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Study of Euglenophytes Bloom and it's Impact on Fish Growth in Bangladesh

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A study was carried out in nine fertilized fish ponds under three treatments (T-I, T-II and T-III) at Bangladesh Agricultural University, Mymensingh to see the bloom of euglenophytes with the intention of observing its impact on the growth of fish in culture condition. Some water quality parameters viz., temperature, dissolved oxygen, pH, PO_4-P and NO_3-N concentration and some biological parameters viz., phytoplankton population and growth of fish were monitored at fixed intervals. Euglenophytes showed a heavy bloom in late August in the ponds of T-II. The bloom was occurred by the genera, *Euglena*, *Phacus* and *Trachelomonas* of which *Euglena* was the most dominant genus. In relation of water quality parameters with euglenophytes bloom, it was hypothesized that euglenophytes prefers higher temperature and acidic environment with higher nutrient concentrations. Acidic environment and nutrient enrichment enhanced the bloom of euglenophytes which hampered the growth of other beneficial algal groups (chlorophytes and bacillariophytes) and fish. Due to heavy bloom, the fishes breathed with difficulty at the surface. The fishes in the heavy bloom ponds presented the weight values were lower than verified for those in the ponds where the bloom did not occur. Total production (calculated) of fish in different treatments ranged from 1355.89 to1760.63 kg ha^{-1} with significantly ($p < 0.05$) lowest in the ponds of T-II.

Key Words: Bangladesh, bloom of euglenophytes, fertilized fish ponds

INTRODUCTION

For getting higher fish production, fish farmers apply high dozes of fertilizers and feeds in their ponds. As a result, the confined waters of the ponds have become eutrophicated due to sedimentation of nutrients from fertilizers and from decomposition organic matters which induce toxic and noxious phytoplankton blooms including euglenophytes. Euglenophytes bloom is the most common phenomenon in warmer shallow and eutrophic water bodies in Bangladesh. *Euglena*-assemblages are known to be widely distributed in higher eutrophicated shallow ponds at elevated temperature (Wild *et al.* 1995).

Some toxic algal blooms kill wild and farmed fish populations while non-toxic algal species may cause problems through biomass effects, shading of submerged vegetation, disruption of food web dynamics and structure and oxygen depletion as the blooms decay. Thick bloom of euglenophytes hampered the growth of edible plankton through inhibiting the light penetration as well as they use nutrients from the water body for their growth. *Euglena*, *Phacus* and *Trachelomonas* have significant effect in reducing the number of other algal species in aquaculture ponds (Leupold 1988).

Concerning the effect of environmental factors on the growth of euglenophytes and their impacts on fish growth, a number of findings have been reported in some countries (Olaveson and Stokes 1989; Xavier *et al.* 1991; Tripathi and Shukla 1993; Zakrys and Walne 1994; Hayashi *et al.* 1995) but research on the relationships between euglenophytes bloom and fish growth have been poorly understood in Bangladesh. Therefore, the present study was done to fond out the bloom dynamics of euglenophytes in relation to water quality parameters and its impact on fish growth.

MATERIALS AND METHODS

Experimental ponds

The experiment was carried out in nine earthen experimental fish ponds situated behind the Faculty of Fisheries, Bangladesh Agricultural University,

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Mymensingh (24°45'N latitude, 90°23'E longitude) for a period from July to November, 2001. All the ponds possessed similar shape, size, depth, basin configuration and bottom type including water supply facilities.

Experimental design and pond management

The experiment was conducted under three treatments with three replications in each treatment. The treatments used in this study were cowdung 1.0 kg and chicken manure 0.5 kg per decimal (T-I); chicken manure 1.0 kg per decimal (T-II); and cowdung 2.0 kg per decimal (T-II). The manuring of the ponds was done weekly as slurry on wet weight basis. All the ponds were stocked with rohu (*Labeo rohita*), catla (*Catla catla*), mrigal (*Cirrhina mrigala*), silver carp (*Hypophthalmichthys molitrix*) and Thai sarputi (*Puntius gonionotus*) fries at the rate of 42 fish per decimal with a ratio of 1:1:1:2:2.

