than the other two sites during both seasons of investigation.

Blue green algae were frequently reported to dominate algal flora of rice fields (Pandey, 1965) whereas in the present study these algae were subdominants which could be explained on the basis that the previous work of Pandy concentrated on planktonic species whereas in this study, both the planktonic and the sessile algae were included. In the present study, cyanophytes were not the most dominant algae although they were present in considerable numbers including the heterocystous, nitrogen- fixing taxa; *Anabaena variabilis* and *Cylindrospermum alatosporum*. The presence of nitrogen fixing organisms in rice fields attracted the attention of many investigators towards the use of these organisms in order to reduce the application of nitrogenous fertilizers (Stewart, 1974). Dispersing dried algal flakes in rice fields increased the yield in the range 7-10 kg /ha (Venkataraman, 1972). The Azolla–Anabaena association has been used in many countries as a nitrogen biofertlizer in rice fields.

Table (2): Occurrence and abundance of algal taxa at the studied sites during the period June – September of the years 1998 and 1999. Marked taxa are those with more than 30% frequency of occurrence.

Year		1998			1999			Index of frequency %
Sites		1	2	3	1	2	3	
Taxa								
Cyanophyta								
***Achronema macromeres* Skuja**						+	+	**25.0**
***Anabaena variabilis* Kütz**	*			+	+	+	+	**50.0**
***A. variabilis* f. *crassa* Woronichin**	*			+	+		+	**37.5**
***Arthrospira platensis* Gomont**					+			**12.5**
***Aphanotheca saxicola* Naeg.**				+				**12.5**
***Chroococcus bitumimsus* (Bory.) Hansgirg**				+				**12.5**
***C. minutus* (Kütz.) Naeg.**		+						**12.5**
***C. turgidus* (Kütz.) Naeg.**			+					**12.5**
***Cyanodictyon endophyticum* Pascher**				+				**12.5**
***Cylindrospermum alatosporum* Frisch**	*		++	++	+			**37.5**
***Gomphosphaeria aponina* Kütz.**				+				**12.5**
***Microcrois irregularis* (Geitler) Kütz.**				++				**12.5**
***M. hansgergiana* (Hansgirg.) Elenkin**				+				**12.5**
***Oscillatoria animalis* Ag.**	*				+	+++	++	**37.5**
***O. chlabea* (Martenes) Gomont**	*		+	+	+	+		**50.0**
***O. mougeotii* Enkin**	*		+	+		++		**50.0**
***O. principes* Vaucher**	*	++		++		+	+	**50.0**
***O. raoi* De Toni**					+			**12.5**
***O. sancta* (Kütz.) Gomont**	*		+	+	+	+		**50.0**
***O. simplissima* Gomont**				+				**12.5**
***O. subbrevis* Schmidle**	*		++	+	++	+	+	**62.5**
***O. terebriformis* Ag.**					+		++	**25.0**
***Spirulina spiroliniodes* (Ghose) Geitler**				+				**12.5**
Euglenophyta								
***Euglena deses v. digrana* Ehr.**					+			**12.5**
***E. deses v. Intermedia* (Klebs) Ehr.**				+				**12.5**
***E. hemichromata* Skuja**				+				**12.5**
***Lepocinclis colligera* Deflandre**				+				**12.5**
***Phacus curvicauda* Hubner**				+				**12.5**
Chlorophyta								
***Closterium closteriodes* (Ralfs) Louis**			+	+				**25.0**
***C. ehrenbergii* v. *Atumidum* Grun.**				+			+	**25.0**
***C. dianae v. dianae* Her.**				+				**12.5**
***C. lanceolatum* v. *lanceolatum* Kütz.**				+			+	**25.0**
***C. moniliferum* v. *Concavum* Klebs**				+				**12.5**
***Cosmarium hammeri* Reinsch**						+		**12.5**
***C. hornavanese* v. *dubovianum* (uto.) Kütz.**						+		**12.5**
***C. impressulum* Her.**			+					**12.5**
***C. lavae v. lavae* Rabeh.**	*	+	+	+			+	**50.0**
***C. obtusatum* Schmidle**	*			+		+	+	**37.5**
***C. octodes v. Amoebum* W. West**				+		+		**25.0**
***C. pachydermum* Mask**		+						**12.5**
***C. pseudopyramidatum* Lund**		+						**12.5**
***C. punctulatum* Kütz.**	*	+		+	+	+		**50.0**
***C. variolatum* Kütz.**							+	**12.5**
***Pediastrum tetras* Ehr.**						+	+	**25.0**
***Scenedesmus magnus* Meyen**							+	**12.5**

