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Effect of Agricultural Pesticides, Hostathion and Kitazin on the Larvivorsity of the Carnatic Rice Fish, *Oryzias carnaticus* (Jerdon, 1849)

[1]K. John Ravindran, [2]Ramesh Daniel, [2]Sunitha Kumari, [2]Susan George and [1]Alex Eapen

[1]National Institute of Malaria Research, Field Unit, Chennai - 600 077, Tamilnadu, India
[2]Department of Advanced Zoology and Biotechnology,
Sir Theyagaraya College, Chennai - 600 021, Tamilnadu, India

Abstract: Application of pesticides in rice fields affect both target and non-target organisms. Pesticides that leach into aquatic habitats may influence various physiological processes that may impact upon the larvivorous potential of fishes. Laboratory observation on the effect of 0.001 and 0.01 mg/l of the insecticide, Hostathion (Triazophos) and 0.5 and 1.0 mg/l of the fungicide, Kitazin (Iprobenfos) on the larvivorous potential of *Oryzias carnaticus*, an indigenous larvivorous fish in India was studied. The mean consumption by fishes were 3.1 and 4.1 times lower than control and was lowest on Day 2 and Day 1 in Hostathion treated solution. It was 4.6 and 4.8 times lower than control and consumption was lowest on Day 1 at both concentrations in Kitazin treated solutions. Mean consumption did not reach the level of control during the four day exposure period. The obtained results indicated larvivorous potential to be affected when fishes were exposed to sub-lethal concentrations of both studied pesticides.

Key words: Larvivorous Fish · Rice fields · Mosquito control · Organophosphorous Pesticides · Toxicity

INTRODUCTION

Application of pesticides remain the most preferred and feasible tool for control of agricultural pests. In the past century, a plethora of pesticides have been used against agricultural pests. Intensive cultivation of crops and frequent infestation by pests demand frequent and intense application of pesticides. Indiscriminate and improper use of pesticides coupled with poor degradation and accumulation have known to contaminate the environment and affect associated fauna [1]. Among the crops, rice cultivation has been extensively carried out in many countries of Asia. Use of pesticides during rice cultivation not only affects the plant pest but also other non-target organism [2]. Aquatic fauna at various trophic levels in the immediate environment including larvivorous fishes remain affected due to contamination. Larvivorous fish, potential predators of immature mosquitoes are known to regulate the density of mosquitoes that breed in rice fields and other associated habitats. Pesticides that leach into aquatic habitats on treatment of rice plant may influence various physiological processes that may impact upon the larvivorous potential of the fish. In the present study, laboratory observation on the effect of sublethal dose of the foliar organophosphorous compounds, Hostathion (insecticide) and Kitazin (fungicide) on the larvivorous potential of *Oryzias carnaticus*, an indigenous larvivorous fish of the rice land agroecosystem in India is reported.

MATERIALS AND METHODS

The agricultural insecticide Hostathion 40% EC (Triazophos) and the fungicide, Kitazin 48% EC (Iprobenfos) were procured from the registered dealer, Chennai, Tamilnadu, India and desired test concentration prepared in distilled water. Bioassays were performed in glass troughs with one litre of test solution. *Oryzias carnaticus* fish netted from ponds in Perungalathur area in the south western outskirts of Chennai city, Tamilnadu, India were transported and maintained in the laboratory under room conditions. Required number of similar sized fishes was segregated and its length and weight were noted. The larvivorous potential of each fish was assessed at sublethal test concentrations of 0.001 and 0.01 mg/l for Hostathion and 0.5 and 1.0 mg/l for Kitazin

Corresponding Author: K. John Ravindran, National Institute of Malaria Research, Field Unit, NIE campus, Phase II, TNHB, Ayapakkam, Chennai - 600 077, Tamilnadu, India.

which were tolerated by the fish. Nine fishes were assigned to each treatment group including control. The fishes were acclimatized in test solution for a period of 24 hours before the trials. All fishes were starved during the period. Thereafter, 20 fourth instar laboratory reared *Aedes aegypti* larvae were provided daily for a consecutive period of four days and the number consumed after every 24 hours was noted. At the time of larval reintroduction all unconsumed larvae, both dead and alive were removed and discarded. No other food was provided until the experiment was completed. Data was subjected to statistical analysis using SPSS software version 11.5 [3]. Kruskal-Wallis test was performed to understand the effect of pesticide treatment on larval consumption.

