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Observation and Comparison of Physico-chemical Characteristics in Carp Rearing Ponds under Two Treatments

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Abstract: Physico-chemical characteristics were observed in carp rearing ponds at Bangladesh Agricultural University, Mymensingh, Bangladesh under two different treatments. Mean values of temperature, Secchi depth, dissolved oxygen, pH, chlorophyll-a, total alkalinity, nitrate nitrogen, ammonia nitrogen and phosphate phosphorous were 29.8 PC, 35.83 cm, 5.17 mgl^{-1}, 7.07, 13.1 mgl^{-1}, 32.5 mgl^{-1}, 1.93 mgl^{-1}, 0.05 mgl^{-1} and 1.19 mgl^{-1} respectively over the experimental period. All the measured water quality parameters varied little among the ponds and no discernible trends were apparent in either or between pond conditions.

Key words: Physico-chemical characteristics, carp, rearing pond

Introduction

in the broadest sense, water quality is determined by a large number of biological, physical and chemical variables that affect the desirability of water for any particular use. In fish culture, water quality is usually defined as the suitability of water for the survival and growth of fish and it is normally governed by only a few variables. Fish culturists are aware of these variables and are acquainted with relationships between them and fish production. The quality and quantity of plant and animal life on which the fish subsist are immensely influenced by the inherent water properties of the habitat. The factors controlling aquatic fertility need to be understood in order to perform adequate management of the water bodies to enhance fish production. In waters used for fish culture, production is increased by using either fertilizers, fish feeds or occasionally both which sometimes cause harmful effects to the environment. Therefore, careful attention to water quality problems is an absolute necessity in fish culture. Though a great deal of works on water quality parameters of inland water bodies in this region was undertaken (Lakhamanan *et al*., 1971; Dewan, 1973; Oppenheimer *et al.,* 1978; Ali *et al*., 1982; Wahab *et al*., 1994; 1996; Ahmed *et al.,* 2000) yet there is still need of information on suitable range of different water quality parameters necessary for carp rearing in polyculture particularly during their early stages of life cycle. The purpose of this present study was aimed to investigate several physicochemical characteristics considered important for fish culture.

Materials and Methods

Ponds, fertilization, fish and feeding: Trials were conducted at ponds owned by Department of Aquaculture and Management, Bangladesh Agricultural University, Mymensingh, Bangladesh. Six ponds each having surface area of 0.01 hectare and depth of 1.5 meter were used. The ponds numbered arbitrarily as 1, 2, .., and 6 were randomly divided into two sets for two different treatments. One set was treated with only fertilizers and the other with both fertilizers and supplementary feed. All ponds were fertilized with urea, triple super phosphate, mutate of potash and mustard oilcake at the prevalent standard rate 20 days before and only urea and TSP 15 days after stocking of fish. Only ponds 2, 4 and 6 were supplementary fed with mustard oilcake daily. Six hundred each of one month old fry of catla, *Carla calla* and rohu, *Labeo rohita* were transferred from the faculty nursery to each pond at 1000 h.

Analyses of water quality parameters: Monitoring of water temperature, Secchi disc depth, pH and dissolved oxygen were done daily between 0900 and 1000 h on the spot. Total alkalinity, nitrate nitrogen, ammonia nitrogen, phosphate phosphorous, chlorophyll-a analyses were made on depth-integrated water samples taken from each pond every 4 days.

Temperatures was recorded using a Celsius thermometer. Dissolved oxygen (DO) end pH were measured directly by a digital DO meter (Jenway, model 9070) and a digital pH meter (Jenway, model 3050) respectively. Secchi disc value was determined using a Secchi disc. Alkalinity was titrated, and measurement of ammonia, nitrate and phosphate was carried out by a Hach Kit (DR/2,000, direct reading, spectrophotometer). Chlorophyll-a was measured following the standard procedures and methods prescribed by American Public Health Association (APHA,1989).

Statistical analysis: One-way Analysis of Variance (ANOVA) and Multiple Range Test (SART) were performed on the data as recorded for each parameter to compare the difference between fertilized and fertilized and fed ponds using a IBM personal computer.

Results

Analysis of the various physical, chemical and biological factors of water facilitated accumulation of large number of data. The overall mean values of each water quality parameter of all ponds for the whole experimental period are presented in Table 1. Combined graphical representations of the water quality parameters are shown in Fig. 1-4.

Temperature: Temperature of both surface and bottom of the ponds were found to range from 29.6 to 30.0°C and from 28.5 to 28.9°C respectively. Temperature varied little over the course of the trials and difference of 0.5-1.0^{5}C was usually occurred between pond surface and bottom.

