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STUDIES ON THE CAUSATIVE GENERA OF PHYTOPLANKTON BLOOM IN FISH PONDS OF MYMENSINGH

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Key Words: **Causative Genera, Phytoplankton Bloom, Fish Ponds.**

Abstract

A study on the causative genera of phytoplankton bloom was carried out in six fish ponds in and around Bangladesh Agricultural University campus. Of the total 38 genera of phytoplankton, seven genera belonging to Bacillariophyceae, 21 to Chlorophyceae, eight to Cyanophyceae and two to Euglenophyceae were recorded during the study among which *Microcystis* was dominant followed by *Chlorella, Euglena, Anabaena* and then *Melosira*. The bloom was formed by *Microcystis* and *Anabaena* during the study. There was almost inverse correlation of *Microcystis* and *Anabaena* with other genera found in almost all the ponds. *Microcystis* had direct correlation with *Anabaena* in all the ponds except pond 6. The correlation values of *Microcystis* and *Anabaena* with other genera indicate that these two genera might have growth inhibitory effect on other genera.

Key Words: **Causative Genera, Phytoplankton Bloom, Fish Ponds**

Introduction

Phytoplankton indicates the productivity status of the ecosystem of a water body. These are the basic sources of energy of the living organisms in the aquatic habitat (Boyd, 1990; Habib *et al.*, 1993). Fixation of solar energy first takes place in phytoplankton form, which then becomes available to the series of organisms through food chain in the aquatic ecosystem (Robarts and Sephton, 1989).

The aquatic organisms directly or indirectly depend on phytoplankton population. The knowledge of planktonic biomass available in an ecosystem is of fundamental importance for fish culture. The value of phytoplankton in a water body forming the basic link in the food chain of fishes is well recognized.

Although phytoplankton is an essential component of an aquatic ecosystem it should be in an optimum range to ensure proper productivity. A large number of phytoplankton populations can produce its bloom, which sometimes can have a detrimental effect (Gromov *et al.*, 1996). So phytoplankton bloom is not always wanted because some species produces toxin (Fulton III and Paerl, 1987) which can spoil the water quality and can cause toxicity to fish population and may lead to fish mass mortality (Sivonen *et al.*, 1989). In most cases water become deep green or blue green or red colour due to phytoplanktonic bloom. There are regular seasonal blooms in some water bodies. But there are also occasional blooms in many water bodies. Due to bloom the colour of water becomes distinctly changed, the water becomes slimy and surface scum appears.

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Bacillariophyles (diatoms), Euglenophytes can also form blooms in freshwater. It has been found that permanent phytoplankton blooms by *Microcystis* spp. or *Anabaena*spp. is common in the derelict ponds of the urban area and these species produce toxins (Sivonen *et al.*, 1990). In such condition toxins reduce the growth of some species of phytoplankton, herbivorus zooplankton and fish (Gromov *et al.*, 1996).

The qualitative and quantitative information of phytoplankton in our country is poor and information on their biological aspects also fragmentary. This present work was initiated to supplement the existing knowledge of qualitative and quantitative aspects of phytoplankton bloom. The present work was undertaken to determine the fortnightly variation of dominant genera in ponds and their interrelationship.

Materials and Methods

The study was conducted in six fish ponds in and around the Bangladesh Agricultural University Campus, Mymensingh, Bangladesh. Fortnightly samples of phytoplankton were collected from these six ponds during the study period.

(i) Collection of samples:

Water samples were collected from the ponds for the qualitative and quantitative study of phytoplankton. Five litres of water samples from surface were collected at every fortnight and then passed through a plankton net of 55 blotting silk of 30 micron mesh size. The collected samples were concentrated to a volume of 20 ml

(ii) Study of sample for phytoplankton:

The quantitative study of phytoplankton of samples was done by Sedgewich Rafter (SR) counting cell, which are 50 mm long, 20 mm wide and one mm deep. The volume of the chamber is one ml. (1000 mm^3 or 1 cc). The counting chamber is equally divided into 1000 fields. Each field has a capacity of one μl. From the concentrated volume of the plankton samples, one ml was taken by a dropper and then put on the SR cell. The counting chamber was covered with a cover slip so as to eliminate the air bubbles and then it was placed under microscope for further analysis. Phytoplankton was counted from 30 random fields (units) out of the fields of the SR counting cell with the help of binocular microscope (magnification 10×10). The cell/L of original water was calculated as per Cleseri *et al.*, (1989). Identidication of phytoplankton was done following the keys of Whitford and Schumachar (1973), Palmer (1980) and Prescott (1984).

