

**A COMPARATIVE STUDY OF PLANKTON PRODUCTION IN NURSERY PONDS SUPPLIED WITH FERTILIZERS AND FEED AND FERTILIZERS**

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**Abstract:** The present study was conducted to study the effects of fertilizers, and feed and fertilizers on plankton production in six Indian major carps' nursery ponds for a period of 28 days. Water quality parameters were found to be within acceptable ranges in all the experimental ponds irrespective of different treatments. Some 52 genera of phytoplankton and 7 genera of zooplankton were recorded from the experimental ponds. The total number of phytoplankton ( $3,131 \times 10^3 \text{ l}^{-1}$ ) and zooplankton ( $15 \times 10^4 \text{ l}^{-1}$ ) in fed and fertilized ponds were slightly higher than that of only fertilized ponds (phytoplankton,  $2,777 \times 10^4 \text{ l}^{-1}$  and zooplankton,  $14 \times 10^4 \text{ l}^{-1}$ ). Among phytoplankton, Cyanophyceae was found to be the most dominant group by numbers ( $1,399 \times 10^4 \text{ l}^{-1}$  in fertilized pond and  $1,683 \times 10^4 \text{ l}^{-1}$  in fed and fertilized pond) but Chlorophyceae by genera (29 genera). Among zooplankton, rotifera belonging to 4 genera was found to be the most dominant group both by numbers ( $9 \times 10^3 \text{ l}^{-1}$  in fertilized pond and  $11 \times 10^4 \text{ l}^{-1}$  in fed and fertilized pond) and by genera. However, the differences in plankton population as obtained from fertilized, and fed and fertilized nursery ponds were not statistically significant.

**Keywords:** Plankton; Nursery pond; Feed; Fertilizer; Indian major carps

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## Introduction

Biotic and abiotic parameters present in nursery pond are very important for the growth of Indian major carps' spawn. Kamal (1976) reported that rohu spawn start feeding on plankton from 5th day after hatching and observed that the food of rohu spawn is composed of zooplankton as a whole. Jhingran (1991) noted that in fingerling stage, *Catla catla* is a surface feeder and consumes water fleas, planktonic algae and some vegetable debris. Dewan *et al.* (1977) stated that fry and fingerlings of catla absolutely feed on planktonic animals. Its feeding preference for animal food increased as it increased in size. George (1963) showed that although major carps ingest a variety of phytoplankton, zooplankton and higher aquatic plants, catla prefers to select plankton, mainly zooplankton while rohu and mrigal prefer to ingest plant matter, including decaying vegetation. Since plankton furnishes direct food of carps' spawn, information on the qualitative and quantitative status of plankton are of enormous importance for proper management of nursery ponds. Therefore, the present study was aimed to determine the qualitative status of plankton in fertilized, and fed and fertilized nursery ponds for a period of 28 days.

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## Materials and Methods

Six earthen experimental ponds of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh were used for the present study. All the experimental ponds were similar with respect to shape, size, depth, basin contour and type of bottom soil, and covered a surface area of 0.01 ha with an average depth of 1.5 meter. The ponds were rain-fed and free from aquatic vegetation, completely independent of each other having no inlet and outlet structure, well exposed to sunlight and were normally used for experimental fish culture. They were arbitrarily numbered as Pond 1 to Pond 6, and were randomly divided into two treatments for the convenience of the study. Treatment one 'T<sub>I</sub>' (pond 1, pond 3 and pond 5) where only fertilizers were used and treatments two 'T<sub>II</sub>' (pond 2, pond 4 and pond 6) where both supplementary feed and fertilizers were used. After filling up of the ponds with rain water during mid-May 1990, they were poisoned with 4 ppm of Dipterax to remove harmful insects and weed fishes and 4 days after poisoning, the ponds were limed at the rate of 250 kg ha<sup>-1</sup> after being further filled up with rain water in the last week of June 1990.

