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Induced Breeding of Carps for Seed Production in Frp Hatchery

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ABSTRACT

Portable Fiberglass Reinforced Plastic (FRP) carp hatchery consisting of one spawning pool, two incubation pools, one egg/spawn collection tank and one overhead tank of capacity 1500 L was established and operated at Amarpur Village under Potaspur Block, West Bengal. In the monsoon of 2016, induced breeding of Indian major carps (Labeo rohita and Catla catla) and Indian minor carp (Labeo bata) was conducted for 4 times in the established hatchery. Induced breeding of these fishes was done successfully using synthetic hormone "Ovatide". Total 20.5 lakh spawn was harvested, viz., Catla catla 10.0 lakh, Labeo rohita 8.0 lakh and Labeo bata 2.5 lakh. Under the optimum temperature range of 29-32ºC, spawning was observed after a latency period of 5-6 h. The fertilization rate was recorded 88-96% and the hatching success was 89-94%. Highest fertilization rate (96%) was recorded in catla followed by Labeo rohita (93%) and Labeo bata (89-91%). Time needed for completion of egg hatching was almost similar among the experimented fishes, i.e., Catla catla (940 minutes), Labeo rohita (920 minutes) and Labeo bata (895-945 min). Spawn production was 0.91 lakh/kg female body weight for catla, 0.94 lakh/kg for rohu and 0.775 lakh/kg (average) for Labeo bata.

Keywords: FRP carp hatchery, Carp, Induced breeding, Seed production

INTRODUCTION

Aquaculture is the fastest growing food producing sector and by 2025, one out of every two fish eaten may come from aquaculture [1]. Quality fish seed is a key factor for increase of aquaculture production. Fish seed from natural sources of spawning possess uncertainty in availability, quality, mixing of predatory and weed fish seeds. The technique of induced breeding helped in mass production of quality carp seed under controlled condition and assured timely supply of stocking material for culture farms. Induced breeding is based on the principles of manipulating hormonal or environmental factors for stimulation of reproduction in fishes [2]. In India the first attempt for induced breeding was done in 1938 and the species was mrigal, *Cirrhinus mrigala* [3]. In 1957, minor carps (*Esomus danricus* and *Pseudotropius atherinoide*) were induced bred [4]. Ramaswamy and Sundararaj in 1956 had done the induced breeding attempts on catfishes (*Clarias batrachus* and *Heteropneustes fossilis*) [5]. Induced breedings were successfully carried out in Indian carps such as *Labeo rohita, Cirrhinus mrigala, Cirrhinus reba* and *Labeo bata* through hormone injections [4]. The need for the production of quality fish seed to stock artificial ponds and natural water bodies through artificial propagation has steadily been encouraged, as it is the only practicable means of producing enough quality fish seeds [6].

Scarcity of carp spawn is a major problem for fish farmers in villages to stock their ponds with seed collected from rivers [7] and due to lack of technical knowledge and basic infrastructure facilities, such as hatchery system; induced breeding of carps was rarely adopted by farmers [8]. The contributions of several researchers starting from hapa breeding to cemented eco-hatchery, and then to portable FRP hatchery have made easy in availability of fish seed for aqua-farming. For timely production of quality seed, "ICAR-AICRP on Plasticulture Engineering and Technology" Center at ICAR-CIFA, Bhubaneswar has designed and developed portable fiberglass reinforced plastic (FRP) carp hatchery [9-14] and it has been installed and successfully operated in 26 states of India [15]. The system is designed

to create an environment friendly atmosphere for fish breeding in the farmers' field. It is capable to bread 10-12 kg of female carps and equal quantity of males in one operation. In one run, 1.0-1.2 million spawn can be produced from the hatchery which is sufficient to stock pond area of about 30 hectares with stocking density @ 5000 fingerlings/ha. There are several benefits of this hatchery *viz*., it is portable, easy to install and operate, requires less quantity of water during fish breeding and spawn production, needs less space for installation and the durable for about fifteen years [10]. In lean season, the hatchery can be used for ornamental fish rearing in which village women may take part in leisure time [16]. One complete operation of the hatchery for 1.0 million spawn production requires 90 m^3 water [17]. This hatchery can be a tool for biodiversity conservation through production of seed of endangered and threatened fish species [15].

