Effect of stocking density and food on growth of spawn of Indian major carps (Catla and Rohu)

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ABSTRACT
Objective: Aquaculture is the fastest growing food production sector, globally. The availability of quality seeds is prerequisites for rapid expansion and growth of aquaculture. The present investigation was undertaken to develop a technique for pure quality fish seed rearing under adverse environmental conditions.

Methods: The fish seed was reared in two different consignments in three cement tanks each of size 5m x 1.22m x 1.22m and capacity of each tank is 7.44 cubic meters. The water inlet in cement cisterns is through a set of three jets at one foot above the bottom outlet because of this, the water is forced to circulate in cistern. The growth of fish seed at interval of 5th, 10th and 15th days was observed.

Results: The growth and survival of Indian major carps (Catla and Rohu) at different stocking densities rearing in cement cisterns was observed. In the first consignment the increment for first five days was 0.82 mm per day (i.e. 9.11%), the increment for next five days was 1.58 mm per day (i.e.12.06%) and for last five days was 1.0 mm per day (i.e. 4.76%). The average growth after fifteen days was 26.0 mm and average survival percentage was 60.03%. In the second consignment the increment for first five days was 0.92 mm per day (i.e. 9.47%), the increment for next five days was observed 1.78 mm per day (i.e.12.62%) and for last five days was 1.0 mm per day (i.e. 4.34%). The average growth after fifteen days was 28.16 mm and average survival percentage was 61.33%.

Conclusions: The higher stocking density and supplementary feeding in the present study was found to be the reason of arresting growth because the other managements were same in both the consignments of fish seed.

Keywords: Stocking density, Spawn rearing, Fish seed, Fish feed

Introduction
Under the national aquaculture strategy, intensive spawn rearing @ 100 million/ha aiming at survival of about 70% can be adopted with rearing pond condition. Rearing of spawn in nurseries is an important and crucial step in fish culture. The adverse conditions and improper management may often lead to severe consequences resulting in mortality of fry to an
extent of 90-98%.\textsuperscript{1} The intensification of culture technologies being followed at present has resulted in high stocking rate thereby increasing the demand of stocking materials. Therefore, it is essential to evolve standardized package for production of quality seed of desired species and size involving minimum cost, time and space. Stocking at higher densities not only results in higher production but also minimizes the total land requirement and water usage. However, high stocking density may directly influence survival, growth, production, behavior, health and water quality.\textsuperscript{2-4} Therefore, it is necessary to predetermine and standardize the optimum stocking density for each species in order to obtain the best possible output. Keeping the above facts in mind, the present investigation was undertaken to evaluate the growth and survival of Indian major carps (\textit{Catla} and \textit{Rohu}) at different stocking densities rearing in cement cisterns under adverse environmental conditions.

**Materials and Methods**

The present study was conducted at department of Zoology Ch. Ballu Ram Godara Govt. Girls (P.G.) College, Sri Ganganagar (Rajasthan). The area of study Sri Ganganagar district is situated in the north-western part of the state of Rajasthan in the Thar Desert. (Latitude 28.4 to 30.6 and Longitude 72.2 to 75). The canal system viz. Indira Gandhi Canal, Gang Canal and Bhakhara canal brought to this region from Punjab and irrigates extensive tracts of this region. Despite huge potential of fisheries in canal area (Sri Ganganagar), the availability of quality seed is difficult locally. Thus, this work will help to raise sufficient quantity of quality seed of various fish species to boost the fish production in local conditions.

**Site description**

The spawn rearing shed at department of zoology, Govt. Girls College, Sri Ganganagar (Rajasthan) consists of three cement tank each of size 5 m × 1.22 m × 1.22 m. The capacity of each tank is thus 7.44 cubic meters. All the tanks are covered by a green net at a height ten feet. This keeps in order avoiding heat radiation. The water inlet is through a set of three jet at one feet above the bottom outlet. Because of this, the water is forced to circulate in cistern, thereby avoiding the short circulation. The outlet is guarded by an aluminum wire mesh in order to avoid seed getting out through the overflow. The bottom of each cistern has a layer of fertilized soil. A separate bottom outlet is provided to each cistern so that the water level in the cistern could be lowered whenever required. Each tank is provided with a set of three showers fixed at three feet height from the water surface. This arrangement ensures oxygenation besides keeping the temperature low because of the cooling effect. Each cistern is provided with an aerator. The air distribution system is of polyurethane flexible piping and T joints of plastics. The diffusers are of coral stones and each cistern has 4-5 diffusers. The showering and circulation of water in the cistern was maintained with the help of electric pump. One small tank made-up of stone slabs was constructed for the development of plankton food. However, it was found to be insufficient hence artificial food was given.

