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Low-cost mobile hatchery produced silver barb (*Barbodes gonionotus*) fingerling: its growth and economic performance in intensive culture system

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ABSTRACT

Objective: To explore the growth performance of low-cost mobile hatchery produced silver barb (*Barbodes gonionotus*) fingerling comparing with typical one, field laboratory complex hatchery.

Methods: Assigning Treatment I and Treatment II stoked with low-cost mobile hatchery and field laboratory complex hatchery originated fingerling of silver barb in plastic circular tank.

Results: The average weight gain (g/day) of fish was 0.18 and 0.16 g, length gain (cm/d) 0.03 and 0.02, gross yield 0.09 and 0.08 kg/tank per month, net yield 0.03 and 0.01 kg/tank per month respectively in Treatment I and Treatment II. The growth of low-cost mobile hatchery produced silver barb was higher ($P<0.05$) although SGR (%/d) was 1.63 and 1.89 and FCR was 2.57 and 2.55 for Treatment I and Treatment II, correspondingly and survival was 100% in both cases. In case of economic efficiency, total operating cost were BDT 68.91 and 67.41, revenue BDT 107.35 and 89.30, net profit BDT 38.44 and 21.89 and BCR 1.55 and 1.32 respectively in low-cost mobile hatchery and field laboratory complex hatchery produced fishes.

Conclusions: The fry from both origins showed more or less similar growth performance and none of them was superior. Considering the economic feasibility in both cases, it is assumed that the intensive culture of silver barb is possible at field level.

1. Introduction

Aquaculture is an important part in food producing sector of Bangladesh. Nowadays it becomes an industry and provides nutritious food, employment opportunities, remittance, etc. to people. Aquaculture production solely depends on the quality fish seed and its decentralization throughout the country when and where necessary[1]. Aquaculture of Bangladesh absolutely depended on natural sources of fish seed during sixties and early seventies. By the time being, natural sources has been declined due to the climate change, habitat destruction and hatchery operation has been started to fill the fish seed requirement[2].

The development plants of aquaculture obviously situated in rural areas where the development objectives have to be tested for producing quality animal protein in order to meet up the malnutrition related poverty among the MGDs targeted countries having better future[3].

To fulfill the fish seed requirement especially in remote areas, to decentralize the hatchery, to minimize the cost of hatchery construction, to minimize the land use for hatchery installment, to transfer it anywhere if needed; low cost mobile hatchery (LCMH) was invented in the Aquaculture Laboratory-I, Faculty of Fisheries, Bangladesh Agricultural University to produce fish seed adopted from Basak[4]. Firstly, silver barb fries were produced by LCMH as testing phase of operation.

There might be a general confusion in the LCMH produced fingerling regarding growth performance compared to commercial hatchery produced fingerlings. To explore

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the insights into the superiority or inferiority of growth of fingerlings between LCMH and typical hatchery, the experiment was carried out focusing the growth performance of fingerling produced in LCMH with typical (commercial type) hatchery produced one as control and to assess economic feasibility of indoor intensive culture of silver barb.

2. Materials and methods

2.1. Location and duration of the study

The present study work was conducted at the Aquaculture Laboratory-I, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh for 30 d from August 2010 to November 2010.

2.2. Sources of larvae

LCMH nursery pond and the larvae of same species collected from field laboratory complex hatchery (FLCH).

2.3. Experimental tank preparation

For experimental purpose, 500 L capacity two circular water holding tanks were used with outlet system.

2.4. Experimental design

A comparative growth study between LCMH and FLCH produced silver barb by establishing an intensive culture system with its economic efficiency. The experiment designed as Treatment I and Treatment II were conducted where two tanks were assigned for each experiment.

2.4.1. Treatment I

Treatment I was designed to study the growth performances of LCMH produced silver barb fingerling with stocking density of 7 fingerlings/tank which is equivalent to 566 fingerlings/dec approximately. Here the individual fish is considered as a replication in the comparative statistically analysis (paired sample *t*-test) with treatment II.