Analysis of water quality parameters

Water quality parameters were analyzed fortnightly. Surface water temperature and dissolved oxygen were measured on the spot by using digital DO meter (YSL Model 58, USA). pH, PO_4-P and NO_3-N were analyzed in the Water Quality and Pond Dynamics Laboratory in Fisheries Faculty, Bangladesh Agricultural University. pH was measured with an electric pH meter (Jenway, Model 3020 UK). The concentration of PO_4-P and NO_3-N were recorded directly from the reading of spectrophotometer (HACH KIT, DR 2010) with Phosver 3 and Nitriver 5 powder pillows for 25 ml filtered water samples.

Study of phytoplankton

For plankton enumeration, water samples were collected from different depth of the pond by plankton net. The determination of phytoplankton was performed with an Olympus phase-contrast microscope at 100 to 400 X, with bright field and phase contrast illumination on concentrated samples preserved with formalin. The taxonomic identification of phytoplankton was done according to APHA (1992) and Bellinger (1992). The quantitative estimation of phytoplankton was done by Sedgewick-Rafter counting chamber (S-R cell) under the microscope.

Study of fish growth

To ascertain the growth of fish, about 10% of fish were collected monthly. The growth of fish was measured in weight gain. Weight gained by fish was calculated by deducting the average initial weight from the corresponding weight recorded each month. The measurement of weight (g) of individual fish was done separately by using a portable electric balance graduated in 0.1 g respectively. At the end of the experiment, all fishes were harvested and counted and the weight of the fish was taken for each pond to assess the survival and production.

Statistical analysis

All the data, collected throughout the study period were analyzed statistically by analysis of variance (ANOVA) and correlation for interpretation of the results.

RESULTS

Environmental parameters

The detailed information on environmental parameters is shown in Table 1. Surface water temperature fluctuated between 23.30-32.10 °C among all the ponds. The dissolved oxygen was found to be variable (2.98-5.93 mg L^{-1}). pH value ranged from 6.01-9.06 with the lowest value recorded in the ponds of T-II. The PO_4-P concentration found to vary from 0.21-1.37 mg L^{-1}. The concentration of NO_3-N was higher than PO_4-P and ranged from 0.61-1.47 mg L^{-1}. Significant ($p < 0.05$) differences (One way ANOVA) among the treatments existed for dissolved oxygen, pH, PO_4-P and NO_3-N concentrations values.

Total phytoplankton

Phytoplankton population in the experimental ponds was found to be consisting of 34 genera belonging to 4 groups such as euglenophytes (3), cyanophytes (9), chlorophytes (17) and bacillariophytes (5) which are listed in Table 2. The fortnightly variations of total phytoplankton abundance in different treatments are shown in Fig 1a. The cell density of total phytoplankton was found to be highest ($205.85 \pm 35.08 \times 10^4$ cells L^{-1}) in the ponds of T-II in late August and the lowest ($5.28 \pm 1.92 \times 10^4$ cells L^{-1}) in the ponds of T-I in early July. On the basis of mean value, higher cell density of total phytoplankton was found in the ponds of T-II ($49.60 \pm 12.23 \times 10^4$ cells L^{-1}) ranked second in the ponds of T-I ($32.61 \pm 9.26 \times 10^4$ cells L^{-1}) followed by the ponds of T-III ($26.91 \pm 8.43 \times 10^4$ cells L^{-1}).

Occurrence and abundance of euglenophytes

Three genera of euglenophytes, *Euglena*, *Phacus* and

Table 1. The mean values (with Standard Deviation) and ranges of different water quality parameters and plankton population in the ponds of three treatments