Table 1: Mean values (±S.E.) and ranpa of water quality observations from ponds during experimental period

Water quality parameter	Fertilized			Fertilized and fed		
	1	3	5	2	4	6
Temperature (°C)						
Surface	29.8±0.34	28.6±0.30	29.9±0.31	29.7±0.39	30.0 ± 0,23	29_8 ± 0.22
	(28.4±31.41	28.6±31.6	28.5±31.5	28.2±31.7	29.0+31.2	28.7±30.7
Bottom	28.5± 0.27	28.9±0.26	28.8+0.24	28.6±0.29	28.9±0.22	28.8±0.18
	127.5±30.01	(28.4±30.3)	(28.3±30.2)	(27.7±30.2)	(28.2+30.0)	(28.1±29.8)
Secchi depth (cml	38±2.42	34±2.52	45±2.91	27±2.62	43±2.38	28±2.87
	(28-47)	(25±47)	(26-52)	(15-36)	(33-50)	(13.39)
Chlorophyll-a (mgl^{-1})	12.4±0.51	13.6±0.69	10.8±0.71	15.4 1 0.30	11.5 t0.70	14.9±0.80
	110.8±14.61	(10.8±16.61	18.9±15.31	112.5±18.41	19.1±14.41	412.1±13.91
pH	7.6±0.26	6.810.19	6.9±0.11	7.8 I 0.29	6.5 ±0.013	6.8±0.14
	(6.7-8.8)	(6.7-9.4)	(6.5-7.3)	(6.7-5.2)	(6.4-6.9)	(6.5-7.6)
Dissolved oxygen	4.8±0.27	8.1±0.25	5.1.10.25	5.8±0.41	5.1 ±0.19	5.1-10.19
(mgl^{-1})	(4.0-4.4)	(4.0-6.0)	14.2-6.0)	14.2-7.5)	J4,4-5.91	14.3-5.8)
Total alkalinity	37±3.63	39±4.83	21+ 4.06	46 15.64	24 ± 4.32	29±3.91
(mgl^{-1})	(30-50)	(29-68)	115-491	136-801	(11-521	120-521
NO_3-N (mgl^{-1})	1.9±0.10	2.0±0.15	2.1±0.19	2.0±0.23	1.8±0.18	1.8.±0.19
	(1.5-2.4)	(1.4-2.6)	(1.5-3.0)	(0.9± 2.8)	(1.2-2.6)	(0.8-2.5)
NH_3-N (mgl^{-1})	9.9 3± 3.5	13.09±0.08	0.07±0.05	0,03±3.3	0.04±0_03	0.04±0.03
	(0.0-0.53)	(0.0-0.681	l0.01-0.491	(0.0-0.221	*{0.0-0.281*	(0-0-0.261
PO_4-P (mgl^{-1})	0.08±0.27	2.01±0.16	1.27±.0.32	1.54±0.37	1.19±0.33	1.03±0.23
	(0.12-2.0)	(1.60-2.68)	(0.47-3.0)	(0.18-2.80)	(0.34-2.60)	(0,42-2.0)

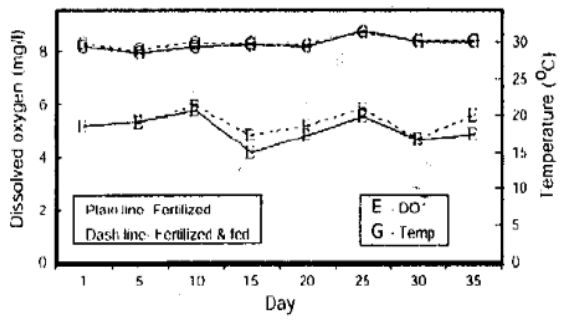


Fig. 1: Relationship between mean dissolved oxygen and temperature over experimental period

