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Original Research Paper

Toxicity of Parathion to a Freshwater Fish, *Channa gachua* (Ham.)

Sanjay Kumar Raju, D. N. Sadhu and Md. Noor Alam*
Department of Zoology, St. Columba's College, Hazaribag, Jharkhand, India
Department of Zoology, Giridih College, Giridih-815 301, Jharkhand

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ABSTRACT

The present research work is oriented to find out toxic effects of an organophosphate insecticide, parathion on a freshwater fish, *Channa gachua*. By following standard procedures for toxicity determination, it was found that 34.0, 33.0, 32.0 and 31.0 ppm of the parathion formed 24 h, 48 h, 72 h and 96 hours LC_{50} doses, whereas LC_0 and LC_{100} doses were 21.0 and 35.0 ppm respectively showing toxic nature of the insecticide.

INTRODUCTION

Different industries like distilleries, cotton mills, tanneries, paper mills, jute mills, fertilizers plants and chemical plants pass out their effluents in adjoining rivers, ponds, ditches and other water resources. Apart from these, the run-off water from agricultural fields carries a lot of pesticides, herbicides, fungicides and weedicides. All these chemicals threaten the existence of flora and fauna and adversely affect the ecological balance leading to unwanted mortality of aquatic biota including fishes (Alam 2002, Sadhu 2004). Though, the survey of literature reveals that a lot of work has been carried out on various aspects of toxicity of different chemicals to fishes, there is little information on the toxicity of parathion. In the present study, an attempt has been made to assess the toxicity of an organophosphate insecticide, parathion on a freshwater air-breathing fish, *Channa gachua* (Ham).

MATERIALS AND METHODS

Live specimens of *Channa gachua* were procured from local fish market at Hazaribag, brought to the laboratory and washed with 0.1% $KMnO_4$ solution to avoid skin infection. The fish were acclimatized to the laboratory conditions for 15 days and fed daily with chopped goat liver and fish food.

The physico-chemical characteristics of the diluent (normal water) and treated water forming LC_{50} dose of the parathion were analysed as per standard procedures of APHA (1998). Parathion is a broad spectrum organophosphate pesticide (trade name, Alkron, Alleron, Thiophos) used against a variety of pests on a variety of crops including paddy.

The toxicity determination was carried out in round bottom glass jars. The fish in healthy condition and almost of same age group and average body weight of 42.0 ± 0.98 g were used in the experiment. The test technique employed was of Doundoroff et al. (1951) and Thakur et al. (1981). For estimating the degree of toxicity of parathion, a batch of 10 test fish were released at a time in each container. Experiments for each dose of the chemical were repeated ten times to get average figure of mortality from a sample test of 100 test specimens. A control experiment with 10 fish was set simultaneously without toxicant to have a comparative idea.

RESULTS AND DISCUSSION

The results of acute toxicity test with parathion as toxicant and *Channa gachua* as test specimen clearly show the toxic nature of the agrochemical, leading to alteration in the physico-chemical quality of water and occurrence of mortality of the test fish at varying rates. The mortality percentage of *Channa gachua* with the toxicant parathion is given in Table 1. The 96 hour LC_{50} value of parathion was found to be 31.0 ppm, whereas LC_0 and LC_{100} doses were 21.0 and 35.0 ppm respectively.

The study on pesticide impact deals, in general, with the reaction of a living organism in an aquatic environment and there is a generalized view that the toxicity of a chemical depends on species concerned, capacity of the individual sp. to detoxify the compound; factors like DO, free CO_2, pH, temperature, etc., and size, length and weight of the test species, as has been expressed by Alam (1998) and Srinivas et al. (1994). Susceptibility of the aquatic biota to other agrochemicals has been investigated by other workers like Basak & Konar (1973), Kumar & Reddy (1997) Marandi (2000) and Pathak et al. (2007) and others.

The behavioural response of the fish towards the toxicant was also investigated in the present study. As released in the toxic media, the fish showed abnormal behaviour. When exposed to higher concentrations, hyperexcitability, increased aerial excursion, and increased opercular movement were observed as immediate response of fish towards the toxicant. Fish were often seen swimming with jerky movements on the surface of water and tried to jump out of the container. The higher concentration of parathion exposure showed white wound patches on the skin surface at the side of the body. The fish tried to remain almost in vertical position perpendicular to the base of the container with the mouth facing upward. Finally, the fish lost balance, settled to bottom and died.

According to Murrihead-Thomas (1971), there is increasing realization that the effects of pesticides on the reaction of fish other than the easily observable mortality effects must be taken in to account in evaluating the complete ecological impact of a contaminating substance. Similar behavioural changes in fishes due to pesticidal pollution or other types of pollution have been studied by Khangarot & Somani (1980), Mishra et al. (1996) and Pandey et al. (1997). On analysing different factors involved in behavioural changes, it appears that immediately after facing the unfavourable toxic media, the test specimen have to exert maximum efforts but due to limitation of energy required and downward trend of opercular movement, the effort lasted for a limited period; finally meeting death end.

On analysing the physico-chemical characteristics of the normal water and treated water having received the agrochemical to cause 50 percent mortality of the tests fishes, a significant level of alteration was found particularly in respect to temperature, pH, DO, free CO2, etc. All these changes have been presented in Table 2. Water temperature is one of the most important factors in the environment of aquatic organisms and plays a vital role in determining their distribution, growth, reproduction, metabolism and behaviour. Several authors including Mohan Rao (1981), Khan (1981), Sharma & Mukherjee (1978) and Patel & Kaliwal (1983) have thrown light on the role of hydrological factors and have come to the conclusion that for normal growth of the fishes, not one factor is possible, rather several physico-chemical factors are involved to cause stress on the survivality of the fishes. Thus, it is concluded that the agrochemical parathion is toxic in nature and utmost care is needed while spraying it over the crop-fields so as to save the fishes and other aquatic biota of nearby water bodies.

