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Improving the Survival Rate of Common Carp *(Cyprinus carpio)* Fry Using Malathion and Prophylactic Measures

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Abstract

A field experiment involving sixteen 600-m^2 nursery ponds was conducted to test (1) the efficacy of malathion for selectively killing the copepod predators of larvae of common carp *(Cyprinus carpio);* (2) prophylactic drug treatment of the carp to avoid bacterial and other infections; and (3) a combination of both treatments.

Significant differences were found between the treatment groups ($P < 0.01$) while differences among the replicates were not significant ($P > 0.05$). The mean survival of fry was 2.8, 1.7, and 3.4 times higher using malathion, prophylactic drugs and both combined, respectively, than in the control.

Introduction

Poor survival during nursing of carp larvae even in well prepared nursery ponds is a common experience. Nursery management practice prevalent in India includes eradication of predatory and weed fishes, predatory insects and production of dense blooms of zooplankton through proper fertilization and manuring schedules (Sinha and Ramachandran 1985). While zooplankton is considered to be the most preferred food of the fry of carps (Alikunhi 1952), some of the cyclopoid copepods and cladocerans are reported to be predacious on fish larvae and fry (Lakshmanan 1969; Selvaraj and Rao 1977; Selvaraj 1978; Gaal et al. 1980; Mishra et al. 1980) causing heavy mortality in nursery ponds either by killing or by injuring and subsequent bacterial or other secondary infection thereupon.

Organophosphorous insecticides are already in use in aquaculture for controlling argulosis and dactylogyrosis. They also efficiently kill copepod and cladoceran populations without affecting rotifers (Konar 1973; Gaal et al. 1980; Mani and Konar 1984, 1985, 1986).

Materials and Methods

An organophosphorus insecticide, malathion (50% emulsion), was used in this experiment at 0.25 ppm concentration as it destroys the copepods and cladocerans harmful to the delicate larvae and fry without affecting the rotifers. Having an optimum size, the latter move slowly and are easy to digest and are suitable as feed for larvae. Prophylactic drug treatment was also undertaken to avoid losses due to stress-mediated infections.

The experiment was conducted in 16 newly constructed nursery ponds each measuring 600 m^2 and having more or less similar ecological conditions during the year 1983. Ponds were drained, dried, cleaned and refilled with water up to a height of 1.6 m. Ponds were manured with fresh cow manure at the rate of 100 kg/pond and were allowed to remain as such for a week until the appearance of zooplankton in sufficient number. Four treatment groups were maintained each with four replicates. Group A ponds were treated with malathion at the rate of 0.25 ppm. Group B ponds received prophylactically treated postlarvae, while group C treatment was the combination of both and group D was untreated and kept as control. For every pond of Groups A and C, 45 ml of malathion was mixed with 25 ml of water and was uniformly spread over the entire water surface, and the water was agitated for proper mixing. Four sets of healthy and mature common carp breeders *(Cyprinus carpio)* were selected and placed into the breeding hapas for controlled breeding. On the following day, fertilized eggs were transferred to the hatching hapas. On the third day after malathion application, soap and oil emulsion was applied in all the ponds to eliminate insect predators. On the fourth day postlarvae were collected from the hatching hapas, pooled together and distributed at the rate of 10,000/bucket in 16 plastic buckets with 5 l of water in each, and stocked separately in 16 experimental ponds. A one-hour bath treatment of postlarvae with oxytetracycline at the rate of 45 $mg{\cdot}l^{-1}$ water was applied in 8 buckets and the treated postlarvae were stocked in Groups B and C ponds. Prior to stocking they were also given a dip treatment for 30 seconds in potassium permanganate solution. The remaining 8 buckets were kept for 1 hour without any treatment and were stocked in Groups A and D ponds. Formulated balanced feed was applied daily in all the ponds at the rate of 100 g/pond and harvesting was done after 28 days of rearing. Plankton samples were collected prior to and after 3 days of malathion application by filtering 50 l of water through a No. 25 bolting silk plankton net (0.064 mm) and preserved in 4% formalin for detailed analysis. Pond water was also analyzed on a weekly basis using a Beckman oxygen monitor II system and Biochem pH meter. Other chemical analysis of water was done following the standard methods (APHA 1955).

Results

The effect of various treatments on the survival rate and growth of common carp fry is presented in Table 1. The mean survival of fry was 2.8, 1.65 and 3.35 times higher in Groups A, B and C,

Table 1. Effect of various treatments on survival and growth of common carp fry.

*Group	Treatment	Survival (%)	Av. wt. attained (g)
A	Malathion	45.5	0.25
B	Prophylactic medication	26.75	0.23
C	Malathion + Prophylactic medication	54.5	0.22
D	Control (without any such treatment)	16.25	0.23

*Each group with four replicates.

respectively, than in the control (Group D). Two way analysis of variance (Table 2) indicated significant differences in the survival rate between the treatment groups ($p < 0.01$) while the differences among the replicates were not significant ($p > 0.05$). The treatments did not show any significant effect ($p > 0.05$) on growth (Table 3). From Duncan's multiple range test also, it is evident that in terms of

Table 2. Two way analysis of variance to show the significant level of survival.

