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Seed production of Indian major and minor carps in fiberglass reinforced plastic (FRP) hatchery at Bali, a remote Island of Indian Sunderban

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Abstract

One unit of FRP carp hatchery with one breeding pool, one hatching pool, one egg/ spawn collection tank and one plastic made overhead tank of capacity 2000 litre was installed and operated at Bali Island, Sunderban, West Bengal during 2014-15. During July - August, 2015 for the first time the successful induced breeding of Indian major carps (rohu, *Labeo rohita* and catla, *Catla catla*) and Indian minor carp (bata, *Labeo bata*) was conducted in the established hatchery and 18.5 lakhs spawn was harvested. In this experiment spawning fecundity of rohu was found to be 0.88-1.0 lakh, catla 0.95 lakh and bata 1.1-1.3 lakh egg/kg bodyweight of female fish. Time for completion of egg hatching was found more or less similar in rohu 920-970 minutes, catla 965 minutes and bata 940-990 minutes. Percentage of spawn survival from egg release was calculated to be 85.5-92.5% in rohu, 84.5% in catla and 86.5-90% in bata. Spawn production per kg female body weight (lakh) was found similar for all the experimented fishes *i.e.*, rohu 0.74-0.88 lakh, bata 0.86-1.2 lakh and catla 0.66 lakh. Water parameters like pH, total alkalinity and total hardness were analyzed by APHA 2005 method in the laboratory at ICAR-CIFA, Kalyani, West Bengal and water temperature was measured by temperature probe.

Keywords: FRP carp hatchery, fish breeding, spawn production, Bali Island.

1. Introduction

The technology of induced breeding through hypophysation has helped in mass production of quality carp seed under controlled condition. It has reduced the dependence on the natural seed collection. Quality seed production can be achieved through scientific brood stock management, establishment of hatcheries, refinement of induced breeding techniques and rearing of seed across the country. The long way contribution of several researchers from hapa breeding to cemented eco-hatchery, and then to portable FRP carp hatchery has made easy in availability of stocking material for aqua-farming. For easy accessibility and timely production of quality seed, "ICAR-All India Coordinated Research Project on Plasticulture Engineering and Technology" Center at ICAR-CIFA has designed and developed fibreglass reinforced plastic (FRP) carp hatchery, which can be transported from place to place for the stated purpose [1-8]. The unit consists of four major parts *i.e.*, breeding-cum-spawning pool, hatching-cum-incubation pool, egg-cum-spawn collection chamber and overhead water storage tank. The system is so designed that it creates an environment suitable for fish breeding in the field conditions for 10-12 kg of female carps in one operation. In one run, up to 1.0-1.2 million spawn can be produced from the hatchery which is sufficient to stock water area of about 30 hectares @ 5000 fingerlings/ha meter of water. The hatchery unit has some benefits *viz.*, it is portable, easy to install and operate, requires less quantity of water during fish breeding and spawn (fish seed) production, needs less space for installation and the product durability is about fifteen years [3]. One complete run of the hatchery requires minimum water quantity of 90 m³ [9]. This hatchery can be a tool for fish biodiversity conservation through seed production of endangered and threatened fish [10, 11].

The present fish breeding trials were conducted in the FRP hatchery installed by ICAR-CIFA at Bali Island, Sunderban, West Bengal. The Sunderbans is situated southern tip of West Bengal and it is the largest deltaic Island in the world covering 10,00,000 ha of land and water area.

Taking account of its richness in biodiversity and ecological importance, Govt. of India has declared it as the Sunderban Biosphere Reserve. It is a very remote area consisting 102 Islands out of which 54 are inhabited and rest of the Islands support mangrove forest. This area is separated from mainland by mainly three big rivers, *i.e.*, the Ganges, the Brahmaputra and the Meghna, and thus communication facility is very much poor in this area. Most of the Islands are devoid of regular electricity. Natural calamity is a very regular feature here and many times it becomes so severe that huge losses are being made to the local villagers. During “*Aila*” (a severe storm in the Sunderban) in 2009 almost all the Islands were flooded with salt water from backwaters and all the agricultural and aquacultural activities were damaged. Till now the poor villagers are facing commendable problems in freshwater aquacultural activities along with malnutrition, starvation and disease.

The fisheries industry plays a significant role in the socio-economy of the communities of the Sunderban. As it is mainly based on captured fishery, fisherman of this area mainly catch shrimp, fish and crabs from the river and cricks within the delta. But, over exploitation and increased number of fishermen have resulted sharp decline of fishes in the river. Moreover they often face tiger attack during fish catch in the core area of the Sunderban. People of this deltaic Island often enter into deep forest to collect honey, though it is a traditional risky practice. But, there is no other alternative for the poor people of this area to earn money for their livelihood.

More efforts have to be given for development of aquaculture, as it provides the cheap animal protein and employment to the growing population in the country. The major constraint for freshwater aquaculture is the timely availability of quality seed for stocking. After installation of FRP carp hatchery, induced breeding trials of two types of Indian major carps *i.e.*, *Labeo rohita*, *Catla catla* and one type of Indian minor carp *Labeo bata* were done for providing quality carp seeds to the fish farmers of the Island.