2.4.2. Treatment II

Treatment II was designed to study the growth performances of FLCH produced silver barb fingerling with same stocking density.

2.5. Feeding

The fingerlings were fed with Mega Feed (Tilapia starter-floating) containing ingredients were crude protein (min)-30%, crude fat (min)-3%, crude fiber (max)-10% and moisture (max)-12%; at a rate of 10% body weight twice in a day.

2.6. Water quality monitoring

Water quality parameters such as temperature (°C), dissolved oxygen (mg/L), pH, ammonium and ammonia-nitrogen (mg/L) were recorded by using Sera test kits. The water samples were collected at 10:00 am to 11:00 am just before water exchanged at 3 d later of water filling throughout the experimental period.

2.7. Sampling

Sampling was done at 5 d interval where the feeding rate was adjusted by measuring the weight of fish to observe the health condition and to keep the record of length and weight of fish. Length and weight of fingerling was measured by centimeter scale and electronic balance (model No. ACB-300) respectively.

2.8. Study of growth and yield of fish

For the comparative study of fishes of the Treatment I and II, the following growth parameter were calculated and analyzed.

Weight gained=Mean final weight of fish–Mean initial weight of fish

Length gained=Mean final length of fish–Mean initial length of fish

$$\text{SGR}(\%/day) = \frac{\log_e W_1 - \log_e W_2}{T_2 - T_1} \times 100$$

$$\text{FCR} = \frac{\text{Food fed (Dry matter)}}{\text{Live weight gain}}$$

$$\text{Survival rate}(\%) = \frac{\text{No. of fishes harvested}}{\text{No. of fishes stocked}} \times 100$$

Gross yield=No. of fish caught×Average final weight

Net yield=No. of fish caught×Average weight gained

2.9. Analysis of length–weight relationship

If an animal is growing isometrically (increasing in all dimensions at the same rate) and its weight will increase in relation to the increase in volume. Thus there is a cubic relationship between length (L) and weight (W) which can be representing by the cubic or power curve equation^[5].

$$W = qL^b \dots\dots\dots (i)$$

Where, b is close to 3 in isometric growth and the parameter q were determined empirically.

2.10. Economic analysis

Economic analysis was conducted to determine economic return of intensive silver barb culture considering the market prices of harvested fishes and all other items (e.g. Capital cost, operating cost, net profit, revenue etc.) expressed in Taka (BDT).

Market price of harvested silver barb was BDT 95 per kg.

3. Results

3.1. Growth performance

Table 1 showed that the growth performance of two treatments with respect to the source of silver barb fingerling named as T1 and T2 where length of fish was expressed in centimeter and weight of fish expressed in gram with standard deviation, which contained five samples showing mean length and weight.

Table 1

Average growth trend in terms of length (cm) and weight (g) of silver barb fingerling at different samples in two treatments.

Sampling No.	Source of fish	Length of fish (cm)	Weight of fish (g)
I	T1	9.00±0.36	8.33±1.48
	T2	8.83±0.33	6.49±0.98
II	T1	9.03±0.36	10.09±0.95
	T2	9.03±0.46	8.29±1.85
III	T1	9.35±0.31	12.20±1.85
	T2	8.98±0.62	10.03±2.36
IV	T1	9.73±0.36	12.46±1.07
	T2	9.35±0.62	10.57±2.53
V	T1	10.00±0.42	13.61±1.95
	T2	9.50±0.42	11.46±1.71

3.1.1. Length of fingerling

The length of fingerling was ranged from (9.00±0.36) to (10.00±0.42) cm with the mean value of (9.42±0.51) cm in Treatment I, whereas in Treatment II the mean value was (9.14±0.52) cm ranging from (8.83±0.33) to (9.50±0.42). Paired Sample *t*-test showed that there was significant difference ($P<0.05$) between Treatment I and II and there also a significant difference ($P<0.05$) between their sampling.

