

## EFFECT OF HARDNESS OF WATER ON THE ACUTE TOXICITY OF DIMETHOATE TO *PUNTIUS TICTO* (HAM.)

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Short term toxicity tests were made against fish *Puntius ticto* a freshwater teleost to dimethoate, in relation to study the effect of hardness of water on toxicity of dimethoate pesticide. The mortality rate were recorded under different hardness. The LC<sub>50</sub> values of dimethoate for 24, 48, 72 and 96 hrs were obtained as 6.839, 5.555, 5.070, 5.012 ppm under normal conditions in laboratory. Hardness of water plays an important role in the toxicity of pesticide. The LC<sub>50</sub> value at 100 ppm and 200 ppm hardness are 4.519 and 5.433, respectively. These values show that the dimethoate toxicity increases with decrease in hardness of water.

### INTRODUCTION

The pesticide are one of the tools for achieving goal of green revolution and play an important role in improving the yield of various crops throughout the world hence they are widely used. Though pesticides play a vital role in controlling the crop pests, it also results in pesticidal pollution of aquatic environment especially inland water bodies. Water pollution is caused by certain substances called pollutants. The entry of pollutants in the aquatic environment causes several changes in the abiotic and biotic factors of water ecosystems. In this context, it is necessary to study in detail the short term or acute effects of pesticides on fishes.

The acute toxicity is useful in determining a sensitive species that can be an indicator species for a particular type of pollution. It also helps in establishing a warning system of acute toxicity and tool for the logical assessment of toxicity amongst various biological systems. The toxicity is governed by variety of environmental factors *i.e.* pH, water hardness and salinity. Among these environmental factors water hardness plays an important role in the toxicity of pesticide to aquatic life specially the commercially important fishes. The hardness of water and pesticide concentration shows a significant influence on the mortality of the fish.

Extensive studies have been made on the acute toxicity of pesticide during the last few decades by a number of workers. Surber & Pickering (1962) studied the toxicity of five herbicides in soft and hardwater. The effect of carbonates and organophosphorus pesticide was studied by Pickering & Henderson (1966) and found two instances where significant differences of toxicity in soft and hardwater was observed. Rashatwar (1981), Kamble (1983), Sonwane & Nikam (1995) also studied the effect of hardness of water in pesticide toxicity.

In India many workers have made important contribution towards the water pollution and its effect on the fish fauna (Hora, 1942; Arunachalam *et al.*, 1980; Yoganabano *et al.*, 1981; Golow & Godzi, 1994; Rao & Mishra, 1998) but very less work has been done on effects of physical factors on toxicity of pesticides. In the present study an attempt has been made on the effect of hardness of water on acute toxicity of dimethoate to freshwater teleost *P. ticto*.

### MATERIALS AND METHODS

The test fish *P. ticto* was selected for the present investigation because of its easy availability

moderate sensitivity and easy maintenance in the laboratory. The test fish were collected in live condition from freshwater resources from around Aurangabad and brought to laboratory avoiding mechanical injuries. The fish were acclimatized to laboratory conditions for four weeks prior being used for test. During this period the fishes were fed thrice a week on live food containing earthworms. Filtered and aged water was used to maintain the fish. The fishes selected for the test ranged from 4200 to 4620 mg in weight and 57-62 mm in length.

For the selection of test concentration some pilot tests were carried out as it is essential to determine the range of toxicity of a particular pesticide. The range of concentration selected was such that it resulted in zero to hundred percent mortality. In order to maintain the level of the toxicant in the water, water was changed at every 24 hr during the short term exposure.

On the basis of results of pilot test series of different concentrations were prepared and five healthy females of uniform size and weight were exposed to various concentration for 96 hr. The effect of total hardness as CaCO<sub>3</sub> of water at 100 ppm shown in Table I and 200 ppm in Table II and they were correlated with the results of toxicity test with dimethoate under normal laboratory conditions as shown in Table III.

