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Phytoplankton in Irrigation and Draining Water Canals of East Nile Delta of Egypt

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Abstract

Phytoplankton in water of River Nile, Ismailia canal and Belbase drain of East Nile Delta of Egypt was studied. The algal counts and biomass in water of River Nile and Ismailia canal ranged from 10^6 to 10^7 L^{-1} and 1 to 62 mg L^{-1} with highest peaks during warm seasons (May to November). The drainage water contained relatively low densities of algae and biomass as compared with irrigation water could be related to the higher salt content of the drainage water. The phytoplankton was found belonging to three major groups, namely *Chlorophyta* (green algae), *Cyanophyta* (blue green algae) and *Bacillariophyta* (diatoms). Diatoms represent the most dominant group (44 to 95% of total algae) followed by blue green algae (6 to 36% of total algae) in both irrigation and drainage water. Green algae represent the low percentage group (1 to 30%) of the total algae. *Eudorina*, *Pediastrum*, *Actinastrum* were the most dominant genera of green algae. *Anabaena* was the most abundant genera of blue green algae. While, the predominant genera of diatoms were *Melosira*, *Bacillaria* and *Synedra*.

Keywords*:* Phytoplankton, River Nile, Ismailia canal, Belbase drain

Introduction

The River Nile is the main source of water for irrigation, industrial and drinking purposes in Egypt. From the great River, there are many canals where Ismailia canal is the most important one as a source for water supply for several Governorates in the east of Nile Delta. Drainage water, when considered suitable, is sometimes used for irrigation. These water sources may be subjected to external pollution affects its biological life.

Biological assessment is a useful for assessing the ecological quality of aquatic ecosystems since biological communities integrate the environmental effects of water chemistry of Rivers and lakes (Stevenson and Pan, 1999). Phytoplankton encountered in the water body reflects the average ecological condition and therefore, they may be used as indicator of water quality (Bhatt, et al., 1999; Saha et al., 2000). Beside, phytoplankton are very suitable organisms for the determination of the impact of toxic substances on the aquatic environment because any effect on the lower level of the food chain will also have consequence on the higher level (Joubert, 1980). Phytoplankton were used for assessing the degree of pollution or as indicator of water pollution of different water bodies (Trivedy, 1986; Sudhaker et al., 1994; Dwivedi and Pandey, 2002). Panigrahi and Patra (2013) revealed that the distribution and population density of phytoplankton species depend upon the physico-chemical parameters of the environment.

Previous studies on Egyptian irrigation and drainage waters were practically limited to their suitability for irrigation. Some studies carried out from the public health point of view, were mainly concerned with the determination of the extent of pollution (Abd-El-Malek et al. 1970). The most dominant types of algae in water courses were considered the most frequent causes of tastes and odors in water supplies. Also, reduce the length filter runs and clogging filter and passed through rapid sand filter especially *Synedra* (Hobbes, 1954; Palmer, 1960&1962). Little are known about phytoplankton in these water resources. The present work, therefore, aimed to study the phytoplankton community in Nile water, Ismailia canal and Belbase drain.

Materials and Methods

The plankton were collected, counted and identified by using the method suggested by APHA (1985) and Prescott (1969). Raw water samples were collected at monthly intervals from the middle of the River Nile at Shoubra-El-Khima, Ismailia canal at beginning (at Mostrod), middle (at Belbase and Kassassin) and terminal (at Ismailia).Drain water samples were collected from Belbase drain at beginning, middle at Belbase and terminal. Water samples were taken from 10-15 cm subsurface as possible.

Phytoplankton in water samples were concentrated by a special phytoplankton net (55 µ). Samples were fixed by added one drop of lugol's solution (10 gm potassium iodide in 20 ml H_2O + 5 gm iodine in 50 ml H_2O plus 5 gm sodium acetate or 10% acetic acid). The treated samples were kept in the dark.

Counting of phytoplankton (organism / L) was determined by a haemocytometer cell. A 0.1 ml of concentrated sample was drawn into haemocytometer cell. Counting was conducted in 50 fields. The dilution factor was taken into consideration in the assessment of available phytoplankton. The systematic identification of planktons was made by standard keys of APHA, (1985).

The biomass was determined by filtrate concentrated water sample through a Sartorius membrane filter (2µ porosity). Following filtration the membrane filter dried at 70^{o}C and weighed.