3.1.2. Weight of fingerling

The weight of fingerling ranged from (8.33±1.48) to (13.61±1.95) g with the mean value of (11.34±2.36) g in Treatment I. On the other hand, the weight in Treatment II was fluctuating from (6.49±0.98) to (11.46±1.71) g with the mean value of (9.37±2.52) g. Paired Sample *t*-test showed that the weight of fingerling had significant difference ($P<0.05$) between Treatment I and II and there was also significant difference ($P<0.05$) between sample of two treatments.

3.2. Different types of growth parameters

Different types of growth parameters of LCMH and FLCH produced fingerling are shown in Figure 1.

3.3. Length–weight relationship of LCMH and FLCH produced fingerling

In case of LCMH, $R^2=0.7430$ i.e. $r=0.86$ and in case of FLCH,

$R^2=0.7966$ i.e. $r=0.89$ that means there were a significant relationship between length and weight (Figure 2).

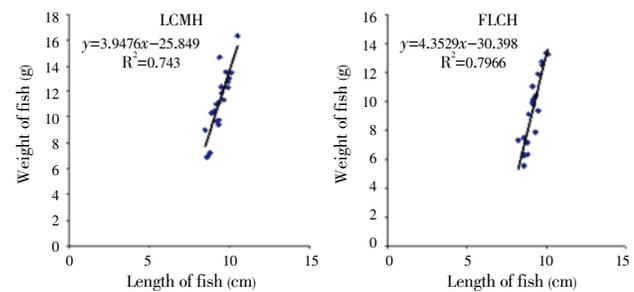


Figure 2. Relationship between length and weight in case of LCMH and FLCH produced fingerling.

3.4. Length–weight relationship of LCMH and FLCH produced fingerling

In case of LCMH, $R^2=0.7430$ i.e. $r=0.86$ in case of FLCH, $R^2=0.7966$ i.e. $r=0.89$ that means there was a significant relationship between length and weight (Figure 2).

3.5. Survival rate

The value of survival rate of both Treatment I and II was calculated as same, which was 100% in both cases.

3.6. Water quality parameters

Figure 3 showed the bar diagram, represent the value of different water quality parameters such as temperature ($^{\circ}\text{C}$), hydrogen ion concentration (pH), dissolved oxygen (mg/L), ammonium and ammonia–nitrogen (mg/L) in which maximum value observed for temperature and minimum value for ammonia–nitrogen in both treatments.

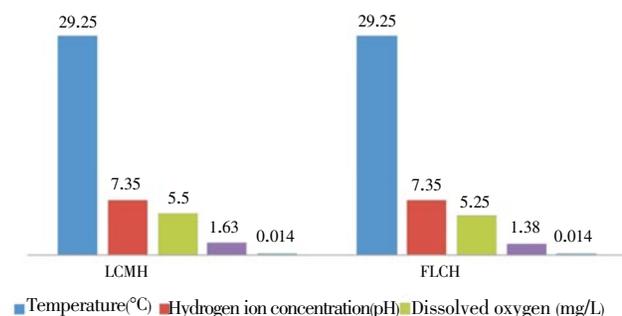


Figure 3. Different types of water quality parameter in two treatments tank.

3.7. Economic feasibility

In the terms of number of fingerlings, examined number was converted into on farm stocking density by which it was observed that it would have to use 100 numbers of fingerlings in a tank. Therefore, the economic analysis was done on that basis. The present study was conducted for 30 d whereas variable cost, revenue and BCR were calculated after rearing them.

In case of LCMH, operating cost, revenue, net profit were

68.91, 107.35, 38.44 and BCR was 1.55 and 67.41, 89.30, 21.89 and BCR 1.32, respectively (Figure 4).