Ponds were fertilized with Urea, Triple Super Phosphate (TSP), Mureate of Potash and mustard oil cake at the rate of 200, 100, 50 and 500 kg ha<sup>-1</sup> respectively, 20 days prior to stocking. Only Urea and TSP at the rate of 100 kg ha<sup>-1</sup> each were also applied 15 days after stocking. Organic fertilizer and mustard oilcake (soaked with water overnight) were applied to each pond by broadcasting over the surface of water. Twenty-five gram of 4 day old spawn of *Labeo rohita* and *Catla catla* at the ratio of 1:1 were released into each pond on 26 June, 1990. The spawn were collected from the hatchery of the Fisheries Research Institute, Mymensingh. Mustard oilcake, at the rate of 100 g per ponds was administered once daily as supplementary feed in T<sub>II</sub>. Amount of feed was increased by 25 g for each pond every 6th day.

Some selected water quality parameters were measured at an interval of 4 days throughout the study period. Surface temperature was recorded using a Celsius thermometer. Dissolved oxygen (DO) was measured by a digital DO meter (Jenway, Model 9070) and pH by a pH meter (Jenway, Model 3050). Secchi disc value was recorded using a standard secchi disc. A one liter water sample was collected from different depths of each pond using a Kemmerer Type Water Sampler. Alkalinity was determined by titrimetric method and ammonia, nitrate and phosphate were determined by using a Hach Kit DR/2,000, direct reading spectrophotometer). Standard producers and methods were followed for the analyses of chlorophyll-*a*.

For study of plankton, two litres of water sample was collected from different areas and depth of each pond by using a Kemmerer Tope Water Sampler at an interval of 4 days. The samples were decanted into a carefully washed two litre labelled plastic jars. Two ml Lugol's iodine was added to each jar for sedimentation and preservation. Plankters were concentrated into 20 ml through a series of settling and resuspension procedures, and stored in sealed plastic bottles for future examination. For each preserved concentrated sample, three subsamples were examined using a Sedgwick Rafter Counting Cell (SRCC) and a binocular microscope (Olympus, Model BH2 with phase contrast facilities). One ml subsample of each stored sample was transferred to the SRCC and left to settle for ten minutes. Plankters present in 10 squares of the SRCC chosen randomly, were enumerated and identified upto generic level.

## Results & Discussion

Water quality parameters as recorded from the experimental ponds during the study period are presented in Table 1.

Table 1. Range and mean ( $\pm$ SE) of different water quality parameters as recorded from fertilized ( $T_I$ ), and fed and fertilized ( $T_{II}$ ) ponds during the experimental period\*.

Water quality parameters	$T_I$	$T_{II}$
	Range (Mean $\pm$ SE)	Range (Mean $\pm$ SE)
Temperature ( $^{\circ}$ C)	29.5 - 34.0 (30.8 $\pm$ 0.48)	29.5 - 34.0 (30.8 $\pm$ 0.49)
Secchi disc value (cm)	28.0 - 88.0 (51.0 $\pm$ 3.96)	31.0 - 82.0 (52.7 $\pm$ 3.98)
Dissolved oxygen ( $\text{mg l}^{-1}$ )	28.0 - 8.8 (6.2 $\pm$ 0.71)	3.0 - 10.6 (5.2 $\pm$ 0.61)
pH	6.4 - 8.4 (7.0 $\pm$ 0.15)	6.4 - 8.0 (6.8 $\pm$ 0.16)
Total alkalinity ( $\text{mg l}^{-1}$ )	15.0 - 35.0 (25.7 $\pm$ 1.08)	18.0 - 43.0 (26.3 $\pm$ 1.31)
Nitrate ( $\text{NO}_3\text{-N}$ ) ( $\text{mg l}^{-1}$ )	0.6 - 1.9 (1.0 $\pm$ 0.12)	0.4 - 2.2 (1.2 $\pm$ 0.14)
Ammonia ( $\text{NH}_3\text{-N}$ ) ( $\text{mg l}^{-1}$ )	0.00 - 0.68 (0.02 $\pm$ 0.01)	0.00 - 0.28 (0.20 $\pm$ 0.01)
Phosphate ( $\text{PO}_4\text{-P}$ ) ( $\text{mg l}^{-1}$ )	0.03 - 2.39 (0.85 $\pm$ 0.15)	0.12 - 1.98 (0.71 $\pm$ 0.12)
Chlorophyll- <i>a</i> ( $\text{mg l}^{-1}$ )	2.2 - 7.5 (5.3 $\pm$ 0.43)	2.7 - 7.9 (5.2 $\pm$ 0.41)

\* Mean and SE in parenthesis.

