

INDUCED BREEDING AND POLY-CULTURE OF *SYSTEMUS SARANA* (HAMILTON, 1822)

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ABSTRACT : *Systemus sarana* (Hamilton, 1822) is mostly found in tropical freshwater bodies and has higher market price than that of the Indian major carps. Henceforth the olive barb is likely to be employed as the candidate species for aquaculture purpose in the carp polyculture. The detailed information on distribution, identification, captive brood-stock development, induced breeding, larval rearing and seed production and grow-out culture of *Systemus sarana* is discussed in this communication. The natural stock of *Systemus sarana* is declining rapidly with increasing fishing pressure and the information presented here could be of conservation importance.

Key words : Induced breeding, growth, conservation, *Systemus sarana*.

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INTRODUCTION

The *Systemus sarana* (Hamilton, 1822) is medium sized carp species commonly known as “olive barb”. It is classified under family Cyprinidae and mostly preferred as table food fish for its high nutritional as well market value including aquarium trade in India. Naturally it’s distributed in fresh and brackish water bodies of Asian countries especially India, Nepal, Bangladesh, Pakistan, Afghanistan, Bhutan, Sri-Lanka, Myanmar and Thailand. However, sudden increased in anthropogenic activity adversely affected these waters which in turn significantly hampered the distribution and abundance of *S. sarana*. Hence, there is an urgent need for conservation of this species through aquaculture that offers scope for an assured conservation through culture and propagation (Chondar, 1999; Mahanta *et al*, 1994). Majority of the ponds water quality parameters were within the acceptable range during yearlong carp culture (Das *et al*, 2004; Sahu *et al*, 2007; Tripathi *et al*, 2000), allocated to regular management measures such as liming, marring and watering. There are different species of minor carp

found in the indigenous water bodies having cultural prospective and regional significance (Das and Mishra, 2016).

Olive Barb conservational status identified as the critically endangered (IUCN Bangladesh, 1998; Ameen *et al*, 2000; Hussain and Mazid, 2004). It is over exploited and during the recent years reduced its population such an extent of placing it under the vulnerable group (Mahanta *et al*, 1994; Mukherjee *et al*, 2002; Chakraborty *et al*, 2003). Kurup (1994) had suggested the ranching of fish in riverine systems of Kerala. As such the fish having culture potential, it can be introduce into carp polyculture in India. So that it would not only help the diversification of the culture practices but also it can serve as for its conservation. The *Systemus sarana* is one of the medium sized carp species, which is having normal growth rate compared to the other Indian major carps. It has more consumer preference even if at a smaller size such as 100–200 g, which showed the species is worthy one for diversification (Chakraborty *et al*, 2003; Gopakumar *et al*, 1999).

Systemus sarana is one of the potential indigenous species for polyculture system in India. Hence, introduction of this species into the culture system with other Indian Major Carps needs an understanding of its habitat preference, food and feeding habit. It usually occurs in Indian waters like streams, rivers, wetlands, lakes, reservoirs and backwaters areas, whereas spawning restricted to running waters among submerged boulders and vegetation (Krishnamoorthy, 1979). It gives more preference to live in the marginal area of the water body where, the availability of submerged marginal weed covers. The species categorised as bottom omnivore for food preferences like plants, prawns, worms, detritus, insects, molluscs and phyto and zooplankton but it shows varied degree of competition with Rohu and Mrigal also for food and space in the culture system (Day, 1994). This species at 15-25% of the stock composition in multi-species farming has shown higher biomass yield as compared to the Major Carp poly-culture system (Jena *et al*, 2007, 2008). The Olive barb is a valuable food fish which is found over India, Pakistan, Afghanistan, Nepal, Bangladesh, Bhutan, Thailand (Talwar and Jhingran 1992) and Sri Lanka (Pethiyagoda, 1991).

Identification characteristics of *Systemus sarana*

The wild species can attain maximum size of about 60.0 cm length and 1.4 kg weight. The morphology of *S. sarana* contains elongated and laterally compressed body, small head, two pairs of barbels, rostral barbels are smaller than maxillary, mouth and eyes are moderate, entire lateral line consist of 30 to 34 scales, olive pigmentation found on back of the body and flanks are silvery with golden reflections, checks golden, reddish-brown barbels, fins are dusky brown to orange, dull blotch on lateral line before caudal base, dorsal fin consist of eight soft rays and three prominent spines and anal fin with five soft rays and two spines.

Captive broodstock development and seed production

Mature fish stocks should be collected from wild and kept in the broodstock development pond at stocking of 1.2-1.5 t/ha at least three months prior to the breeding season. Sexual maturity in male and female of *S. sarana* is attained in the first year and size of mature males is generally less than that of their female counterpart of the same age group. However, mature individuals of >2 year age-group are preferred for induced breeding. In order to facilitate proper feeding, it is usually recommended to maintain the brooders of *S. sarana* separately from the Major Carp brooders and supplemented with groundnut oil cake and rice bran



Fig. 1 : *Systemus sarana* (Hamilton, 1822).

mixture @ 3 to 5% of body weight.

