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GROWTH PERFORMANCE OF BIGHEAD CARP *ARISTICHTHYS NOBILIS* (RICHARDSON) IN MONOCULTURE SYSTEM WITH AND WITHOUT SUPPLEMENTARY FEEDING

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ABSTRACT

Growth performance of bighead carp (*Aristichthys nobilis)* in monoculture system with and without supplementary feeding indicated that supplementary feeding played an important role in better growth of bighead carp. The average initial weight of bighead carp at the time of stocking was 11.40 ± 3.25g and final weight of 902.00 ± 4.63g was recorded after 12 months of experiment using organic (cow dung) and inorganic (urea and single super phosphate) fertilizers. The average initial weight at the time of stocking of bighead carp was 10.3 ± 1.32g and average final weight was 1170 ± 4.85g at the end of experiment using fertilizers and supplementary feed with 20% crude protein. Significantly higher ($P<0.05$) weight gain of 1170.0 ± 3.25g was achieved in treatment with supplementary feeding compared to 902.00 ± 4.63g without supplementary feeding. Temperature range of 26-33°C (during May to July) was found to be suitable for fish growth, as better weight gain and lower feed conversion ratio were recorded during this period. Lower growth was observed during the months of December, January and February, when average temperature was 7-15°C.

Key words: Bighead carp (*Aristichthys nobilis)*, monoculture, supplementary feeding, FCR, growth.

INTRODUCTION

Bighead carp (*Aristichthys nobilis)* has been introduced in Pakistan to enhance the number of species for polyculture fish farming system. Bighead carp is recognized throughout the world, primarily because of its versatility in aquaculture operations (Opuszynski, 1981). The growth performance of bighead carp under various culture systems (monoculture and polyculture) is expected to show considerable variations for its potential benefits and risks like other introduced fish elsewhere in the world (Coates, 1986). Monoculture is practiced less frequently than polyculture because in polyculture natural productivity of pond can fully be utilized (Tapiador *et al.,* 1977). However, monoculture of consumer preferred species has been practiced in many countries and has resulted in high survival rate and production (Reddy *et al.,* 2002).

Supplementary feeding plays an important role in intensive and semi-intensive fish culture system. It also offers best means of fish production within shortest possible time in ponds (Devaraj *et al.,* 1986). The use of supplementary feed in carp culture has become inevitable for the success of fish culture (Shahzadi *et al*., 2006). Cremer and Smitherman (1980) reported that bighead carp has the feeding habit to consume floating pellets that could be better utilized by the fish. Several artificial feedstuffs of plant and animal origin (by-products) are useful to formulate the feed for different developmental stages of carp and trout. Supplementary feeding is known to increase the carrying capacity of culture systems and hence enhance fish production by many folds (Samocha *et al.*, 2004).

The main objective of this study was to compare the growth performance of bighead carp under monoculture system, with and without supplementary feeding, in semi intensive culture system.

MATERIALS AND METHODS

Fertilization of ponds

Ponds were fertilized with organic and inorganic fertilizers. Organic manure (cow dung) was added @ 10,000 $kgha^{-1}$ (Jhingran, 1995). The inorganic fertilizers (urea and single super phosphate) were added @ 200kg ha^{-1} (Garg and Bhatnagar, 2000).

Stocking of fish fingerlings

Fingerling of bighead carp (*A. nobilis*) with an average initial weight of 10.3 ± 1.32g were acquired from Aquaculture and Fisheries Program, National Agricultural Research Center, Islamabad, Pakistan for this experiment. Fish fingerlings were stocked @ 2000/ha with a stocking rate of 160 fish in 0.08 ha ponds with three replications (3 ponds for each treatment). Two treatments were given to earthen ponds. In treatment 1, ponds were fertilized only and no supplementary feed was offered. In treatment 2, ponds were given supplementary feed in addition to fertilization. Growth performance of bighead carp was

monitored in a monoculture system for 12 months from August 2004 to July 2005.

Supplementary feeding

Supplementary feed containing 20% crude protein was offered to the fish @3% of body weight daily in two equal meals during morning (08:00h) and evening (18:00h). Supplementary feed was prepared from locally available feed ingredients viz. fish meal, rice bran, soybean meal, wheat bran, rapeseed meal and vitamin premix (Table 1).