**Table I :** Effect of total hardness in different concentrations on different parameters.

Parameters	100 ppm	200 ppm	Normal lab. condition
Temperature (°C)	26°C (24-28°C)	26°C (24-28°C)	26°C (24-28°C)
Conductivity	0.71 m MHO	0.69 m MHO	0.73 m MHO
Acidity	2.0 (1.7-2.5) ppm	2.1 (1.7-2.5) ppm	3.6 (3.2-4.3) ppm
Alkalinity	36 (29.5-37.5) ppm	39.2 (29.5-37.5) ppm	29 (27-31) ppm
Total hardness	100 (99.5-101.5) ppm	200 (99.5-101.5) ppm	71 (68-79) ppm
Dissolved oxygen	5.9 (5.7-6.4)	6.1 (5.9-6.5)	6.6 (6.2-6.9)
PH	7.6 (7.3-7.9)	7.9 (7.5-8.3)	7.4 (7.2-7.7)
Weight of Fish	44.00 mg (4200-4620)	4410 mg (4250-4620)	4325 mg (3925-4625)
Length of Fish	59.0 mm (57-62)	59 mm (57-63)	63 mm (56-67)

## RESULTS AND DISCUSSION

The study of tolerance of the fish to different hardness of water along with dimethoate pesticide is essential as the fish is a freshwater animal. The fishes were exposed to 100 ppm and 200 ppm hardness of water with different concentration of dimethoate. The 96 hr LC<sub>50</sub> values at 100 ppm and 200 ppm are 4.519 and 5.433 ppm, respectively (Table III). The result shows that survival rate of fishes was higher at higher concentrations in 200 ppm and survival was decreased in the lower concentrations i.e at 100 ppm hardness.

Thus the results obtained revealed that the toxicity of dimethoate pesticide is higher at 100 ppm than at 200 ppm hardness of water.

Surber & Pickering (1962) examined the toxicity of five different herbicides to three species of fish in soft and hardwater. Diquat was more toxic to blue gill and fathead minnows in soft than hardwater. Endothal was slightly more toxic to fathead minnow in soft water but blue gill showed little difference. Calamari *et al.* (1980) reported the influence of water hardness on cadmium toxicity to *Salmo gairdneri* is increased by reduction in water hardness. Deoray (1993) studied the effect of hardness on toxicity of mercuric chloride and copper chloride to *Channa gachua* and observed that toxicity increased with increase in hardness.

**Table II :** Toxicity test with dimethoate in *P. ticto*.

S. No.	Conc. (ppm)	Survival and mortality							
		24hr		48 hr		72 hr		96 hr	
		S	M	S	M	S	M	S	M
100 ppm									
1.	3.6	100	00	100	00	100	00	80	20
2.	4.2	100	00	100	00	80	20	60	40
3.	4.8	80	20	60	40	60	40	40	60
4.	5.4	60	40	60	40	60	40	20	80
5.	6.0	60	40	40	60	40	60	20	80
6.	6.6	40	60	40	60	20	80	00	100
7.	7.2	40	60	20	80	20	100	-	-
8.	7.8	20	80	00	100	-	-	-	-
9.	8.4	00	100	-	-	-	-	-	-
10.	9.0	00	-	-	-	-	-	-	-
200 ppm									
1.	3.9	100	00	100	00	100	00	100	00
2.	4.5	100	00	100	00	80	20	80	20
3.	5.1	80	20	80	20	60	40	60	40
4.	5.7	80	20	60	40	60	40	40	60
5.	6.3	60	40	40	60	20	80	20	80
6.	6.9	60	40	40	60	20	80	20	80
7.	7.5	40	60	20	80	20	80	00	100
8.	8.1	40	60	20	80	00	100	-	-
9	8.7	20	80	00	100	-	-	-	-
10.	9.3	00	100	-	-	-	-	-	-
Normal Laboratory Conditions									
1.	3.6	100	00	100	00	100	00	100	00
2.	4.2	100	00	100	00	80	20	80	20
3.	4.8	80	20	80	20	60	40	60	40
4.	5.4	80	20	60	40	40	60	40	60
5.	6.0	60	40	40	60	40	60	20	80
6.	6.6	60	40	40	60	40	60	20	80
7.	7.2	40	60	40	60	20	80	00	100
8.	7.8	20	80	20	80	-	100	-	-
9.	8.4	20	80	00	100	-	-	-	-
10.	9.0	20	80	00	-	-	-	-	-
11.	9.6	00	100	-	-	-	-	-	-

