

Effect of Organic and Inorganic Fertilizers on the Growth Performance of Bighead Carp (*Aristichthys nobilis*) in Polyculture System

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ABSTRACT

Present study was conducted to evaluate the growth performance of bighead carp (*Aristichthys nobilis*) under the polyculture system with major carps (*Labeo rohita*, *Catla catla* and *Cirrhinus mrigala*) and Chinese carps (*Hypophthalmichthys molitrix* and *Ctenopharyngodon idella*). Four different treatments i.e., control (no fertilizer), organic fertilizer (T1), Inorganic fertilizer (T2) and combination of organic and inorganic fertilizer (T3) were used to determine the effect of different fertilizers on the growth of bighead carp in polyculture system. The growth of fish in treatment (T3) was found higher i.e., 1008.37 g among different treatments followed by treatments (T1) 937.98 g, which significantly differed from rest of the treatments. The control had lowest value i.e. 606.43 g. Overall, bighead carp showed significantly higher growth among other species under polyculture system followed by silver carp (*H. molitrix*) 852.85 g and grass carp (*C. idella*) 852.10 g. The value of thaila (*C. catla*) was found to be significantly higher i.e., 816.75 g amongst the major carps. The temperature range of 26 - 32°C was the best temperature range for the growth performance of bighead carp in polyculture.

Key Words: Bighead carp; Polyculture; Major carps; Chinese carps

INTRODUCTION

Polyculture is the practice of culturing more than one species of aquatic organism in the same pond. The motivating principle is that fish production in ponds may be maximized by raising a combination of species having different food habits. In this system pond fertilization plays a greater role in supplementing nutrient deficiency as well as stimulating plankton functioning through autotrophic and heterotrophic pathways (Khan *et al.*, 2002; Sughra *et al.*, 2003). Pond fertilization is a management protocol to enhance biological productivity using both organic manure and inorganic fertilizers (Bhakta *et al.*, 2004).

Carps in Indian subcontinent are usually cultured under polyculture system. A general practice is to rear together five carp species of Indian and Chinese carps including catla, rohu, mrigal, grass carp and silver carp in the same pond. Polyculture with only three species viz., catla, rohu and mrigal is also in practice and some farmers practice monoculture, with one species of a higher consumer preference (Reddy *et al.*, 2002).

A. nobilis is a popular food fish and ranks fourth in world aquaculture production (FAO, 1999). Bighead carp is also used in polyculture along with the other species like grass carp, silver carp and channel catfish. Bighead carp can also be raised alone in fertilized ponds (Stone *et al.*, 2000).

After the introduction of bighead carp in Pakistan for possible enhancement for number of species, studies on the appraisal of this exotic fish for the risks and compatibility in the new environment are scarce, although some information is available from the countries like China, Nepal and India. These reports show feasibility of bighead carp culture in an analogous system to what would be in Pakistan. The concern, however, is the biological yield of the fish under the environment of Pakistan. Hence, before final decision on introduction of the fish for aquaculture system in Pakistan, it is obligatory to conduct a comprehensive appraisal study on the culture of fish on scientific lines. Present study was aimed at to test the growth performance of bighead carp under polyculture system by using different treatments of organic and inorganic fertilizers.

MATERIALS AND METHODS

Fish fingerlings of Chinese carp i.e., *Aristichthys nobilis*, *Ctenopharyngodon idella* and *Hypophthalmichthys molitrix* and major carps i.e., *Labeo rohita*, *Cirrhina mrigala* and *Catla catla*, were procured from Government Hatcheries and acclimatized at local condition before stocking. Treatments given to ponds were as under:

Control. No fertilizer was offered:

Treatment 1. Organic manure (cattle manure) was applied

at the rate of 12000 kg ha⁻¹ year⁻¹. One fifth of the total quantity (2400 kg ha⁻¹) was applied as basal dose a week prior to stocking of fish seed. The remaining amount was applied in equal splits at bimonthly intervals (Jena *et al.*, 2002).