Table 1: Mortality percentage of *Chana gachua* exposed to different concentrations of parathion.

Concentration (ppm)	No. of Specimens	Mortality percentage				Remarks
		24 hr	48 hr	72 hr	96 hr	
21	100*	-	-	-	-	
23	100*	-	-	-	2	
25	100*	-	1	2	4	
27	100*	2	4	6	10	
29	100*	10	15	20	30	
31	100*	20	35	40	50	LC_{50}**
32	100*	35	45	50	60	
33	100*	40	50	60	70	
34	100*	50	65	80	90	
35	100*	65	75	90	100	LC_{100}***
Control	10	-	-	-	-	

*Total number of test specimens tested in 10 sets of experiments; **Incipient LC_{50}/96 hr dose.
***Incipient LC_{100}/96 hr dose.

Table 2: Physico-chemical characteristics of the diluent (plain water) and LC_{50} dose of parathion.

Parameters	Diluent (plain water)	31.0 ppm media*
Odour	Odourless	Unpleasant
Temperature°C	25.0 ± 0.5	25.75 ± 0.15
pH	7.6 ± 0.1	7.2 ± 0.20
DO, mg/L	6.8 ± 0.12	4.25 ± 0.25
Free CO_2,mg/L	1.5 ± 0.10	3.70 ± 0.18
Total alkalinity, mg/L	51.0 ± 0.30	56.5 ± 0.15

*LC_{50} dose for *C. gachua*

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REFERENCES

Alam, M.N. 1988. Studies on toxicity of a pesticide Metacid 50 to the fingerlings of *C. mrigala*. The Indian Zoologist, 12(1&2): 45-47.

Alam, M.N. 2002. Toxicity of Kadett 36 to an air-breathing fish, *Clarias batrachuls* (L). Nat. Env. Pollut. Tech., 1(4): 427-430.

APHA 1998. Standard Methods for the Examination of Water and Wastewaters. American Public Health Association, Washington DC.

Basak P.K. and Konar, S.K. 1976. Pollution of water by pesticides and protection of fisheries. Parathion Proc. Nat. Acad. Se., India, 46B: 332-392.

Doudoroff, P., Anderson, B.G., Budrick, G.E., Gatsoff, P.S., Hart, W.B., Patrick, R., Strong, E.R. and Vanhorn, W.N. 1951. Bio-assay methods for the evaluation of acute toxicity of individual wastes to fish. Sewage Industrial Wastes, 23: 1380-1397.

Khan, R.A. 1981. Pollution of inland waters. Zoologiana, 4: 15-27.

Khangarot, B.S. and Somani, R.C. 1980. Mercury on the gills of freshwater teleost *Puntins sophore.* Curr. Sc., 49(21): 832-834.

Kumar, A.V. and Reddy, S.L.N. 1997. Haematological assessment of freshwater fish, *C. batrachus* exposed to endosulfan and cypermethrin. J. Aq. Biol., 12: 53-58.

Marandi, S. 2000. Effect of monocil on the ovary and pituitary of *L. guntea*. Ph.D. Thesis, V.B. University, Hazaribag.

Mishra, C.K., Hakim, A., Kumar, J. and Tiwari K.N. 1996. Toxic impact of two organophosphate pesticides on the fish *C. punctatus*. Behaviour and mortality studies. J. Freshwater Biol., 8: 39-45.

Mohan Rao, D. 1981. Toxicity of Carboryl to freshwater fish. Ph.D. Thesis, Nagarjuna University, Nagarjuna Sagar.

Murihead-Thomas, R.C. 1971. Pesticides and freshwater fauna. Academic Press, London and New York.

Pandey, A.K., George, K.C. and Peer Mohammed, M. 1997. Histopathological alterations in the gill and kidney of an estuarine mullet, *Lizaparsia* (Ham.) caused by sub-lethal exposure to lead. Ind. J. Fish, 44(2): 171-180.

Patel, H.S. and Kaliwal, M.B. 1983. Influence of cadmium, copper and zinc on oxygen consumption rate of a freshwater prawn *Macrobranchium* hander-sodyaum. Env. & Ecol., 1: 175-177.

Pathak, Renu, Sadhu, D.N., Alam, M.N. and Sadhu S. 2007. Toxicity of pesticide cartriz to fish *Channa punctatus*. Env. & Ecol., 255(2): 369-372.

Sadhu, Sukant 2004. Studies on toxicity and histopathological effects of an agricultural pesticide on some vital organs of an air-breathing fish. Ph.D. Thesis, V.B. University, Hazaribagh.

Sharma, N. and Mukherjee, A.P. 1978. An examination of environmental factors for the cause of summer fish kill in a tank near Allahabad. Curr. Sci., 47(11): 389-391.

Srinivas, S.D., Jelyasulresh, B., Edwin, S. and Dwarkanath, S.K. 1994. The behavioural responses of *Gambusia attinis* in relation to leaf extracts of *Azadirachta indica*. Ecotoxicol. Evnir. Monit., 4(1): 75-76.

Thakur, G.K., Choudhary, B.P., Pathak P., Thakur, P.K., and Choudhary, M.N. 1981. Effect of BHC on an air-breathing fish *C. batrachlus*. J. Adv. Zool., 2: 80-85.