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Growth performance of olive barb *Puntius sarana* (Hamilton, 1822) in response to use of different supplementary feeds during high density rearing of spawn to fry stage

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ABSTRACT

Rearing of olive barb spawn at high stocking density (2400 m⁻²) was carried out for one month in large concrete seed rearing tanks having soil base. The spawn were fed with three feed combinations (treatments) namely, T1: groundnut oil cake + rice bran at 1:1, T2 : ground nut oil cake + rice bran + fish meal at 40:40:20 and T3 : Soyamilk + egg custard. After 30 days rearing, T2 showed approximately 20% higher survival than T1 (50.5±1.9%), whereas the survival was significantly lower in T3 (43.2±5.2%). In T2, the fry showed a clear edge in growth within 10 days of rearing, which continued further to register 24 and 47.3% higher weight over T1 and T3 respectively, after 30 days. Higher survival, final body weight as well as biomass yield in T2 over T1 revealed requirement of additional animal protein (fish meal) in the diet for better nourishment of olive barb in nursery phase. But in T3, despite presence of soybean and egg protein, fry showed poor survival (43%) and growth, indicating unsuitable or inadequate nutrient supplementation through this diet as compared to the other two.

Keywords: Fry, Growth, High density rearing, Nursery, Olive barb, Survival

Introduction

The olive barb *Puntius sarana* (Hamilton) has been identified as a potential cultivable species for inclusion into the species spectrum of freshwater aquaculture in India (Gopakumar *et al.*, 1999; Chakraborty *et al.*, 2005; Jena *et al.*, 2008). During last decade, propagation of this species through aquaculture has helped in its restoration from 'vulnerable' status (Mahanta *et al.*, 1994; Mukherjee *et al.*, 2002; Chakraborty *et al.*, 2003) to the status of 'least concerned' as per IUCN Red List of Threatened Species (www.iucnredlist.org). Jena *et al.* (2007) studied the compatibility of olive barb with the three Indian major carps in grow out system. While they reported it to be compatible with catla, the rohu-olive barb and mrigal-olive barb combination yielded more biomass than the rohu-mrigal combination, which prompted them to suggest its suitability to culture with both rohu and mrigal under the polyculture system. Induced breeding technique of the species has been standardised using synthetic inducing agent ovaprim (CIFA, 2007). However, pond rearing of fry and fingerlings of the species has been reported to be marred with problems of heavy mortality (Chondar, 1999), lower growth, survival and susceptibility to diseases and deformities (Chakraborty *et al.*, 2003;

Parvez and Khan, 2005). Jena *et al.* (2007) reported higher survival in rearing of fry to fingerlings with use of groundnut oil cake (GOC) and rice bran (RB) mixture (1:1) added with 5% fish meal (FM). In another study on rearing fry to fingerling, Das *et al.* (2011) reported the fry of olive barb to exhibit higher growth when fed GOC and RB mixture along with live aquatic insects (Notonectids). While these reports suggested probable requirement of animal protein for better nourishment of early life stages of olive barb, no systematic information is available on its nursery rearing. In this context, the present study aimed to evaluate suitability of selected supplementary feeds on growth performance during nursery phase.

Materials and methods

The spawn rearing study was carried out for 30 days in six concrete tanks (10 m x 5 m x 1.2 m) having 15 cm thick soil base and filled up to 1 m water depth. Tank preparation involved use of manures and fertilisers applied at conventional dose (Jena *et al.*, 2009), *i.e.*, 750 kg of GOC, 200 kg cow dung and 50 kg single super phosphate (SSP) per ha in three splits. While the first dose was used three days prior to spawn stocking, the other two splits were used on 8th and 16th day after