Treatment 2. Inorganic fertilizers in the form of urea and single super-phosphate were added at the rate of 200 kg ha⁻¹ year⁻¹ in 1:1 ratio, respectively in fortnightly doses as source of nitrogen and phosphorus.

Treatment 3. Cow dung and inorganic fertilizer were given. Cow dung was used @10,000 kg ha⁻¹ (Jhingran, 1995) and inorganic fertilizers @200 kg ha⁻¹ year⁻¹ (Garg & Bhatnagar, 2000).

Fish fingerling of bighead carp, silver carp, grass carp, rohu, thaila and mori in the ratio 2: 2: 1.0: 2: 1.5: 1.5, respectively with mean weight of 24.5 - 27.2 g were stocked in four earthen ponds (0.08 ha in size) @ 2000 ha⁻¹ (160 fishes in each pond with equal numbers). Fish samples were taken on monthly basis with the help of drag net of 2.5 cm stretched mesh size to record weight data for growth performance study. Sampling was done on monthly basis for a period of 12 months from March 2003 to February 2004. Physico-chemical characteristics of ponds water including temperature, pH, total alkalinity and dissolved oxygen (DO) were monitored on monthly basis. Effect of various treatments on the investigated traits was analyzed by analysis of variance (ANOVA) and the significance of difference between the mean was evaluated by using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Mean weight gain (g) of bighead carp in control and all treatment were found significantly higher ($P < 0.05$) from other Chinese and major carps, while silver and grass carp were non-significant ($P > 0.05$) to each other. Similar trend was observed between *L.rohita* and *C.mrigala*, whereas the value of weight gain (g) of *C.catla* was found significantly higher ($P < 0.05$) than other major carps and significantly lower value ($P > 0.05$) than Chinese carps (Table I). Total weight gain (g) of all species (Chinese & grass carps) in control and all the three treatments were significantly different from each other. A significantly ($P < 0.05$) greater of weight gain was noted in three treatments while a lowest one ($P > 0.05$) in control (Table I).

Growth performance of different fish species under the polyculture system with bighead carp in relation to the temperature is given in Fig 1. The values were found to be in the range of 23.42 - 136.19 g during the course of the study. Maximum growth was found in month of July 2003 and significantly higher ($p < 0.05$) in July when temperature ranged between 26 - 32°C. The significantly lower values ($P > 0.05$) were found in the month of December, when temperature was lower. Physicochemical parameter of ponds water including temperature, pH, total alkalinity and dissolved oxygen (DO) varied between 12 - 33°C, 7.5 - 8.5,

Fig. 1. Growth performance of different fish species under the polyculture system with bighead carp (*Aristichthys nobilis*) in relation to ponds water temperature

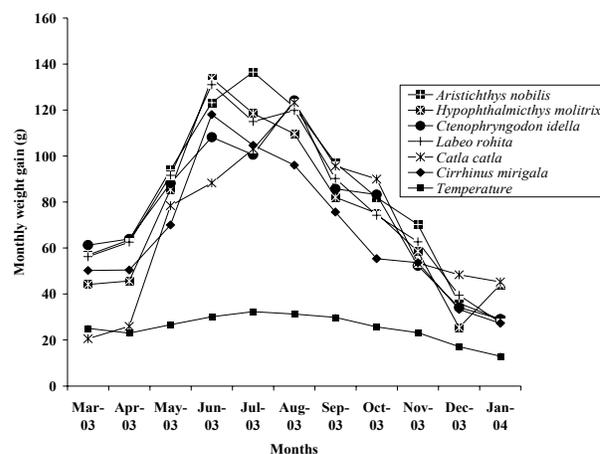
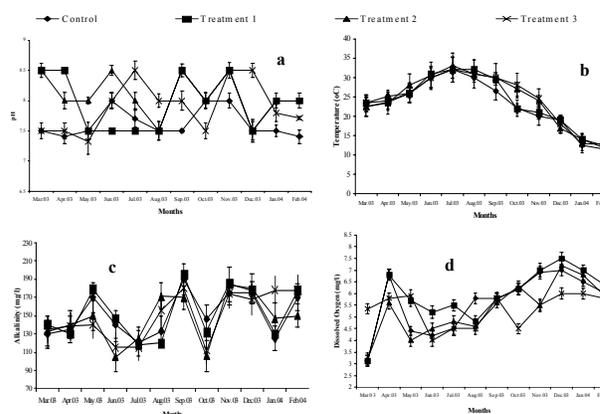


