Stocking Carp Post larvae in Nursery Ponds

After controlling all factors which might lead to mortality of the stocked carp post larvae, as described in the preceding section, the most appropriate time for stocking a nursery pond is when it abounds with zooplankton, especially rotifers and cladocerans in adequate density (preferably rotifers only). Before actually stocking the nursery pond with post larvae, it is necessary to make an estimate of the types and abundance of plankton present. This can be done by adopting appropriate limnological methods. A rough field method for estimating plankton has been developed in which about 55 liters of water, taken from different sections of the nursery pond, are filtered through an organdy or muslin ring net with a 2.5 cm diameter glass specimen tube tied to the lower end of the net. A pinch of powdered common salt is added to the water in the tube after the plankton is collected and the tube detached from the net. Within 15-20 minutes of adding the salt, most of the organisms settle on the bottom. If the column of plankton sediment is at least 15 mm high from the bottom of the tube and the sediment found to consist mostly of cladocerans and rotifers, the pond may be considered sufficiently rich in plankton to stock at the rate of 1.5 million post larvae per hectare. The animal or plant nature of plankton sediment is roughly indicated by either a pale-brownish or greenish color of the sediment, the former indicating preponderance of zooplankton and the latter of phytoplankton. If the predominant plankton population be not of zooplankton, then further organic manuring should be done at doses recommended earlier to rectify the situation before stocking.

To avoid any abrupt change in quality and temperature between the water of the hatching tank and that of the nursery pond, the post larvae should be kept in a suitable container having water initially from the former (hatchery tank) to which the water from the nursery pond should be gradually added in stages, eventually substituting almost the entire hatchery water of the container by the water from the nursery pond. The container should then be slowly dipped and tilted in the nursery pond letting the larvae free to swim out of the container. Stocking should be done late in the evening or early morning, a procedure which gives post- larvae time to acclimatize themselves during the ensuing night relatively free from the predations of enemies. Stocking rate of post larvae in a nursery pond depends on the management practices being attended. If natural food in the form of zooplankton is to be produced by continued pond manuring and supplemental feeds are also to be given, and if facilities exist to remedy oxygen deficiency condition should this occur under conditions of heavy stocking, then the stocking rate may be as high as 10 million per hectare.

Post Stocking Practices

Feeding is based on natural live food organisms generated in the pond itself and augmented through fertilization and on supplemental feeds given exogenously. There is a great deal of difference between complete fish feeds and supplemental feeds. Soon after being stocked in manured nursery ponds containing rich zooplankton, carp post larvae start grazing voraciously on natural food. At this time the feed requirements of spawn are so huge that within two to three days of stocking, the plankton initially present in the pond gets exhausted and steps must be taken not only to generate more natural food but also to administer artificial feeds. Supplementary feeding with manuring of a pond, when done simultaneously, leads to high survival and fast growth of the stocked post larvae in nurseries. The commonly administered artificial feeds for common carp, Chinese and Indian major carps are rice bran and oilcakes of ground nut, coconut, mustard, soybean meal, etc. Artificial feeds typically refer to various ingredients which are mixed together and broadcast on the surface of the water. Formulated feeds are feeds which mix finely ground ingredients together using a standard formula then extruded or pelleted. For young fish, the resulting pellets may be crushed or even reground, to make a crumble or powder. Artificial and formulated feeds are always given in finely powdered form to carp post larvae. Formulated feeds are more likely to contain significant amounts of soybean meal and oil due to the highly nutritious characteristics, ease of use, price and consistent availability.

It has been found that among the combinations of various artificial and formulated feeds containing protein, fat, carbohydrate, minerals, roughage and vitamins, etc., the maximum growth of post larvae is obtainable with feeds having a combination of hydrolyzed proteins and carbohydrates (50:30). Complex proteins and pure carbohydrates give poorer results. Further, rice bran alone, a food most often given singly, gives much poorer results than a mixture of oilcakes, rice powder and black gram in powdered form. Silkworm pupae, soy, and fishmeal give still better results.