In India, several efforts were made to standardise seed production technologies of *S. sarana* and seed are being produced in commercial scale. The species responded very well for induced breeding with different synthetic hormone formulations like Ovaprim, Ovatide WOVA-FH and HCG in FRP Carp Hatchery/ Eco-hatchery Model.

Induced breeding, hatching and spawn rearing

The most preferable breeding season for *S. sarana* is the onset of monsoon and continues during the rainy season. It is a batch spawner releasing adhesive eggs in weed masses and provision of aquatic weed in bunches in the breeding tank facilitates its spawning. The stem and leaf surface of weed such as Hydrilla, Chara are also acts as a substratum for the adhesive eggs of Olive Barb. Matured males at freely milt oozing condition and females with bulging abdomen and protruding genital papillae and oozing eggs on slight pressure on the abdomen are collected from the broodstock rearing ponds using suitable net. Brooders transported to the hatchery complex carefully in thick canvas bags filled with water. The males and females are kept separately in two breeding hapas for acclimatization in previously fixed in the circular breeding pool under a shower. The male: female sex ratio heeded usually at 1:1. Though, ripe female are larger than the male in these species, breeding pair is selected based on the weight. The pair with minimum weight difference is to be selected for better breeding result. In case of male being too small compared to female, the male sex ratio may be increased to 1:2. The fishes were sedated with quinaldine at 20 ppm for 2 minutes and a single intermuscular injection of Ovaprim/ Ovatide administrated at a dose of 0.3ml per kg female and 0.15 ml per kg male brooder. is being used for successful spawning of *Systemus sarana*. The hormone injected *Systemus sarana* pairs or brooders were allowed to spawn naturally in the tank or hapa along with the egg collector.

The spawning response time in *Systemus sarana* varies between 8 to 12 hours at water temperature 27-28°C. Collect the egg collector stalks bearing fertilized eggs from the breeding hapa are incubated in the circular

hatching tank/pool. Eggs are hatching out in an incubation pool soon after the 15 hours latency period at 27-30°C temperature. The newly hatched larva were small, transparent containing moderate yolk called hatchlings are retained in the incubation tank/pool for another 60-62 hours during which yolk absorption is completed and the larvae develop to tiny fish called spawn. The size of newly hatched *Systomus sarana* and spawn is about 1.8-2.0 mm and 4-5 mm, respectively. Yolk absorbed Spawns are recovered is in the range of 70,000-80,000 per kg female body weight.

Nursery rearing of *Systomus sarana* is generally achieved in 200-1000m² earthen ponds with depth of 1.0 to 1.5 m, large-scale seed production carryout in the 0.5 ha ponds. However, high density seed rearing is carryout in the concrete tanks of 50 to 100 m² with 1.0-1.2m water depth are preferred for early fry rearing to get the higher survival. Nursery pond preparation for *Systomus sarana* is similar to that of Major Carps. Essentially, the pond management practices involves environmental and biological manipulations for obtaining higher levels of seed or growout fish production, which can be broadly classified as pre-stocking, stocking and post-stocking operations.

Nursery pond preparation, stocking and supplementary feed

Nursery pond preparation begins with removal of causes like weeds and predators. Which is helpful in generate and enhance the adequate natural fish food organisms to ensure the higher rate of survival and growth and thereby yields. Eradication of predatory and weed fishes in perennial nursery ponds is foremost important step of pond preparation. Dewatering followed by sun drying the pond is the most effective method adopted for eradication of these fishes as well as pond parasites. The other methods include:

- (i) Manual method involve repeated netting
- (ii) Application of bio-toxicants like Derris root powder (40-100kg/ha), Cube root powder (40-100kg/ha) and Tobacco dust (2.5 ton/ha)
- (iii) Application of Mahua oilcake @ 2,500 kg/ha two-three weeks before stocking, which act as piscicide and latter serves as organic manure.
- (iv) Application of commercial bleaching powder (30% chlorine) @ 350 kg/ha-m of water (approximately 10 mg/l chlorine).
- (v) Alternatively, application of urea @ 100 kg/ha and bleaching powder @ 175 kg/ha is effectively controls weed and predatory fishes.

Generally, soil with 6.5-7.0 pH is considered productive, while pH below 6.5 is always associated with low productivity. Acidic soils are treated with lime for increasing the soil pH. High dose of organic manure (3.0-5.0 t/ha) and agricultural waste (organic mulch) is applied to reduce pH of moderately alkaline soil, while alum and ammonium sulphate is used in the case of highly alkaline soil. Soil pH in most parts of the country falls in the range of 6.5-7.0; soil of ponds with such a pH is amended by application of agriculture lime @ 200 kg/ha. Liming is also done at the same dose for every meter water depth as a turbidity removal, catalyst for fertilizer and disinfecting agent during culture operation to maintain the water pH in alkaline range (7.5-8.5).

