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Research Article

STUDY OF ORGANOPHOSPHATE INSECTICIDE MONOCROTOPHOS INDUCED TOXICITY ON MOZAMBIQUE TILAPIA (*OREOCHROMIS MOSSAMBICUS*)

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ABSTRACT

This study attempts to determine the 96-h LC_{50} of organophosphorous insecticide Monocrotophos, which is extensively used in agricultural farms. Fish species, Mozambique tilapia (*Oreochromis mossambicus*) were selected for the bioassay experiments. Data obtained from the toxicity tests were evaluated using the probit analysis and the 96-h LC_{50} value was calculated as 360µl/l. The abnormal behaviours were observed in the lethal concentrations exposed tilapia than control.

Keywords: Monocrotophos, LC_{50}, *Oreochromis mossambicus*, Toxicity, Acute.

INTRODUCTION

Fishery is an important source of protein food and employment generation throughout the world (Allison, 2001). Growing human population affects the aquatic ecosystems and ultimately to fisheries due to depredating water quality. The constant flow of agricultural effluent into the water bodies often leads to a variety of pollutant accumulation. The organophosphate pesticides used in agricultural crops is highly toxic to the aquatic biota (Sreenivasan and Swaminathan, 1967). Extensive use of organ phosphorus chemicals pollutes the aquatic ecosystems, which alters metabolic and physiological activities of fauna and ultimately changes biochemical constituents of fish (Anon, 1975). LC_{50} is commonly used test to approach the toxicity measure of the potential risk of a chemical (Jach de Bruijin *et al.*, 1991). Monocrotophos is an organophosphate insecticide which is widely used to control various insects in the paddy fields of district Jabalpur, M.P. in India. Monocrotophos has neurotoxic property as it inactivates the enzyme acetyl cholinesterase which is an indispensable player for the conduction of nerve impulse. Many studies have been conducted to assess the effect of organophosphate chemicals on different species of fishes (Paul and Pant, 1987; Maheswari *et al.*, 1988, Gopalakrishnan, 1990 and Ganguly *et al.*, 1997). However, very few studies have been carried on the effect of Monocrotophos on fishes (Sulekha *et al.*, 1999). Similarly, the effect of insecticide Monocrotophos on *Oreochromis mossambicus*has rarely been scrutinized. The present study deals with the effect of different concentration of Monocrotophos on *O. mossambicus*.

MATERIAL AND METHODS

Healthy *O. mossambicus*, weight ranging from 2.3-5.9gms were obtained from local pond namely Supatal, Jabalpur. Prior to the experiment, fish were conditioned for 2 weeks in de-chlorinated water of 30-50l glass aquaria under laboratory conditions. The water temperature, pH and dissolved oxygen of the experimental water and Monocrotophos concentration in the experiments are given in table 1. A total of eight fishes were treated in each of the eight aquaria with continuous aeration maintained by electric air pumping compressor and the fish were fed once a day with pellets of wheat flour during this conditioning

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period. The feeding was stopped 2 days before the initiation of the experiment. The temperature, pH and dissolved oxygen of the aquaria were monitored on daily basis throughout the experiment. The acute toxicity test was performed for 4 days with a replicate of seven different concentrations (320, 330, 340, 350, 360, 370 and 400 µl/l) at 24, 48, 72, and 96 hours. Dead fishes were counted at different concentrations along with the control group and dead individuals were removed immediately, and behavioural changes were observed closely. The fish in control group was kept in normal water without being subjected to any toxic compound.

The insecticide used was Monocrotophos 36% from the Dhanuka Agritech limited India. In this study the data of toxicity for Monocrotophos upon the *O. mossambicus* were evaluated using probit analysis technique (Finney, 1952) for determining LC_{50} values (Table 2 and Table 3). Also the logarithm of Monocrotophos concentrations against the empirical probit values of the mortality of *O. mossambicus* individuals is given (Figure 1).

Table 1. The water temperature, pH and dissolved oxygen values of each aquarium used in the toxicity experiments of Monocrotophos upon *Oreochromis mossambicus.*

Concentration µl/l	Temperature ºC	pH	Dissolved oxygen mg/l
320	23.4	8.32	8.2
330	23.9	8.65	8.1
340	22.5	8.28	8.3
350	23.0	8.22	8.2
360	22.6	8.12	7.7
370	21.4	8.78	7.9
400	21.0	8.77	7.6

RESULTS

The calculated 96 h Lc_{50} value of organophosphate insecticide Monocrotophos to *O. mossambicus* (3.320-7.531 gms) was 360 µl/l. The result shows that Monocrotophos is highly toxic to *O. mossambicus.* Observations of behavioural response of tilapia were conducted after every 12 h during the acute toxicity tests. The control group showed normal behaviour during the test period. After dosing with 400 µl/l (highest), fishes exhibit fast swimming and perpendicular or upside down swimming patterns and started turned around their vertical axis and tried to gulp air from the water surface. After 4 hrs, fishes were constantly swimming sideways and lost balance. First mortality was recorded at 24 hrs. After 96 hrs all fishes died eventually. In 360 µl/l, the fishes were swimming sideways, shaking their head and had a spiral twist in the tail region and the four mortalities were recorded after 96 h out of eight fishes. The highest mortality was recorded at 400 µl/l and the lowest was recorded at 320 µl/l (Table 2).

The 96 h LC_{50} value of Monocrotophos in *O. mossambicus* were found to be 360 µl/l in which four fishes died out of eight fishes.

Table 2. The mortality rate of *Oreochromis mossambicus* individuals in 96 hr at different concentrations of Monocrotophos.

