Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

Vol. 9	No. 3	pp. 633-637	2010

Original Research Paper

Toxic Effects of Some Pesticides on Fingerlings of a Carp, *Labeo rohita*

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Nat. Env. Poll. Tech.
ISSN: 0972-6268
www.neptjournal.com

Key Words:
Pesticides
Toxic effects
Fingerlings
Labeo rohita

ABSTRACT

The present paper deals with evaluation of acute toxicity of some popular and widely used insecticides like Endosulfan (O.C.), Malathion, Nuvacron, Nuvan, Dimecron (all O.P.) and Fenvalerate (pyrethroid) to the fingerlings of a carp, *Labeo rohita.* Among these insecticides Fenvalerate was found to be most toxic followed by Endosulfan, Malathion, Nuvacron, Dimecron and Nuvan, with their LC_{50}/96 hr values in the order: 0.20ppm < 0.4ppm < 0.75ppm < 1.00ppm < 1.25ppm < 5.0ppm respectively. Accordingly, the acute toxicity of these insecticides was found in order: Nuvan < Dimecron < Nuvacron < Malathion < Endosulfan < Fenvalerate. Suggestive measures include use of insecticide around fishery resources with precaution so that access of sprayed chemicals into the adjoining water bodies may be checked.

INTRODUCTION

Pollutional problem is now encountered in all developed and developing countries of the world. With rise in industrialization, urbanization, excess use of agrochemicals such as insecticides, pesticides, herbicides, fungicides, etc. to enhance yield of agricultural products, there is more production of industrial wastes, urban sewage and agricultural wastes. The chemicals, which reach the inland water resources through various sources, create nuisance by changing the water quality of ponds, lakes, reservoirs and other enclosed water bodies so much so that the water becomes unsuitable for human consumption and fish growth (Konar 1969, Kaur & Toor 1977, Srivastava & Kumar 1977). In such a situation, the prospect of fish production gets reduced in the numerical sense as well as in consideration to the quantum of fish yields. Besides chance of costing life, the contaminated or otherwise deteriorated water may affect the growth of the surviving fishes to a noticeable extent (Chakravorty & Konar 1974, Das & Konar 1974).

In recent years several reportings have been made on the pesticidal concern of water pollution which have revealed that use of agrochemicals in the crop-fields has got the potentiality of changing abiotic and biotic characters of the aquatic media, affecting the tolerance limit of aquatic flora & fauna, creating noticeable disaster to the ecosystem and reducing the overall prospect of the fish yields from the inland water sources. From the review of relevant literature, it appears that pollution biologists have given their attention more towards studies on toxicity of agro-chemicals (insecticides and pesticides) rather than the industry based pollutants or organic wastes, because of more likelihood of contamination of the inland water resources, including rivers, ponds and adjoining crop-fields by these agrochemicals. Such studies are numerous inclusive of those of Verma et al. (1977), Peer Mohammed et al. (1979), Alam (1987), Alam & Sadhu (2001), Maheswari et al. (2001), Sadhu (2004), Renu Pathak et al. (2007) Sadhu & Pathak (2008) and Sanjay Raju et al. (2009).

In consideration to the above facts and in view of the higher demand of carp fishes, it was thought purposeful to estimate acute toxicity of certain popular and widely used pesticides to the fingerlings a carp fish, *Labeo rohita.*

MATERIALS AND METHODS

Fingerling specimens (4.0-5.5 cm) of the carp, *Labeo rohita* were procured from the local fish farm and fish dealers and transferred into acclimation containers to lessen the high mortality rate during first few days in the laboratory because of shock and mechanical damage. They were washed with 0.1% $KMnO_4$ solution to avoid dermal infection and were allowed for acclimatization for a period of 15 days. During acclimation the fingerlings were fed with artificial fish diet. Excess food and waste matter was cleared from the bottom of the tank periodically. Special precautions were followed to prevent injury due to handling.

The pesticides Endosulfan, Malathion, Nuvan, Nuvacron, Dimecron and Fenvalerate were procured from the local market. They belong to different groups of pesticides, display a wide range of toxicity and are widely used on a variety of crops in this region.

Static bioassay tests were conducted in 20-litre glass aquaria. Concentrations of the pesticides were prepared by dilution technique. Triplicate tests were run for each concentration with 10 fingerlings in each test container and LC_{50} values of the pesticides were estimated as per standard procedure of APHA (1998). A control experiment having 10 fingerlings, without toxicant was run simultaneously to have a comparative idea.