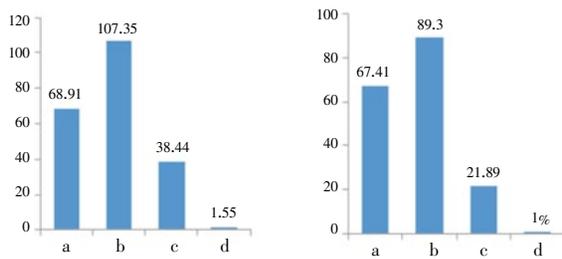


Figure 4. Total cost, revenue, net profit and BCR of LCMH and FLCH produced fingerling.

a: Total cost; b: Revenue; c: Net profit; d: BCR.

4. Discussion

The effects on the growth performance of LCMH produced fingerling were investigated in this experiment. However, the growth performance, water quality and economic efficiency of LCMH produced fingerling were more or less similar with different literature were discussed below:

4.1. Growth performance

The value of length gain (cm/day) was 0.03 and 0.02 cm, weight gain (g/day) 0.18 and 0.16 g, gross yield 0.09 and 0.08 kg/tank/month, net yield 0.03 and 0.01 kg/tank/month in Treatment I and II respectively where feed is applied at 10% of body weight twice daily. Above growth parameters showed that the value of Treatment I *i.e.* of LCMH produced silver barb fingerling was higher than Treatment II *i.e.* FLCH produced silver barb fingerling. Behind these results, it can be said that matured brood fishes were selected where male female ratio was 2:1 as because healthy fry was produced. For intensive care of hatchling, proper nourishment was confirmed by hardly boiled chicken yolk during exact first feeding time and provided continuously it at 6 hours interval for two days. The value of SGR (%/day) was 1.63 and 1.89 in Treatment I and II respectively *i.e.* the growth of LCMH produced silver barb fingerling was lower than FLCH produced silver barb fingerling individually, although the weight gain was higher on an average. The value of FCR was 2.55 and 2.57 in Treatment I and II respectively. LCMH produced silver barb fingerling might have been enough healthy thus the feed acceptance and digestion was higher. Moreover, the value of survival rate of both treatments was calculated as same, this was 100% in both cases. It might be due to intensive care has taken during culture period and quality healthy fry as well as proper feeding, stocking density and water quality maintenance.

In case of length–weight relationship, the coefficient of determination (R^2) are 0.7430 and 0.7966, following the correlation coefficient (r) are 0.86 and 0.89 in case of Treatment I and II, that are near to 1; indicating that there is a higher correlation between length and weight *i.e.* if the length is

increased or decreased weight follow the same trend of fluctuation and its positive value reflected that the slope (b) is positive that means the relationship was positive. Sethuramalingom *et al.* determined the co-efficient of correlation (r) of *Puntius filamentus* is found to be 0.88056 in river which are slightly higher than the present study because of there was no natural food for fingerling^[6].

4.2. Water quality parameters

4.2.1. Temperature (°C)

For aquatic organism water temperature is one of the most important factor that influence the physiology, the growth and the production of fishes. In the present study, water temperature ranged from 29 to 30 °C during the experimental period both in Treatment I and II with average temperature of 29.25 °C. Boyd reported that the range of water temperature of 26.06 to 31.97 °C is suitable for fish culture^[7]. Swann described the suitable water temperature for warm water species would be 24 to 32 °C for recirculation system^[8]. The average temperature is 29.25 °C in present study; which found in suitable range might be due to season, time of day and laboratory condition.

4.2.2. Dissolved oxygen

Among the dissolved gases in the intensive culture system, water oxygen is most important and critical one. In the present study, dissolved oxygen ranged from 4 to 7 mg/L and 5.5 mg/L averagely in Treatment I and 4 to 6 mg/L and 5.25 mg/L averagely in Treatment II. DoF reported that the suitable ranged of dissolved oxygen should be 5.0 to 8.0 mg/L for fish culture^[9]. Swann described the suitable dissolved oxygen content for warm water species would be 5 mg/L for recirculation system which is more or less similar to the present study^[8]. During the experiment, the regular water supply was done so that the optimum dissolved oxygen level can be found.