stocking. Each tank was stocked at 2400 m² of spawn (24 million ha⁻¹). The spawn were fed with three feed combinations (treatments) namely, T1: GOC + RB at 1:1, T2 : GOC + RB + FM at 40:40:20 and T3 : Soyamilk + egg custard. Two replications were maintained for each treatment. The crude protein content of GOC, rice bran, soybean and FM (anchovy) were: 41.2, 10.8, 42.4 and 61.8%, respectively. Treatment T3 was included in the study to represent the farmer's practice of nursery rearing of the species. All the feed ingredients in T1 and T2 were powdered to 50-100 μ particle size in a feed mill before preparing the feed mixture. For preparation of soyamilk, overnight soaked soybean was made into paste, added water and filtered through 80 mesh net cloth to collect the milk, while egg custard was made by making paste out of half boiled eggs. The two ingredients were mixed together and diluted with more water before feeding. The powdered feed mixture was dispensed gently over the water surface to ensure floating, while the liquid mixture of T3 was sprinkled uniformly in the tanks.

In T1 and T2, daily feed was provided at 200, 300, 400 and 500% of the initial spawn biomass (1.0 lakh spawn weigh approximately 140 g) during 1st, 2nd, 3rd and 4th week, respectively. In T3, the daily feed during the 1st week consisted of milk prepared from 200 g soybean which was mixed with custard of one boiled hen's egg. Quantity of soybean for milk preparation was increased by 50% in every subsequent weeks (300, 450 and 675 g in 2nd, 3rd and 4th week, respectively), while egg number increased to two per day during 3rd and 4th weeks.

Fish sampling in tanks was carried out at 5 day intervals. Length and weight of 25 fry from each replicate tank were recorded. Sampling of water was also carried out between 07:00 and 08:00 hrs at 5 day intervals to measure the important parameters. While water temperature and pH were measured *in situ*, samples were brought to laboratory and analysed for dissolved oxygen (DO, after fixing at the site), total alkalinity (TA), total hardness (TH) and inorganic nutrients *viz.*, total ammonia nitrogen (TAN), nitrite, nitrate and phosphate as per standard methods (APHA, 2005). Fry were harvested after 30 days by repeat netting followed by complete draining. Data were recorded for calculation of the yield attributes. The data on fish growth, survival and biomass production were statistically analysed using PC-SAS program for Windows, release v6.12 (SAS Institute, Cary, NC, USA) and Duncan's multiple range test was performed to compare the growth and yield of the stunted fingerlings.

Results and discussion

Water temperature in the tanks varied within a narrow range of 29.1-31.8 μ during the study. Mean

DO concentrations varied in the range 2.29-6.62 mg l⁻¹. There was a marked depletion of DO in almost all the tanks on day 5 (Fig. 1a). At high density, apart from fish respiration, continuous overcast during 3rd to 6th day could be the possible reason for depletion in DO. However, DO level improved later and remained at moderate levels for the rest of the period with no marked fluctuation among the treatments. The water pH (7.13-8.82) also remained similar among the treatments (Fig. 1b), attributed mostly to the interim liming. Ahmed (1997) reported the need for maintenance of minimum level of water quality such as DO at 5 mg l⁻¹, pH at 6.7-8.6 and free CO₂ at <3 mg l⁻¹, ammonia at <0.02 mg l⁻¹ and alkalinity at above 20 mg l⁻¹ to maintain fish health. Further for carps, generally DO level of >3 mg l⁻¹ in the morning hours and fluctuations of diurnal water pH within a range of 7.5-8.3 are generally considered ideal. In the present study, morning DO (4.4-4.8 mg l⁻¹) and pH in tanks were close to the ideal ranges suggested by Ahmed (1997). Total alkalinity and hardness were also above 40 mg l⁻¹ in treatments, indicating prevalence of a good growing environment for the nursery phase (Ahmed, 1997; Basavaraja and Anthony, 1997). Both these parameters showed gradual increase with progress of rearing (Fig. 1c,d), which could be attributed to the cumulative increase of the alkaline earth (Ca) and bicarbonate in water through liming (Boyd, 1990); as well as the increased rate of CO₂ production from decomposition of accumulated organic matter such as the 3 split dosages of manure, faeces and excess feed (Knud Hansen, 1998; Thakur *et al.*, 2004). The TAN did not show marked variation during the study period except for a peak on day 30 in all the treatments (Fig. 1e). Though the TAN level, especially on day 30 was much higher than the ideal ammonia level (0.02 mg l⁻¹) suggested by Ahmed (1997), we have not encountered any abnormal behaviour or mortality of fry. T1 showed lower NO₂-N and NO₃-N levels than the other two treatments, (Fig. 1f, g) probably due to absence of animal protein in the former. The PO₄-P showed buildup in the tanks (Fig. 1h), but without any systematic trend.

