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BREEDING PERFORMANCE, SPAWNING AND NURSING OF BLACK CARP (*MYLOPHARYNGODON PICEUS*)

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Abstract: Successful induced breeding of black carp was performed by using Pituitary Gland (PG) extract and synthetic hormone Flash™. For PG, the female received two doses at the rate of 2 mg/Kg and 8 mg/Kg body weight respectively; where male received only single dose at the amount of 2 mg/Kg body weight. For Flash, the male and female was received only one dose at the amount of 0.3 ml/Kg body weight for male and 0.25 ml/Kg body weight for female respectively. The ovulation period was 12 hours for PG and 11 hours for Flash after lost injection. In total 6.1 Kg of hatchling was obtained from 23 kg of female black carp under the two treatments. While, the ratio of hatchling and female fish body weight was 1 : 4.28 for PG and 1 : 3.34 for Flash. The study also indicates that the spawn Production of black carp and nursery operation ware profitable. In the spawn production, the profit rate was 872.76% ware observed and the cost benefit ratio recorded as 1: 8.72. In cases of profit from spawn production and nursery operation combined of black carp, the return was 247.95%. While, cost benefit ratio was 1 : 2.47. For income generation through hatchery and nursery operation for sustainable aquaculture extensive study is needed in this regards.

Key words: Black carp, breeding, spawn, nursery operation, cost-benefit analysis

INTRODUCTION

There are namely natural, induced and strip spawning approaches are used for finfish seed production. In natural spawning, fish mature and spontaneously spawn in their natural habitat or in captivity. In induced spawning, either wild or captive brood stocks are induced to spawn through the use of a hormone or without hormone treatment but with environmental manipulation. The strip method is the manual stripping of eggs and sperm, and artificial fertilization, after hormonal treatment. Natural or induced spawning dominates the fish hatchery industry, as it is more effective than the strip method (Juario *et al.* 1984, Watson 1987, Liu 2000). In Bangladesh, tradi-tionally in the point of view of fish hatchery business, the seed and fry production technique of Indian major carps: Rui (*Labeo rohita*), Catla (*Catla catla)*, Mrigal(*Cirrhinus cirrhosus)* and Kalibaush (*Labeo calbasu*) through induced breeding have

Been well developed and documented. As the first successful induced spawning in Bangladesh was performed by Ali (1967) in carps through hypophysation and then standardized by (Haque 1975, Islam and Chowdhury 1976, Ahmed 1983, and Alam 1983 etc.).

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Bangladesh is an important biodiversity hotspot and enriched with more than 260 freshwater fishes, though many species are being commercially cultured. So far 12 exotic species have been introduced to Bangladesh (Rahman 2005) for commercial aquaculture. Both endemic like Indian major and minor carps, exotic fishes such as common carp, tilapia, catfishes as well as perches plays important role in aquaculture sector having enormously contributed to the total aquaculture and major production in closed water inland fisheries. In addition employment opportunity, income generation, empowerment of women, improves subsistence as a whole of sustainable aquaculture and improved livelihood status of fish farmer are recognized. Black carp also known as Snail carp was introduced for the first time in Bangladesh by the Department of Fisheries in 1983. A consignment of 2000 fry were brought by Chinese officials from Kwantung Province and were raised in ponds of Aquaculture Experimental Station at Mymensingh and the Fish Hatchery and Training Center at Raipur (Rahman 2005). It has been prescribed as one of the most suitable candidate Bangladesh for its fast growth rate and good table quality (Ameen 1987). It can grow up to 70 kg in weight (Peirong 1989). The fish uses the bottom layer of the ecosystem that is often unused in Bangladesh, so the species has a technical advantage in polyculture with surface and mid water feeder species (Ameen 1987). Black carp females are sexually matured in 5-8 years; however, males usually mature one year earlier than the females (Peirong 1989). The first successful induced breeding of the black carp was achieved in China with artificial ovulatory agents in 1963 (Shigang 1989). Though every hatchery owners of Bangladesh have limited stock of the species but they did not perform the breeding like other aquaculture species. The potentiality of commercial aquaculture of the species is promising but the research on fry production and fingerling rearing and their economy are still now scanty. Therefore, the present study aimed to be assessment of breeding performance and calculate hatchery economy and nursery operation on captive condition.