Results and Discussion

The algal counts and biomass in River Nile and Ismailia canal water samples ranged between 10^6 – 10^7 organism and 1 to 62 mg per liter (Table 1 and Fig. 1&2). The highest counts and biomass were recorded in warm season (May to November) and the lowest counts and biomass in cold season (December to March). This is in agreement with Shehata and Bader (1985) who found that the count of algae in Nile water ranged from 10^6 - 10^7 organisms per liter with the highest peaks during spring and summer seasons. Baykal, et al. (2011) observed that the abundance and biovolume of phytoplankton in Melen River in the Western Black Sea region of Turkey were low in winter, though higher values were recorded in late spring and summer. The drainage water in Belbase drain contained relatively low densities of algae and biomass if compared with the irrigation water in Ismailia canal. This may be attributed to the higher salt content of the drainage water.

Table 1: Phytoplankton densities in water of Nile River, Ismailia canal and Belbase drain.

Location	March	April	May	June	July	August	September	October	November	December	January	February
Counts x 10^6 L^{-1}												
River Nile	27	38	35	30	38	63	50	50	50	10	13	15
Ismailia canal												
Mostrode (start)	33	38	38	40	63	50	63	60	63	8	5	15
Belbase (middle)	43	43	48	55	45	63	45	46	45	15	13	25
Kassassin (mid.)	20	38	45	50	50	58	42	45	42	13	13	30
Ismailia (terminal)	30	30	43	50	50	63	44	43	44	10	5	20
Belbase drain												
Start	14	13	14	21	22	23	25	24	25	4	4	12
Middle	21	22	23	27	23	31	24	18	18	5	4	7
Terminal	17	16	24	23	31	32	22	16	17	8	7	15

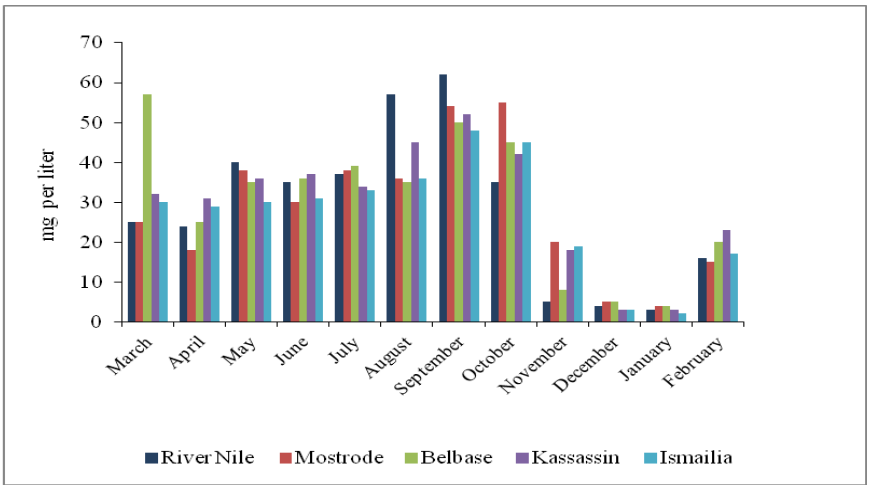

Figure 1: Biomass of phytoplankton in water of River Nile, and Ismailia canal.

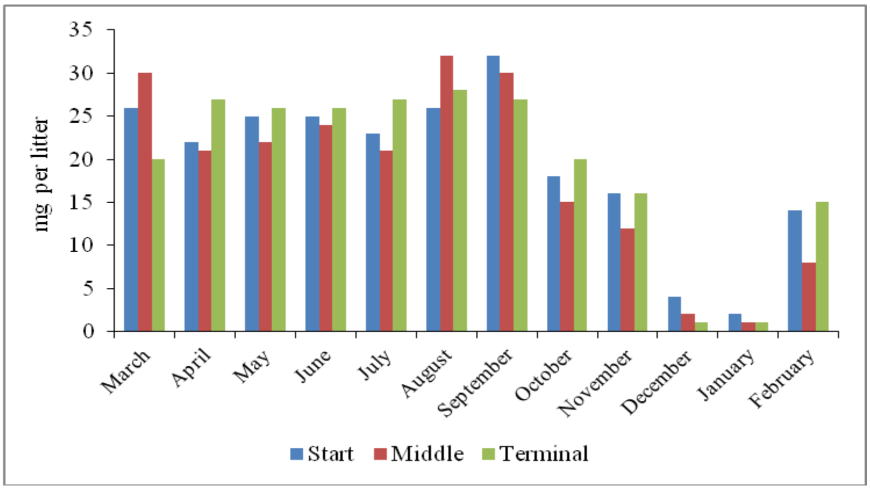

Figure 2: Biomass of phytoplankton in water of Belbase drain.