**Water quality**

The important physico-chemical parameters of water such as temperature, pH, DO, dissolve CO\textsubscript{2}, alkalinity, nitrate, phosphate etc. were analyzed from the water samples collected alternate days between 8 a.m. to 9 a.m. following standard methods.\textsuperscript{5,7} Similarly, the plankton samples were collected by filtering 50 liter of water from each tank with the help of bolting silk net which were analyzed quantitatively following direct census method. The important soil characteristics such as pH, phosphate and nitrate were also analyzed for the samples collected at the beginning of the experiment.

**Growth pattern of fish seed**

The spawn rearing programme was started in June, 2015. The initial size of the fish seed was thus of 9 mm and the total no. of seed was 50,000. The seed was 70% catla and 30% rohu. The seed was acclimatized for 30 minutes and unpacked and released @ 16000 in cistern no. 1 and 17000 in each cistern no. 2 and 3 respectively. The particulars are given in Table
The growth of fish seed at interval of 5th, 10th and 15th days and total seed harvested is also shown in the same table. The growth gets influenced by varieties of causes, primarily being stocking density, water quality, availability of natural food and lastly the growth promoting efficiency of the supplementary feed. In the present rearing programme, the feeds were given as-(i) natural plankton (ii) ready food for aquarium fishes (Toya feed) (iii) rice bran and mustard oil cake and (iv) prepared feed (Soyabean + wheat flour + ground nut oilcake rice bran + egg + mineral powder). The average growth after fifteen days was 26.0 mm and average survival percentage was 60.03%.

Length and percent length increment per day at a fixed interval in 1st consignment is shown in Table 2. The growth increment was 0.8 mm per day (8.8%) in first five days and 1.4 mm per day (10.76%) for next five days and 0.8 mm per day (4.00%) for last five days. The growth was slow

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in starting five days and higher in next five days and reduced in last five days. The stocking density in each 2\textsuperscript{nd} and 3\textsuperscript{rd} cistern was 17000 (i.e.2787/m\textsuperscript{3}). The stocking size of fish seed was also 9.0 mm. The growth increment in 2\textsuperscript{nd} cistern was 0.8 mm (8.8\%) for first five days and 1.6 mm per day (12.30\%) for next five days and 1.0 mm per day (4.76\%) for last five days. The growth increment in 3\textsuperscript{rd} cistern was 0.9 mm (10.00\%) for first five days and 1.7 mm per day (12.59\%) for next five days and 1.2 mm per day (5.45\%) for last five days. The growth increment was highest (1.7 mm i.e. 12.59\%) in cistern no.3 which was fed with prepared feed.

The stocking size, total number and percent composition of spawn in second consignment are shown in table-3. The average growth after fifteen days was 28.1 mm and average survival percentage was 61.33\%.

The average growth was recorded 23.0 mm after 10 days. This works out 1.30 mm per day i.e. 13.68\%. The length and percent length increment in 2\textsuperscript{nd} consignment varied from cistern to cistern and shown in table 4. The growth increment in cistern no.1 was higher than the growth increment of same cistern of first consignment. It was observed 0.9 mm per day (9.47\%) for first five days and 1.8 mm per day (12.85\%) for next five days and 1.0 mm per day (4.34\%) for last five days. The growth increment in 2\textsuperscript{nd} cistern was 0.9 mm (9.47\%) for first five days and 1.6 mm per day (11.42\%) for next five days and 0.9 mm per day (4.09\%) for last five days. The growth increment in 3\textsuperscript{rd} cistern was 1.0 mm (10.52\%) for first five days and 1.9 mm per day (13.10\%) for next five days and 1.2 mm per day (5.00\%) for last five days. The growth pattern of the 2\textsuperscript{nd} consignment was similar that of 1\textsuperscript{st} consignment but growth increment was higher than the 1\textsuperscript{st} consignment. This tends to indicate that growth is related to stocking density, lower the stocking density and higher is the growth. During second consignment the growth increment was again highest (1.9 mm i.e. 13.10\%) in cistern no.3 which was fed with prepared feed. This indicates that supplementary feeding also influence the growth of fish seed.

