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Pollutional Potency of the Insecticide, Bayrusil with Respect to Mortality and Behaviour of *Heteropneustes fossilis* (Bloch)

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ABSTRACT

The paper deals with the effect of an agro-chemical, Bayrusil on the mortality and behaviour of a catfish *Heteropneustes fossilis*. It was inferred from the experiment that 38.0 and 41.0 ppm of the insecticide represented LC_{50} and LC_{100} doses respectively showing acutely toxic nature of the pesticide. Some remarkable changes were also observed in the fish in pesticidal media, such as thrilling and bending of body, jerky movement, surfacing and gulping air, dashing against the wall of container, frequent jumping, loss of balance, muscular weakness and finally death.

INTRODUCTION

Since the second world war, with rapid industrialization, urbanization and better socio-economic conditions there has been a rise in human population in different parts of the world. Naturally, a large increase in consumption of different types of food materials has occurred. As a result to meet this ever-increasing demand of growing human population extensive use of pesticides, insecticides, herbicides, fungicides and other biocides in the crop-field has been made with a view to eradicate undesirable insects, pests and weeds for increased crop production. On the other land, these agro-chemicals reach aquatic environment in considerable amount via agricultural run-off, urban run-off, atmospheric fall-out and through rain and change the abiotic and biotic characteristics of the aquatic environment to a great extent. Hence, considerable magnitude of threat has been imposed to the aquatic biota, in general, and amongst them fishes, which form the staple food to mankind, are the worst victims (Sadhu 1984, Pauli & Money 2000, Alam 2005). Several authors have reported toxicity of different pesticides on fishes and other organisms. Among them mention may be made of Konar (1975), Choudhary et al. (1981), Kumar (2000), Alam (1989), Sadhu et al. (2003) and others.

In the present investigation an attempt has been made to study the effect of an organophosphate insecticide Bayrusil (Quinal phos 25% EC, a product of Bayer Crop Science Limited, Mumbai, India) on an air-breathing fish, *Heteropneustes fossilis* (Bloch).

MATERIALS AND METHODS

Healthy adult specimens of *Heteropneustes fossilis* were collected from local market and freshwater ponds and were brought to the laboratory. They were washed thoroughly with 0.1 % $KMnO_4$ solution to avoid dermal infection. The fish were allowed acclimatization for a period of 15 days and were fed with fresh fish food. The fish were subjected to different concentrations of the pesticide in varying time-periods. Observations were made for 96 hours and LC_{50}/96hr and LC_{100}/96hr doses of the pesticide were determined. A control experiment with same number of fish was set simultaneously without the toxicant to have a comparative idea. The behavioural responses and alterations in the opercular beat of the fishes in the toxic media were also observed.

The physico-chemical analysis of the diluent (plain water) and treated water forming LC_{50} dose was made in respect to certain factors like temperature, pH, dissolved oxygen (DO), free CO_2, total alkalinity, etc. as per standard procedure of APHA (1989).

RESULTS AND DISCUSSION

Experimental endeavour for allowing intoxication of the fish in the media contaminated with the agro-chemical Bayrusil, has shown the polluted nature of the pesticide in respect to occurrence of mortality of the test specimens and deterioration in the quality of water showing changes in some physico-chemical factors, and alterations in the behavioural pattern of the fish *H. fossilis*, showing the potentiality of the pesticide to affect the fish and consequently deprive the fish farmers of the fish wealth from inland water resources.

The results of acute bioassay test on mortality of fish are presented in Table 2. The LC_{50}/96 hr value of Bayrusil was found to be 38 ppm whereas 30 ppm and 41 ppm represented respectively LC_0 and LC_{100}/96 doses.

On giving consideration to the earlier records of investigations on the effects of indiscriminate use of pesticides and laboratory experiments on the determination of toxicity of the agro-chemicals to fishes, it appears that fishes are very much susceptible to such chemicals. In this respect the information given by Choudhary et al. (1981), Alam (2002), Alam & Sadhu (2001), Panigrahi & Mishra (1978), Piska et al. (1992), Pathak et al. (2007) and Soni & Gupta (2007) are quite useful. The toxicity of the pesticides also varies with species, weight, size, age and condition of test species along with dose and time of toxicant and other experimental factors, as similarly reported by Sprague (1969) and Gupta et al. (1981.)

On comparison of the various physico-chemical factors of the diluent with the contaminated water forming LC_{50} dose of the pesticide (Table 1), a significant level of change was found particularly in respect to temperature, pH, free CO_2, DO, total alkalinity, etc. All these changes were indicative of direct impact on the survival potency of the exposed fish, and a sign of the physical distress, as also reported by Belsare (1985), Sultan & Sharma (1990) and Nanda & Tiwari (1999).