RESULTS AND DISCUSSION

Rice fishes are found in fresh and brackish water habitats from India to Japan and south along the Indo-Australian archipelago, China and many parts of South Asia [4]. The spotted rice fish, *Oryzias carnaticus* is widely distributed in Eastern India, Sri Lanka and Bangladesh and are found to inhabit coastal brackish and freshwater habitats [5, 6]. In India, *Oryzias carnaticus* has been reported to be present in the state of Karnataka, Orissa and Tamilnadu [7]. In the present study, *Oryzias carnaticus* tolerated the experimental concentration and mortality was not observed during trials with Hostathion and Kitazin. *Aedes aegypti* larval mortality was observed and mortality per day in control, 0.001 and 0.01 mg/l was 2.6±3.7, 5.6±4.8 and 6.6±5.4 in trials with Hostathion and 2.2±3.6, 5.5±5.2 and 8.7±4.8 with Kitazin. Particulars of fish and larval consumption are given in Table 1. During trials with Hostathion, the mean larval consumption per fish per day in control was 58.0%. Daily consumption ranged between 43.5 to 71%, the minimum consumption being recorded on Day 1 (Figure 1). The mean larval consumption at 0.001 and 0.01 mg/l test concentration was 19.0 and 14.0%. Daily consumption ranged from 16 to 35 and 12 to 21.5%, the minimum consumption being on Day 2 and Day 1 respectively. Results of Kruskal-Wallis test on pooled daily larval consumption by fish in different treatment groups showed statistically significant difference ($H = 27.4$; $df = 2$; $p<0.01$).

In the case of trials with Kitazin, the mean consumption of larvae per fish per day was 65.0% in control and daily consumption ranged between 62 and 67%, the minimum consumption being recorded on Day 1 (Figure 2). In test concentrations of 0.5 and 1.0 mg/l, mean consumption of larvae per fish per day was 14.0 and 13.5. Daily consumption ranged from 8.5 to 19 and 4.0 to 25.0%, the minimum consumption being recorded on Day 2 and 1 respectively. Kruskal-Wallis test showed statistically significant difference in larval consumption by fishes in different treatment groups ($H = 35.5$; $df = 2$; $p<0.01$).

Larval consumption by fishes exposed to sublethal concentrations of Hostathion and Kitazin were found to be less than control. Consumption was proportional to concentration and fishes exposed to higher concentrations consumed fewer larvae. The mean larval consumption at 0.001 and 0.01 mg/l test concentration of Hostathion was is 3.1 and 4.1 times lower than control and at 0.5 and 1.0 mg/l of Kitazin it was 4.6 and 4.8 times less. Decreased consumption may be attributed to avoidance of food or the inability to capture larvae due to the toxic effects of the pesticides. The reduced consumption observed herein is due to avoidance of food and not due to change in the predatory ability of the fish as the prey and predator have been limited to the same space with required visual perception for predation. Pesticidal stress therefore impacted the larvivorous potential. Further, during the exposed period of four days, larval consumption was comparatively higher on Day 4 than

Table 1: Particulars of fish and larval consumption in treated and untreated solutions

		Particulars of fish and larval consumption*			
S. No	Pesticides / Concentration (ppm)	Length (cm)	Weight (g)	Larvae consumed / fish/day[1]	Percent consumption (Mean only)
I	Hostathion				
1.	0.01	3.2±0.3	0.3±0.1	2.8±1.1	14.0
2.	0.001	3.3±0.3	0.3±0.1	3.8±2.3	19.0
3.	Control	3.3±0.3	0.3±0.1	11.6±2.9	58.0
II	Kitazin				
1.	1.0	3.4±0.2	0.4±0.1	2.7±1.5	13.5
2.	0.5	3.3±0.3	0.3±0.1	2.8±0.9	14.0
3.	Control	3.3±0.3	0.3±0.1	13.0±0.5	65.0