Table (2) continue

Year **Sites**	**1998**			**1999**			**Index of frequency %**
	1	**2**	**3**	**1**	**2**	**3**	
Taxa							
***S. protuberans* v. *Donubianus* Uherk**			++				**12.5**
***S. spinosocululatus* Chod.**			+				**12.5**
Bacillariophyta							
***Anomoeoneis sphaerophora* Her.**	+		+	+	+	++	**62.5**
***Caloneis bacillum* v. *bacillum* Grun.**				+			**12.5**
***C. pulchra* Messikommer**					+	+	**25.0**
***C. silicula* (Her.) Cleve**						+	**12.5**
***Cyclotella meneghenian*a Kütz.**						+	**12.5**
***Cymbella minuta* Hilse ***		+	+			++	**37.5**
***C. uso e an* (Berkeley) Cleve**				+		+	**25.0**
***C. pusilla* Kütz.**				+		+	**25.0**
***C. reinhardtii* Her.**		+	+				**25.0**
***Denticula tenuis* Kütz.**				+		++	**25.0**
***Eunotia arcus* Her.**	+					+	**12.5**
***E. faba* Her.**			+			+	**25.0**
***E. paralella* Ehr.**						+	**12.5**
***E. tenella* Grun.**						+	**12.5**
***Feagilaria tenuicellis* Kütz.**					+	+	**25.0**
***F. ulna* (Nitzsch) Lange-Bertalot**						++	**12.5**
***F. virescens* v.*capiatata* Ostr.**						+	**12.5**
***Gomphonema angustatum* Kütz.**						+++	**12.5**
***G. gracile* Her.**	+						**12.5**
***G. lanceolatum* Her.**			+			+	**25.0**
***G. olivaceum* (Lyngb.) Kütz.**						+	**12.5**
***G. truncatum* Her.**	+						**12.5**
***Mastigolia elliptica* (Ag.) Cleve ***		+		+		+	**37.5**
***Meridion circulare* Grev.**	+						**12.5**
***Navicula capitata* v. *capitata* Ehr.**	+						**12.5**
***N. cari* v. *angusta* Grun.**			+				**12.5**
***N. confervacea* Kütz.**		+++				+	**25.0**
***N. uso e an* Kütz.**					+		**12.5**
***N. cuspidata* v. *heribaudi* M. Perigallo**					+	+++	**25.0**
***N. falaisiensis* Grun.**		+			+		**25.0**
***N. gregaria* Donk. ***	+			+		+	**37.5**
***N. uso e an* v. *uso e an* (Ag) Kütz.**						+	**12.5**
***N. pupula* v. *pupula* Kütz.**	+						**12.5**
***N. vulpina* v. *vulpina* Kütz.**	+						**12.5**
***Nitzschia uso e an* Grun.**			++				**12.5**
***N. angustata* (W.Smith) Grun.**				+		+	**25.0**
***N. compressa* (Baily) Boyer**			+	+			**25.0**
***N. dissipata* Kütz.**				+		+	**25.0**
***N. elegantula* Grun.**					+	+	**25.0**
***N. frustulum* Kütz.**			+			+	**25.0**
***N. linearis* (Ag.) W. Smith**						++	**12.5**
***N. uso e* W. Smith**						+	**12.5**
***N. palea* Kütz. ***	+	+				+	**37.5**
***N. solita* uso.**		+					**12.5**
***N. thermalis* Kütz. ***	+	+	++	+	+	+	**75.0**
***N. umbunata* (Ehr.) Lange- Bertalot**						+	**12.5**
***N. vivax* Hantz.**					+		**12.5**
***Pleurosigma strigosum* W. Smith**	+						**12.5**
***Rhopalodia gibba* (Ehr.) O Müll.**						+	**12.5**

Table (2) continue

Sites / Year	1998			1999			Index of frequency %
	1	2	3	1	2	3	
Taxa							
***Surierella ovalis* Breb.**						++	**12.5**
***S. ovata* Kütz.**			+			+	**25.0**
***S. robusta* Ehr.**				+		+	**25.0**
Number of taxa /site	**18**	**17**	**40**	**23**	**23**	**48**	
Total number of taxa	**59**			**66**			

Scale of abundance: + = sporadic (less than 20 specimens / 10 microscopic fields); ++ = subdominant (20-40 specimens / 10 microscopic fields); +++ = dominant (more than 40 specimens / 10 microscopic fields).

Although we did not record Azolla in the studid rice fields of El-Kharga Oasis, the occurrence of this aquatic fern in Egypt was reported by Ibrahim and El- Aggan (1993). Azolla has a wide ecological niche of pH and temperature (Watanabe and Liu, 1992) and if introduced to the area of our study, could possibly survive and grow. It is worth mentioning that the yield of some rice varieties was reported to increase by 18- 47% when Azolla was applied at a rate of 10t fresh weigh/ ha (Singh, 1977).