RESULTS AND DISCUSSION

Experiments on intoxication of the carp fingerlings in the water contaminated with the agrochemicals have revealed convincingly the toxic nature of all the test chemicals in respect to occurrence of mortality of test specimens at varying rates (Table 1). Among all the pesticides, Fenvalerate (pyrethroid) was most toxic followed by Endosulfan, Malathion, Nuvacron, Dimecron and Nuvan.

The LC_{50} value of Endosulfan was estimated to be 1.0, 0.75, 0.5 and 0.4 ppm for 24, 48, 72 and 96 hours respectively. Some workers have reported that organochlorine insecticides are highly toxic to fish, and carp fingerlings are more susceptible than the adult carp and other fish (Konar 1970, 1971, Basak & Konar 1976).

The LC_{50} values of Malathion were found to be 1.25, 1.0, 0.9 and 0.75 ppm for 24, 48, 72 and 96 hours exposure respectively. The reported LC_{50}/96 hr values of Malathion are 0.72 ppm for *Tilapia mossambica* (Das & Konar 1974), 15.0 ppm for *Heteropneustes fossilis* (Verma et al. 1979), 2.15 ppm for *Trichogaster fasciatus* (Panvar et al. 1976), and 3.15 ppm for *Cyprinus carpio* (Arora et al. 1971). On comparing these values with the results of the present findings, it is clear that Malathion is more toxic to carp fingerlings. This pesticide is reported to persist for about 10 days in the environment and, therefore, it is suggested not to be applied in ponds or nearby after stocking of fish seed and if it is already applied, a stocking interval of at least 15 days be observed prior to stocking of fish seed to avoid chances of mortality of fish fries and fingerlings.

The LC_{50} values of Nuvacron were 6.0, 4.0, 2.5 and 1.0 ppm for 24, 48, 72 and 96 hr indicating its far more toxic nature to the fish. Dimecron is a systemic phosphoric acid ester and it is used for the control of sucking insect pests of agricultural crops and acts as a strong stomach poison. It contains phosphamidon as active ingredient. In the present investigation the LC_{50} values of the Dimecron for

Table 1: Median lethal concentration (LC_{50} values) of six pesticides for the fingerlings of major carp, *Labeo rohita*.

	Pesticides	LC_{50} values (ppm)			
		24 hr	48 hr	72 hr	96 hr
1.	Endosulfan	1.1	0.75	0.5	0.4
2.	Malathion	1.25	1.0	0.9	0.75
3.	Nuvan	9.5	8.0	6.5	5.0
4.	Nuvacron	6.0	4.0	2.50	1.0
5.	Dimecron	3.0	2.5	1.50	1.25
6.	Fenvalerate	0.9	0.75	0.5	0.2

24, 48, 72 and 96 hrs to fingerlings were 3.0, 2.5, 1.50 and 1.25 ppm respectively. Many workers have reported acute toxicity of Dimecron to different fishes. The reported value of LC_{50}/96 hr for *Puntius ticto* was 163.4 ppm, 267.5 and 122.5 ppm for *H. fossilis* and *Clarias batrachus* (Chakravorty & Chourasia 1981), 62 and 280 ppm for *Anabas scandens* and *H. fossilis* (Gouda et al. 1981), indicating its low toxicity to fishes. The results of the present study show that it is quite toxic to the fingerlings of the test fish, *Labeo rohita*.

Nuvan (DDVP) is an organophosphate insecticide with contact and fumigational toxic effect. Its LC_{50} values were determined for 24 hr, 48 hr, 72 hr and 96 hr exposures as 9.5, 8.0, 6.5 and 5.0 ppm respectively. Verma et al. (1979) reported LC_{50}/96 hr values for Nuvan as 6.61 mg/L for *Saccobranchus fossilis*, 2.3 mg/L for *Ophiocephalus punctatus*, 0.45 mg/L for *Mystus vittatus*, 0.29 mg/L for *Cirrhina mrigala* and 7.3 mg/L for *Channa punctatus*. Konar (1969) reported 168 hr LC_{50} values of DDVP to be 11.22 and 22.38 ppm for fry and fingerlings of *Labeo rohita,* 1.0 and 6.16 ppm for fry and adult of *Puntius sophore*, and 2.81 and 18.19 ppm for fry and adult of *Esomus danrica*. Among the four organophosphate insecticides tested in the present study Nuvan was found to be least toxic and malathion most toxic to the fingerlings of *Labeo rohita*.