*Mean ±SD; [1]n = 36

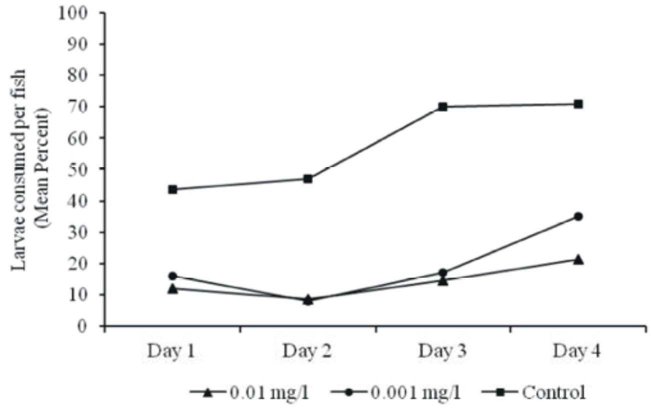

Fig. 1: Daywise larval consumption of *Oryzias carnaticus* in test solution treated with hostathion

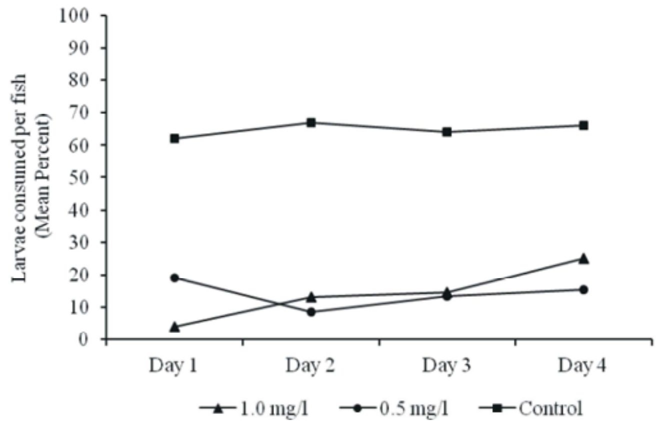

Fig. 1: Daywise larval consumption of *Oryzias carnaticus* in test solution treated with Kitazin

other days. This may be due to the rapid degradation of the organophosphorous compounds studied which is reflected by the increase in daily consumption by fishes. Generally, accumulation of pesticides or its residue in fishes which occurs orally or through gills [8] cause toxicity that manifests as abnormal physiological functions such as poor consumption. The increase in the daily consumption does therefore reflect decrease in daily toxicity levels due to poor bio accumulation. It should also be noted that the consumption by fishes maintained in the pesticide treated solutions did not reach up to the level of control indicating that recovery of the larvivorous potential may not reach the fullest potential until pesticide free condition is restored. The results, therefore confirm that the larvivorous potential is affected when fishes are exposed to sub-lethal concentrations of Hostathion and Kitazin. However, under natural conditions, the realistic concentration and its effect may vary due to the multiplicity of factors and situations [9].

Organophosphorous pesticides are frequently used against pest because of their high insecticidal property, low mammalian toxicity, less persistence and rapid biodegradability [10]. These also affect non-target organisms either directly or indirectly. In rice land agroecosystem, all organisms including larvivorous fishes can be affected [11]. At lower concentrations, physiological functions including the larvivorous potential are affected and results of the present study indicate the same. Indiscriminate and prolonged use may lead to mortality and depletion of the fish population. Re-establishment of fish population takes a longer duration when compared to the mosquito population. Since vector mosquito control using larvivorous fishes is considered to be an environmental friendly and safe alternative to insecticides [12], judicious use of pesticides preserving the natural habitat of these fishes is important. Integrated pest management, biological and genetical control for agricultural pests will help in the preservation of the biotic communities in the rice land ecosystem. Further, there is a need to monitor ecotoxicity whenever larvivorous fishes are used as a biocontrol agent in vector mosquito control programmes.

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