Parameter	Treatment		
	T-I	T-II	T-III
Temperature (°C)	28.56 (2.82)	28.60 (2.77)	29.00 (2.67)
	24.37-32.10	23.30-31.83	23.57-31.50
Dissolved oxygen (mg L^{-1})	5.39 (0.63)	4.68 (0.37)	5.64 (0.52)
	4.30-5.75	2.98-5.83	5.20-5.93
pH	7.40 (0.99)	7.05 (0.60)	7.97 (0.86)
	6.54-8.96	6.01-7.83	7.12-9.06
PO_4-P (mg L^{-1})	0.64 (0.38)	0.92 (0.39)	0.55 (0.19)
	0.21-1.26	0.25-1.37	0.22-0.66
NO_3-N (mg L^{-1})	0.99 (0.12)	1.15 (0.18)	0.77 (0.23)
	0.87-1.27	0.93-1.47	0.61-1.07
Total phytoplankton (x 10^4 cells L^{-1})	32.61 (9.26)	49.60 (12.23)	26.91 (8.43)
	5.28-86.97	6.51-205.85	9.85-70.40
Euglenophytes (x 10^4 cells L^{-1})	13.21 (7.80)	26.46 (11.79)	4.52 (1.80)
	1.41-47.80	1.55-117.99	1.36-8.77
Cyanophytes (x 10^4 cells L^{-1})	16.41 (7.44)	21.46 (11.47)	17.46 (9.50)
	2.07-38.23	4.11-87.28	5.65-54.43
Chlorophytes (x 10^4 cells L^{-1})	2.51 (1.09)	1.42 (4.28)	4.36 (2.09)
	0.76-6.02	0.43-2.78	2.26-5.80
Bacillariophytes (x 10^4 cells L^{-1})	0.48 (0.17)	0.26 (0.13)	0.68 (0.29)
	0.18-1.00	0.15-0.44	0.41-1.44

Table 2. Generic status of phytoplankton obtained during the study period

Phytoplankton group	Genera under each group
Euglenophytes	*Euglena, Phacus, Trachelomonas*
Cyanophytes	*Aphanocapsa, Apanizomenon, Anabaena, Anabaenopsis, Chroococcus, Gomphospheria, Microcystis, Merismopedia, Gloeocapsa*
Chlorophytes	*Actinastrum, Ankistrodesmus, Botryococcus, Chlorella, Coelastrum, Closterium, Scenedesmus, Pediastrum, Teraedon, Staurastrum, Selenastrum, Ulothrix, Zygnema, Volvox, Oocystis, Teubaria, Micractinium*
Bacillariophytes	*Cyclotella, Fragilaria, Navicula, Nitzschia, Synedra*

Trachelomonas were recorded. Euglenophytes was overwhelmingly occurred by the genus *Euglena*. The fortnightly variations of euglenophytes cell density among the treatments are shown in Fig 1b. Euglenophytes showed it's highest cell density (117.99 ± 21.41 x 10^4 cells L^{-1}) in the ponds of T-II in late August and the lowest (1.36 ± 0.76 x 10^4 cells L^{-1}) in the ponds of T-III in early July. Euglenophytes started to form bloom from early August and showed a heavy bloom in late August in the ponds of T-II with a rapid decrease of the bloom was found from the beginning of September down to on the late November. The ranges and mean values of euglenophytes cell density among the treatments are shown in Table 1.

Euglenophytes bloom and water quality parameters

The relations among euglenophytes bloom, dissolved oxygen, pH, PO_4-P and NO_3-N are shown in Figs 2 & 3. During the heavy bloom of euglenophytes observed in the ponds of T-II, the mean value of temperature was 30.23°C, dissolved oxygen 2.98 mg L^{-1}; pH value 6.01; PO_4-P 1.37 mg L^{-1} and NO_3-N was 1.47 mg L^{-1}). By comparison with water quality parameters associated with euglenophytes bloom, it was observed that cell density of euglenophytes increased at acidic environment with higher PO_4-P and NO_3-N concentrations and showed a declining trend at alkaline condition (pH >7.0) with lower nutrient concentrations. The size of euglenophytes population in the treatments appeared to be correlated with dissolved oxygen, pH and the surrounding nutrients. The population size of euglenophytes was positively correlated with PO_4-P ($r = 0.23$, $p < 0.05$) and NO_3-N concentrations ($r = 0.28$, $p < 0.05$) while negatively related with dissolved oxygen ($r = 0.46$, $p < 0.05$) and pH (r =