The present work was carried out at Kharialpara, Amarpur Village, Potaspur Block, East Midnapore District of West Bengal through induced breeding of carps in FRP hatchery installed by ICAR-CIFA in that place. The village is a remote area with very poor road connectivity and habitants mostly depend on agriculture for their livelihood. People of Kharial community also engaged in making baskets using khari. The Bagui River flows through the northern border of the village, plays a significant role in the capture fishery scenario of the village. But, aquacultural activities have not received much attention because of their dependency on insufficient and low quality spawn supply, and aquaculture knowledge gap. To provide an alternative livelihood and employment opportunity to the villagers of Amarpur through aquaculture, ICAR-CIFA, Bhubaneswar, Odisha has supplied the FRP carp hatchery under its TSP programme. Induced breeding of Indian major and minor carps, i.e., *Labeo rohita, Catla catla* and *Labeo bata* were done successfully, which ensured of getting quality carp seed in right time to the fish farmers of the village.

MATERIALS AND METHODS

FRP hatchery unit

Portable FRP carp hatchery unit consisting of four parts, i.e., one spawning pool, two incubation pools, one egg/spawn collection tank and one overhead water storage tank of capacity 1500 L was installed at Amarpur Village, Potaspur Block, East Midnapore District of West Bengal for operation and seed production.

Spawning pool

The breeding pool is cylindro-vertical in shape with specifications such as, diameter 2.15 m, height 0.9 m, bottom slope 1:22 and water holding capacity 3409 L (operation capacity: 2950 L) with provisions of water circulation through duck mouth pipes and shower. The wall thickness varies between 5.0 and 6.0 mm and water supply to the pool is from the overhead tank placed at a height of 3.1 m from the base level of the hatchery. Water circulation is given in the breeding pool through 5 numbers of 15 mm diameter rigid PVC elbows fitted with carrying nipples. These are fitted in the same direction. A water inlet of 25 mm diameter is also fitted in the sidewall of the pool bottom. All the water inlet pipes are interconnected with individual full-way valves to regulate the flow of water. A water shower is provided on the top margin of the pool for water showering. The installed system is suitable for breeding of 20-24 kg of carps (both male and female) per single operation.

Incubation pool

The incubation or hatching pool is with specifications such as, diameter 1.4 m, height 0.98 m, total volume 1400 liter and net egg incubation volume 1200 L with a FRP inner chamber (diameter 0.4 m and height 90 cm covered with nylon bolting cloth of 0.25 mm mesh to filter the excess water to the central drain pipe), water inlet through six numbers of 15 mm diameter duck-mouth pipes fitted in the bottom of the hatchery. The pool has drainage outlets at the center and also at the lower part of the outer chamber of the pool. It has the capacity of hatching 1.0-1.2 million eggs per operation.

Egg/spawn collection tank

The egg/spawn collection tank is rectangular in shape with 1.0 m length, 0.5 m breadth and 0.5 m height. Water holding capacity of the tank is 250 L. During operation the water level in the tank is maintained at a height of 0.45 m by fixing a drainpipe of 63 mm diameter at a distance of 38.7 cm from the tank floor. Net operational water volume of the tank is 225 L. Matching to the tank size, the cotton inner hapa is used inside it to collect egg/spawn from spawning/ incubation pool, respectively. Generally, spawn is collected from the incubation pool on 4^{th} day of fish spawning.

Water supply system

One plastic overhead water storage tank of capacity 1500 liter is installed near the hatchery unit to supply water for hatchery operation. Supply lines from it are connected with the spawning and incubation pools. One 1.0 HP capacity pump set with 2" suction and 2" delivery is used to fill the overhead storage tank.

Brood stock

Matured brood stocks of three different carp species *viz.,* rohu (*Labeo rohita*), catla (*Catla catla*) and bata (*Labeo bata*), free from diseases and any kind of abnormalities, were selected for the breeding programme from the brood stock pond of the "*Amarpur Kharialpara Mathsyauthadan Samity*" located near the hatchery. The samiti members collected these brood fishes from the village ponds 2 months prior to the breeding progamme and maintained and managed in a 0.32 ha pond, scientifically fed with conventional supplementary feed as well as CIFABROOD™, a feed developed by ICAR-CIFA. The importance for selection of brood fishes on the basis of weight was also to be maintained: catla: not below 1.5 kg; rohu: not below 1.25 kg; bata: not below 0.30 kg.

