

# A Comparative Study on the Toxicity of a Synthetic Pesticide, Dichlorvos and a Neem based Pesticide, Neem-On to *Labeo rohita* (Hamilton)

BILAL AHMAD BHAT<sup>1\*</sup>, IMTIYAZ AHMAD BHAT<sup>1</sup>,  
SANTOSH VISHWAKARMA<sup>1</sup>, ALOK VERMA<sup>2</sup> and GEETA SAXENA<sup>1</sup>

<sup>1</sup>Department of Zoology, Govt. Science and Commerce College Benazir, Bhopal - 462 008 (India).

<sup>2</sup>Department of Zoology, Govt. College Lateri vidisha - 464 114 (India).

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## ABSTRACT

Fish and other organisms are affected by pesticides which pollute the natural water through agricultural runoff. Fishes are common bioindicators of water pollution. In the present study bioassay of synthetic pesticide, Dichlorvos and a plant origin natural pesticide, Neem-On was separately done on *Labeo rohita*. Data obtained from the toxicity tests were evaluated using the Probit Analysis Statistical Method. The 96h LC<sub>50</sub> of Dichlorvos and Neem-On was found to be 16.71ppm, 42.66ppm respectively. The fish exhibited erratic swimming, copious mucus secretion, loss of equilibrium and hitting to the walls of test tank prior to mortality. In this study, Neem-On was less toxic to fish as compared to Dichlorvos. Plant based pesticides are biodegradable and are target specific than the highly persistent broad spectrum synthetic chemicals. Therefore, use of plant based pesticides is less disastrous and more ecofriendly.

**Key words:** Dichlorvos, Neem-On, *Labeo rohita*, Toxicity, 96h LC<sub>50</sub>

## INTRODUCTION

Increased used of pesticide results in the excess inflow of toxic chemicals, mainly in to the aquatic ecosystem (Baskaran *et al.*, 1989; Kalavanthy *et al.*, 2001). The aquatic environment is currently under threat by the indiscriminate use of synthetic pesticides by the human activities and causing high risk to non-target organisms (Kumar *et al.*, 2010). Among different classes of pesticides, organophosphates are more frequently used, because of their high insecticidal property, low mammalian toxicity, less persistence and rapid biodegradability in the environment (Singh *et al.*, 2010). Dichlorvos is recommended for application as a high or a low volume spray on crops such as paddy, wheat, soyabean, apple, sugarcane, mustard, sunflower and cashew. The Environment Protection Agency (EPA) has classified dichlorvos as toxicity class 1 highly toxic (URL: 1). Several species of fish are susceptible to deleterious effects

when exposed to heavy metals, pesticides and other environmental stressors (Khangrat *et al.*, 1988; Areechon and Plump, 1990).

To overcome the hazardous effects of these organic pesticides, recent emphasis is on the use of natural pesticides, which are usually of plant origin. Some plants contain compounds of various classes that have insecticidal, piscicidal and molluscicidal properties. Unlike synthetic chemical pesticides, which leave harmful residues in the aquatic environment (Koesomadinata, 1980; Cagauan, 1990; Cagaun and Arce, 1992) botanical insecticides are believed to be more environmentally friendlier because they are easily biodegraded and leave no residues in the environment. Azadirachtin derived from neem (*Azadirachta indica* A. Juss) is a very effective and extensively used pesticide. Pesticides based on azadirachtin may have direct adverse effects on aquatic organisms and their toxicity depends on

various factors. It has been reported that neem extracts in aquatic environments are lethal to benthic populations and drastically decrease the number of organisms in the food web and nutrient cycling process (Goktepe *et al.*, 2002; El-Shazly *et al.*, 2000). Pesticides containing bioactive compounds from the neem plant, *Azadirachta indica* Juss are reported to be target specific and comparatively less toxic.

However little work has been done on the toxic effect of neem based pesticides on fish. It is possible to substitute organic pesticides with the pesticides of plant origin. Hence the present study was carried out to evaluate the comparative effect of organophosphate pesticide Dichlorvos and neembased pesticide Neem-On to *Labeo rohita* (Ham.).