A feed compounded from dried and finely powdered and sieved notonectids (which are highly predatory to carp spawn), small prawns and shrimps and cheap pulses or lentils in the ratio of 5:3:2 gives much better results for survival and growth of hatchlings of

Catla, rohu, mrigal and silver carp than the conventional mixture of rice bran and oilcake, besides utilizing an otherwise wasted product.

For monoculture of rohu spawn, good results are obtainable with zooplankton, followed by silkworm pupae, mustard oilcake with rice bran and ground nut cake with wheat bran in the order stated. Normally post larvae stocked in nursery ponds attain a length 2.0 to 2.5 cm (when they are termed fry) in about 15 days with artificial feeding giving a survival of about 50% in earthen ponds. A higher survival rate may be expected if a system of intensive controlled culture of rotifers and crustaceans to serve as fry food is developed and facilities for intensive aeration are provided. The fry may be transferred to prepared fry-rearing tanks or otherwise taken care of for further rearing if not sold to the fish farmers.

Rearing Pond Management

Rearing or growout ponds are deeper and larger than nursery ponds, and are more liable to get infested with weeds. An overgrowth of weeds deprives the pond soil of nutritive elements, restricts the movement of fish, interferes with netting operations and harbors predatory and weed fishes and insects. Weeds occupying different habitats and niches have to be controlled in different ways. Floating weeds like *Eichhornia* and *Pistia* are best removed by manual labor. Chemical herbicides like 2, 4-D are quite effective and economical against *Eichhornia,* though not as much against *Pistia.* When mixed with common domestic detergent, 2, 4-D acts effectively against weeds like *Pistia, Nymphaea* and *Nelumbo* in which leaves are either hairy or waxy. Simazine WP-50, another herbicide, applied at 5.6-11.2 kg/ha kills *Pistia, Eichhornia* and *Colocasia* completely within two to three weeks even during rains. Taficide-80, a third herbicide, at a dose of 2.2 kg/ha, is also effective against *Eichhornia.* Marginal weeds like *Typha,* grasses, sedges, rushes, *Ipomoea, Jussiae, Jagittaria* and *Cocasia* are effectively controlled by ploughing in, grazing by livestock, burning during dry season or repeated cutting and deepening or marginal shelves. All herbicides should only be used strictly according to the directions on the manufacturer's label. In fact, in Pakistan and most other countries it is illegal to use the herbicide in any manner other than the labeled directions. Workers applying herbicides should be provided with proper protective clothing and safety gear including respirators. Applicators should also receive training in proper use of the gear, explicit training in methods of application according to the label and first aid in case of accident.

Rooted emergent weeds like *Limnanthemum, Trapa, Myriophyllum,* etc. are successfully removed by repeated cutting of leaves before fruiting at weekly intervals, for about six to eight weeks. Alternatively, spraying once or twice with, 2, 4-D (at 5.6-11.2 kg/ha) kills these plants. Rooted submerged weeds are cleared by a number of simple, manually operated devices like bottom rakes, log weeders, metal spikes, with or without barbed wire attachment, forks, drag chains or bamboo poles fixed with cross pieces at their lower ends followed by repeated netting with strong wire or rope nets. Other methods employed include shading by floating plants like *Pistia* or *Salvinia* for a period of 8-10 weeks or by creating algal blooms or algal mats by repeated fertilization with N:P:K fertilizers.

The best known fish that is used for biological control of weeds is grass carp, *Ctenopharyngodon idella.* Grass carp feeds most voraciously on *Hydrilla, Najas* and *Ceratophyllum.* It can also control infestations of *Ottelia, Vallisneria, Nechmandra, Utricularia, Trapa, Myriophyllum* and *Limnophila.* Anhydrous ammonia gas, obtainable in gas cylinders, controls *Hydrilla, Najas, Wolffia, Nymphaea, Ottelia, Limnanthemum* and *Nelumbo* when injected in the subsurface layers with an applicator at 112-334 kg/ha or 6.9-19 ppm. Much of the ammonia applied enters the pond's production cycle by nitrogen enrichment resulting in phenomenal growth of plankton soon after weed clearance. Some blue-green algae, particularly, *Microcystis,* can form long persistent blooms which deplete oxygen and often cause fish mortality. Simazine at a dose of 0.5 to 1.0 ppm clears algal blooms and mats and brings about prolonged control without affecting production of other plankton and fish.

