Effect of bifenthrin on the toxicity and behaviour of *Heteropneustes fossilis*

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ABSTRACT

Present work deals with behavioural response and morphological deformities in the freshwater fish *Heteropneustes fossilis* caused by exposure to pyrethroid pesticide, bifenthrin at different sublethal concentrations *i.e.*, 0.0161 ppm, 0.0347 ppm and 0.0628 ppm. *Heteropneustes fossilis* in this medium exhibited restlessness, erratic movements, hyperactivity and loss of buoyancy and they started swimming at the surface of water. The response of the fish towards toxicity was dependent on concentration of bifenthrin and length of exposure.

Key words: *Heteropneustes fossilis*, pyrethroid, bifenthrin, sublethal and behavioural response.

INTRODUCTION

Pesticides have very important role both in agriculture and in hygiene. On the other hand they are dangerous for the environment, nature and for the human beings. It is an important group of environmental pollutants and many of which are reported as to be mutagenic (Sandhu *et al.*, 1985 and Waters *et al.*, 1982).

Bifenthrin is an insecticide used for the control of termites and borers in timber, insect pests in agricultural crops and turf, and for general pest control like spiders, ants, fleas, flies and mosquitos (Australian Pesticides and Veterinary Medicines Authority, 2008). A third generation synthetic pyrethroid, it has low water solubility but binds strongly to sediment and has a relatively long environmental persistence time. It is extremely toxic to terrestrial and aquatic insects, crustaceans and fish, disabling the central and peripheral nervous systems by interfering with the sodium channels (Johnson *et al.*, 2010). It is more toxic to aquatic than terrestrial organisms because it inhibits enzymes required for osmoregulation and the maintenance of ionic balances in an aquatic environment and is readily absorbed by gilled animals (Boyd *et al.*, 2002).

Fishes are excellent subject for study and monitoring of aquatic genotoxicity as they metabolize xenobiots and accumulate pollutants (Grisolia and Cordeiro, 2000). They can also respond to mutagens at low concentration of toxicants in manner similar to higher vertebrates (Goksoyr*et al.* 1991 and Al-Sabti and Metcalfe, 1995).

Behavior provides a unique perspective linking the physiology and ecology of an organism and its environment (Little and Brewer, 2001). Behavior allows an organism to adjust to external and internal stimuli in order to the best meet the challenge of surviving in a changing environment. Conversely, behavior is also the result of adaptations to environmental variables. Thus, behavior is a selective response that is constantly adapting through direct interaction with physical, chemical, social and physiological aspects of the environment.

Since behaviour is not a random process, but rather a highly structured and predictable sequence of activities designed to ensure maximal fitness and survival of the individuals of a species, behavioural endpoints serve as valuable tools to discern and evaluate effects of exposure to environmental stressors. Fish are able to uptake and retain different xenobiotics dissolved in water via active or passive processes. They can be used to detect and document pollutants released into their environment. Sublethal concentrations of pesticides in aquatic environments cause structural and functional changes in aquatic organisms and this is more common than mortality (Sancho *et al.*, 2003). Behavioural modification is one of the most sensitive indicators of environmental stress and many affect survival (Olla *et al.*, 1983 and Byrne and O'Halloran, 2001). Alterations in fish behavior, particularly in non-migratory species, can also provide important indices for ecosystem assessment. Any change in the behavior of fish indicates the deterioration of water quality, as fish are the biological indicator and hence index of environmental suitability and the cost of survival. Most physiological and environmental changes can induce variations in fish behavior (Israeli-Weinstein and Kimmel, 1998; Almazán-Rueda *et al.*, 2004).

Hence the present study was undertaken to evaluate the aquatic toxicity of bifenthrin with special emphasis on behavior of fresh water fish *Heteropneustes fossilis*.

MATERIAL AND METHOD

In the present study, specimens of fresh water fish *Heteropneustes fossilis* were collected from local water bodies. The fishes were acclimatized for one week under laboratory conditions. During the period of acclimatization the fishes were fed, after every 24 hours. The acclimatized healthy fishes showing normal activities were selected for chronic toxicity tests. After acclimation, the fishes were divided into experimental and control groups. The experimental groups of fishes were exposed to sub lethal concentration of bifenthrin for a period of 144 hrs. A group of ten healthy fishes of average weight (4 to 5 gm) and of average length (7.2 to 9.0 cm) were selected for the present study. After exposing the test fish to sub lethal concentrations of bifenthrin, the survival and behavior of test fish was studied for 30 days.

RESULTS

Effect of bifenthrin on the mortality of fish

The concentrations of 1.00 ppm, 0.75 ppm and 0.50 of bifenthrin were found to be lethal for *Hetropneustes fossilis* as 100% mortality was observed after 10 hours, 15 hours and 30 hours respectively (Table 1). When the fishes were exposed to the concentrations of 0.0161 ppm, 0.0347 ppm and 0.0628 ppm of bifenthrin, no mortality was observed even after 30 days of exposure.

Effect of bifenthrin on the behaviour of fish

Exposure to bifenthrin caused significant changes in the behaviour of *Heteropneustes fossilis.* When the fishes were transferred to the aquaria containing pesticides, they became restless, showed hyperactivity and erratic swimming.

At the beginning they stopped swimming and accumulated at the bottom but after some time they started swimming faster than the normal speed. They started frequent surfacing to get more and more oxygen. After some time, they started to lose their balance.

The colour of the skin was also changed due to exposure to these compounds. It was more faded in *Heteropneustes fossilis* after exposure, their skin colour became very light as the pigmentation in the skin decreased with increase in exposure period. Sometimes they stretched their body and tried to jump out of the aquarium. At higher concentrations ofbifenthrin the fishes became lethargic, their swimming became abnormal, their body was tilted, and they lost their balance.

Table 1: Mortality of *Heteropneustes fossilis* due to exposure to various concentrations of bifenthrin

No. of fishes exposed	Exposure period in days	Concentration of bifenthrin					
		1.0000 ppm	0.7500 ppm	0.5000 ppm	0.0161 ppm	0.0347 ppm	0.0628 ppm
06	01	All died after 10hours	All died after 15 hours	1 died / 5 alive	All alive	All alive	All alive
06	02	-	-	2 died / 4 alive	All alive	All alive	All alive
06	05	-	-	3 died / 3 alive	All alive	All alive	All alive
06	10	-	-	3 died / 3 alive	All alive	All alive	All alive
06	15	-	-	3 died / 3 alive	All alive	All alive	All alive
06	20	-	-	4 died / 2 alive	All alive	All alive	All alive
06	25	-	-	5 died / 1 alive	All alive	All alive	All alive
06	30	-	-	All died	All alive	All alive	All alive

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