Water temperature was found to range from 29.5 to 34.0  $^{\circ}$ C and there is no treatment to treatment variation. Average secchi disc value was higher (52.7 cm) in  $T_{II}$  but the range was wider (28.0 - 88.0 cm) in  $T_I$  while in case of dissolved oxygen the average value was higher (6.2  $\text{mg l}^{-1}$ ) in case of  $T_I$  but the range was wider (2.6 - 10.6  $\text{mg l}^{-1}$ ) in  $T_{II}$ . pH,  $\text{NH}_3\text{-N}$ ,  $\text{PO}_4\text{-P}$  and Chlorophyll-*a* were higher in  $T_I$  than  $T_{II}$  while total alkalinity and  $\text{NH}_3\text{-N}$  were higher in  $T_{II}$  than in  $T_I$ . Relation between Chlorophyll-*a* and secchi disc values as exhibited by both the treatments are shown in Fig. 1. Some 52 genera of phytoplankton consisting of Bacillariophyceae (6), Chlorophyceae (29), Cyanophyceae (10), Euglenophyceae (3) and Xanthophyceae (4), and seven genera of zooplankton consisting of Hydrozoa (1), Crustacea (2) and Rotifera (4) were collected, identified and recorded including some crustacean nauplii (Table 2).

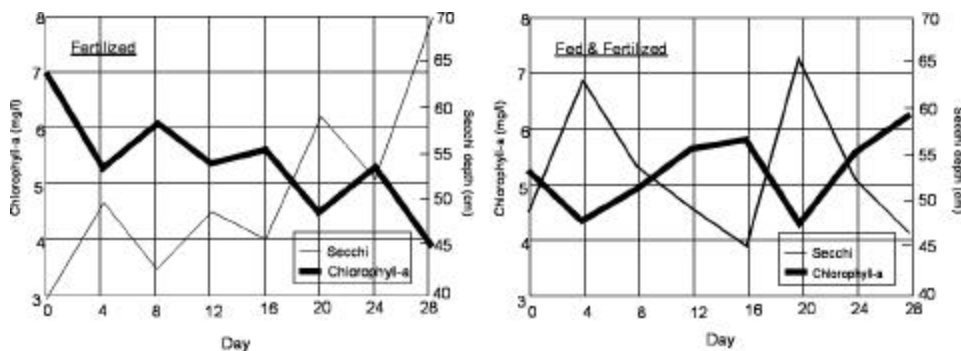


Fig. 1. Relationship between chlorophyll-*a* and secchi disc values as obtained from the nursery ponds.

Table 2. Generic status of plankton as collected from the nursery ponds.

Phytoplankton		Zooplankton
<u>Chlorophyceae</u>	<u>Bacillariophyceae</u>	<u>Hydrozoa</u>
<i>Actinastrum</i>	<i>Cyclotella</i>	<i>Hydra*</i>
<i>Ankistrodesmus</i>	<i>Diatoma</i>	<i>Crustacea</i>
<i>Asterococcus</i>	<i>Frustulia</i>	<i>Candona</i>
<i>Botryococcus</i>	<i>Navicula</i>	<i>Daphnia</i>
<i>Characium</i>	<i>Terpsinoe</i>	
<i>Chlorella</i>		<u>Rotifera</u>
<i>Closterium</i>	<u>Cyanophyceae</u>	<i>Asplanchna</i>
<i>Coelastrum</i>	<i>Anabaean</i>	<i>Brachionus</i>
<i>Cosmarium</i>	<i>Aphanocapsa</i>	<i>Notholca</i>
<i>Crucigenia</i>	<i>Chroococcus</i>	<i>Lecane</i>
<i>Gloeocystis</i>	<i>Chroococcus</i>	
<i>Gonatozygon</i>	<i>Dactylococcopsis</i>	
<i>Haematococcus</i>	<i>Gloeotrichia</i>	
<i>Lagerheimia</i>	<i>Gomphospheria</i>	
<i>Oocystis</i>	<i>Merismopedia</i>	
<i>pediastrum</i>	<i>Microcystis</i>	
<i>Pleurococcus</i>	<i>Oscillatoria</i>	
<i>Protococcus</i>		
<i>Scenedesmus</i>	<u>Euglenophyceae</u>	
<i>Sphaerocystis</i>	<i>Euglena</i>	
<i>Stichococcus</i>	<i>Phacus</i>	
<i>Spirogyra</i>	<i>Trachelomonas</i>	
<i>Tetraedrus</i>		
<i>Tetraedron</i>	<u>Xanthophyceae</u>	
<i>Treubaria</i>	<i>Centritractus</i>	
<i>Ulothrix</i>	<i>Characiopsis</i>	
<i>Volvox</i>	<i>Clorellidiopsis</i>	
<i>Xanthidium</i>	<i>Ophiocytium</i>	