S = Survival; M = Mortality

**Table III :** Toxicity of dimethoate in hardness of water and survival rate of *P. ticto*.

S. No.	Conc (ppm)	LC <sub>50</sub>			
		24 hr	48 hr	72 hr	96 hr
1.	100	6.0592	5.689	5.012	4.516
2.	200	7.499	6.095	6.026	5.433
3.	300	6.839	5.555	5.070	5.012



Rashatwar (1981) observed similar results in *N. denisonii* with dimecron and baseline toxicity at 100 ppm and 200 ppm water hardness. Kamble (1983) observed similar results in *L. thermalis* during BHC and sumithion toxicity studies.

In present study the effect of dimethoate on *P. ticto* at 100 ppm hardness and 200 ppm shows that the survival rate of fishes increased with increase in water hardness. Similar results were observed by Khillare & Davane (1987 & 1992) in *Barbus stigma* to endosulfan, sevin and malathion. Sonwane & Nikam (1995) observed in *L. thermalis* that the survival rate of fishes was increased at higher concentration of BHC in higher hardness i.e. 200 ppm hardness of water than 100 ppm. Thus from the results it can be concluded that the toxicity to dimethoate decreases with increase in hardness of water.

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### REFERENCES

- ARUNACHALAM, S.K., JAILAKSHMI & ABOOBAKAR, S.A. 1980. Toxic and sublethal effects of carbaryl on a freshwater cat fish *Mystus vittatus* (Bloch.). *Arch. Environ. Contam. Toxicol.* **9** : 307-316.
- CALAMARI, D., MARCHETTI, R. & VAILATI, G. 1980. Influence of water hardness on cadmium toxicity to *Salmo gairdneri* (Rich.). *Water Res.* **14** : 1421-1426.
- DEORAY, S.V. 1993. Biology of fresh water fish in relation to pollution. *Ph.D. Thesis, Dr. B.A. Marathwada University, Aurangabad, India.*
- GOLOW, A.A. & GODZI, T.A. 1994. Acute toxicity of deltamethrin and dieldrin to *Oreochromis niloticus* (Linn.). *Bull. Environ. Contam. Toxicol.* **52**(3) : 351-354.
- HOAR, W.J. 1942. Short note on the pollution of stream in India and its likely effects on fisheries resources. C.T. Hoster Jr. *Bull. Environ. Contam. Toxicol.* **12** : 599.
- KAMBLE, S.B. 1983. Effect of pesticide on freshwater fish *Lepidocephalichthys thermalis* (C. & V.) from Marathwada region. *Ph.D. Thesis, Dr. B.A. Marathwada University, Aurangabad, India.*
- KHILLARE, Y.K. & DAVANE, P.M. 1987-1992. Pesticide toxicity in fish *Barbus stigma* (Ham.). *Marathwada Univ. J. Sci.* **26**(19) : 76-81.
- RAO, D.V.P. & MISHRA, K.P. 1998. Acute toxicity of LABS containing detergent shudh to juvenile (fingerling) stage of Indian major carp *Labeo rohita*. *Indian J. Environ. Sci.* **2**(2) : 119-124.
- RASHATWAR, S.S. 1981. Effect of pesticide on fishes of Maharashtra state. *Ph. D. Thesis, Dr. B.A. Marathwada University, Aurangabad, India.*
- SONAWANE, S.R. & NIKAM, S.R. 1995. Effect of hardness of water on the acute toxicity to benzene hexachloride to *Lepidocephalichthys thermalis*. *J. Aqua. Bull.* **13**(1) : 110-112.
- SURBER, L.W. & PICKERING, Q.H. 1962. Acute toxicity of endosulfan, diquat, dalapon and silvex to fish *Taros*. *Amer. Fish Soc.* **91** : 175.
- YOGANABANO., SHAIKH, A.A. & HAMEED, T. 1981. Effect of sublethal concentration of DDT on muscles constituents of an air breathing cat fish *Clarias batrachus*. *Proc. Indian Acad. Sci.* **90**(1) : 33-37.