Inducing agent

Ovatide, an indigenous, cost-effective hormonal formulation developed by Mumbai-based pharmaceutical company, M/s Hemmo Pharma was used for the breeding programmes. Ovatide has been successfully tested for ovulation of several fishes, including *Labeo rohita, Labeo calbasu, Cirrhinus mrigala, Catla catla* and *Clarias batrachus* in India [18]. The Ovatide is easy to store at room temperature, simple to use and less expensive [19].

Breeding programme

The present carp breeding experiment was conducted in the FRP hatchery installed at Amarpur Village during June-July 2016. Normal hatchery operation practice was followed for production of carp seed [10-12]. Three different carp species *viz.,* rohu (*Labeo rohita*), catla (*Catla catla*) and bata (*Labeo bata*) were tried with induced breeding for production and supply of seed to aqua-farmers of the area. Brooders were selected from brood stock pond and their sexes were identified based on morphological characters like swollen abdomen, pinkish vent and smooth pectoral fin in female; and rough pectoral fin in mature male. Brooders were then carefully transferred to the hatchery avoiding much handling and conditioned for one hour in the spawning pool prior to administration of inducing agent, Ovatide. Male and female brooders were injected @ 0.2 ml/kg and 0.5 ml/kg body weight, respectively, into the intra-peritoneal region of the fish in a single dose. CIFE in 1998 [20] reported the Ovatide dose of 0.20-0.45 ml/kg for female and 0.1-0.2 ml/kg for male carps. The injected fishes were released in the spawning pool for egg laying. After egg and milt release, the brood fishes were removed from the breeding/spawning pool with the help of a scoop net. Water circulation was maintained as per recommendation [17]. The fertilized eggs were kept in the incubation pool for the next three days and the pool was disinfected by sprinkling 5.0 ppm potassium permanganate solution at an interval of two hours. The flow rate of water during egg collection was maintained 1.0-1.5 l/s. The flow rate in the pool during operation was maintained at 0.3-0.4 l/s.

Total number of eggs spawned (spawning fecundity) was estimated by counting the egg in 1.0 g of egg mass [21]. Relative fecundity (number of eggs per g) was found out by the process as described by Kahkesh et al. [22]:

$$\text{Relative fecundity} = \frac{\text{No. of stripped eggs}}{\text{Body weight}}$$

Percent fertilization per female was calculated with the following formula [23]:

$$\text{Fertilization} = \frac{\text{No. of fertilized eggs}}{\text{Total No. of egg counted}} \times 100$$

Percentage hatchability was determined by direct counting of the number of hatchlings of two days old and estimated as follows [24]:

$$\text{Hatchability} = \frac{\text{No. of hatchlings (two days old)}}{\text{Total No. of fertilzed egg}} \times 100$$

Latency period for egg release, effective spawning period and spawn production per kg body weight of different female species were determined [25].

RESULTS AND DISCUSSION

Native carps including *Labeo rohita, Catla catla* and *Labeo bata* given with single injection of Ovatide were successfully induced to spawn in FRP carp hatchery during the month of June-July, 2016. Results of the experiments have been summarized in Table 1. Induced breeding was conducted for one time for *Labeo rohita* and *Catla catla,*

and twice for *Labeo* bata. Total 20.5 lakh spawn was harvested, *viz.,* catla 10.0 lakh, rohu 8.0 lakh and bata 2.5 lakh. In optimum temperature of 29-32°C, spawning was observed after a latency period of 5-6 h. The fertilization rate was recorded 88-96% and the hatching success 89-94%. Pandey et al. [26] also found that fertilization rate of 95-100% and 90-98% hatching success in *Labeo rohita* at a water temperature of 28-31 C using hormone Ovatide. Dhawan and Kaur [27] used Ovatide and Ovaprim for induced breeding of Indian carps. They found that Ovaprim was more effective than Ovatide in breeding induction in *Catla catla*; however, in *Labeo rohita* and *Cirrhinus mrigala*, Ovatide resulted in high fecundity and fertilization rate. Khan et al. [28] stated that Ovatide was better than Ovaprim-C in induced spawning, fecundity, hatching and fertilization of *Labeo rohita.* Effective spawning period of catla was calculated to be 55 min, rohu 40 min and bata 45-75 min. Highest fertilization rate (96%) was recorded in catla followed by rohu (93%) and bata (89-91%). Time for completion of egg hatching was more or less similar in trend for catla (940 min), rohu (920 min) and bata (895-945 min). Percentage of hatchability was 92.50% in catla, 93.7% in rohu and ranged 84.50-89% in bata. Spawn production was 0.91 lakh/kg female body weights for *Catla catla*, 0.94 lakh/kg for *Labeo rohita* and 0.775 lakh/kg (average) for *Labeo bata* (Table 1).