For further rearing of carp fry to fingerlings, either monoculture or polyculture may be carried out. The stocking density of fry measuring 25.4 mm to 37.8 mm weighing 0.15 to 0.75 g each may be 125,000/ha to 250,000/ha. A practice recommended for healthy fry rearing is that the size of the fry in a rearing pond at the time of stocking should be as uniform as possible. This is accomplished by first segregating the catch in holding pens, made of gunny or canvas bottom and split bamboo sides supported on stakes. It is necessary to periodically clean the holding pen of debris, fish excreta, etc. which is done by lifting the bottom and removing the rubbish manually. Size grading is done by sifting fry through sieves of different mesh gradations made of split bamboo. Fry attain the fingerling length of 100 mm to 172 mm in about three months. A survival of up to 80% may be expected provided that a full complement of management measures for environmental enrichment are adopted and that the fry have natural food as well as artificial feed given to them. Artificial feeding may be on oilcake, mustard or ground nut or coconut and rice bran in the ratio of 1:1. The density of feeding in the first month may be equal to the initial total weight of fry stocked daily and in the second and third months, twice the initial weight of fry stocked daily.

In the case of nursery ponds, harvesting may be done by repeated seining with fine meshed nets. In rearing ponds, where fry are grown to fingerling stage, periodical harvesting may be done at an appropriate time to avoid overcrowding. After harvesting, the fingerlings may be stocked unless sold. The function of a carp hatchery is completed after fingerlings have been produced.

BREEDING OF TILAPIA

Mono-sex Tilapia Seed Production

Tilapia are mouth breeders, and in the genus *Oreochromis*, the female tilapia lay their eggs in pit nests built by a male and after fertilization by the male, the female collects eggs in her mouth (buccal cavity) and keeps there until hatching (Iq and Shu-Chien, 2011). This poses a problem when large numbers of eggs must be collected for rearing of fish seed on commercial basis. To overcome this problem, the tilapia spawning should be synchronized to produce progeny groups as uniform in size and age as possible. Spawning of Tilapias is influenced by both environmental (e.g. photoperiod, temperature, food availability) and social factors (social stimuli exchanged between neighboring females) (Costa-Pierce, 1997). Therefore, the strategy for synchronizing spawning involves maintaining brood stock separated by sex in a suitable holding facility, conditioning by proper feeding, and evaluation of the sexual maturity condition of females. Tilapia brood stocks are readily conditioned with good feeding, warming water temperatures, and separation of the sexes for a short while. In higher latitudes, warming water temperatures with lengthening photoperiods will further condition the fish.

***Oreochromis niloticus* (Nile Tilapia)**

***Oreochromis* spp. (Red hybrid tilapia)**

Breeding in Hapas

A 'hapa' is a fixed net enclosure, similar to a mosquito net. It is typically made of polyethylene netting sewn into an open top cage with nylon thread. Hapas of different sizes can be used but the most commonly used size is 1 m (width) x 2 m (length) x 1 m (depth) with a mesh size of 1.0 to 2.0 mm. Several males will be kept in one hapa and females in another. Holding potential male and female breeders together helps to synchronize spawning by exchanging social stimuli (e.g. pheromones) (Huertas et al., 2014).

After conditioning, the female breeders should be checked for their readiness to spawn by visually examining their morphological characteristics. Female breeders are then categorized in one of the following maturity conditions: 'ready to spawn' (RS), 'swollen' (S), 'not ready to spawn' (NRS), and 'has spawned' (HS). Female breeders categorized as 'ready to spawn' are first selected for pairing with a male in breeding hapas.