Phytoplankton structure in irrigation and drainage water are shown in Figs. 3, 4 and 5. The phytoplankton was found belonging to three major group, namely *Chlorophyta* (green algae), *Cyanophyta* (blue green algae) and *Bacillariophyta* (diatoms). There are no great differences in phytoplankton structure in irrigation and drainage waters. Diatoms represent the most dominant group (44 to 95% of phytoplankton community) followed by blue green algae (6 to 36% of the total algae). Similar results were obtained in the Ohio River by Palmer and Poston (1956), in central Rivers at the south central area of the USA according to Palmer (1964) and in River Nile by Shehata and Bader (1985). Panigrahi and Patra (2013) revealed that diversity of phytoplankton species in River Mahanadi, Odisha, India were *Chlorophyceae* 53.45%, *Cyanophyceae* 20.78% and *Bacillariophyceae* 25.77%.

As to the seasonal variation in density, green algae were present throughout the year, yet they tend to increase in number during July (summer season). Blue green algae exhibit a lesser degree of seasonal variation throughout the year. They tended to develop periodic pulses one in June, another in August and the third in October. Diatoms, however, represent the most abundant group throughout the year. Its maximum occurrence was obtained in winter season. This indicated that lower temperature favoured the growth of diatoms. Patrick (1969) feels temperature is an important factor in controlling the succession of fresh water algae, but not the only factor. She reported that diatoms prefer 20 – 30^{o}C, green algae 30 – 35^{o}C and blue green algae 35^{o}C. As temperature increased, the algae group with the highest growth rate changed from diatoms to green algae to blue green algae (Canale and Vogel, 1974).

Microscopic examination of water samples show that phytoplankton represented by 41 different genera. Twenty one genera of green algae namely, *Eudrina, Scenedesmus, Pediastrum, Actinastrum, Ankistrodesmus, Oocystis, Botryococcus, Staurastrum, Coelastrum, Selenastrum, Sphaerocystis, Tetraedron, Clostrium, Micractinum, Mougeotia, Chlorella, Spirogyra, Pandorina, Euglena, Chlamydomonas and Volvox*. Six genera of blue green algae namely, *Cylindrosperum, Microcystis, Agmenellum, Anabaena, Oscillatoria* and *Spirulina*. Fourteen genera of diatoms were detected namely, *Cyclotella, Melosira, Bacillaria, Synedra, Nitzchia, Navicula, Asterionella, Cymbella, Cymatopleura, Pinnularia, Gomphonema, Fragillaria, Cocconies* and *Surirella*. Mukati et al (2014) reported that different class such as *Chlorophyceae, Cynophyceae, Tebouxiophyceae, Ulvophyceae and Zygnematophyceae* were identified from various freshwater habitats in Narmada river of West Nimar, India.

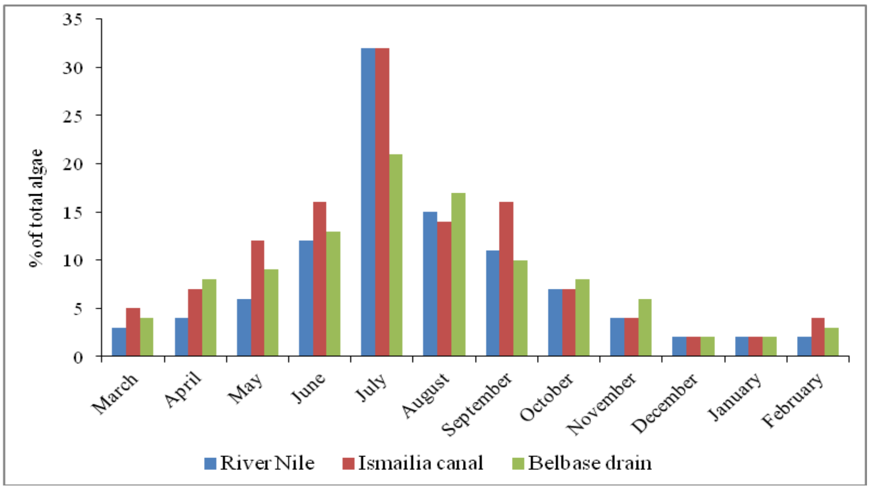

Figure 3: Percentage distribution of green algae in water of River Nile, Ismailia canal and Belbase drain.