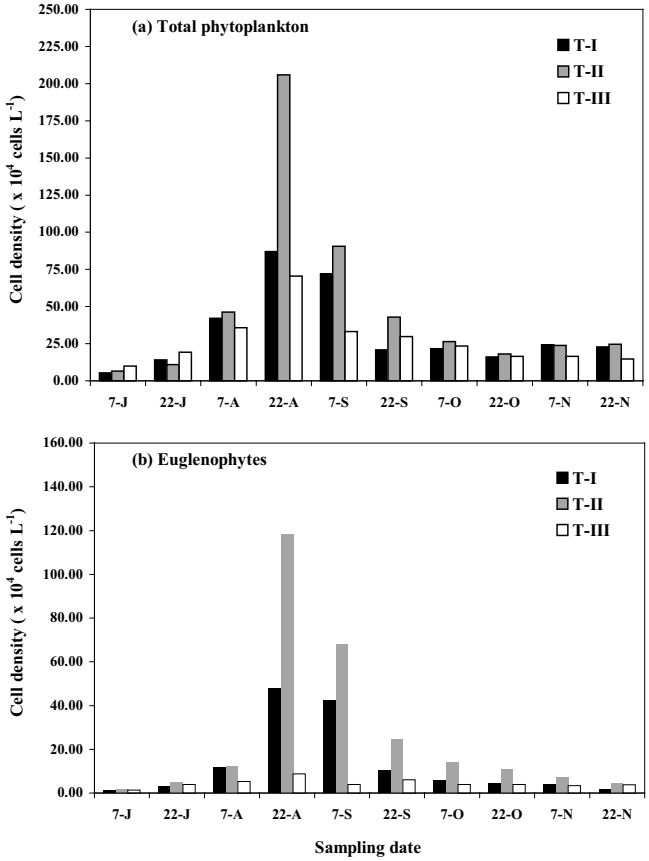

Fig. 1. Fortnightly variations in the abundance of (a) total phytoplankton and (b) euglenophytes in the ponds of three treatments.

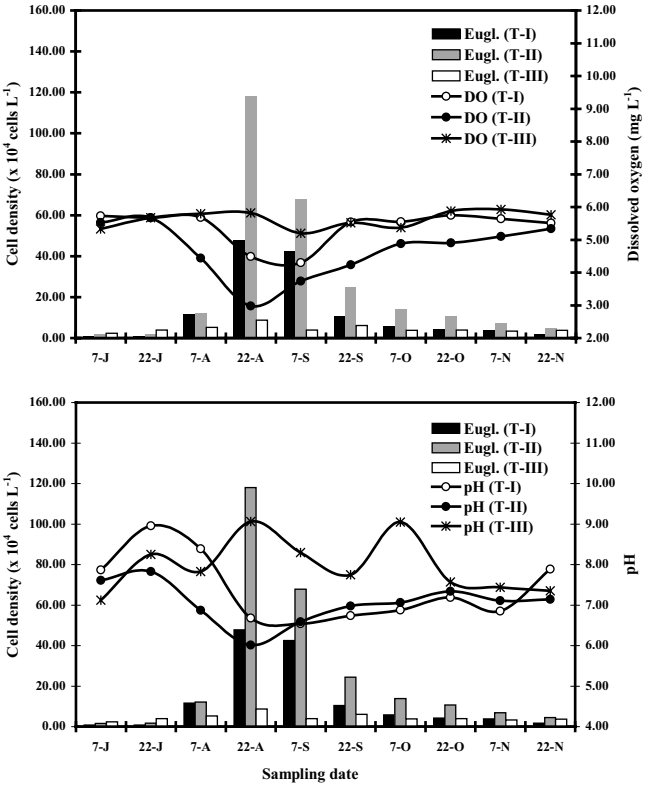

Fig. 2. Relation among the abundance of euglenophytes, dissolved oxygen and pH in the ponds of three treatments.