Table 1: Composition of supplementary diet fed to bighead carp in monoculture system

Ingredients	Amount (%)
Fish meal	20.00
Soybean meal	10.00
Rapeseed meal	5.00
Rice bran	40.00
Wheat bran	23.00
Vitamin premix	2.00
Chemical composition	
Crude protein (% dry matter)	22.76
Energy (Kcal/kg)	281.00
Fibre (% dry matter)	1.40
Price/Kg (in Rs)	14.00

Fish sampling for growth studies

Water level in ponds was maintained at the depth of 1.4-1.5m during the whole study period. Fish samples were collected on monthly basis from August 2004 to July 2005 with the help of drag net of 2.5 cm stretched mesh size to record data on body weight for growth performance study. The sample was restricted to 20% of stocking density (32 fish). The feed conversion ratios (FCR) were calculated by taking the amount of feed provided and net fish yield.

Monitoring of water quality parameters

Water quality of ponds was monitored fortnightly to record physicochemical characteristics viz. temperature, pH, dissolved oxygen and total alkalinity.

Statistical analysis

Mean values (± SE) for each parameter were computed. The effect of various treatments on the investigated traits was analyzed by analysis of variance to determine the significant growth in different months and student t-test to determine the significant growth between two treatments. The significance of difference between the means was evaluated by using the Duncan's multiple range test (Steel *et al.,* 1996).

RESULTS

Growth performance without supplementary feeding

The average initial weight of bighead carp at the time of stocking was 11.40 ± 3.25g and the final weight of 902.00 ± 4.63g was recorded after 12 months of experiment using fertilizers (T1) alone. Significantly higher ($P<0.05$) weight gain was recorded during the month of July (208.3 ± 5.66g), followed by June and May (178.8 ± 3.52 and 137.6 ± 2.56g, respectively). Significantly lower values of weight gain were recorded during the months of December, January and February with the increment of 12.4 ± 2.10, 12.9 ± 3.12 and 17.7 ± 2.56g, respectively, however, weight gains in December and January did not differ from each other (Table 2).

Table 2: Growth performance of bighead carp in monoculture without supplementary feeding

Months	Temperature (°C)	Weight (g)	Monthly weight gain (g)
July	31.5	11.40 ± 3.25	
August	28.5	88.00 ± 7.50	76.6 ± 8.66 d
September	25.0	154.50 ± 5.77	66.5 ± 5.77 e
October	21.0	213.40 ± 4.52	58.9 ± 4.23 f
November	19.0	244.50 ± 5.36	31.1 ± 2.32 i
December	14.0	256.90 ± 5.23	12.4 ± 2.10 k
January	7.0	269.80 ± 4.12	12.9 ± 3.12k
February	15.0	287.50 ± 3.26	17.7 ± 2.56j
March	23.5	321.00 ± 2.36	33.5 ± 2.52 h
April	25.5	377.30 ± 1.25	56.3 ± 2.20g
May	26.0	514.90 ± 2.32	137.6 ± 2.56 c
June	30.0	693.70 ± 2.15	178.8 ± 3.52b
July	32.0	902.00 ± 4.63	208.3 ± 5.66a

Values with different alphabets differ significantly from each other ($P<0.05$).

Growth performance with supplementary feeding

The average initial weight of bighead carp at the time of stocking was 10.3 ± 1.32g and the average final weight was 1170 ± 4.85g at the end of the experiment in fish given fertilizers and supplementary feeding (Table 3). Statistical analysis showed that highest monthly weight gain was recorded in July (296.00 ± 2.32g). The values for the months of May and June (150.00 ± 2.12 and 174.00 ± 1.65g) were lower than for July, but did differ from each other. The lowest weight gain was found in January (23.00 ± 1.53g). Feed conversion ratios (FCR) were higher during winter months and lower during summer months.

When comparing growth of fish in ponds with and without supplementary feed (Table 4), a significantly higher (P<0.05) final weight of 1170.0 ± 4.85g was achieved in monoculture experiments with supplementary feed versus 902.00 ± 4.63g in fertilized ponds without supplementary feeding. Total weight gain of bighead carp fed with supplementary feeding was also significantly higher (P<0.05) than without supplementary feeding. FCR for whole experiment was 4.24 ± 1.17 (Table 4).

Physicochemical characteristics viz. temperature, pH, dissolved oxygen and total alkalinity in two types of ponds were recorded. The values of temperature, pH, dissolved oxygen and total alkalinity varied between 7.0-33^{o}C, 7.0-8.5, 4.05–7.0 mg/l and 123-217 mg/l, respectively in both the treatments (Figure 1 a, b, c and d). Water temperature did not differ between the experimental ponds, however, were found to be influenced by seasonal changes, lower temperature was recorded during December to February (7-15^{o}C) and optimum during May-August (26-33^{o}C). Dissolved oxygen in two treatments showed some variations; lower values were found during summer months and higher in winter months. The pH did not show variations between the treatments except for the month of August and April. Alkalinity varied between 123-217 mg/l in both the treatments.