2 Methodology

2.1. FRP carp hatchery unit installed in the Island

2.1.1. Breeding / spawning pool

The spawning pool is cylindro-vertical in shape with 2.15 m diameter, 0.9 m height, 1:22 bottom slope and 3409 litre water holding capacity (operation capacity: 2950 litre) with the provision of water circulatory system and shower. The flow rate during egg collection is maintained 1.0-1.5 l/sec. Water supply to the pool comes from the overhead tank placed at a height of 2.0 m from the hatchery floor. To provide water circulation inside the breeding pool, 5 numbers of 15 mm diameter rigid PVC elbows, carrying nipples are fitted in the same direction. A single point water inlet of 25mm diameter is also fitted at the sidewall of the pool bottom. All the water inlet pipes are interconnected and fitted with individual full-way valves to regulate the flow of water. One shower is provided at the top of the pool for better aeration.

2.1.2. Egg / spawn collection tank

The egg / spawn collection tank is rectangular size of 1.0 x 0.5 x 0.5 m and water holding capacity of 250 litre. The water level in the tank during operation is maintained at a height of 0.45 m (net water volume 225 litres) by fixing the drainpipe of 63 mm diameter at a distance of 38.7 cm from the bottom. Cotton inner hapa of the tank size is fixed inside to collect egg/spawn from breeding/ incubation pool, respectively. Spawn is collected after 4th day from the incubation pool.

2.1.3. Hatching / incubation pool

The hatching or incubation pool is of 1.4 m diameter and 0.98 m height to rear the hatchlings; 1400 litre total volume and 1200 litre net egg incubation volume with a FRP inner chamber (0.4 m diameter and 90 cm height covered with nylon bolting cloth of 0.25 mm mesh to filter the excess water to the drain), water supply system through six numbers of 15 mm diameter duck-mouths fitted at the bottom of the hatchery at 45° angle. It has drainage outlets at the centre and at the outer chamber of the pool. About 1.0-1.2 million eggs can be incubated per operation using this FRP carp hatchery. The flow rate in the pool during operation is maintained at 0.3-0.4 l/sec.

2.1.4. Water storage tank

Water storage tank of capacity 2000 litre is required to operate the hatchery unit. The water lines from it are connected to the breeding and hatching pools. One 1.0 HP pump set is used to fill the storage tank periodically to supply water to hatchery continuously.

2.2. Breeding Programme

Three different carp species *viz.*, rohu (*Labeo rohita*), catla (*Catla catla*) and bata (*Labeo bata*) were tried for induced breeding during July-August 2015. The brooders were maintained in a 0.07 ha brood pond at the campus of Wildlife Protection Society of India, Bali Island, Sunderban, West Bengal. The fishes were checked for free of all diseases and maturity. The brooders were transported to the hatchery in hammock and conditioned for one hour in the breeding pool prior to administration of inducing agent, Ovaprim. Brood fishes were weighed and injected with the inducing agent @ 0.2 ml/kg of male and 0.5 ml/kg of female intra-peritoneal in a single dose [12, 13]. The injected fishes were released in to the spawning pool for egg laying. After completion of release of fertilised eggs, the brood fishes were removed from the breeding/spawning pool with the help of a scoop net. Hatching occurred after 18-20 hours of injection and hatchling were kept in hatching pool for three days until yolk sac was fully absorbed. Latency period for egg release, effective spawning period, percentage of fertilization of eggs, hatching time, percentage of spawn recovery, and spawn production per kg body weight of different species were calculated.

Latency period = Time between hormone administration and initiation of spawning.

Effective spawning period = Time between initiation and stoppage of spawning.

Spawn production per kg body weight = Total spawn harvested / total weight of female.

Water parameters like pH, alkalinity and hardness were analyzed by APHA 2005 [14], method in the laboratory at ICAR-CIFA, Kalyani, West Bengal and water temperature was measured by temperature probe.

3 Results and Discussion

During July - August, 2015 induced breeding programmes of Indian major carps (*L. rohita* and *C. catla*) and Indian minor carp (*L. bata*) were conducted at Bali Islands, Sunderban, West Bengal. Total 18.5 lakh spawn was harvested, *i.e.*, rohu 10 lakh, catla 3 lakh and bata 5.5 lakh. Induced breeding was conducted 3 times each for *L. rohita* and *L. bata*, and once for *C. catla*. The results are shown in the Table - 1. In the present experiment spawning fecundity of rohu was found to be 0.88-1.0 lakh, catla 0.95 lakh and bata 1.1-1.3 lakh egg/kg body weight of female fish. Effective spawning period of rohu was

calculated to be 45 - 55 minutes, bata 55-70 minutes and catla 60 minutes. Percentage of fertilized eggs in rohu and catla was 90-95% and bata 95%. Time for completion of egg hatching was more or less similar in trend for rohu (920-970 minutes), catla (965 minutes) and bata (940-990) minutes. Percentage of spawn survival from egg release was ranged 85.5-92.5% in rohu, 84.5% in catla and 86.5-90% in bata. Spawn production per kg female body weight (lakh) was 0.74-0.88 lakh/kg

female body weight for rohu, 0.86-1.2 lakh/kg for bata and 0.66 lakh/kg for catla.