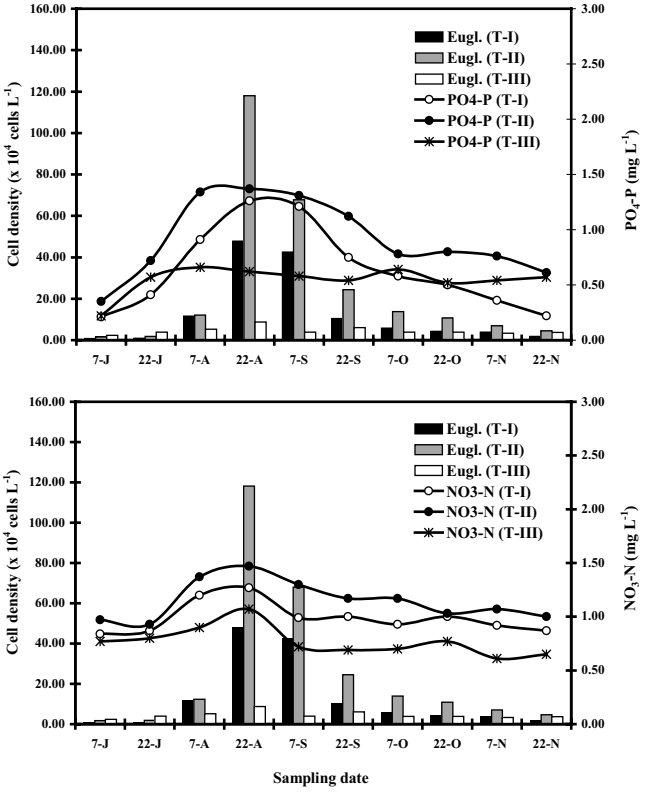

Fig. 3. Relation among the abundance of euglenophytes, PO_4-P and NO_3-N concentrations in the ponds of three treatments.

0.30, $p < 0.05$).

Euglenophytes abundance and other phytoplankton groups

A comparison between euglenophytes abundance and other phytoplankton groups is shown in Fig. 4. Euglenophytes and Cyanophytes were recorded as the dominant or co-dominant phytoplankton groups over the study period among the treatments. In ponds of T-I, euglenophytes showed its highest cell density in early September and in ponds of T-II in late August whereas cyanophytes showed the second highest cell density in the same treatments (Fig. 4). In the ponds of T-III, cyanophytes was the dominant algal group over the study period whereas euglenophytes and chlorophytes were recorded as co-dominant group. Cyanophytes reached its highest cell density ($87.28 \pm 24.69 \times 10^4$ cells L^{-1}) as co-dominant group during the heavy bloom of euglenophytes in the ponds of T-II. Chlorophytes was the third most abundant group in the ponds of T-I and T-II whereas in the ponds of T-III was second most abun-

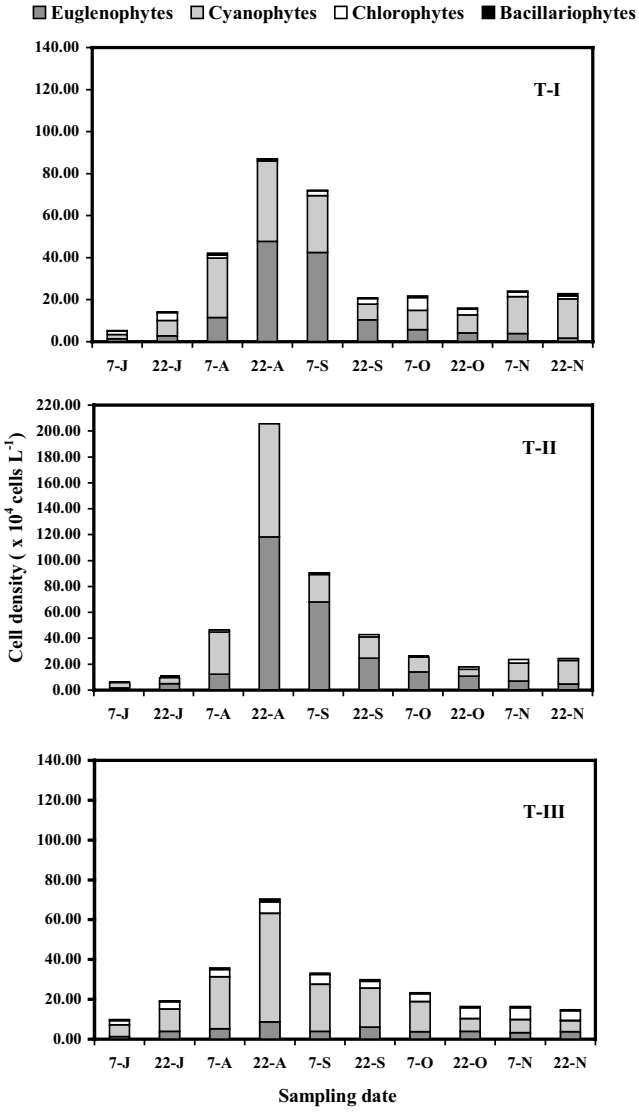

Fig. 4. Comparison of euglenophytes, cyanophytes, bacillariophytes and chlorophytes abundance among the treatments.