Growth performance of bighead carp in ponds with and without supplementary feeding in relation to temperature is given in Tables 2 and 3. The better growth was found in months of July, June and May when temperature was in the range of 26-33°C, whereas the lower growth was in the months of December, January and February, when the temperature was between 07-15°C.

Table 3: Growth performance of bighead carp in monoculture with supplementary feeding

Months	Temperature (^{0}C)	Mean weight (g)	Monthly weight gain (g)	Feed offered (g)	FCR
July	32.0	10.30 ± 1.32			
August	28.5	85.30 ± 2.65	75.00 ± 2.52d	94.86 ± 2.32h	1.26 ± 0.12f
September	25.0	175.30 ± 2.52	90.00 ± 3.65cd	168.60 ± 2.54g	1.87 ± 0.01f
October	21.0	280.00 ± 2.85	104.70 ± 4.21c	238.08 ± 2.12f	2.27 ± 0.32ef
November	19.5	322.00 ± 2.65	42.00 ± 2.23e	276.21 ± 2.02e	6.57 ± 0.14c
December	14.0	352.00 ± 3.25	30.00 ± 3.52e	286.20 ± 3.25e	9.54 ± 0.10b
January	7.50	375.00 ± 2.65	23.00 ± 1.53f	314.65 ± 3.52d	13.68 ± 0.21a
February	15.0	402.00 ± 3.65	27.00 ± 1.35f	331.50 ± 2.25cd	12.27 ± 0.11a
March	23.5	444.20 ± 4.12	42.20 ± 2.32e	348.04 ± 4.23cd	8.24 ± 0.21b
April	25.0	550.00 ± 4.26	105.80 ± 3.65c	462.52 ± 4.12c	4.37± 0.12d
May	26.0	700.00 ± 4.32	150.00 ± 2.12b	602.4 ± 3.65bc	4.01± 0.01d
June	31.5	874.00 ± 2.36	174.00 ± 1.65b	815.92 ± 2.36b	4.68 ± 0.01d
July	33.0	1170.00 ± 4.85	296.00 ± 2.32a	981.0 ± 3.25a	3.31± 0.12e

Values with different alphabets within a column differ significantly from each other (P<0.05).

Table 4: Over all weight gain (g) with and without supplementary feeding under monoculture system

Treatments	Initial weight	Final weight	Total weight gain	Mean daily weight gain	Feed offered	FCR
Without supplementary feeding (T1)	11.4 ± 3.25a	902 ± 4.63b	890.6 ± 2.32 b	2.47 ± 1.12b	—	—
With supplementary feeding (T2)	10.3 ± 1.32a	1170 ± 4.85a	1159.7 ± 3.21a	3.20 ± 1.10a	4920.00 ± 3.05	4.24 ± 1.17

Values with different alphabets within a column differ significantly from each other (P<0.05).