Synthetic pyrethroids are non-polar and non-lipophilic like organochlorine insecticides, but they are non-persistent and nonvolatile. Fenvalerate is a strong neurotoxicant and is highly toxic systemic pyrethroid used for the control of a variety of agricultural pests. In the present work, the fenvalerate was highly toxic to the carp fingerlings. Its LC_{50} values for the carp fingerlings were 0.9, 0.75, 0.5 and 0.2 ppm for 24 hr 48 hr, 72 hr and 96 hr respectively.

Thus, on the basis of the results of toxicity tests, LC_{50}/96 hr values of the insecticides in the present study were in the order: 0.20ppm (Fenvalerate) < 0.4ppm (Endosulfan) < 0.75ppm (Malathion) < 1.00ppm (Nuvacron) < 1.25ppm (Dimecron) < 5.0 ppm (Nuvan)

Accordingly, the acute toxicity of these insecticides was found in the order: Nuvan < Dimecron < Nuvacron < Malathion < Endosulfan < Fenvalerate

From the results of toxicity determination inferences can be drawn that:

1. The toxicity of a toxicant can be related to various factors including physicochemical factors (DO, free CO2, pH, temperature, etc.) of the medium, and biological behaviour.
2. It is also related to the status of the fish, which includes size, body weight, age, sex and life-cycle stage.
3. The toxicity of the toxicant is also related to difference in the test concentration, capacity of the individual species to detoxify the compound and species specificity of the test chemical.

On comparing the present results with the results of some earlier research workers, an impression was drawn that different kinds of pesticides have different degree of toxicity to fishes and different kinds of fishes have varied mortality rates in toxic media. There is also a direct evidence to the fact that size of the fish in any stage of life has an effective role in the event of mortality. Larger fishes have more tolerance than smaller fishes. As such, consequences of pesticide poisoning to fishes produce a different result due to variation in their size, age or body weight.

Thus, in view of present findings on the response of the carp fingerlings to LC_{50} concentrations of the test chemicals, it is evident that these all pesticides are acutely toxic to the fingerlings. Among the insecticides used, Fenvalerate was most toxic followed by Endosulfan, Malathion, Nuvacron, Dimecron and Nuvan. It is suggested that the insecticides should only be used with precaution in and around fishery waters and the fish culturists and agriculturists be educated regarding toxic effects of the insecticides to fish seed. The crop-field which is ready for receiving spray action, should be properly examined for the existence of any linkage of the accumulated water of the field to the nearby fish ponds or nursery tanks. The linking source, if existing, should be properly cut off by raising earthen bunds in between these.

ACKNOWLEDGEMENT

The authors are grateful to Prof. (Dr.) Arvind Kumar, Vice-Chancellor Vinoba Bhave University, Hazaribag for inspiration and suggestion.

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ENVIRONMENTAL NEWS

Emissions Disclosure

India's greenhouse gas emissions have risen by 58%. With first time disclosure of its carbon emissions, India can claim to be a front-runner among developing nations disclosing emissions. Its emissions from electricity, cement and waste have more than doubled since 1994 dut to increase in its industrial activity that has made it world's fifth biggest emitter.

India relied on coal for 90% of its electricity which accounts for more than a third of the country's emissions. Its carbon intensity fell by 30% between the two reporting periods. India's Union Environment Minister, Jairam Ramesh, assured to publish its emissions inventory every two years from now.

Guardian News, May 25, 2010

Energy Saving Certificate

There is a proposal to introduce tradebale 'Energy Saving Certificate,' for energy intensive industries like steel plants and other major commercial consumers like hotel malls and theaters etc. The government will prescribe how much energy an industry can use for each unit of production, say. a tonne of steel, manufacturing a car or a refrigerator. Energy consumption will be measured in units in terms of MTOE (per tonne of oil equivalent).

Those meeting the norm or consuming even less energy than is prescribed, will earn the certificate in proportion to their saving, and who fail, will buy such certificates in proportion to the excess power or energy they consume.

The proposal is lead to a revolution and transform the manner energy, particularly electricity, is used. India wastes 20% of energy, particularly electricity, due to inefficient usages. About half of this can be saved through rightful ways of electricity use.

The proposal also visualizes bringing existing commercial buildings, such as office complexes or hotels and malls etc. within the ambit of energy efficiency norms. The government would be vested with powers to ban such manufacturing or import of equipment and appliances that do not meet energy efficiency norms.

Indian Building Congress, March 2010