Fig 2. Mean values of different physical and chemical parameters in ponds water under polyculture system



2.9 - 6.9mg L⁻¹ and 130 - 184 mg L⁻¹, respectively (Fig 2a - d). Water quality parameters were within normal range (Shah, 1998).

Different fish species cultured in polyculture system performed better in treatment 3 (organic & inorganic fertilization) followed by treatment 1 (organic manure), while lowest growth was observed in treatment 2 (inorganic fertilizer) as described by Morissens *et al.* (1996). Pond fertilization plays an important role in meeting nutrient deficiency as well as stimulating plankton production and functioning through autotrophic and heterotrophic pathways (Bhakta *et al.*, 2004; Sahu *et al.*, 2007).

Total weight gains of bighead carp in control and three treatments were 698, 1063.6, 873 & 1097.7 g, respectively. This revealed that the total weight gain of bighead carp was greater in T1 and T3 followed by T2. Lower value was found in the control, which was different from three treatments. Average monthly weight of bighead carp in T1 and T3 was higher, while lower weight gain was observed in T2, where only inorganic fertilizers were used.

Table I. Total weight gain in (g) of Chinese carps (bighead carp, grass carp & silver carp) and major carp (rohu, mori & thaila)

Fish	Total weight gain (g)				
	Control	Treatment 1	Treatment 2	Treatment 3	Mean
Bighead carp	698±7.72d	1063.6±8.88a	873.0 ± 5.96 b	1097.7±8.88a	933.10±92.66A
Silver carp	588±5.13d	949.1±7.83b	849.1±5.98b	1025.2 ± 8.77a	852.85±5.36B
Grass carp	638±7.29d	954.70±6.60 a	809.20±4.94 b	1006.5±7.48 a	852.10±82.68B
Rohu	571±4.06d	829.00±5.64 b	777.8±5.39 c	920.5±6.12 a	774.62±73.94C
Thaila	582±5.18d	893.51±4.85b	799.02±6.52c	991.9±5.23a	816.75±87.4BC
Mori	560±5.47d	835.50±5.98 b	762.60±5.69 c	872.9±6.37 a	757.94±96.6C
	606±21.30D	937.98±35.95B	821.62±17.20C	1008.4±32.44A	

Mean sharing the same alphabets are not significant with each other (P<0.05)

In polyculture systems, average monthly weight gain of bighead carp (84.28 g) was higher from rest of major and Chinese carps. Bighead carp out-performed Chinese carp (silver & grass carps), which is in line with the work done by Opuszynski (1981). *C. idella* and *H. molitrix* showed better growth than *L. rohita*, *C. mrigala* and *C. catla* (Mahboob & Sheri, 1997; Tripathi *et al.*, 2000).

Higher monthly weight gain (g) of bighead carp was found during the month of July, when temperature ranged between 26 - 32°C. Lower weight gain was observed in the month of December, January and February when temperature was not suitable for fish growth. General trend of growth performance found in the polyculture of bighead carp (*A. nobilis*) with other carps was temperature dependant. The better growth was found in the range of 26 - 32°C, which is considered to be the best optimum temperature for the fish growth (Bettoli *et al.*, 1985).

In conclusion, treatment 3 with organic and inorganic fertilizers showed better result than others two for rearing of bighead carp in a polyculture system with Indian and Chinese carps, which is presently being practiced in the country. Furthermore, the temperature range of 26 - 32°C was the best for the growth performance of Chinese carp including bighead (*A. nobilis*) and Indian major carps.

Acknowledgement. We thank Punjab Fisheries Department for providing us bighead carp for experimental purposes.

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(Received 12 March 2007; Accepted 05 May 2007)