Nursery pond needs to have adequate quantity of desired kind of natural food for the spawn. Phased manuring with a mixture of groundnut oil cake at 750 kg, cow dung 200 kg and single super phosphate (SSP) 50 kg (total quantity 1000 kg) per ha is used for production of desired plankton on a sustained basis during the nursery phase and in the seed rearing ponds of Indian Major Carps. This method has also been found to be equally effective in seed rearing of the *Systomus sarana*. A thick paste of one third to half the total dose of the three inputs is prepared and applied as basal dose one week earlier to the spawn stocking. The remaining quantity of the paste is applied in 2-3 split doses depending on the algal consortium present in the pond during the nursery rearing of *Systomus sarana*.

Fertilized nursery pond shows the increasing trend in the level of plankton in 5-7 days along with plankton infestation of insect is a common problem in culture practice. Soap oil emulsion (Soap @ 18 kg ha⁻¹ with Vegetable oil @ 56 kg ha⁻¹) is most commonly used for control of harmful air breathing insects like Notonecta, Ranatra, Nepa etc. The mixture is prepared by slight heating after mixing the ingredients and sprayed over the surface of the water before the 20-24 hours of stocking of spawn. Oil film covering the entire pondwater surface and retained for sufficient period of time to kill the air breathing insects through suffocation. Emulsion of kerosene @ 100 litre ha⁻¹ or diesel @ 50-75 litre ha⁻¹ and liquid soap @ 500- 560 ml ha⁻¹ or detergent powder @ 3 kgha⁻¹ water area can be applied as an effective substitute.

The spawn are collected and transferred from the hatchery to the nurseries during cool hours, preferably in the early morning, soon after proper acclimatization to the pond environment. For earthen nursery ponds the ideal range of spawn stocking density recommended for different *Systomus sarana* is 3-5 million/ha (300-500/

m²), with an outcome of 30-40% survival. The ideal density recommended for *Systomus sarana* in large cement nursery tanks is 1000 spawn/m³ with an outcome of 60-70% survival.

The supplementary feed used during nursery phase is the pulverized groundnut oil cake and rice bran (rice polish) in combination at 1:1 ratio by weight. The dry feed mixture is added in nurseries normally at 0.4 kg/lakh spawn /day, from the second day of release of spawn in a prepared nursery pond/tank. Daily feed quantity is increased roughly by 50-75 g/lakh spawn/ day depending on the consumption pattern. Daily ration may preferably be provided in two splits for better utilization of supplementary feed. The nursery period usually extends up to 25-30 days in *Systomus sarana* during which they grow to a size of 15-20 mm.

Rearing fry to fingerlings

Like nursery ponds, the rearing ponds also need specialized management for good survival and production of healthy fingerlings. Some of the basic operation such as clearing aquatic weeds, soil pH correction and control of predatory and weed fishes are done as in nursery pond preparation. Pond fertilization is carried out with application of raw cow dung @ 12-15 tonnes/ha depending on the organic carbon load of the soil. While one third of this amount is applied 10-12 days before stocking, the remaining amount is applied in equal split doses at fortnightly intervals. In case poultry droppings are applied, the dose may be reduced from one third to half of the amount of cow dung. In addition to the organic manures, inorganic fertilizers such as urea and single super phosphate are applied depending on the nutrient status.

Stocking is preferably done in rearing pond during morning or evening hours after proper acclimatization of the seed to the new environment. The usual stocking density varies from 2.0 to 3.0 lakh fry/ha. In ponds with facilities for water circulation/exchange or aeration, the fry density can be further increased to a considerably higher level. Since fry of *Systomus sarana* are planktophagic with preference for zooplankton, the normal method of pond fertilization is applicable in the rearing pond for supporting the natural productivity. Feed requirements of the growing fingerlings are met through the available natural algal consortium and application of groundnut oil cake and rice bran mixture at 1:1 ratio by weight. Supplementary feed quality can be improved through incorporation fish meal, soybean flour, vitamin-mineral mixture etc. Periodical samplings of the fry/advance fry at fortnightly interval are done to assess the growth and biomass. Feed is provided at the rate of 8-

10% of biomass of fry stocked per day during the first month, which is reduced to 6-8% and 4-6% of the standing biomass during the subsequent two months. The fingerlings show better acceptability to crumbled pellets of 1-2 mm diameter, which may also reduce the feed wastage. The fish fingerlings are harvested after 3 months of the rearing phase.

Grow-out culture

The grow-out fish farming in our country is mostly carried out for one year period depending on the water availability. Ponds are usually stocked with 7,500-10,000 carp fingerlings/ha. In a polyculture study, Olive Barb (*Systomus sarana*) along with Catla, Silver Carp and Rohu combination showed lower FCR and higher biomass yield compared to that species combination with Mrigal in place of Rohu. This indicated feasibility and advantage of culturing Rohu with Olive Barb rather than Mrigal. The study further suggested feasibility of replacing Mrigal with Olive Barb in the grow-out carp polyculture system.

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