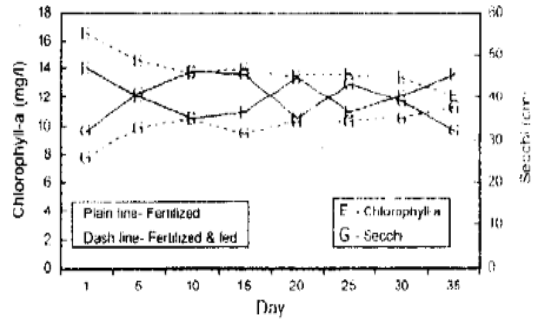


Fig. 3: Mean Seochi disc and chlorophyll-a values aver experimental period

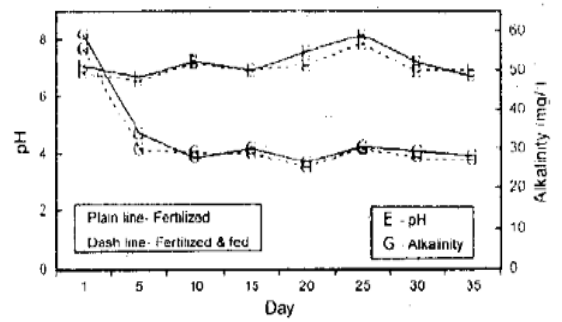
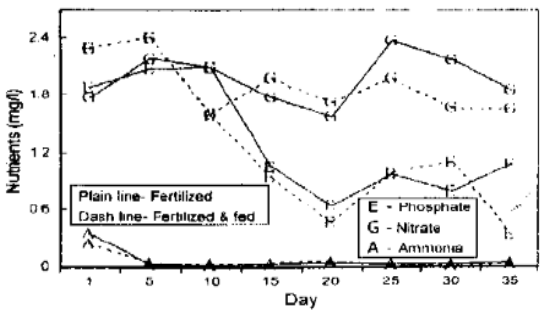


Fig. 2: Changes in mean pH and total alkalinity over experimental period



Fg. 4: Changes in mean phosphate, nitrate and ammonia over experimental period

Dissolved oxygen: Mean dissolved oxygen values for the fertilized ponds were found to vary from 4.8 to 5.1 mgl^{-1} and those for the fertilized and fed ponds from 5.1 to 5.8 mgl^{-1}.

pH: Over the study period, the pH level of the pond water was found to be almost neutral. No noticeable heterogeneity in pH among ponds was observed. The lowest and highest mean values of pH observed were 6.8 and 7.6 respectively for the fertilized ponds and those of pH were 6.5 and 7.8 ler fertilized and fed ponds.

Total alkalinity: The values of total alkalinity appeared variably during the study period when they were considered for individual pond. Alkalinity was always relatively low in all ponds. In fertilized ponds mean values of alkalinity ranged from 21 to 39 mgl^{-1} and in case of fertilized and fed ponds those varied from 24 to 46 mgl^{-1}

Secchi depth: Mean Seochi disc values showed variation

with sampling dates and it ranged from 34 to 45 cm in fertilized ponds while it varied from 27 to 43 cm in fertilized and fed ponds.

Chlorophyll-a: For fertilized, and fertilized and fed ponds, Chlorophyll-a concentrations were recorded as ranged from 10.9 to 13.6 and from 11.5 to 15.4 mgl^{-1} respectively.

Nitrate nitrogen (NO_3-N): Mean nitrate concentration ranged from 1.9 to 2.1 mgl^{-1} in fertilized ponds while from 0.9 to 1.7 mgl^{-1} in fertilized and fed ponds.

Ammonia nitrogen (NH_3-N): The level of unionized ammonia measured over the experimental period was not harmful for fish culture. It was found to range from 8.8^{-3} to 0.09 mgl^{-1} and from 0.03 to 0.04 mgl^{-1} in fertilized, and fertilized and fed panda respectively.

Phosphate phosphorous (PO_4-P): The average values of reactive phosphorous were found to vary from 0.08 to 2.01 mgl^{-1} in fertilized ponds whereas from 1.03 to 1.54 mgl^{-1} in fertilized and fed ponds.

Considering all the results, it was evident that there was no discernible trend in each water quality parameter of both fertilized, and fertilized and fed ponds during the experimental period. Water quality was recommended within the acceptable ranges for all parameters for fish culture. One-way Analysis of Variance (ANOVA) and Multiple Range Test (MRT) performed an the data as recorded for each parameter illustrated that there was no significant difference between fertilized and fertilized and fed ponds at 95% confidence level.

Discussion

The measured limnological parameters over the entire period of study in both treatments of this present experiment showed to be more or less similar with the findings of several previous works (Islam *et al.*, 1974; Islam and Saha, 1975; Mumtazuddin *et al.,* 1982; Rahman *et al.*, 1982; Dewan *et al.,* 1991; Wahab *et al.,* 1994, 1995, 1996; Ahmed *et al.,* 2000).

Total alkalinity occurred low in concentration in our study. Moyle (1946) reported that ponds and lakes with the range of total alkalinity of 0.0-20.0 mgl^{-1} are of low productivity, those with 20.0-40.0 mgl^{-1} are of medium productivity and those with 40.0-90.0 mgl^{-1} are of medium to high productivity. Lakshminarayana (1965) and Dewan (1973) observed that the total alkalinity was found to be higher during the winter and lower in the monsoon. Ahmed *et al.* (2000) found similar trend of low alkalinity in their research on carp fry polyculture.

The transparency of a water body normally indicates its productivity. Dewan *et al.* (1991) observed an inverse relationship between chlorophyll-a concentrations and Secchi depth values in fry-fingerling rearing ponds in their study. A similar relationship between transparency and plankton production was also observed by Sahai and Sinha (1969).

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