In general, the observed water quality, without marked variations among the treatments, indicated a uniform growing environment in all the tanks. Further, it also indicated that use of the three different diets did not lead to any marked variation in the water parameters.

Survival is an important consideration for the success of seed rearing. After 30 days of nursery phase, fry survival varied among the diet types with significantly higher survival in T2 (70.2%) followed by T1 (50.5%) and T3 (43.2%) (Table 1). Chakraborty *et al.* (2003) have reported 49.2 - 62.9% survival for same species in earthen nursery pond, after six weeks of nursery phase, but at lower

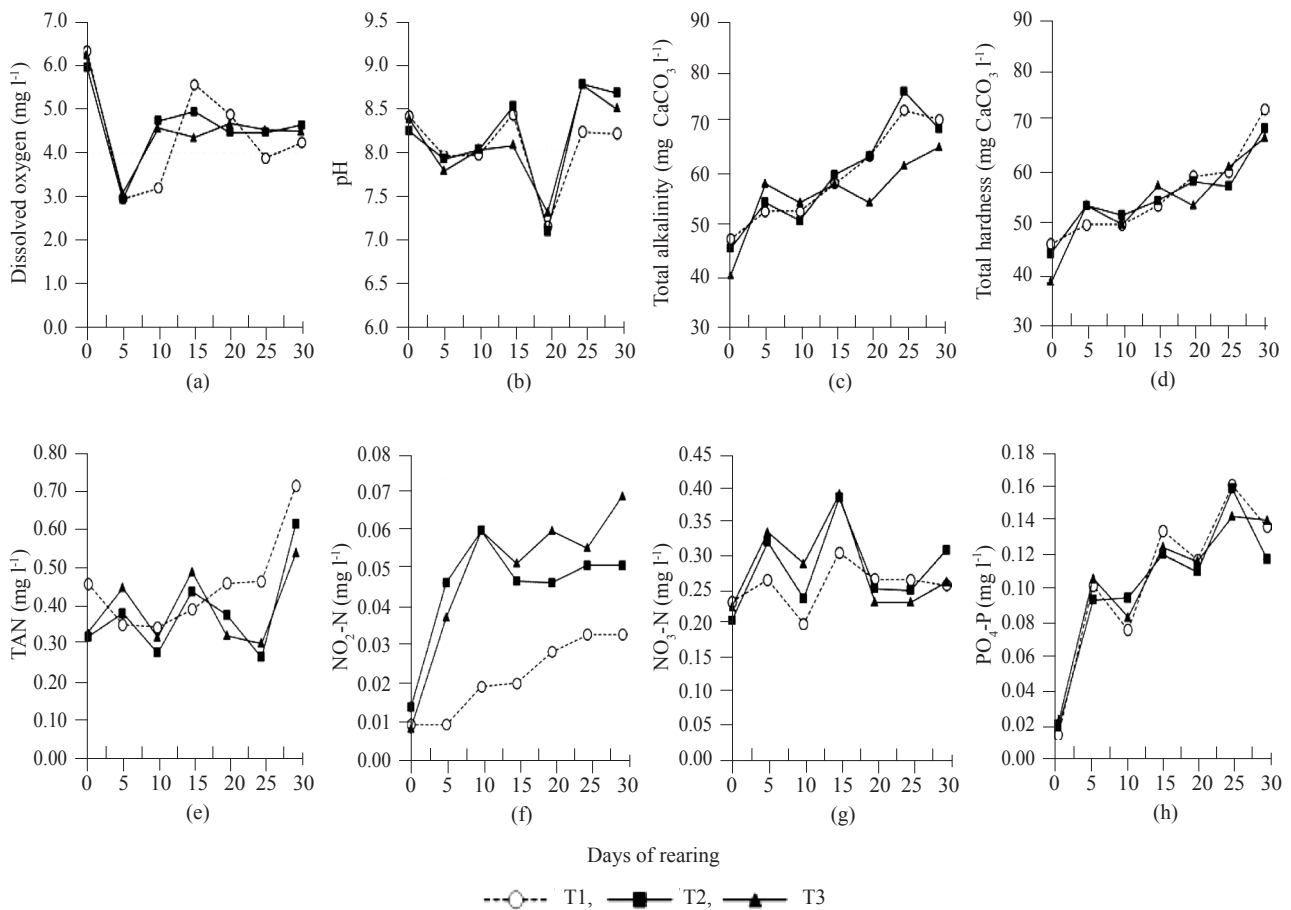


Fig. 1. Water quality parameters in the experimental tanks during nursery rearing of olive barb

Table 1. Yield attributes of the fry of *P. sarana* during fry rearing with different feed combinations

Treatment	Initial length (mm)	Initial weight (mg)	Survival (%)	Final length (mm)	Final body weight (mg)	Harvest biomass (kg tank ⁻¹)	Harvest biomass (kg ha ⁻¹)
T1 (RB+GOC)	5.0	1.51	50.5±1.9 ^b	16.27±1.4 ^a	45.5±11.0 ^a	2.74±0.56 ^b	547.9±112.6
T2 (RB+GOC+FM)	5.0	1.51	70.2±3.8 ^a	17.6±1.0 ^a	56.4±4.0 ^a	4.74±0.18 ^a	947.4±35.7
T3 (Soyamilk+Egg)	5.0	1.50	43.2±5.2 ^c	16.1±1.1 ^a	38.3±10.0 ^a	1.94±0.30 ^c	388.4±60.7

Values (Mean±SD) bearing same superscripts in a column do not differ significantly ($p>0.05$, $n=3$)