MATERIAL AND METHODS

Study site: The study was conducted in Dipanchal Agrofisheries Hatchery (22˚ 46.833´ N and 90˚ 38.909´ E) at Bhola Sadar in Bhola district of Bangladesh. The hatchery was 12 km away from Bhola Sadar and situated on the bank of Meghna River. The study was performed between November 2013 and September 2014. The hatchery complex has two parts- one is the hatchery proper (20 decimal) where breeding activities were performed and another was the culture unit (9 acre) where brood rearing, nursing and culture were done. The hatchery proper possessed of one overhead tank, fourteen hatching jars, six circular tanks as well as four delivery tanks. River water also collected and then kept in a pond and used it for breeding and hatchery purposes. There were eleven ponds of which seven are brood fish pond of carps and catfish namely Pangus.

Brood source: Total 50 yearlings of black carp were collected from fry market at Chachra of Jessore in 2007 then stocked in (1 yearling/5 decimals appox.) a hectare size pond. The brood were ready after six years of rearing.

Management of broods and brood pond: In the month of November 2013, the embankments and the pond bottom were cleaned and repaired manually. Quicklime was applied in the pond at the rate of 1.0 kg/decimal as initial dose before seven days of fertilization. Pond was fertilized with urea, triple super phosphate (TSP) and master oil cake at the rate of 150 g/decimal, 100 g/decimal 1Kg/decimal respectively. After seven days of fertilization brood fishes were released in the ponds at the density of 10 Kg fish per decimal. Water depth of brood fish pond maintained from one to1.5 meters. Partially water exchange was done regular basis using plastic pipe to keep the fish disease free and early maturation. To control unwanted fishes like tank goby, glassy fish and small prawn etc. Magic card at the rate of 30 g/decimal for 5 feet depth (the product of MEGA agrovet industries Bangladesh).

Breeding performance: For breeding male and female black carp were harvested in the early morning and kept at tanks separately 6-7 hours for conditioning. During condition period no feed was provided to keep their stomach free from foods. Before injection the broods were kept on wet foam to minimize the stress and the eyes were covered with cloth to free from movement. The single pair of black carp brood was injected with PG extract at the pectoral fin bases at 45° angle. After 6 hours of first dose females received a second dose. Males received a single dose during the second dose of female. Another one pair of black carp brood was injected with synthetic hormone namely Flash at the pectoral fin bases at 45° angle. In this case male and female received only one dose. After ovulation eggs were collected from the female in a bowl by stripping i.e., by giving gentle pressure on the abdomen of female. Then milt was collected from the male by applying the same procedure. The eggs and milts were mixed by using a feather for fertilization. The fertilized eggs were transferred to the hatching jar.

Management of black carp nursery: The nursery pond of black carp was 50 decimal of size and rectangular of shape. The dike and the bottom of the pond were cleaned and repaired manually. Quicklime was applied in the pond at the rate of 1.0 kg/decimal as initial dose before seven days of fertilization. The pond was fertilized with urea, triple super phosphate (TSP) and master oil cake at the rate of 150 g/decimal, 100 g/decimal and 1Kg/decimal respectively. To control harmful aquatic insects and undesirable zooplanktons and minute insects applied Delitics (Deltamethrin 1.75%; products of FishTech BD. Ltd.) at the rate of 0.70 ml/decimal for 4 feet water depth and applied two times before stocking of spawn in the pond. Spawn stocking density was 50 g/decimal. Feeding was done at the rate of 4 kg/ 2.5 kg hatchling/ day for the first one week, 5 kg for the second weeks, 6 kg for the third week then 130 kg feed also used another 2 months rearing period. Selling of fry was started after 21 days nursing of fry.

Data collection and statistical analysis: Data on pond lease value, embankments of bottom repairing cost, water exchange cost for brood pond, netting of pond, water expenses for hatching, Hormone, PG, medicine, marketing, miscellaneous and salary of technicians and labours cost were collected from register book and hatchery owner face to face interview. Data on different parameters of the study were measured, tabled and presented by using MS Word and MS Excel 2007.

RESULTS AND DISCUSSION

Breeding performances: In the present investigation, the successful breeding was performed among two pair of male and female of black carp by using PG and synthetic hormone name Flash. Artificial seed production of black carp in Bangladesh was reported by Kamal *et al.* (2006) and Sarder (2007). The average weight of male and female was 7.5 kg and 11.5 kg respectively, whereas they were same age group 6^+. For PG treatment, the female was received two doses at the rate of 2 mg/Kg and 8 mg/Kg body weight respectively; Dose two was received apart from 6 hours after of first dose. In cases of male, the fish was received only single dose at the amount of 2 mg/Kg, while the female receive her single dose (Table 1). Similar application of PG extract for breeding of carps were observed by Bhuiyan and Aktar (2011) in the hatcheries of Rajshahi district and Minar *et al.* (2012) in the hatcheries of Barisal district of Bangladesh. For using the Flash, the male and female was received only one dose at the rate of 0.3 ml/Kg for male and 0.25 ml/Kg for female respectively (Table 1).