#### MATERIAL AND METHODS

Healthy and active adult *Labeo rohita* were obtained from Patra fish farm barkhedi Bhopal (M.P). They weighed  $55g \pm 1g$  and their length was in the range  $15cm \pm 1$ . They were brought to laboratory carefully in oxygen filled polythene bags in cardboard boxes to avoid any injury and disinfected by giving a bath for five minutes in  $KMnO_4$  solution. Thereafter, they were transferred to glass aquariums filled with dechlorinated water. The fishes were acclimated to the laboratory conditions for at least 20 days prior to the experiment. During acclimatization fishes were fed daily with commercial fish food which was given at morning hours. Water was replaced every 24h after feeding in order to maintain a healthy environment for the fish during acclimation and experimental period.

This ensures sufficient oxygen supply for the fish and the environment is devoid of any accumulated metabolic wastes. Dead fishes when ever located were removed immediately to avoid fouling of the water.

Water quality characteristics were determined and maintained. Nuvan (dichlorvos 76% EC) manufactured by Syngenta India ltd. 14, J. Tata road, Mumbai and Neem-On Manufactured by Jai Kissan Agro Pvt. Ltd., Sangam nagar, Indore, (M.P) purchased from local market were used for evaluation of their toxicity to fish. . For determining  $LC_{50}$  concentration different stock solutions were prepared, separate glass aquariums were taken and different concentrations of Dichlorvos and Neem-on were added from the stock solution. Simultaneously a control set was run with the experiment. During assay no food was administered to fishes. The  $LC_{50}$  concentration for 96h was calculated by probit analysis method of Finney's (1971). The control, Neem-On and Dichlorvos exposed fish were kept under continuous observation during experimental periods.

#### RESULTS

The 96h  $LC_{50}$  value of Dichlorvos and Neem-On was found to be 16.71ppm and 42.66ppm respectively. The  $LC_{50}$  concentration for 96h was calculated by probit analysis method of Finney's (1971). Table 1 and 2 shows the relation between the Dichlorvos, Neem-On concentration and the mortality rate of *Labeo rohita* and the graphs below show the plot of Finney's probits against  $\log_{10}$  conc. for calculating  $LC_{50}$  value of both the pesticides.

Table 1: For Dichlorvos

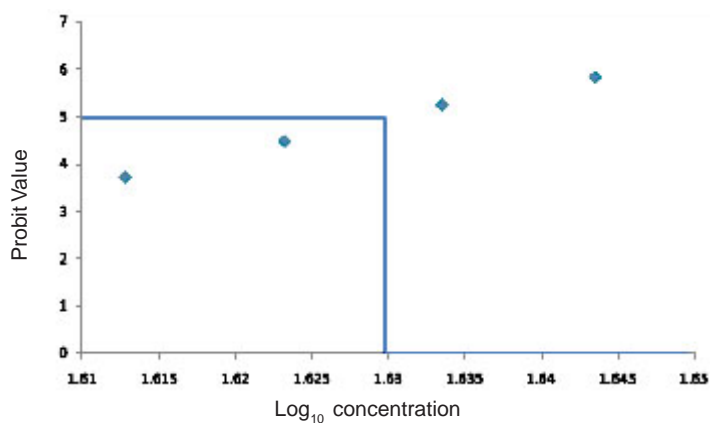
Conc.(mg/L)	Log10Conc.	Total No.	No. Dead	%Mortality	Probit.
14	1.1461	10	0	0%	-
15	1.1761	10	16	10%	3.72
16	1.2041	10	3	30%	4.48
17	1.2304	10	6	60%	5.25
18	1.2553	10	8	80%	5.84
19	1.2788	10	10	100 %	-

Table 2: For Neem-on

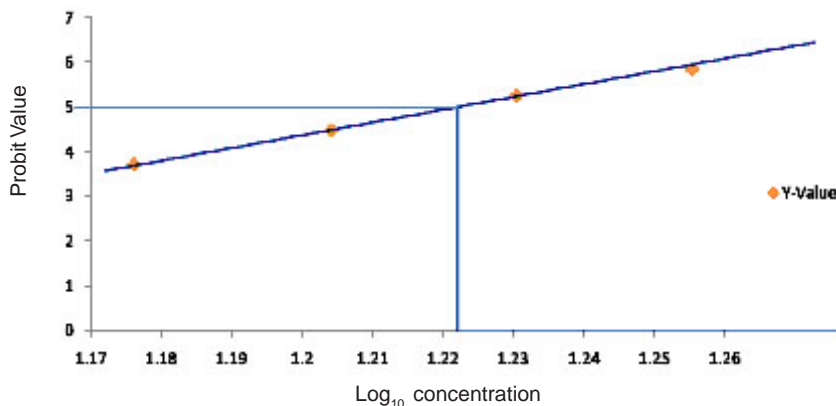
Conc.(mg/L)	Log10Conc.	Total No.	No. Dead	%Mortality	Probit.
Control		10	0	0	-
40	1.6021	10	0	0	-
41	1.6128	10	1	10	3.72
42	1.6232	10	3	30	4.48
43	1.6335	10	6	60	5.25
44	1.6435	10	8	80	5.84
45	1.6532	10	10	100	-