dant group. The higher cell density of chlorophytes (5.80 ± 1.71 x 10^4 cells L^{-1}) was found in early November in the ponds of T-III where euglenophytes bloom did not occur. Bacillariophytes was the least abundant group throughout the study period with maximum abundance (1.44 ± 0.37 x 10^4 cells L^{-1}) was recorded in the ponds of T-III in late August. When euglenophytes bloom was observed in the ponds of T-II, the cell density of chlorophytes and bacillariophytes was found to be very low (0.43 ± 0.11 x 10^4 cells L^{-1}, 0.15 ± 0.03 x 10^4 cells L^{-1}), respectively.

Growth of fish

The growth performance of different species of fish in terms of initial and final weight, weight gain, survival and total production are shown in Tables 3 & 4. There was no significant ($p < 0.05$) variations among the initial weight of various species in different treatments. The mean weight gain for all species was significantly ($p < 0.05$) higher in the ponds of T-III followed by the ponds of T-I but there was no significance difference between T-I and T-III. The fishes in the ponds of T-II presented the weight values significantly ($p < 0.05$) lower than in the ponds of T-I and T-III. The average survival of different fish species was significantly ($p < 0.05$) lower in the ponds of T-II (62%) whereas in the ponds of T-I was 74 % and in T-III 75%. The highest yield was found in the ponds of T-III (1760.63 kg ha^{-1}) followed by the ponds of T-I (1605.89 kg ha^{-1}). Significantly ($p < 0.05$) lower yield was found in the ponds of T-II (1355.89 kg ha^{-1}).

DISCUSSION

Euglenophytes bloom and environmental parameters

The growth and development of euglenophytes depend on the combination of a set of factors such as sunlight, temperature and nutrient concentrations. In accordance with Nwankwo (1995), higher number of euglenoid species were recorded when water temperature, nutrient values and BOD were high. During the bloom in the ponds of T-II, the water temperatures was around 30°C which is quite similar to the findings reported by Munwar 1972; Eckartz 1986; Reynolds 1988; Suykerbuyk 1991; Xavier *et al.* 1991.

The value of dissolved oxygen during the heavy blooms in the ponds of T-II was lower (2.98 mg L^{-1}) than the ponds of T-III where the bloom did not occur. High carbon dioxide content and oxidisable organic matter with low oxygen content favours the abundance of euglenophytes (Munawar 1970). Furthermore, Munawar (1972) and Xavier *et al.* (1991) concluded the same: euglenophytes proliferate in environments poor in oxygen. Lower oxygen in the ponds of T-II probably due to oxidation of organic matter or decomposition of excessive manure in the ponds or the thick bloom which might be inhabited photosynthesis of other phytoplankton and the intense respiration of the algal bloom possibly contributed to this situation.

In the present study, it was found that a pH of around 6.0 is most conducive to the heavy bloom of euglenophytes. This result was supported by Olaveson and Nalewajko (2000) they found that both *Euglena mutabilis* and *Euglena gracilis* were acid tolerant, growing optimally at pH 2.5 to 7.0. Furthermore, Xavier *et al.* (1991)