Table 1. Showing breeding performance of black carp in Dipanchal Agro-fisheries of Bhola, Bangladesh

Parameters	PG treatment	Synthetic hormone treatment	Mean ± SD	Total
Number of Male	1	1	--	2
Number of Female	1	1	--	2
Age of Male	6^+	6^+	--	-
Age of Female	6^+	6^+	--	-
Weight of Male	8	7	7.5±0.707	15
Weight of Female	12	11	11.5±0.707	23
1st dose for male [(mg/k)/(ml/Kg)]	2	0.3	--	--
1st dose for female [(mg/k)/(ml/Kg)]	2	0.25	--	--
2nd dose for female [(mg/k)/(ml/Kg)]	8	--	--	--
Ovulation period (hrs)	12	11	11.5±0.707	23
Weight of hatchling (kg)	2.8	3.3	3.05±0.353	6.1
Ratio	1 : 4.28	1 : 3.34		

The more or less of identical doses of synthetic hormone Ovupin solution used for carp seed production in Nimgachi Fish Hatchery and Training Center, Sirajgonj, Bangladesh and was also reported by Mondol *et al.* (2014). In the present experiment, the mean ovulation period was11.5 hours and for PG treatment, it was 12 hours; whereas 11 hours of ovulation period was observed for Flash treatment (Table 1). The more or less ovulation period was also observed by Mondol *et al.* (2014) for Indian major carps and minor carps. In the present study, the total 6.1 Kg of hatchling was found from 23 Kg of female black carps under two treatments. For extracted PG hormone treatment, 2.8 Kg of hatchling was found from 12 Kg of female fish, while the ratio of hatchling and body weight of female fish was 1 : 4.28. In cases of synthetic hormone Flash treatment, 3.3 Kg of hatchling was found from 11 Kg of female fish, whereas the ratio of hatchling and body weight of female fish was 1 : 3.34 (Table 1). The investigations indicate that the synthetic hormone Flash treatment was less hazardous than PG treatment for big black carp fishes.

Cost of brood pond operation: Expenditure of brood pond operation has been presented in the Table 2. Among various expenditure groups the pond lease value was dominant and occupied by 61% of total expenditure and cost was 1253 Tk.

Table 2. Showing expenditure of brood pond operation of black carp and inputs for per kg spawn production in the hatchery management of Dipanchal Agro-fisheries in Bhola, Bangladesh

Issue	Unit	Unit cost (Tk)	Total units	Total cost	Percentage (%)
Pond lease (7 months)	Decimal	44.75	4	1253	61
Pond bottom and dike repair (7 months)	Decimal	21.83	4	611	30
Liming	Decimal	13	4	52	2
Fertilizations	Decimal	15	4	60	3
Feeding	Kg	0	0	0	0
Control of unwanted species	Kg &decimal	4.5	4	18	1
Medicine	-	-	-	20	1
Netting		10	4	40	2
Total (TK)				2054	100%
Brood rearing cost (Per Kg Spawn) =Total brood rearing cost (2054) ÷ Total produced (6.1) Spawn					337

The second dominant criteria of expense was pond bottom and dike repair and comprised of 30% total expenditure as well as cost was 611 Tk; and

followed by 3% and 60 Tk; 2% and 52, 40 Tk; 1% and 20, 18 Tk were also observed non dominant expenditure as well as used for the purposes of application of fertilizations, liming, netting, medicine and control of unwanted species respectively (Table 2).

Cost of hatchery operation: The expenditure of hatchery operation cost, salary of technician and labours and other inputs for per Kg spawn production of black carp of Dipanchal agro-fisheries have been presented in the Table 3. The dominant cost was 35% and 421 Tk spent for the purposes of salary of technicians and labours of the hatchery. Whereas, the depreciation of hatchery fixed assets and repair of hatchery complex and others apparatuses were constitute of 3% and 32 Tk and 13% and 155 Tk respectively. While the water expenses for hatchling cost was 61 Tk and comprised of 5% of total expenditure. In cases of PG and hormone cost were 131 and 292 Tk respectively and this group occupied by 35% of total expenditure. 96 Tk was also used for the purposes of oxygen and polybag for packaging of spawn. For the purposes of marketing and miscellaneous 17 Tk was used (Table 3).