After exposure of both the pesticides, the *Labeo rohita* showed behavioral changes, they aggregated at one corner of aquarium, irregular, erratic and darting swimming movements and loss of equilibrium. They slowly became lethargic, hyper excited, restless and secreted excess mucus all over their bodies. The fish exhibited peculiar behavior of trying to leap out from the pesticide

medium which can be viewed as an escaping phenomenon. They often spiral rolled at intervals and finally the fishes sank to bottom with their least operculum movements and died with their mouth opened. However, the behavioral changes were more prominent for the synthetic pesticide Dichlorvos as compared to Neem-on.



Graph of Neem-0n



Graph of Dichlorvos

## DISCUSSION

Newer biological pesticides are developed to replace deleterious chemical pesticides. Even though chemical pesticides are target specific and effective, their impact on the environment is mostly deleterious. Plant based pesticides contain active principles with low half-life period and their effects on the environment are not too detrimental (Sharma *et al.*, 1995). In the present study, the pesticide containing azadirachtin is less toxic to fish compared to Dichlorvos. The 96h LC<sub>50</sub> of Dichlorvos is 16.71 ppm. Whereas azadirachtin is much higher 42.66ppm indicating the less toxic nature of the plant based pesticide. Das *et al.*, 2002 have studied the acute toxicity of neem in the fingerlings of Indian major carps i.e., *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* and the 96h LC<sub>50</sub> values were found to be 2.36, 2.04 and 2.78ppm respectively. Hassanein *et al.*, 2007 reported the 96h LC<sub>50</sub> value of a neem biopesticide (Triology) on the grass carp fish, *Ctenopharyngodon idella* and was found to be 112ppm. Cagauan *et al.* (2004) showed that the lethal concentration of neem to Nile tilapia *Oreochromis niloticus* L. was 12.4 ml/L and mosquito fish *Gambusia affinis* Baird and Girard was 8.31 ml/L and the corresponding 96 h LC<sub>50</sub> values were 2.57 and 3.0 ml/L ). The LC<sub>50</sub> values of Dichlorvos has been reported by various workers as in *Cyprinus carpio* 6gm it was 0.34ppm for 96h (Verma *et al.*, 1981) in *Cirrhinus mrigala* it was 9.1ppm for 96h (Velmurugan *et al.*, 2009) and in *Ctenopharyngodon idella* it was

13.1ppm for 24h (K.S Tilak and Swarna Kumari 2009).

Comparison of the LC<sub>50</sub> values clearly indicates that the plant based pesticide is less toxic compared to the chemical one. To reduce the chemical load on the environment, it is suggested that use of plant based pesticides should be encouraged (Schmutterer, 1990). However, care should be taken to use even the plant based pesticide at moderate levels. Furthermore, plant based pesticides disintegrate easily into constituent elements without leaving any indelible impression in different regions of the environment (Khan and Ahmed, 2000). It is advocated that more and more plant products should be developed with proper and targeted action and this eventually helps in keeping the environment free from hazardous chemicals. From the present study, it could be concluded that Dichlorvos contamination is dangerous to aquatic ecosystems, and this fact should be taken into consideration when this insecticide is used in agriculture or in the control of mosquito populations. It can be also concluded that although neem based pesticides are considered as less toxic and environmental friendly, but precautions must be taken when it is used in fish inhabiting areas since the excess application can affect the life of organisms. This type of study can also be useful to compare the sensitivity of the various species of aquatic animals and potency of chemicals using LC<sub>50</sub> values and to derive safe environmental concentration by which there is no lethality and stress to the animals.

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