\* Hydra was not found in fed and fertilized (T<sub>II</sub>) ponds.

In T<sub>I</sub>, the total number of phytoplankton was found to range from  $2,153 \times 10^4$  to  $3,763 \times 10^4$  l<sup>-1</sup> with the mean value being  $2,777 \times 10^4$  l<sup>-1</sup> and that of zooplankton from 0 to  $32 \times 10^4$  l<sup>-1</sup> with the mean value standing at  $14 \times 10^4$  l<sup>-1</sup>. The highest number of phytoplankton and zooplankton were recorded on day 24 and 4 respectively, and the lowest numbers were recorded on day 8 only (Table 3). On the other hand, in case of T<sub>II</sub>, the total numbers of phytoplankton was found to range from  $2,185 \times 10^4$  l<sup>-1</sup> to  $23 \times 10^4$  l<sup>-1</sup> with the mean value of  $15 \times 10^4$  l<sup>-1</sup>. The highest numbers of phytoplankton and zooplankton were recorded on day 20 and 24 respectively, whereas the lowest on day 0 (Table 3). Among the phytoplankton, Cyanophyceae was found to be the most dominant group by number while of Chlorophyceae by genera. Among Zooplankton, Rotifera was found to be the most dominant group, which was closely followed by the Crustacea. Among the genera of phytoplankton *Navicula*, *Ankistrodesmus*, *Crucigenia*, *Gloeocystis*, *Scenedesmus*, *Tetaedron*, *Anabaena*, *Chroococcus*, *Euglena* and *Trachelomoan* were found in large number in both T<sub>I</sub> and T<sub>II</sub>. Among zooplankton *Asplanchna* was recorded as the most dominant genus during the experimental period. Most of the genera of phytoplankton were recorded in all sampling dates except a few whereas in case of zooplankton only *Asplanchna* was found in all sampling dates.

All the water quality parameters were found to be within acceptable ranges in all the ponds belonging to T<sub>I</sub> and T<sub>II</sub> for the growth of plankton as well as fish. There was no abrupt changes in any parameter either in intra or inter-sets of ponds. The indices obtained in the present study for the different parameters of water largely conform to the results obtained by different workers in the same line. Ali *et al.* (1982) reported water temperature to range from 20.5 to 36.5 °C, pH from 7.5 to 9.5 and dissolved oxygen from 7.2 to 7.5 mg l<sup>-1</sup> in their experiment. Mumtazuddin *et al.* (1982) observed secchi disc value to vary from 40 to 54 cm and dissolved oxygen from 5.0 to 10.0 mg l<sup>-1</sup> in

Table- 3. Group wise mean plankton numbers ( $\times 10^4 \text{ l}^{-1}$ ) as recorded from the nursery ponds on day/days after stocking with spawn and comparison (level of confidence 95%) of different plankton groups belonging to T<sub>I</sub> and T<sub>II</sub>.