stocking density of 0.7 - 0.9 million spawn ha⁻¹. However, considering the duration of nursery phase, survival in the present study after 30 days were much closer to the range (56 - 78%) reported by Hossain *et al.* (2007) after 35 days of nursing olive barb fry in laboratory. Compared to these earlier studies, the survival obtained in T1 and T2, despite use of much higher stocking density (24 million), can be considered better in terms of number of fry harvested. The results also demonstrated the advantage of using concrete tanks for nursery phase of the species over earthen ponds, attributed to greater control on the water quality and feed management.

Incorporation of fish meal at 20% level in diet T2 led to approximately 20% increase ($p<0.05$) in the survival

compared to control (T1) (Table 1). Though average final body weights (ABW) were similar in treatments, such higher survival in T2 compared to T1 was obviously attributed to inclusion of fish meal, since it was the only variable ingredient between these two treatments. Good availability of plankton, particularly zooplankton is reported to favour better survival and growth during early life stages of the Indian major carps (Chakraborty *et al.*, 2003; Jena *et al.*, 2009). The present study also revealed higher requirement of animal protein for olive barb fry. However, survival in T3 (43.2±5.2%) was significantly lower compared to the other two diets despite high protein contents of the two ingredients. While no earlier report is available on use of this diet for nourishing olive barb spawn to fry stage, the observed survival can be considered as an

appreciable level in nursery phase, making use of this diet by farmer a feasible option for nursery phase of olive barb.