Result and Discussion

During the study period a total of 38 genera of phytoplankton was recorded of which 7 belonged to Bacillariophyceae, viz., *Cyclotella, Fragillaria, Frustularia, Melosira, Navicula, Nostoc, Surirella,* 21 to Chlorophyceae viz., *Actinastrum, Ankistrodesmus, Botryococcus, Chlorella, Closterium, Coelastrum, Cosmarium, Crucigenia, Gonatozygon, Micrasterium, Oocystis, Pediastrum, Scenedesmus, Sphaerocystis, Ceratium, Spirogyra, Staurodesmus, Tetradesmus, Tetraedon, Volvox, zygnema,* eight to Cyanophyceae viz., *Anabaena, Aphanocapsa,*

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Micro cystics, Oscilliatoria. The group Euglenophyceae was represented by two genera such as *Euglena* and *Phacus*. Dewan (1973) recorded 46 genera of phytoplankton in a Mymensingh lake. Vyas and Kumar (1968) found 50 species of algae belonging to 38 genera in the year round study in the tank. Of the 50 species, 23 belonged to Chlorophyceae, 13 to Myxophyceae, eight to Bacillariophyceae, three to Xanthophyceae, two to Chrysophyceae and one to Euglenophyceae.

Among the 38 genera of phytoplankton, *Melosira, Chlorella, Anabaena, Microcystis, Euglena* were found to play the dominant role in all ponds. In this study, *Microcystis* played most dominant role to create bloom. Similar results have also been reported by Habib *et al.* (1984) and Ali *et al.* (1985). The dominancy of Cyanophyceae may be due to favourable time and nutrient in pond. Alam *et al.* (1989) observed that *Anabaena* was the most dominant genera followed by *Microcystis*.

Melosira was almost absent on Jan. 10 and 25, 1999 in all the pond (Table I). It was absent only in pond 3 on Feb. 10, 1999. *Melosira* had dominancy in all the ponds on Feb. 25, 1999. *Chlorella* was found dominant on Jan. 10 and 25, 1999 except in ponds 3 and 4. Whereas the abundance of *Anabaena* was found dominant on Dec. 10, 1998 in all the ponds except ponds 2 and 4. But *Microcystis* found dominantly higher in all the ponds except pond 4 on Jan. 10, 1999 than in other sampling dates. *Euglena* was also dominantly higher in all the ponds except pond 1 on Jan. 10, 1999 than in other sampling dates. *Chlorella, Microcystis* and *Euglena* were abundant throughout the sampling period. Almost similar trend was recorded in ponds 3, 4 and 5, *chlorella, Anabaena* and *Microcystis* were found more abundant than *Melosira* and *Euglena* in pond 6. However, *Microcystis* and *Anabaena* were found dominant during the study which has the similarity with the findings of Alam *et al.* (1989). The inhibition of growth of microalgae may be due to the toxin produced by the *Microcystis* (Utkilen and Gohme, 1992).

The inhibition of growth of *Melosira* and *Chlorella* by *Microcystis* was proved by the inverse correlation among them in most of the ponds (Tables II, III, IV, V, VI and VII). Similar trend was recorded in cases of *Euglena* and *Microcystis*. Habib *et al.* (1986) recorded that *Microcystis* and *Anabaena* had inverse relation with most of the other microalgae. The inhibition of growth may be due to the production of toxins by *Microcystis* and *Anabaena* which agrees with findings of Lam and Silvester (1979). *Microcystis* had almost directly significant correlation with *Anabaena* in ponds except ponds 3 and 6. Similar findings was observed by Habib and Mohsinuzzaman (1986). Many authors identified the toxic blue-green algae among which *Microcystis* and *Anabaena* are prominant (Sivonen *et al.*, 1990). These blue green algae had toxic effect on the growth of herbivorous zooplankton when fed on them (Fulton III and Pearl, 1987) and other animal like mouse (Sivonen *et al.*, 1989 and Gromov *et al.*, 1996). Therefore, it is concluded that *Microcystis* and *Anabaena* are bloom forming algae and have the growth inhibitory effects on the other algae.