Con. µl/l	log dose	24hrs	48hrs	72hrs	96hrs	Total
Control	0	0	0	0	0	0
320	2.50515	0	0	0	0	0
330	2.518514	0	0	0	1	1
340	2.531479	0	0	1	1	2
350	2.544068	0	1	1	1	3
360	2.556303	1	1	1	1	4
370	2.568202	1	1	2	2	6
400	2.60206	2	2	1	3	8

Table 3. Mortality and empirical probit values for the concentration of Monocrotophos.

Con. µl/l	log dose	Mortality	Percentage	Probit
320	2.50515	-	-	-
330	2.518514	1	12.50	3.82
340	2.531479	2	25.00	4.33
350	2.544068	3	37.50	4.67
360	2.556303	4	50.00	5.00
370	2.568202	6	75.00	5.67
400	2.60206	8	100.00	8.09

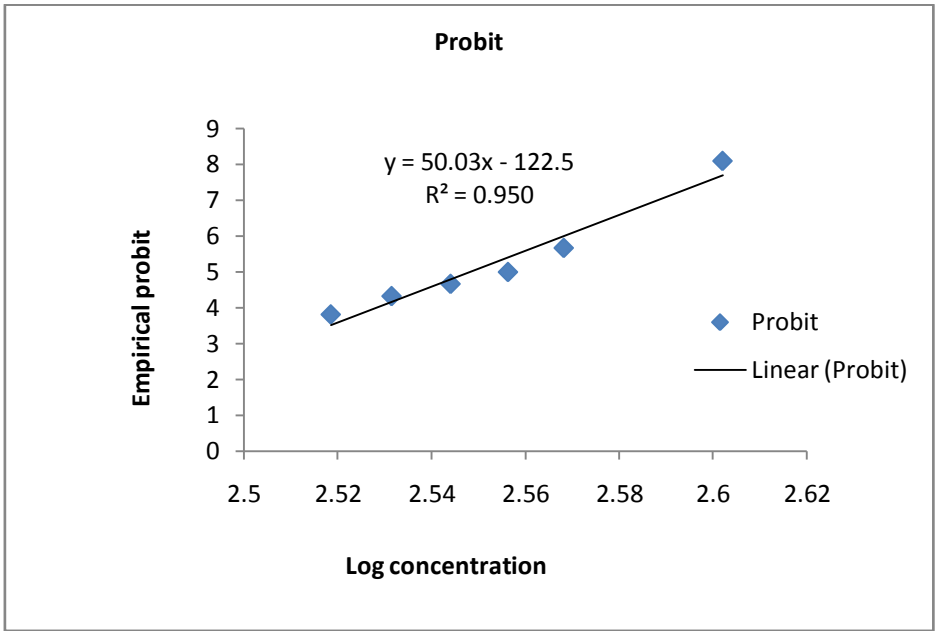

Figure 1. The logarithm of Monocrotophos concentration against the empirical probit values of the mortality of *Oreochromis* mossambicus individuals.

DISCUSSION

The study was executed to assess the toxicity of Monocrotophos and the lethal median concentration (LC_{50}) of *O. mossambicus.* Fish being a very sensitive tool, is employed for monitoring the behavioural patterns at lethal and sub lethal concentrations of Monocrotophos on the fish *O. mossambicus.* The calculated LC_{50} value of Monocrotophos was evaluated as 360 µl/l by using Finney's probit method and the observations of behavioural responses were conducted during the course of experiment. After dosing with 360 µl/l, the fishes were swimming sideways, shaking their head and had a spiral twist in the tail region. Halappa and David (2009) observed the Carp exposed to chlorpyrifos exhibited disrupted schooling behaviour, migrating to the bottom of test chamber, moving to the corners of the test chamber. Such acts were considered as avoidance behaviour of the fish to Chlorpyrifos. Monorcrotophos is well known for its bioaccumulation and neurotoxic property, because it acts on the enzyme acetyl cholinesterase which is a neurotransmitter. After 4 hrs, fishes exhibit abnormal behaviours like gulping of air restlessness, loss of equilibrium. Santhakumar and Bajaj (2000) found similar results in *Anabas testudineus* on exposure to Monocrotophos like decrease in opercular movements, loss of equilibrium, increase in surfacing behaviour, change in body colour, increase in mucus secretion all over the body and irregular swimming activity. Andre Luis da Cruz (2002) reported that the effect of Monocrotophos on aggressive behaviour may have important ecological consequences. Ladipo *et al.,* (2011) observed similar kind of changes in the Paraquat treated fish, exhibiting abnormal behaviours like incessant jumping and gulping of air, restlessness, loss of equilibrium, increased opercular activities, up down, sudden movement and resting at the bottom. Behavioural characteristics are obviously sensitive indicators of toxicant effect. However, it becomes necessary to select behavioural patterns for monitoring of

the relationship of organism and the environment to derive a more accurate assessment of the hazards that a contaminant may induced in natural system. At elevated concentration of Monocrotophos, fishes exhibit fast swimming, decline in opercular movement and loss of appetite. Similar results were observed by Sajad *et al*., (2014) and they revealed that the lethal concentration of Rogorin altered behavioural responses such as restlessness, hyperactivity and sometimes jerky swimming, decline in opercular movement, frequent surfacing and gulping, avoidance behaviour, loss of appetite, discoloration of skin and increase and accumulation of mucus on gills so also on the body.

CONCLUSION

In the present study, as evidenced by the results, the abnormal behaviours in the fish exposed to lethal concentration of Monocrotophos are time and concentration dependent. Although LC_{50} values of organophosphate insecticide on fish has been reported by several authors, but a very few detailed information is available on the aquatic toxicity of Monocrotophos on the early life stages of *O. mossambicus.* Therefore, the use of organophosphate pesticides should be least used or alternate inorganic compounds should replace the use of Monocrotophos.

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