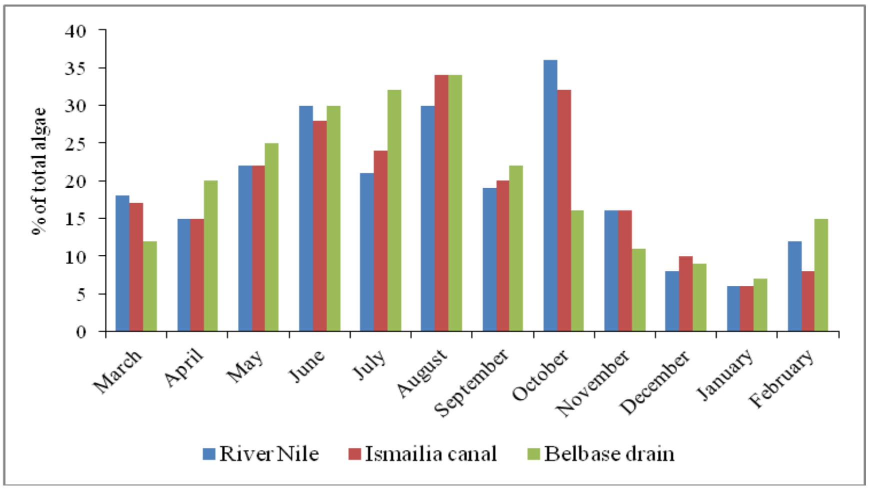

Figure 4: Percentage distribution of blue green algae in water of River Nile, Ismailia canal and Belbase drain

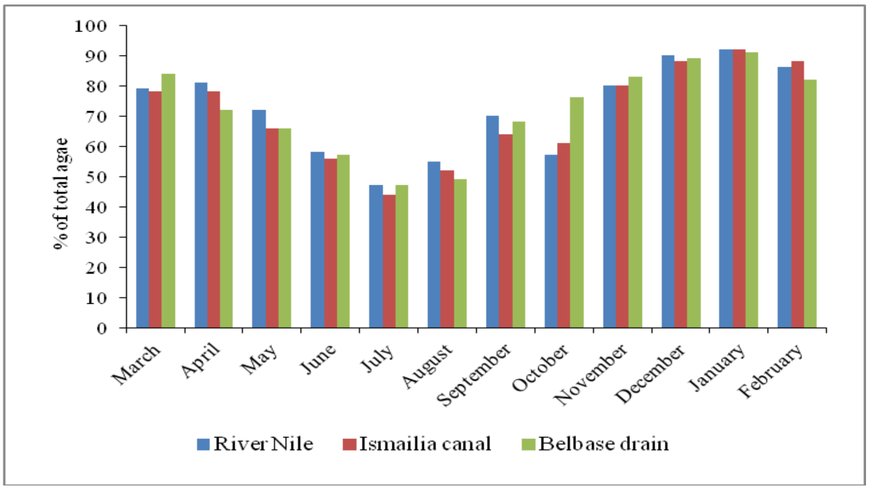

Figure 5: Percentage distribution of diatoms in water of River Nile, Ismailia canal and Bebase drain.

Eudrina, Pediastrum and Actinastrum was the most dominant genera of green algae. *Anabaena* was the most abundant genera of blue green algae. While, the most predominant genera of diatoms were *Melosira*, *Bacillaria* and *Synedra*. Palmer (1960) revealed that *Cyclotella, Synedra, Melosira, Navicula, Asterionella* and *Stephanodiscus* were the most dominant genera in some Rivers at the south central area of USA. Greenberg (1964) records that the diatoms *Synedra, Cyclotella* and *Melosira* were generally the dominant algae in the Sacramento River. Shehata and Bader (1985) found that *Cyclotella, Synedra, Melosira, Bacillaria, Cylindrosperum, Eudorina, Scenedesmus* and *Ankistrodesmus* were the dominant genera in Nile water. Essien-Ibok (2013) showed that a total of 102 species of phytoplankton in general and five taxonomic groups were collected from the Mbo River in Akwa Ibom State, Nigeria. Of this total, the diatoms had the highest number of species (45 species), followed by *chlorophyceae* with 25 species.

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