Cost of nursery operation: Nursery operation cost of black carp is also shown in the Table 4. Among nursery operation cost of black carp, the major cost group was the salary of labour 28000 Tk and comprised of 40% of total operation cost. Another major cost group was feeding and 12220 Tk spent and constituted of 17% of total nursery operation expenditure. 15% of total nursery operation cost was for oxygen and poly bag for packaging of fry/fingerling (Table 4).

Table 3. Showing expenditure of hatchery operation cost, salary of technician and labour and inputs for per Kg spawn production of black carp of Dipanchal Agro-fisheries in Bhola, Bangladesh

Issue	Total cost	Percentage (%)	
Depreciation of Hatchery fixed asset	32	3	
Repair of hatchery complex and others apparatuses	155	13	
Technicians and labours salary	421	35	
Water	61	5	
PG	131	11	
Hormone	292	24	
Oxygen and poly bag	96	8	
Marketing	7	0	
Miscellaneous	10	1	
Total(Per Kg)	1205	100%	
Total spawn production cost = Total spawn × Total cost/kg spawn =(6.1×1205)			7350

The cost of pond lease and pond bottom and dike repair were 8950 Tk and 4367 Tk as well as occupied of 13% and 6% of total operation cost respectively. The water exchange cost was 2208 Tk. whereas, 650 Tk also used for liming of pond. While, Fertilizations and medicine cost were 1800 and 730 Tk respectively. 900 Tk was also spent for the purposes of marketing of fry and fingerling of black carp (Table 4).

Table 4. Showing expenditure of black carp nursery operation cost (2.5 Kg Hatchling) of Dipanchal Agro-fisheries in Bhola, Bangladesh

Issue	Unit	Unit cost	Total units	Total cost	Percentage (%)
Pond lease (4 months)	decimal	44.75	50	8950	13
Pond bottom and dike repair (4 months)	decimal	21.83	50	4367	6
Water exchange	Liter	69	32	2208	3
Liming	decimal	13	50	650	1
Fertilizations	decimal		50	1800	3
Medicine	decimal	14.60	50	730	1
Feeding	kg	52	235	12220	17
Labour salary (4 months)		7000	4	28000	40
Oxygen and poly bag			445	10680	15
Marketing				900	1
Total				70505	100%

Selling statas of black carp fry/fingerling: Selling and distribution status of black carp fry/fingerling of Dipanchal agro-fisheries have been presented in the Table 5. Dipanchal agro-fisheries hatchery operate black carp nursery and produced 197 Kg and 445000 individual and sold out by worth of 224050 Tk as well as distribute the fry/fingerling among 9 districts of Bangladesh. On the basis of percentage composition of distribution of black carp fry/fingerling 27% distribute in Laxmipur and followed by 18% in Bhola, 16% in Noakhali, Comilla and Jessore, 2% in Chittagong, Cox`s bazar and Feni as well as 1% in Barisal in the occurrence of total distribution. The study, total 197 kg of fry/fingerling found from 2.5 Kg of hatchling. Among total weight of black carp fry/fingerling, the range of distribution was from 3.5 kg in Barisal to 50 Kg in Bhola. Whereas, the individual weight of black carp fry/fingerling was diverse from 0.33 g/ individual in Noakhali to 0.7 g/ individual in Barisal. In cases of, the individual selling value was fluctuated from 0.4 Tk/ individual in Noakhali to 0.8 Tk/ individual in Barisal. The selling status comprised of 24% in Laxmipur and followed by 22%, 21%, 13%, 12% 2% in Jessore, Bhola, Noakhali, Comilla, Chittagong, Cox`s bazar, Feni and Barisal respectively (Table 5).