The spawn fed with diet T2 showed a clear edge in growth (Fig. 2) within 10 days of rearing, which continued further to register 24 and 47.3% higher weight attainment at the end of nursery phase compared to T1 and T3, respectively (Table 1). Statistically however, there was no significant difference in the average final body weight (ABW) or length (ABL) of the fry in the three treatments ($p>0.05$), which was probably due to their wide size variation within population of each tank (Table 1). Despite

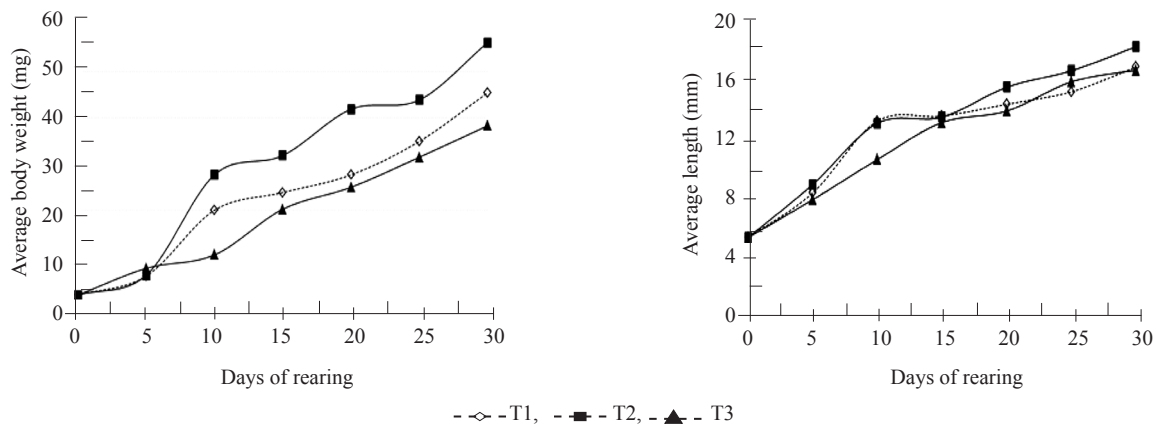


Fig. 2. Growth curve of olive barb fry fed with different diet during the nursery phase

similar harvested size, T2 showed significantly higher biomass yield ($p<0.05$) over T1, attributed to its increased survival, and demonstrated the advantage of fish meal supplementation for fry growth. Further, size variation was minimal in tanks in T2 (lower standard deviation) which implicated more uniform supplementation of nutrient through this diet as compared to the other two. In an earlier study by us on the same species (Das *et al.*, 2011), fry had also shown significantly higher growth when fed with prepared diet along with animal protein (live notonectids) compared to the prepared diet alone, which demonstrated better nutritional supplementation through co-feeding. We have also reported (Das *et al.*, 2011) highly carnivorous behaviour of olive barb during nursery phase. The present result in terms of higher realisation of the survival, harvested body weight as well as biomass yield in T2 also indicated such carnivorous food habit and requirement of additional protein (fish meal) in diet for better nourishment during nursery phase. Whereas, T3 having both soya milk and egg as the protein sources, showed poor fry performance, indicating probable unsuitability or inadequacy of the nutrient supplementation through this diet as compared to the other two diets.

Availability of natural plankton is an important criterion for growth and survival of the fry during the

nursery phase of carps and barbs (Jena *et al.*, 2009). Plankton concentrations also largely influence the water quality in nursery ponds. Though plankton enumeration has not been done in the present study, prevalence of an almost similar water environment in the tanks across the treatments (Fig. 1 and 2) indicated their undifferentiated influence on the fry growth. So, the varietal growths observed in the fry in treatments revealed significant role of diet type in fry growth realisation in olive barb. While the study revealed advantage of using diet enriched with fish meal for higher survival and growth realisation, the

poor show with use of egg and soya milk combination warranted the need to study nutrient supplementation of these feeds and their suitability for olive barb fry.

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