The community of green algae of the rice fields was dominated by desmids in spite of the previously reported nature of these organisms as being acidophilic and calciophilic (Hutchinson, 1967). Our results are in agreement with the results of Wolkerling and Gough (1976) who found considerable populations of desmids in the alkaline Wisconsin lake. These authors criticized the hypothesis that relates desmids to acidic, calcium- rich environments.

The recorded taxa agreed in taxonomic description with the diagnoses reported in the used keys of identification (Materials and Methods).

III- Taxonomic Remarks on Some Rarely Recorded Taxa to The Flora of Rice Fields

Given below are the diagnoses of some taxa that appeared rarely recorded for the algal flora of rice fields in the literature cited, illustrations of these taxa are given in Plates II and III. The morphological features of these organisms agreed with the descriptions outlined in the monographs on desmids (Rüžička, 1977) and chlorococcales (Komarek and Fott, 1983).

Closterium closterioides var ***closteriodes***:

Cells straight, fusiform, 5-7 times longer than broader. Poles rounded, wall yellowich-brown, chloroplast with about 8 longitudinal ridges and 8 pyrenoides, 260- 270µm long and 50- 58µm broad.

Closterium ehrenbergii var ***atumidum*** Menegh.**:**

Cells 165- 170µm long and 12-15µm broad, apices rounded, 5µm broad, ventral margin curved, concave without middle portion, wall smooth, chloroplasts with many pyrenoids (5– 6) in each semicell.

Closterium dianae var. ***dianae*** **:**

Cells strongly curved, gradually attenuated towards the obtusely rounded apices which have an oblique, truncate, thickened dorsal margin, wall smooth, chloroplast with 5 – 6 pyrenoids, 167- 211µm long and 11- 21µm broad.

Closterium moniliferum var ***concavum :***

Cells crescent-shape, with 9-10 pyrenoids, ventral margin flat, wall finely straight with 5 pyrenoids, apex rounded, cells 205- 214µm long and 25- 28µm broad, apex l0µ.

Closterium moniliferum var**. *submoniliferum*:**

Cells 207– 230µm long, 26-28µm broad, 6 µm at the apex, cells strongly curved, ventral margin, slightly concave, wall smooth.

Cosmarium granatum :

Cells very deeply constricted, sinus linear with a shightly dialated extremity and opening outwords, semicells narrowing, sides rounded, slightly concave, apex slightly obtuse, cell wall densely granulate, with 2 pyrenoids in each semicell. Cells 22- 25µm long and 13- 18µm broad.

Cosmarium hammeri var ***hammeri*** Reins.:

Cells very constricted, sinus linear with a slightly dialated extremity and opening outwords, semicells narrowing rapidly, basal angles rounded, sides slightly concave, apex slightly obtuse, cell wall densely puncatate, the margin attenuates towards the obtuse center of the semicell, cells 30- 32µm long and 23µm broad, apex broad, isthmus 7µm thick sinus 5 µm deep.

Cosmarium hornavenese var ***dubsvionum :***

Semicell frustum- shaped, all sides of the cell undulated, each semicell with 6 undulations, a cell has a chloroplast with 2 pyrenoides, chloroplast semicircular, apex straight, sinus 5µm, isthmus 10µm, cells 30- 35µm long and 18- 20µm broad.

Cosmarium impressulum :

Cells 30-35µm long and 23µm broad, at isthmus 9µm thick, sinus deep and closed, semicells subcircular, with 8 even marginal crenae, the two basal crenae straight, apex obtuse, cells in side and end views broadly elliptic wall often thicker at apex, closely punctate.

Cosmarium laeve var. ***laeve:***

Cells relatively longer than broader, sinus moderately constricted , semicells widely ovate from the broad base, apex rounded or slightly truncate, wall punctate. Cells 28-30µm long and 20- 22µm, at isthmus 4µm.

Cosmarium octhodes var**. *amoebum:***

Semicells subcirculr, sinus 15 µm and isthmus 17 µm, cells 60 µm long and 35- 40µm, sides conspicuously crenate with 11-13 crenae, apex smooth.

Cosmarium pachydermum var**. *pachydermum:***

Cells 73-75 µm long and 65µm broad, semicells elliptical with rounded ends and flattened apex, wall smooth, pyrenoid clear appearing in the two semicells, isthmus 30 µm, sinus linear.

Cosmarium pseudopyramidatum :

Cell relatively longer than broader, no granules, pyrenoides one in each semicell, apex rounded, sinus deep 7µm, cell 40- 44 µm long and 25- 27µm, semicells pyramidal, wall punctate, thickened.

Pediastrum tetras Ehr ***:***

Coenobia have 8-16 polygonal cells arranged in a stellate plate, peripheral cells of the colony differ in shape from inner cells, they have one, two or three processes, cell wall smooth.