Table 3. Monthly mean weight gain (g) in fishes in the ponds of three treatments

Fish species	Treatment	Initial weight (g)	Cumulative weight gain (g)			
			August	September	October	November
Rohu	T-I	1.78 ± 0.26	39.05 ± 8.48	71.42 ± 11.68	106.41 ± 21.86	130.33 ± 34.40
	T-II	1.77 ± 0.21	26.63 ± 7.35	51.03 ± 12.08	89.61 ± 19.31	101.34 ± 32.74
	T-III	1.77 ± 0.24	47.66 ± 11.65	82.02 ± 15.16	118.26 ± 24.93	138.55 ± 39.18
Catla	T-I	2.98 ± 0.40	102.36 ± 14.67	221.34 ± 29.91	272.91 ± 40.72	346.55 ± 58.98
	T-II	2.96 ± 0.38	95.86 ± 13.69	168.23 ± 22.09	251.46 ± 35.87	304.16 ± 61.23
	T-III	2.96 ± 0.43	132.49 ± 18.99	248.35 ± 33.74	302.97 ± 43.47	371.05 ± 67.87
Silver carp	T-I	10.31 ± 2.28	111.76 ± 16.11	283.13 ± 37.63	470.28 ± 51.41	587.11 ± 77.93
	T-II	10.23 ± 1.98	84.29 ± 14.39	262.38 ± 32.97	426.71 ± 43.31	524.33 ± 70.03
	T-III	10.26 ± 2.14	109.71 ± 22.63	307.39 ± 41.85	490.91 ± 50.63	601.27 ± 69.87
Mrigel	T-I	1.85 ± 0.27	28.73 ± 9.85	61.69 ± 14.73	88.31 ± 28.58	104.64 ± 35.60
	T-II	1.86 ± 0.29	24.39 ± 7.46	49.28 ± 15.42	76.55 ± 26.87	92.09 ± 30.40
	T-III	1.84 ± 0.31	33.81 ± 9.79	66.31 ± 15.99	95.77 ± 24.32	120.23 ± 34.60
Sharputi	T-I	1.30 ± 0.31	25.06 ± 7.38	52.43 ± 15.29	81.31 ± 22.98	96.47 ± 32.03
	T-II	1.27 ± 0.34	21.65 ± 6.27	39.37 ± 13.64	66.29 ± 20.79	85.27 ± 27.98
	T-III	1.29 ± 0.29	27.66 ± 6.97	56.94 ± 12.91	84.86 ± 26.24	108.20 ± 37.01

Table 4. Growth, survival and production of fish (with Standard Deviation) in different treatments during the study period

Growth performance	Fish species	Treatments		
		T-I	T-II	T-III
Initial weight (g)	Rohu	1.78 ± 0.26	1.77 ± 0.21	1.77 ± 0.24
	Catla	2.98 ± 0.40	2.96 ± 0.38	2.96 ± 0.43
	Silver carp	10.31 ± 2.28	10.23 ± 1.98	10.26 ± 2.14
	Mrigel	1.85 ± 0.27	1.86 ± 0.29	1.84 ± 0.31
	Sharputi	1.30 ± 0.31	1.27 ± 0.34	1.29 ± 0.29
Final weight (g)	Rohu	130.33 ± 34.40	101.34 ± 32.74	138.55 ± 39.18
	Catla	346.55 ± 58.98	304.16 ± 61.23	371.05 ± 67.87
	Silver carp	587.11 ± 77.93	524.33 ± 70.03	601.27 ± 69.87
	Mrigel	104.64 ± 35.60	92.09 ± 30.40	120.23 ± 34.60
	Sharputi	96.47 ± 32.03	85.27 ± 27.98	108.20 ± 37.01
Weight gain (g)	Rohu	128.55	99.57	136.78
	Catla	343.57	301.20	368.09
	Silver carp	102.79	90.23	118.39
	Mrigel	576.80	514.10	591.01
	Sharputi	95.17	84.00	106.91
Survival rate (%)	Rohu	73.0 ± 3.67	61.0 ± 4.67	76.0 ± 2.67
	Catla	74.0 ± 2.33	62.0 ± 5.33	75.0 ± 3.33
	Silver carp	76.0 ± 2.33	64.0 ± 4.67	75.0 ± 4.33
	Mrigel	72.0 ± 1.67	60.0 ± 3.33	71.0 ± 3.67
	Sharputi	73.0 ± 2.67	61.0 ± 5.33	76.0 ± 3.33
Production (Kg treatment^{-1})	Rohu	0.44	0.34	0.49
	Catla	1.17	0.94	1.35
	Silver carp	3.93	3.37	4.14
	Mrigel	0.35	0.31	0.43
	Sharputi	0.61	0.53	0.71
Total production (kg ha^{-1})		1605.70	1355.91	1760.60

reported that *Euglena sanguinea* bloom developed when the pH value was around 6.9.

There is known a positive correlation between population size of freshwater algae and phosphate concentration even in the hypertrophic reservoirs (Barone and Flores 1994). The positive correlation between population size and nitrate concentration accords with the report (Munawar 1972) that the fluctuation of the euglenoid population was affected by NO_3-N concentration in the polluted sewage. The observed values of PO_4-P and NO_3-N concentrations during the heavy bloom of euglenophytes were 1.37 mg L^{-1} and 1.47 mg L^{-1}, respectively. The levels of PO_4-P and NO_3-N as recorded during the bloom period were higher than that reported by Xavier *et al.* (1991) who registered 0.35 mg L^{-1} of PO_4-P and 0.15 mg L^{-1} of NO_3-N during the *Euglena sanguinea* bloom occurred in fish breeding tanks. The higher values of nutrients recorded in the present study might be due to regular fertilization in the ponds.