Plnkton group	Day 0		Day 4		Day 8		Day 12		Day 16		Day 20		Day 24		Day 28		Mean	
	T <sub>I</sub>	T <sub>II</sub>	T <sub>I</sub>	T <sub>II</sub>	T <sub>I</sub>	T <sub>II</sub>	T <sub>I</sub>	T <sub>II</sub>	T <sub>I</sub>	T <sub>II</sub>	T <sub>I</sub>	T <sub>II</sub>	T <sub>I</sub>	T <sub>II</sub>	T <sub>I</sub>	T <sub>II</sub>	T <sub>I</sub>	T <sub>II</sub>
<b>A. Phytoplankton</b>																		
Bacillariophyceae	48	74	76	59	27	94	26	95	36	120	48	109	116	153	108	139	61 <sup>a</sup>	106 <sup>a</sup>
Chlorophyceae	739	1111	1280	969	811	996	930	912	890	1095	839	1042	1456	1291	1530	1158	1050 <sup>a</sup>	1069 <sup>a</sup>
Cyanophyceae	1173	101	1051	1533	1110	1522	1224	1588	1215	1731	1618	1970	1980	1652	1788	1649	1399 <sup>a</sup>	1683 <sup>a</sup>
Euglenophyceae	454	192	313	297	197	193	197	208	167	149	144	212	176	300	237	366	239 <sup>a</sup>	1683 <sup>a</sup>
Xanthophyceae	32	7	47	27	8	5	24	18	23	11	30	26	31	19	46	39	31 <sup>a</sup>	20 <sup>a</sup>
Total phytoplankton	2446	2185	2767	2885	2153	2810	2391	2821	2331	3180	26789	4360	3763	3415	3709	3343	2777 <sup>a</sup>	3131 <sup>a</sup>
<b>B. Zooplankton</b>																		
Crustacea	0	3	10	10	0	0	0	3	7	7	3	3	10	3	0	3	4 <sup>a</sup>	4 <sup>a</sup>
Hydrozoa	0	0	1	0	0	0	3	0	1	0	0	0	3	0	0	0	1 <sup>a</sup>	0 <sup>a</sup>
Rotifera	5	4	21	7	0	10	6	19	7	7	19	14	0	20	14	6	9 <sup>a</sup>	11 <sup>a</sup>
Total zooplankton	5	7	32	17	0	10	9	22	15	14	22	17	13	23	14	9	14 <sup>a</sup>	15 <sup>a</sup>
Total plankton	2451	2192	2799	2902	2153	2820	2328	2843	2346	3194	2701	4377	3776	3438	3723	3352	2791 <sup>a</sup>	3146 <sup>a</sup>

T<sub>I</sub> = Fertilized and T<sub>II</sub> = Fed and fertilized  
 Values with same superscript are not significantly different.

the month of July and August in ponds in Mymensingh. Dewan *et al.* (1991) recorded temperature to range from 30.2 to 34.0°C, pH from 6.6 to 8.8, dissolved oxygen from 2.2 to 8.8 mg l<sup>-1</sup>, secchi disc and phosphate from 0.1 to 0.7 mg l<sup>-1</sup> in nursery ponds. Lakshmanan (1971) recorded 6.0 - 9.3 pH, 19.4 - 70.8 mg l<sup>-1</sup> total alkalinity, 0.04 - 0.8 mg l<sup>-1</sup> nitrate and 0.03 - 4.1 mg l<sup>-1</sup> phosphate from fish culture ponds in India. Swingle (1957) suggested the agreeable pH range is 6.5 - 9.0 for fish culture. Islam and Saha (1975) observed that 0.23 - 6.0 mg l<sup>-1</sup> nitrate, 0.02 - 2.80 mg l<sup>-1</sup> phosphate, 3.51 - 4.59 mg l<sup>-1</sup> dissolved oxygen and 7.5 - 9.8 pH were favourable for the growth of blue-green algae and diatoms. Bhuiyan (1970) stated that the total alkalinity of medium productive water ranged from 25 - 100 mg l<sup>-1</sup>.

The present observation of the existence of inverse relationship between transparency of water and Chlorophyll-*a* concentration in all the experimental ponds is probably due to the fact that increase in phytoplankton population reduced the transparency of water. This agrees with the finding of Dewan *et al.* (1991) and Sahai and Sinha (1969). The number of genera and the total number of plankton population recorded per liter of water in the present study indicate that the ponds were highly productive. The result agrees with the finding of Mumtazuddin *et al.* (1982) who recorded 32 genera of phytoplankton belonging to Bacillariophyceae, Chrysophyceae, Euglenophyceae, Myxophyceae, and Xanthophyceae, and 14 genera of zooplankton belonging to Crustacea and Rotifera. It was further observed in the present study that the total number of both phytoplankton and zooplankton in T<sub>II</sub> ponds were slightly higher than that of T<sub>I</sub> ponds. It might be due to the fact that the supplementary feed used may have been implicated to the lesser utilization of the planktonic feed by the spawn. However, the differences in number were not statistically significant.

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