Scenedesmus alternans Reinsh***:***

Coenobia are composed of 8 cells, arranged in two alternating rows, cells oval in shape and curved in mid-region, have rounded tips, no spines, cells 7µm long and 5µm broad.

Scenedesmus magnus Meyen :

Coenobia are composed of 4 cells arranged in one row, cells ellipsoidal, swollen in the mid region in terminal cells which have 4 spines, spines 40µm long, cell wall granulate, cells 35- 38µm long, 15µm broad.

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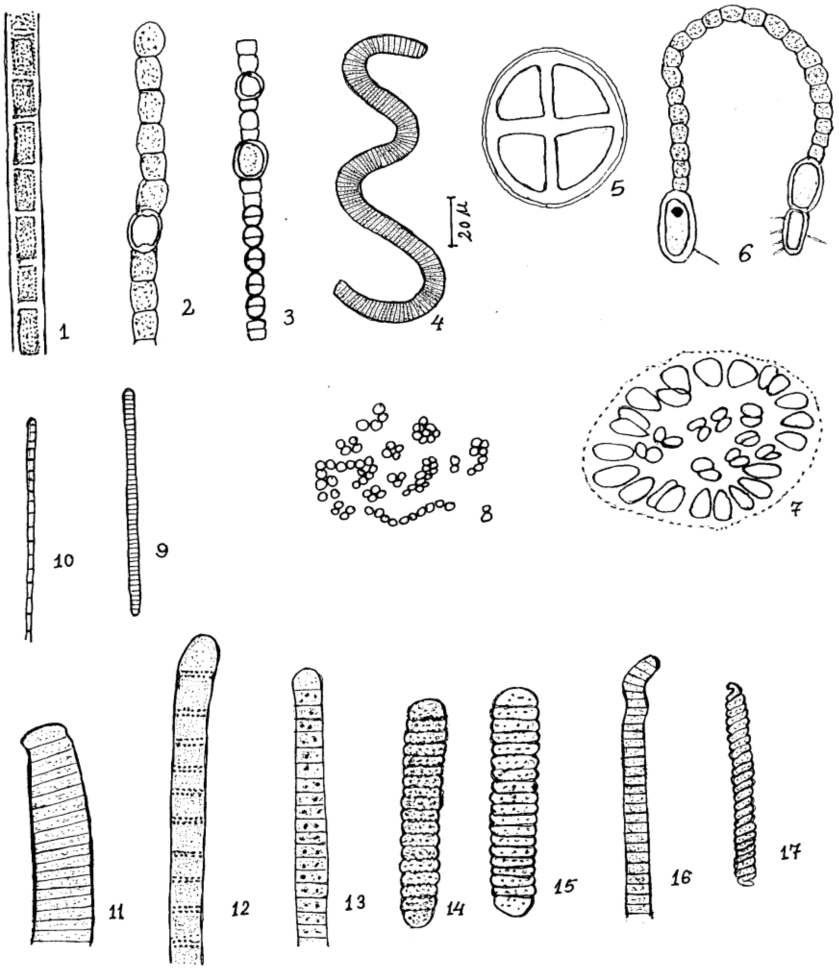
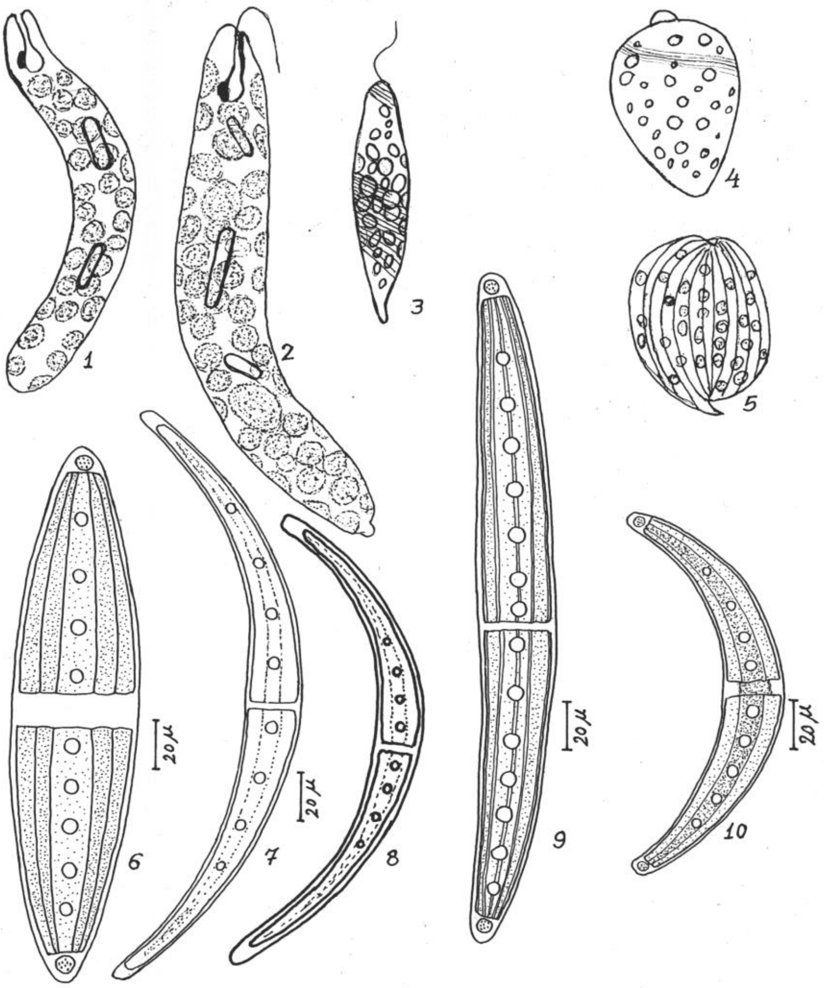
PLATE (I)