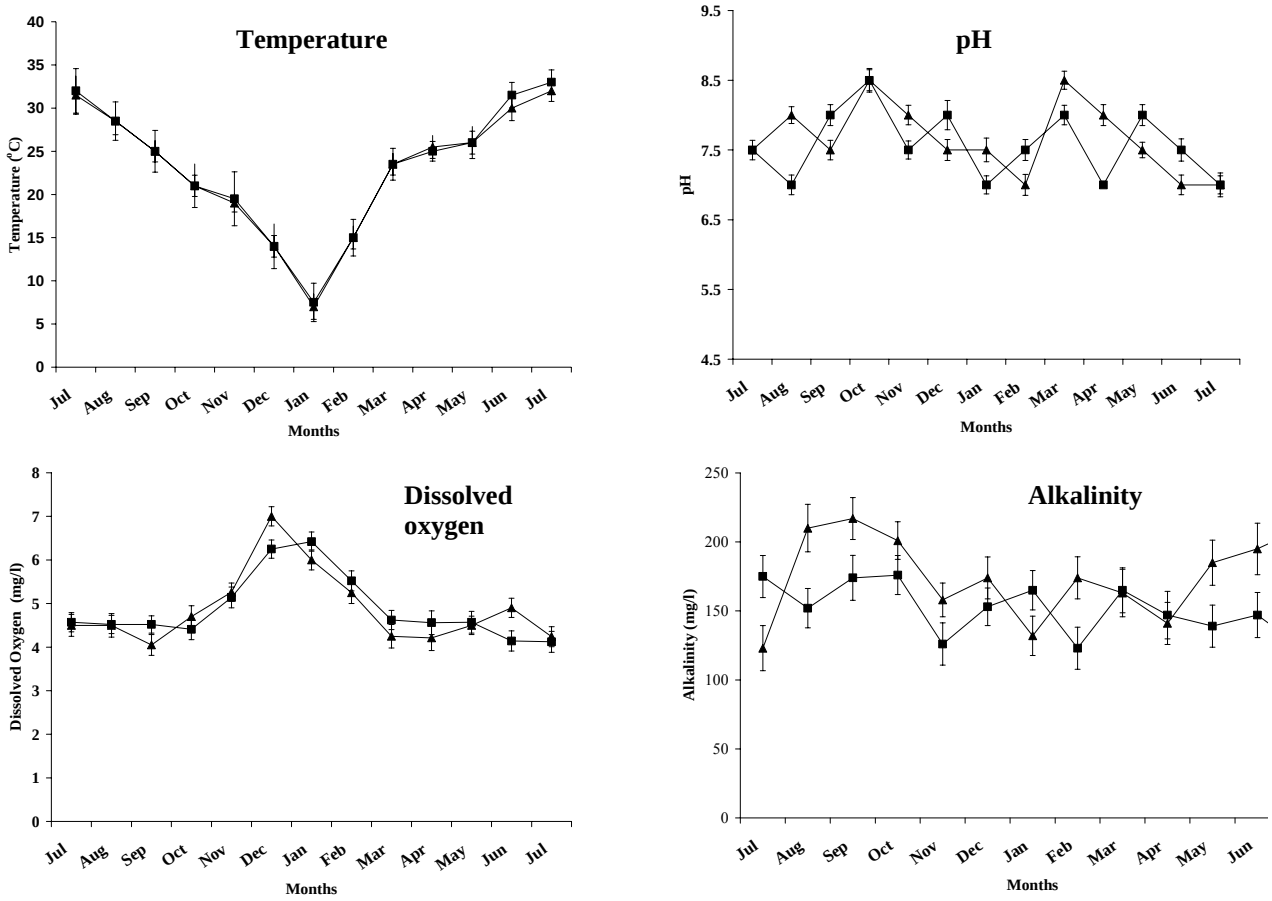

Fig. 1: Mean values of different physicochemical parameters in ponds water under monoculture system (▲ = treatment 1, ■ = treatment 2)

DISCUSSION

Supplementary feeding is known to increase the carrying capacity of culture systems and can enhance fish production by several folds (Jhingran, 1995). In the present study, the average monthly weight gain was higher in bighead carp fed with supplementary feed than in fertilized pond without supplementation in a monoculture system which is in agreement with the findings of Devaraj *et al.* (1986), Diana *et al.* (1994), Abdelghany and Ahmad (2002) and Khan *et al.* (2004). According to Cremer and Smitherman (1980), bighead carp growth was 57% higher in ponds receiving supplementary feeding, as supplementary feeding provides fish with the additional proteins and good carbohydrates, which results in better growth (Jena *et al*., 2002)

The maximum weight gain was recorded in the month of July, followed by the months of May and June. Sifa *et al.* (1980) observed that bighead carps were fed most intensively for 18 hours each day during July and August, feeding peaked between 1200 and 2000h. Lower values of monthly weight gain were recorded in December, January and February, which might be due to decreased food intake by fish at low temperatures (Kolar *et al*., 2005). Better FCR was found in the month of July which is similar to Sinha and Saha (1980) but higher than 1.75-1.77 reported by Sahu *et al*. (2007). The growth and FCR are good tools to compute the acceptability of supplementary feed in fish feeding experiments (Inayat and Salim, 2005).

Water temperature did not differ between the experimental ponds, but were found to be influenced by seasonal changes. Lower temperature was recorded during December to February and optimum during May-August. The pond water temperature ranged between 26°C and 33°C during June to August was found to be suitable for the growth of bighead carp as at these temperatures fish fed extensively on natural and supplementary feeds (Bettoli *et al*., 1985). Dissolved oxygen in two treatments showed some seasonal variations but its level was within acceptable range and had no adverse effect on fish growth (Shah *et al.,* 1998). The pH and total alkalinity remained in the

range of 7.0-8.5 and 123-217 mg/l respectively, which are considered suitable for fish culture (Boyd, 1982).

The present study indicates that supplementary feeding plays an important role for better growth of bighead carp and can increase the pond production. It can easily be interpreted that the temperature range of 26-33^{o}C is suitable for the growth of bighead carp in monoculture system.

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