Source of variation	Degrees of freedom	Sum of square	Mean square	Variance ratio (f)	Probability values
Treatment	3	3,631.5	1,210.5	29.056	$P < 0.01$*
Replicates	3	53.5	17.83	0.427	$P > 0.05$#
Error	9	375	41.66		
Total	15	4,067	271.13		

* Highly significant # Not significant

Table 3. Two way analysis of variance to show the significant level of growth.

Source of variation	Degrees of freedom	Sum of squares	Mean square	Variance ratio (f)	Probability values
Treatment	3	0.0019	0.0006333	1.5100	$P > 0.05$#
Replicates	3	0.000225	0.000075	0.1788	$P > 0.05$#
Error	9	0.003775	0.0004194		
Total	15	0.0059	0.0003933		

\# Not significant.

survival Group C is significantly different from Groups B and D and superior to A while in terms of weight they are comparable as they do not differ significantly (Tables 4 and 5).

Hydrological parameters ranged between the normal limits and the differences in these values in the experimental ponds were also not very wide. Dissolved oxygen, free carbon dioxide, ammonia, total alkalinity and pH of the water ranges were 4.8-8.5 ppm, 1.30-2.80 ppm, 0.005-0.015 ppm, 91-120 ppm and 7.3-7.6, respectively. Total sestonic volume prior to malathion application was 0.75-1.6 $cm^3 \cdot 50\ dm^{-3}$ and zooplankters dominated in all the samples ranging from 204 to 377 individuals$\cdot dm^{-3}$. Major groups of zooplankton consisted of copepods (45-65%), cladocerans (20-40%) and rotifers (10-20%).

Table 4. Evaluation of differences of survival rates using DMRT.

Treatment	Survival (%)[a]	DMRT[b]
C	54.50	
A	45.50	
B	26.75	
D	16.25	

Table 5. Evaluation of differences in growth rates using DMRT.

Treatment	Weight (g)[a]	DMRT[b]
A	0.25	
B	0.23	
D	0.23	
C	0.22	

[a]Average of 4 replicates.
[b]Any two means connected by the same vertical line are not significantly different at 5% level of significance.

Plankton samples collected on fourth day after malathion application from Groups A and C ponds showed depletion in total plankton volume (0.30-0.75 $cm^3 \cdot 50\ dm^{-3}$) and the rotifers contributed about 98-100% to the zooplankton population while in Groups B and D ponds the total plankton volume ranged between 0.85 and 1.95 $cm^3 \cdot 50\ dm^{-3}$ with the majority of zooplankton being about 80-90% copepods and cladocerans. Details of the plankton status of pre- and post-malathion-treated ponds are summarized in Table 6.

Table 6. Effect of malathion treatment on the pond zooplankton population (Group A and C ponds).

Planktonic group	Pretreatment	Post-treatment (4 days after treatment)
Sestonic volume ($cm^3 \cdot 50\ dm^{-3}$)	0.75-1.60	0.3-0.75
Total zooplankton (dm^{-3})	204-377	185-322
Copepods (dm^{-3})	106-210 (45-60%)	0-6 (0-2%)
Cladocerans (dm^{-3})	55-135 (20-40%)	0-3 (0-2%)
Rotifers (dm^{-3})	27-71 (10-20%)	182-315 (98-100%)

Discussion

It is obvious from the results that by selectively killing copepods and cladocerans which normally take heavy toll, survival rate can be increased significantly during early rearing of carps. Fabian (1960), Nikol'sky (1963), Lakshmanan (1969), Selvaraj and Rao (1977), Selvaraj (1978), Mishra et al. (1980) have also experienced similar mortality of carp fry due to predation by cyclopoid copepods. Saha et al. (1971) recorded the occurrence of *Mesocyclops leuckarti* in an unmanured perennial pond at a density ranging from 72 to 234 l^{-1}. The studies of Alikunhi et al. (1955) have also shown that the copepods sometimes formed swarms in manured ponds with density ranging from 952 to 3,820 l^{-1} causing increased risk of predation of the fry. We have previously experienced that without taking any control measure against predation by copepods and cladocerans the survival could be enhanced only to a limited extent by prestocking prophylactic treatment and balanced formulated feed during larval rearing of Indian major carp rohu, *Labeo rohita* (unpublished data).

In the present communication, it is evident that under conditions of the experiment, control of predatory plankton populations by malathion treatment alone increased the survival by about 28-29%.

Prophylactic antibiotic treatment had added effect in the order of 9 to 10.5%. The latter might have helped in preventing poststocking mortality due to handling stress and subsequent infection. Bejerano et al. (1979) and Kumar et al. (1986) reported prevention of similar losses by prophylactic antibiotic treatment.

The growth of fry does not appear to be significantly different among the treatment groups thus omitting any apparent potential risk to fish health due to malathion application. Also when predatory forms of plankton were killed, rotifers which are choice food of carp larvae started emerging in abundance.

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