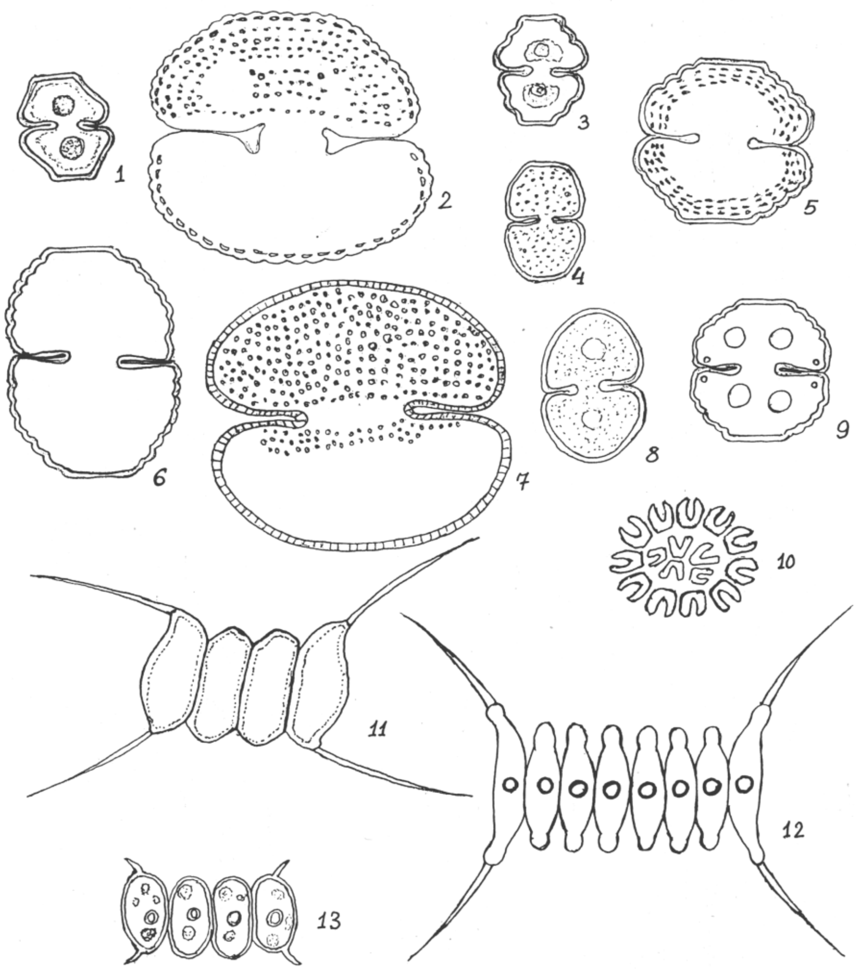
Figures (1-17): 1- ***Achronema macromeris*****, 2-** ***Anabaena variabilis*****,**
3- ***A variabilis*** **f.** ***crassa*****, 4-** ***Arthrospira platensis*****, 5-** ***Chroococcus turgidus*****,**
6- ***Cylindrospermum. alatosporum*****,- 7-** ***Gomphosphaeria aponica*****,**
8- ***Microcystis hansgirgiana*****, 9-** ***Oscillatoria animalis*****, 10-** ***O. chlabea*****, 11-** ***O. principes*****,**
12- ***O. raoi*****, 13-** ***O. sancta*****, 14-** ***O. simplissima*****, 15-** ***O. subbrevis*****, 16-** ***O. terebriformis*****,**
17- ***Spirulina spirulinioides.***
10µ= 9.0 mm if not otherwise indicated.