Euglenophytes bloom and other phytoplankton groups

It is reported that algal population size is determined by a biological interaction of individuals, populations and species for environmental resources (Levandowsky 1972). From the plankton data, it was observed that euglenophytes and cyanophytes were the dominant or co-dominant groups followed by chlorophytes and bacillariophytes. This finding agrees fairly well with finding of Mishra and Saksena (1993) they reported that the percentage of cyanophytes and euglenophytes were greater compared to chlorophytes and bacillariophytes in nutrient rich water bodies. According to present study, euglenophytes showed negative correlation with chlorophytes and bacillariophytes that might be indicate that euglenophytes effects the growth of chlorophytes and bacillariophytes directly or indirectly which agree the findings of Hosmani (1988) who reported that the blooms of *Franceia ovalis*, *Euglena elastica*, *Euglena gracilis* and *Trachelomonas charkoweinis* have a significant effect in reducing the number of other algal species. This phenomenon was also supported by Leupold (1988). However, euglenophytes form bloom in that environmental condition which might not be favourable for growth of other phytoplankton. On the other hand, thick bloom of euglenophytes inhibited light penetration which greatly hampered photosynthesis of other phytoplankton. Furthermore, during peak bloom of euglenophytes, the lower cell density of chlorophytes and bacillariophytes might be due to higher concentration of ammonia present in the ponds. It is reported that most euglenoid prefer environment of high ammonia concentration (Munawar 1972; Xavier *et al.* 1991). In contrast, it is frequently assumed that ammonia in higher concentration may be toxic to some phytoplankton (Wetzel 1983). Phytoplankton assemblages are also variable due to grazer. However, the relative importance of loss factors (grazing by zooplankton, fish etc, natural death and consequent sedimentation) of biological origin on the structure and diversity of phytoplankton assemblages in the ponds were not considered in this study.

Euglenophytes bloom and fish growth

Fish growth depend on a variety of factors of which genetic growth potential, culture technique, environmental parameters, nutrients and plankton population are the most important. In the present study, the lowest growth of all species was recorded in the ponds of T-II whereas highest in the ponds of T-III. Variation in fish growth among the treatments in this study might be due to bloom of euglenophytes as well as to difference in the environmental parameters. Water having dissolved oxygen below 5.0 mg L^{-1} is to be unproductive (Banerjee 1967; Swingle 1969) and neutral or almost alkaline waters are the most important for fish growth when pH 7.0 to 8.00 (Huet 1973). Blooms make a problem with oxygen deficiency which greatly hampered the normal growth of fish resulting lower production. Furthering, acidic pH with higher nutrients content is the most conducive to the bloom of euglenophytes whereas acidic pH is unfavourable for the growth of other plankton and fish. During the bloom period, large number of euglenophytes cells attached to the gills caused fish breathe with difficulty and fishes were gulping on the water surface. As a result fishes were fallen into stress condition and finally affected their normal growth. Xavier *et al.* (1991) argued that the heavy bloom of *Euglena sanguinea* affect the growth of fish by hampering breathing. In the present investigation, the highest production of fish was obtained from the ponds of T-III which might be due to better water quality parameters and optimum quantity of plankton populations.

Correspondence analysis of abundance data for euglenophytes and from data in the literature, it can be concluded that euglenophytes prefers higher temperature, lower dissolved oxygen and acidic environment with higher nutrient concentration. Thick bloom of euglenophytes affected the growth of other phytoplankton by hampering light penetration and by using most of

the nutrients. Acidic pH enhanced the bloom of euglenophytes but affected the growth of other phytoplankton. Acidic environment and little quantity of edible phytoplankton finally affected the growth of fish. Furthermore, lower level of dissolved oxygen caused by decomposition of heavy euglenophytes bloom also affected the growth of fish. Therefore, an effort should be made in future work to control or minimize the negative impact of euglenophytes bloom and its use as a food source in aquaculture for getting better fish production from euglenophytes fish ponds.

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