Physico-chemical parameters of hatchery water were found suitable for induced breeding of carps (Table - 2). Water temperature during breeding operations ranged between 27.5 and 32.6 °C, which is the ideal temperature (28- 32 °C) for carp breeding [8]. Water pH was 7.1-7.8, total alkalinity 72.4- 80 mg/l and total hardness 72-90 mg/l.

Table 1: FRP carp hatchery operation data from Bali Island, Sunderban, West Bengal

Parameters	No. of breedings						
	Rohu			Bata			Catla
	I	II	III	I	II	III	I
Number of male breeders	4	5	3	5	5	5	3
Number of female breeders	3	3	3	4	5	4	2
Total weight of male breeder (kg)	5	6.4	3.7	1.5	2.35	2.5	4.2
Total weight of female breeder (kg)	3.5	5.1	2.7	1.5	1.25	1.8	3.8
Time of first egg released after hormone injection (in minute) (latency period) (A)	300	315	325	290	310	330	340
Completion time of egg release from time of injection (in minute) (B)	345	360	380	345	380	390	400
Effective spawning period (B-A) (minute)	45	45	55	55	70	60	60
Egg released (lakh)	3.08	4.9	2.7	1.5	1.6	2.4	3.61
Spawning fecundity per kg body weight of female (lakh)	0.88	0.97	1.0	1.1	1.3	1.3	0.95
Fertilization rate of egg (%)	90	95	90	90	90	95	95
Time of first hatching observed from spawning (in minute)	620	650	600	660	625	630	630
Time of completion of hatching (in minute)	920	970	930	990	940	960	965
Spawn recovered (lakh)	2.8	4.6	2.6	1.5	1.6	2.4	3
Spawn survival (%)	92.5	85.5	91.5	86.5	89.5	90.0	84.5
Spawn production (lakh/kg body weight of female)	0.74	0.77	0.88	0.86	1.14	1.2	0.66

Table 2: Intake water parameters during hatchery operation

Water parameters	Breeding trials						
	Rohu			Bata			Catla
	I	II	III	I	II	III	I
Water temperature (°C)	28.5 to 32.6	29.2-32.5	28.3-32.0	27.9-31.8	27.7-31.5	27.5-31.7	28.2-32.3
pH	7.1-7.6	7.3-7.8	7.0-7.5	7.4-7.8	7.2-7.6	7.0-7.4	7.2-7.5
Total alkalinity (mg/l)	72.4	80	76.2	72.4	80	76.2	72.4
Total hardness (mg/l)	90	80	72	90	80	72	90

Odisha Watershed Development Mission (OWDM) conducted fish breeding operations in FRP carp hatcheries under the project “Western Odisha Rural Livelihood Project (WORLP)” at Nuapada and Bargarh Districts [15, 16]. In its first year of operation in 2005, total 5.5 million fish seeds were produced, which served as stocking material for grow out culture in 530 ha of pond area in Western Odisha. The water quality and temperature regime were within the limits of hatchery operation in field condition. At Nuagaon, Nayagarh District of Odisha, the rohu breeder was transport from a reservoir 22 km away from the hatchery, reared in a less deep pond prior to breeding produced 0.8 - 0.925 lakh eggs/ kg of female, 75-95% fertilization of eggs and 0.46 - 0.65 lakh spawn/ kg of female [8]. In the present experiment the breeders were maintained in the same farm prior to breeding. The stress in breeders due to transportation from far off places was not there at Bali Island, hence, the production of egg and spawn were higher at Bali than the FRP carp hatchery established at Nuagaon. According to Sarangi *et al.* [8] the FRP hatchery produced similar results in rohu seed production at Tanar village, Kendrapada District, Odisha. 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 at Subarnapur Village of Gop Block, Puri District, Odisha, India during monsoon months of 2014 [11]. A total of 92.0 lakh spawn (carp seed) was produced (rohu 42 lakh, catla 30 lakh and mrigal 20 lakh). Spawning fecundity of rohu,

mrigala and catla was found to be 1.43-1.72; 1.41-1.54 and 1.15-1.23 lakh egg/kg female body weight respectively. Percentage of fertilized eggs during spawning was found to be 90-95%. Spawn production per kg female body weight was found to be 1.07 - 1.36 lakh/kg of rohu, 1.17 - 1.36 lakh/kg of mrigal and 0.9 - 0.95 lakh/kg of catla.

4. Conclusion

The present study demonstrated that two objectives of seed production and livelihood support for poor farmers can be achieved simultaneously through installation and operation of FRP hatchery at one place. The established hatchery at Bali Island, Sunderban, West Bengal became a carp seed source for the village ponds, thus provided seed support to the local fish farmers to initiate aquaculture in their ponds.

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