PLATE (II)



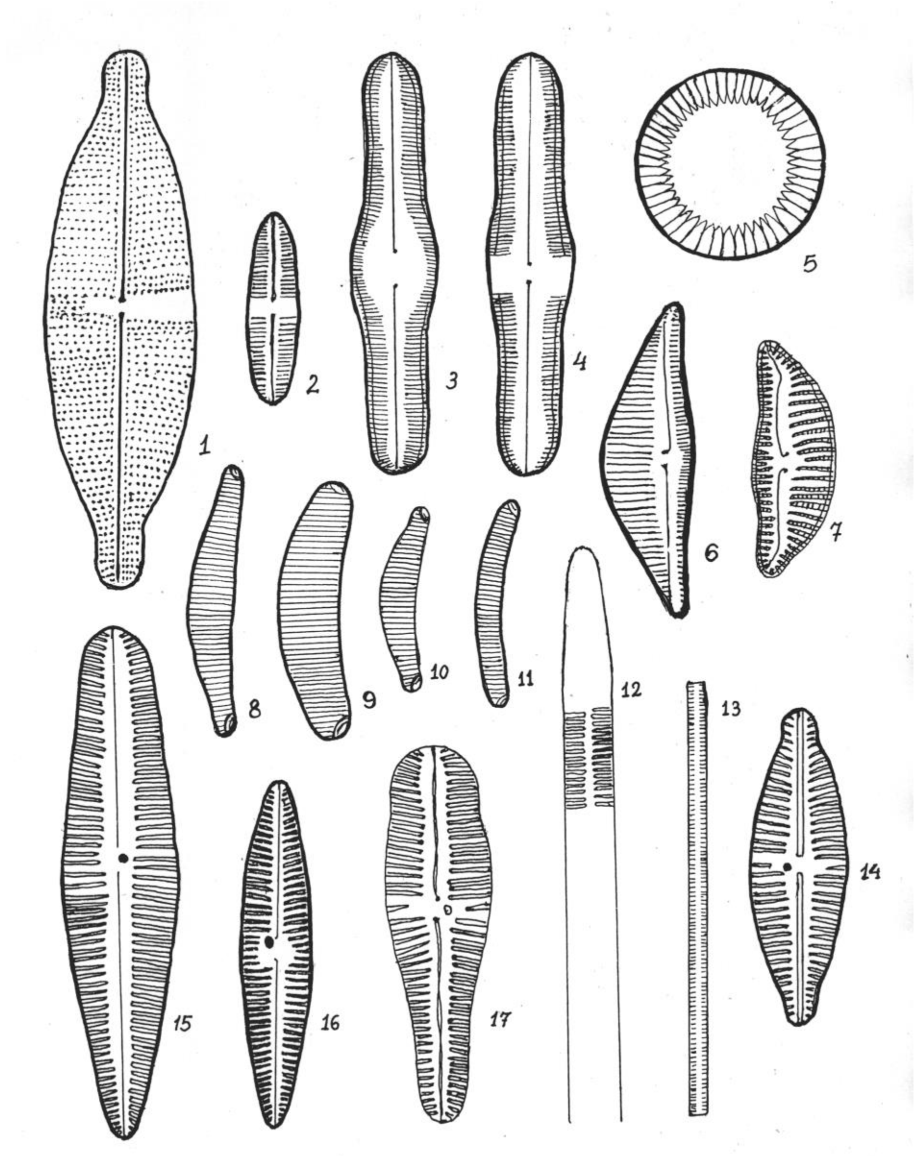
Figures (1-10): 1- *Euglena deses* v. *digrana*, 2-*E.deses* v. *intermedia*, 3- *E. hemichromata*, 4- *Lepocinclis colligera*, 5- *Phacus curvicauda*, 6- *Closterium closteriodes*, 7- *C. ehrenbergii* v. *atumidum*, 8- *C. dianae* v. *dianae*, 9- *C. lanceolatum* v. *lanceolatum*, 10- *C. moniliferum* v. *concavum*.
10μ= 9.0 mm if not otherwise indicated.