Table 5. Showing selling and distribution status of black carp fry/fingerling of Dipanchal agro-fisheries in Bhola, Bangladesh

Place	Total weight (Kg)	Individual weight (g)	Number of fry/fingerling	Unit value (Tk)	Total sell value (Tk)	Percentage (%)	
						Value (Tk)	Number
Noakhali	23.5	0.33	70000	0.40	28000	13	16
Laxmipur	44.4	0.37	120000	0.45	53640	24	27
Chittagong	3.7	0.37	10000	0.45	4470	2	2
Cox`s bazar	3.7	0.37	10000	0.45	4470	2	2
Feni	3.7	0.37	10000	0.45	4470	2	2
Comilla	23.5	0.33	70000	0.40	28000	12	16
Jessore	41	0.59	70000	0.70	49000	22	16
Bhola	50	0.62	80000	0.60	48000	21	18
Barisal	3.5	0.70	5000	0.80	4000	2	1
Total	197		445000		224050	100	100
Range	3.5-50	0.33-0.7		0.4-0.8			
Mean ± SD	21.89±19.35	0.45±0.14		0.52±0.15			

Cost benefit analysis: Cost benefit analysis and their ratio of black carp spawn production and nursery operation of Dipanchal agro-fisheries is shown in the Table 6. Total expenditure 1542 Tk/ Kg spawn was found the present study. Whereas, the brood pond operation cost was 337 Tk/Kg spawn. While, Hatchery operation and marketing cost was1205 Tk/Kg spawn. The present study, the selling value was 15000 Tk/Kg spawn. Higher sell value of black carp spawn was reported by Sharif and Abdulla-Al-Asif (2015) from Jessore in Bangladesh. In these cases, the profit from spawn selling was 13458 Tk/Kg spawn. The profit rate was 872.76% and the cost benefit ratio recorded 1: 8.72. The recorded return rate was found higher than that of the findings of Kumar *et al.* (2008). In addition to, the black carp spawn is rear in Bangladesh; only few hatcheries produced black carp spawn. So, spawn production business of black carp is more profitable. Hossain and Humayon (2001) reported that carp spawning to fry rearing generated higher net returns (Tk 124895) than that of fry to fingerling rearing (Tk 96660) respectively. Total brood pond operation cost was 2054 Tk and comprised 3% of total expenditure of spawn production and nursery operation cost. While, 7350 Tk also expenses for hatchery operation marketing purposes and occupied of 9 % of total expenditure on the occurrence of percentage composition. The dominant expenditure 88% and 70505 Tk were used for the purposes of nursery operation of black carp. Dipanchal agro-fisheries earns 54000 Tk from sell of spawn and 224050 Tk from fry/fingerling sell of black carp respectively which comprised of 19% and 81% of total income.

In cases of profit from spawn production and nursery operation of black carp, the return was 198141 Tk and 247.95%. While, cost benefit ratio was 1 : 2.47. Katiha, (2001) reported that the cost benefit ratio (4.71) for fry fingerling rearing in India which was higher than from our findings. Thus, their study was more or less consistent to the present study for the point of view of spawn production and fry/ fingerling rearing of black carp.

Table 6. Showing cost benefit analysis and their ratio of black carp spawn production and nursery operation of Dipanchal agro-fisheries in Bhola, Bangladesh

Description		Issue	Purposes (Tk)	Percentage (%)
Per kg spawn production and selling	Expenditure	Brood pond operation cost [Spawn(kg/Tk)]	337	22
		Hatchery operation and marketing cost [Spawn(kg/Tk)]	1205	78
		Sub total	1542	100
	Income	Spawn sell (Kg/Tk)	15000	
	Profit	(Income- Expenditure)	13458	872.76
	Ratio	Cost : Benefit	1 : 8.72	
Total spawn production and nursery operation and their selling	Expenditure	Brood pond operation cost	2054	3
		Hatchery operation and marketing cost	7350	9
		Nursery operation cost	70505	88
		Sub total	79909	100%
	Income	Spawn sell (3.6×15000)	54000	19
		Fry/ fingerling sell	224050	81
		Sub total	278050	100%
	Profit	(Income- Expenditure)	198141	247.95
	Ratio	Cost :Benefit	1 : 2.47	

In the present study, it was observed that black carp responded to extract of PG and synthetic hormone Flash and successful breeding was occurred. Spawn production and nursery operation of black carp were profitable. Rahman (2005) reported the species (Black carp) attained an average weight of 1587 gm with few specimens attaining over 4200 g during 13 month of rearing period and the species provided with highly developed molariform teeth, which are used for crushing of snails. In the point of view of commercial aquaculture or confined fish poly culture system the species may introduce at low stocking density for grazing of molluscan fauna of the pond aquaculture system. Therefore, extensive research is needed by stocking black carp in fish pond poly culture system and

in relation to snail control and conservation of molluscan fauna to minimize the concern of freshwater pond molluscan fauna in commercial aquaculture of Bangladesh.

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