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Table -1
Fortnightly variation (mean ± SD) of dominant genera of phytoplankton ($\times 10^3$ cells/L) in ponds and their fortnightly significant differences at 5% level of probability after Tukey test.

Date	*Melosira*	*Chlorella*	*Anabaena*	*Microcystis*	*Euglena*
Dec. 10, 1998	1.87 ± 1.85^{b}	4.13 ± 1.29^{d}	25.86 ± 2.34^{a}	66.40 ± 0.40^{a}	4.20 ± 0.40^{c}
Dec. 25, 1998	1.87 ± 0.61^{b}	3.87 ± 0.61^{d}	12.93 ± 0.92^{b}	23.73 ± 0.46^{e}	4.26 ± 0.23^{c}
Jan. 10, 1999	0.0^{c}	30.93 ± 4.01^{b}	7.60 ± 0.69^{c}	59.33 ± 18.58^{b}	8.07 ± 1.03^{b}
Jan. 25, 1999	0.0^{c}	37.07 ± 2.20^{a}	2.00 ± 0.0^{d}	18.23 ± 3.74^{f}	10.87 ± 0.83^{a}
Feb. 10, 1999	1.87 ± 0.23^{b}	11.47 ± 0.83^{c}	1.33 ± 0.30^{d}	45.07 ± 4.40^{c}	4.12 ± 0.46^{c}
Feb. 25, 1999	12.93 ± 3.59^{a}	13.07 ± 0.46^{c}	2.53 ± 0.23^{d}	39.07 ± 3.21^{d}	4.33 ± 1.89^{c}

Figures in common letters don't differ significantly at 5% level of probability. df = (11, 6)sssss

Table – 2
Correlation matrix of different dominant genera of phytoplankton in Pond 1.

	Chlorella	*Anabaena*	*Microcystis*	*Euglena*
Melosira	-0.330	0.426	-0.389	-0.415
Chlorella	-	-0.265	-0.485*	0.503*
Anabaena	-	-	0.556*	0.342
Microcystis	-	-	-	-0.244

df = 16, * $P < 0.05$, ** $P < 0.01$

Table - 3
Correlation matrix of different dominant genera of phytoplankton in Pond 2.

	Chlorella	*Anabaena*	*Microcystis*	*Euglena*
Melosira	0.478*	0.308	-0.266	0.422
Chlorella	-	-0.244	-0.289*	0.360
Anabaena	-	-	0.545*	-0.534*
Microcystis	-	-	-	-0.388

df = 16, * $P < 0.05$, ** $P < 0.01$

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Table - 4

Correlation matrix of different dominant genera of phytoplankton in Pond 3.

	Chlorella	*Anabaena*	*Microcystis*	*Euglena*
Melosira	-0.625	-0.523*	-0.476*	-0.368
Chlorella	-	-0.577*	-0.389	0.249
Anabaena	-	-	0.406	-0.485*
Microcystis	-	-	-	-0.217

df = 16, * P < 0.05, ** P < 0.01

Table - 5

Correlation matrix of different dominant genera of phytoplankton in Pond 4.

	Chlorella	*Anabaena*	*Microcystis*	*Euglena*
Melosira	0.421	0.308	0.268	-0.528*
Chlorella	-	-0.623**	-0.492*	0.712**
Anabaena	-	-	0.577*	-0.655**
Microcystis	-	-	-	-0.205

df = 16, * P < 0.05, ** P < 0.01

Table - 6

Correlation matrix of different dominant genera of phytoplankton in Pond 5.

	Chlorella	*Anabaena*	*Microcystis*	*Euglena*
Melosira	-0.428	0.250	-0.372	-0.476*
Chlorella	-	-0.528*	-0.420	0.505*
Anabaena	-	-	0.489*	-0.470*
Microcystis	-	-	-	0.362

df = 16, * P < 0.05, ** P < 0.01

Table - 7

Correlation matrix of different dominant genera of phytoplankton in Pond 6.

	Chlorella	*Anabaena*	*Microcystis*	*Euglena*
Melosira	-0.633**	-0.325	-0.312	-0.505*
Chlorella	-	-0.450*	-0.388	0.482*
Anabaena	-	-	0.270	-0.202
Microcystis	-	-	-	-0.497*

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