PLATE (III)



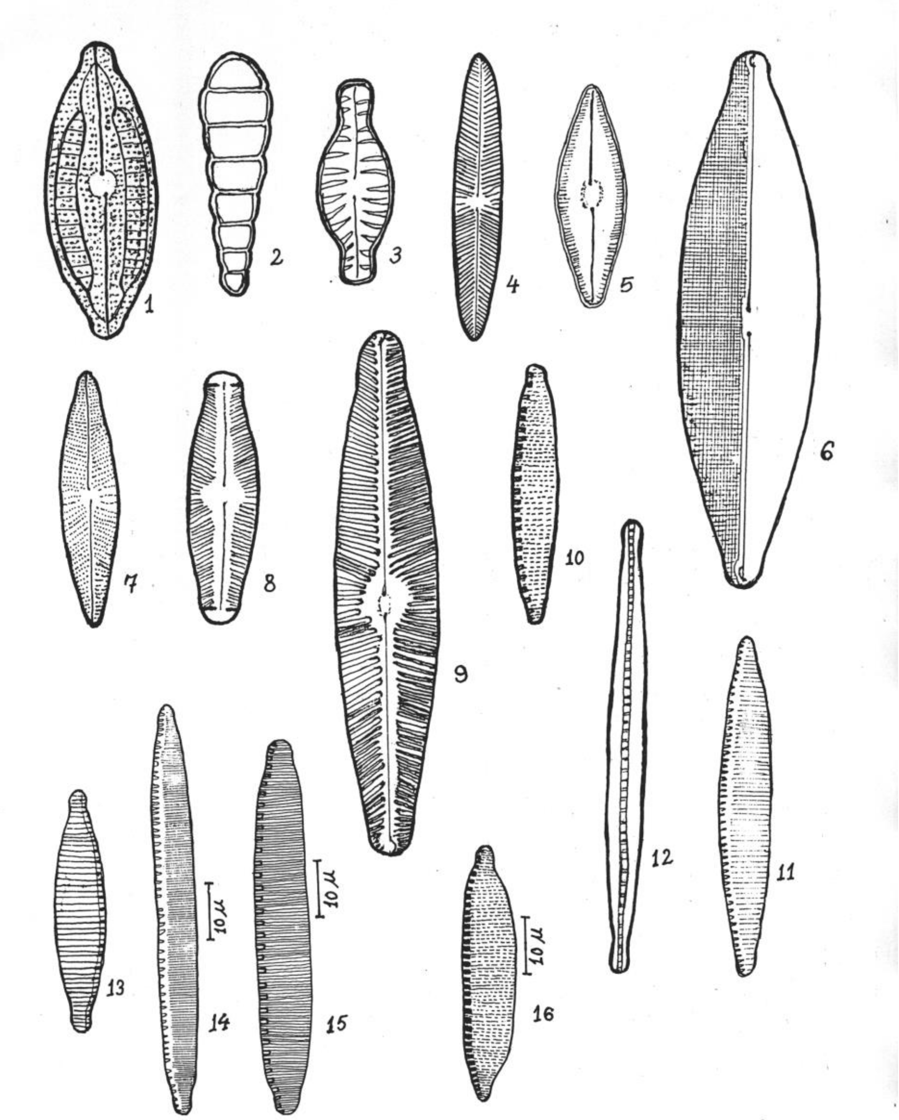
Figures (1-13): 1- *Cosmarium hammeri*, 2- *C. hornavanese* v. *dubovianum*, 3- *C. impressulum*, 4- *C. lavae* v. *lavae*, 5- *C. obtusatum*, 6- *C. octodes* v. *amoebum*, 7- *C. pachydermum*, 8- *C. pseudopyramidatum*, 9- *C. punctulatum*, 10- *Pediastrum tetras*, 11- *Scenedesmus magnus*, 12- *S. opoliensis*, 13- *S. spinosoaculatus*.
10μ= 9.0 mm if not otherwise indicated

PLATE (IV)