Portable fiberglass reinforced plastic (FRP) carp hatchery designed and developed by ICAR-CIFA has added a feather towards blue revolution in the country, by producing quality fish seed at farmers' field [12]. At Subarnapur Village of Gop Block, Puri District, Odisha, India; ten trials of induced breeding of three Indian major carps, *Labeo rohita* (4 times), *Catla catla* (4 times) and *Cirrhinus mrigala* (2 times) were conducted during monsoon season of 2014 using FRP carp hatchery. Total 92.0 lakh spawn was produced (*Labeo rohita* 42 lakh, *Catla catla* 30 lakh and *Cirrhinus mrigala* 20 lakh) [16]. In the present experiment spawning fecundity and fertilization rate were found higher compared to the breeding operations conducted using FRP hatchery at Nuagaon, Nayagarh District of Odisha. At Nuagaon brood fish, rohu was transported from a reservoir 22 km away from the hatchery and reared in a pond with 0.5 m depth of water prior to breeding. It produced 0.8-0.92 lakh eggs/kg body weight of female, 75-95% fertilization rate of eggs and 0.46-0.65 lakh spawn/kg of female [16]. This may be attributed to suitable water quality parameters in the present experiment, which were well within the limits of hatchery operation and also lesser handling stress to the breeders, as breeders were collected from a nearby pond and acclimated well before hormone administration. Erikson et al. [29] reported that fish exposed to stressful stimuli during transport, e.g., handling, netting, loading and unloading, transport in high densities, inadequate water exchange and poor water quality, usually suffer from physiological stress response. The acute primary physiological response of fish to netting, handling and transport may return to normal levels within 6–24 h. However, the physiological recovery in fish may take 10–14 days, if the stressors persist and are not lethal [30]. So, fish can be transported to long distances for induced breeding provided the optimal conditions and time for their adaptation are ensured and disturbances are minimized.

Response of *Catla catla, Labeo rohita* and *Labeo bata* to Ovatide was found to be good in present study considering the breeding success in terms of spawning fecundity, fertilization rate and hatchability. So, it is clear that, successful spawning and hatching can be achieved by inducing these species with Ovatide in fiberglass reinforced plastic (FRP) carp hatchery system. Ovatide is the cheaper hormone and 70% more economical as compared to Ovaprim [31]. The

Table 1: Induced breeding of carps in FRP carp hatchery at Amarpur, Potaspur, West Bengal

Parameters	No. of breedings			
	C. catla	*L. rohita*	*L. bata*	
	I	I	I	II
Number of male brooders	5	7	4	8
Number of female brooders	5	6	4	6
Total weight of male brooders (kg)	9.9	9.1	1.1	2.1
Total weight of female brooders (kg)	10.95	9.75	1.45	1.75
Time of first egg released after hormone injection (in min) (latency period) (A)	310	335	305	325
Completion time of egg release from time of injection (in min) (B)	365	375	380	370
Effective spawning period (B-A) (min)	55	40	75	45
Egg released (lakh)	11.26	9.16	1.40	1.84
Spawning fecundity per kg body weight of female (lakh)	1.02	1.07	0.96	1.05
Fertilization rate (%)	96	93.2	91	88.7
Time of first hatchling observed from spawning (in min)	665	670	680	630
Time of completion of hatching (in min)	940	920	895	945
Spawn recovered (lakh)	10.0	8.0	1.12	1.38
Hatching rate (%)	92.5	93.7	89	84.5
Spawn production (lakh/kg body weight of female)	0.91	0.94	0.77	0.78

Ovatide suppresses the Ovaprim giving an equal result of seed production in hatcheries. FRP make small-scale carp hatchery enables the farmers to operate it with less labor and manage it effectively. Land and other infrastructure facilities required are also low as it is small in size.

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