In the present study impact of Bayrusil was also observed in the behavioural pattern of the fish, *H. fossilis*. At the start of the exposure, the fish were alert and stopped swimming and remained in position in response to sudden change in the surrounding environment. But after some time they became agitated and showed sign of restlessness. Pronounced aggressive behaviour was noted in fishes. The irregular and erratic movement and restlessness increased with increasing concentration and time of exposure duration. They repeatedly made upward and downward movement. They frequently tried to jump out of the toxic media. In the beginning faster opercular activity was observed as surfacing and gulping of air. The hypersensitivity was indicated by violent erratic and fast swimming and extreme irritability on slight mechanical disturbance. A large amount of mucous was secreted which made a thin cover

Table 1: Physico-chemical analysis of diluents (normal water) and treated water with LC_{50} dose of the pesticide, Bayrusil for *H. fossilis*.

Parameters	Diluent (Plain Water)	Treated Water (38 ppm media *)
Temperatuer,°C	23.0 ± 0.5	23.0 ± 0.5
Turbidity, ppm	8.0 ± 0.25	10 ± 0.5
pH	7.2 ± 0.01	7.0 ± 0.03
DO, mg/L	6.8 ± 0.15	5.2 ± 0.2
Free CO_2, mg/L	1.4 ± 0.04	3.2 ± 0.5
Tot. alkalinity, mg/L	50.1 ± 0.25	44.2 ± 0.1

* LC_{50} dose of Bayrusil.

Table 2: Mortality percentage of *Heteropneustes fossilis* (av. length 18-20 cm) in different concentrations of the pesticide, Bayrusil.

Concentration of pesticide (ppm)	No. of specimens	Mortality percentage				Remarks
		24 hr	48 hr	72 hr	96 hr	
30	100*	-	-	-	-	
32	100	-	-	-	2	
34	100	-	-	4	12	
36	100	3	8	15	24	
37	100	11	15	26	35	
38	100	22	30	41	50	LC_{50}
39	100	30	40	52	60	
40	100	45	55	65	80	
41	100	52	68	84	100	LC_{100}
42	100	87	100	100	100	
Control	10	-	-	-	-	

*Total number of test fish tested in 10 sets of experiments

over the body of the fish. The fish lost balance, consciousness and became lethargic. They settled to the bottom with their bellies turned upward and died.

The greatest sign of toxic effects in respect to behavioural changes was seen in the variation in opercular movement of the fish (Table 3). It was found that in the initial period of intoxication there was a gradual increase in ventilatory movement (opercular beat) but gradually the beat rate decreased as the exposure period increased.

The behavioural responses of the fish, *H. fossilis* when exposed to LC_{50} media of Bayrusil, was in general sense, similar to those observed by several research workers (Bakthavatsalam 1980, Choudhary et al. 1981, Mishra et al. 1998, Alam et al. 2003). The movement of the fish to the bottom of the tank following addition of Bayrusil clearly indicates the avoidance behaviour of the fish, which was reported by Pickering (1980) in fathead minnow. The decrease in opercular movement and corresponding increase in frequency of surfacing of fish clearly indicates adaptive shifts towards serial respiration and the fish tries to avoid contact with the pesticidal media through gill chamber (Karuppaswamy 2001). Some authors are of the opinion that the air-breathing fishes avoid waterborne toxins by towering gill ventilation (Kullakatolical & Karmer 1988, Mishra et al. 1996). Mucous secretion is a protective device of skin against toxicant damage and to avoid absorption of the toxicant by general body surface. This finding agrees with the earlier findings of Subathra & Karuppaswamy (2003) and Sivakumar et al. (2006).

Table 3: Changes in opercular movement of *Heteropneustes fossilis* exposed to LC_{50} concentration of Bayrusil.

Exposure Time-Period	Opercular beat/minute	% Change
Control	60	-
15 minutes	62	+ 3.33
30 minutes	65	+ 8.33
45 minutes	67	+ 11.66
1 hour	74	+ 23.33
5 hour	80	+ 33.33
12 hour	64	+ 6.66
24 hour	57	- 5.0
48 hour	54	- 10.0
72 hour	50	- 16.6
96 hour	48	- 20.0

Thus, it can be concluded from the present study that fishes are highly sensitive to the pesticides and their mortality rate is dose dependent. Bahavioural changes are very useful in assessing the pollutional status of the water bodies. So, it is suggested that necessary steps should be taken to prevent entry of these pesticides to fishery resources so as so save the fish wealth.

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