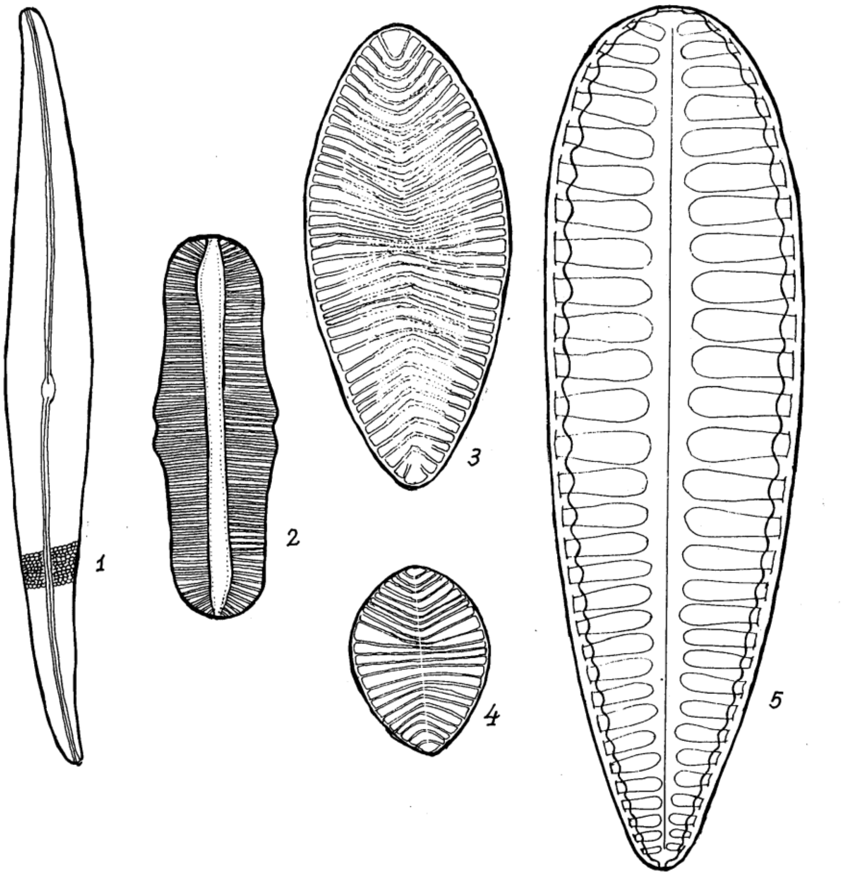
Figures (1-17): 1- *Anomoeoneis sphaerophora* , 2- *Caloneis bacillum* v. *bacillum*, 3- *C. pulchra*, 4- *C. silicula*, 5- *Cyclotella meneghenianа*, 6- *Cymbella minuta*, 7- *C. prostrata*, 8- *Eunotia arcus*, 9- *E. faba*, 10- *E. pectinalis* v. *minor*, 11- *E. tenella*, 12- *Feagilaria ulna*, 13- *F. virescens* v. *capiatata*, 14- *Gomphonema angustatum*, 15- *G. gracile*, 16- *G. olivaceum*, 17- *G. truncatum*.
10μ= 20 mm if not otherwise indicated.

PLATE (V)



Figures (1-16): 1- *Mastigolia elliptica*, 2- *Meridion circulare*, 3- *Navicula capitata* v. *capitata*, 4- *N. cari* v. *angusta*, 5- *N. confervacea*, 6- *N. cuspidata*, 7- *N. lanceolata* v. *lanceolada*,8- *N. pupula* v. *pupula*, 9- *N. vulpina* v. *vulpina*, 10 - *Nitzschia amphibia*, 11- *Nitzschia angustata*, 12- *N. dissipata*, 13- *N. frustulum*, 14- *N. linearis*, 15- *N. umbunata*, 16- *N. vivax*. 10μ= 20 mm if not otherwise indicated.

PLATE (VI)



Figures (1-5): 1- *Pleurosigma strigosum*, 2 - *Rhopalodia gibba*, 3- *Surierella ovalis*, 4- *S. ovata*, 5- *S. robusta*.
1μ= 1.2 mm.

الفلورا الطحلبية فى مزارع الأرز بواحـة الخارجـة بمصـر.

محمد عبد الوهاب الناغى وأحمد الشاهد وعادل أحمد فتحى وجمال الدين غريب أحمد
قسم النبات –كلية العلوم جامعة المنيا- المنيا 61519- مصر

تناول البحث دراسة الفلورا الطحلبية والخصائص الفيزيوكيميائية لمزارع الأرز بواحة الخارجة التابعة لمحافظة الوادى الجديد. وخلال فترة الدراسة تم تسجيل 99 نوعا طحلبيا كان من بينها 23نوعا ممن الطحالب الخضراء مزرقة تتبع 11 جنسا، و19 نوعا من الطحالب الخضراء تتبع لأربعة أجناس و52 نوعا من الطحالب العصوية تتبع 15 جنسا من الطحالب العصوية وكذلك خمسة أنوع من الطحالب اليوجلينية تتبع ثلاثة أجناس. وقد تباين تركيب العشائر الطحلبية فى مزارع الأرز المختلفة إلا أن الطحالب العصوية كانت هى الأكثر سيادة فى منطقة الدراسة. وقد اشتملت الطحالب التى حققت نسبة مئوية عالية لنردد الظهور (أكثر من 66.6%) على: أوسيلاتوريا كلابيا، أ. موجيشى، أ. برنسيبس، أ. راؤى و أ. سمبليسيما من الطحالب الخضراء المزرقة؛ كوزماريام ليفى, ك. بسيدوبيراميداتوم من الطحالب الخضراء؛ أنيمونيس سفيروفورا ونيتشيا ثرماليس من الطحالب العصوية. وقد تضمن البحث وصفا تصنيفيا للأنواع التى ندر تسجيلها فى المراجع المتاحة فيما يختص بمزارع الأرز. وتشتمل الدراسة أيضا على رسوم توضيحية (باستخدام كاميرا لوسيدا) لـ 78 من الأنواع التى تم تسجيلها مدرجة فى ست لوحات.