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**Results and Discussion**

Physico-chemical parameters of water play an important role in the biology and physiology of fish. These parameters are considered critical because they affect the health and productivity of the culture system. Table 5 shows the water quality of the rearing waters for two different consignments. It would be seen from table that all the water quality parameters of the experimental ponds were within the acceptable ranges for aquaculture and there was no abrupt change in any parameter of the pond water. Therefore the variation in the growth of spawn cannot be attributed to variations in water quality parameters.

Stocking density is one of the most important variables in aquaculture because it directly influences survival, growth, production, behavior, health and water quality. High stocking densities are associated with stress, competition for food and living space, voluntary appetite suppression and more energy expenditure in antagonistic interactions.
There are varied views regarding the stocking rate of Indian major carp spawn. Alikunhi gave it as 10-20 lac/ha depending on the availability of plankton.\textsuperscript{13} Sen suggested the rate of 10 million/ha to give the survival of 66.6\% in the rearing period of 11-15 days.\textsuperscript{14} Tripathi et al while supporting the stocking rate of Sen, obtained the survival of 80.73\%.\textsuperscript{14,15} The stocking rate in the present study was 16,000-17,000 (early fry of about 9.0 mm for 6.1 m\(^2\) area). This works out 26.2-27.8 million/ha with a survival range of 59.2-60.6\% after 15 days. Our system of spawn rearing was found to be less effective after 15 days attaining the size of 25-28 mm, as after attaining this size heavy mortality began showing in the cisterns and growth also slowed down. This was due to overcrowding. It is felt that after attaining the growth of around 25 mm the density of the seed must be thinned out besides manipulating supplementary feeding. The higher stocking density in the present study was found to be the reason of arresting growth due to the high competition of food and space.

The quality and quantity of feed are important factors affecting growth and reproduction in fishes.\textsuperscript{16-18} Quality of food provided during the rearing period of larvae is a critical step in larval culture.\textsuperscript{19} In the present investigation, the feeding experiments could not be framed in the scientific way. However, feeding had shown certain distinct advantages and disadvantages of different feeds. It was observed that the Toya feed (readymade feed) could be a good feed for aquarium fishes but is not suitable for IMC seed. The seed accept the food and it was observed that hanging feeding trays overcrowded with seed avidly eating the Toya feed. The rice bran and mustard oil cake in the ratio 1:1 was used in the cistern no.2 throughout the rearing period and growth was satisfactory. In the third cistern prepared feed was given and highest growth was obtained. Table 1 and 3 shows that the average growth was recorded higher in 3\(^{rd}\) cistern (28 mm and 30 mm) as compared to that of 1\(^{st}\) cistern (24 mm & 28 mm) and 2\(^{nd}\) cistern (26 mm and 26.5 mm). The higher growth in 3\(^{rd}\) cistern in comparison to 1st and 2\(^{nd}\) was due to the effect of prepared feed (Soya bean+ wheat flour + ground nut oilcake + rice bran +egg + mineral powder). The prepared feed is more effective as compared to ready (Toya) feed and traditional feed MOC and rice bran. Thus stocking density and supplementary feeding both influences the growth of fish seed.

### Conclusions

After studying the performance of cemented cistern in the present study we feel that the proper density of the seed of 8-10 mm size would be 10000 to 20000 per tank i.e. 1639 to 3279 per cubic meter of water. We learn that ICAR has found stocking density for fry as 5000 per cubic meter. However, we were unable to confirm this. The highest stocking density in the present study was 2787/ m\(^3\). The prepared feed is more effective as compared to ready (Toya) feed and traditional feed MOC and rice bran. Thus stocking density and supplementary feeding both influences the growth of fish seed. It is felt that after attaining the growth of around 25 mm the density of the seed must be thinned out besides manipulating supplementary feeding. In present investigation the suitable feeds appear to be prepared mix feed (Soya bean+ wheat flour + ground nut oilcake rice bran +egg + mineral powder) supplemented with natural feed of plankton.
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