4.2.3. Hydrogen ion concentration (pH)

In the intensive culture system, pH is a vital chemical factor which indicates the amount of ions in a water body as well as the acidity–alkalinity condition of the water body. It is also called the productivity index of a water body. The pH of water as recorded in the present study is ranging from 7.3 to 7.4. DoF reported the suitable range of pH for fish culture is 6.5 to 8.56^[9]. Swann described the suitable ranges of pH for warm water species would be 6.5 to 9.0 for recirculation system^[8]. The pH range during the experimental period is suitable for fingerling rearing and this might be due to regular water exchange.

4.2.4. Ammonium and ammonia

Ammonium–nitrogen ranged from 0.05 to 3.00 mg/L in Treatment I and II with the average value 1.625 and 1.375 mg/L respectively whereas ammonia ranged from 0.006 to 0.02

mg/L and 0.014 mg/L averagely in Treatment I and 0.005 to 0.02 mg/L and 0.01375 mg/L averagely in Treatment II during the experimental period. Islam recorded NH₄-N from 0.05 to 0.26 mg/L in six earthen ponds. In the present study, the ammonium and ammonia (mg/L) were found in suitable range^[10]. The artificial feed are very much rich in nitrogen. However, intensive culture system totally depends on the artificial feed thus if the sediment is not removed by siphoning regularly, ammonium converts to ammonia. Moreover, there was a negative relationship within ammonia, dissolved oxygen and pH. If the amount of ammonia is increased, the dissolved oxygen and pH will be decrease. Therefore, it would be necessary to take special care to remove uneaten feed and feces at certain interval.

4.3. Economic feasibility

In the present study total operating cost are calculated as BDT 68.91 and 67.41 and revenue BDT 107.35 and 89.3; net profit around BDT 38.44 and 21.89 and BCR's are 1.55 and 1.32 in Treatment I and II. Long *et al.* conducted an experiment on rice–fish polyculture in Mekong delta where the fish yield 808 and 482 kg/ha and BCR 1.82 and 1.81 for farm–households at 1 fish/m² and at 2 fish/m² stocking densities^[11]. Phommachan *et al.* reported that the economic profit of these three treatment silver barb were \$ USA 41 for T2, \$ USA 26 for T1, \$ USA 32 for T3 for nursing of silver barb^[12]. The findings of the present study were more or less similar with mentioned evidences. The total operating cost is higher in LCMH comparatively; however it is at profitable level because of its higher production. BCR is an indicator whatever a farm or project either profitable or not. The BCR of LCMH produced silver barb fingerling culture unit was slightly higher (1.55) than that of the FLCH produced silver barb fingerling culture unit (1.32). The difference between them was 0.23 which about to approximately double for per unit revenue in case of LCMH than FLCH. Total revenue, net profit and BCR in both cases that might be viable at the farmer level economically. Based on this lesson, intensive carp culture could be researched for producing more fish in limited area.

In this breeding technique, only PG was used as inducing agent, no drugs, no chemicals, no lime or salt were used. So, in this way of culture technique, produced fish can be easily accepted by consumers who are interested in taking organic fish at home and abroad.

Although the SGR (%/day) of LCMH produced silver barb fingerling was lower but the weight gain (%/day), gross yield, net yield *etc.* were better than that of the FLCH produced silver barb fingerling. The length–weight relationship was also encouraging in both cases. Generally, the production and profit depend on the three aspects such as quality fish seed, culture technique (including the water quality management, good quality feed supply and health management) and marketing period. As the culture technique and marketing period was the same for both treatments, now it is concluded

that there are no negative impact were found on fingerlings' growth being produced from LCMH; moreover, good quality fry was found and further better growth was also found during experimental period. As BADC (Bangladesh agricultural Development Corporation) “quality seeds bring quality production”. Then it can be said that “give healthy brood together with a LCMH and a technical personnel, it is possible to produce quality seed to meet the seed requirement which ultimately give better production.

Conflict of interest statement

We declare that we have no conflict of interest.

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