Voyager: Vol. VIII, 2016 ISSN (P): 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919

Voyager
A Journal of Sciences- Life Sciences

Toxicity of Pesticide Toxaphene on Fresh Water Fish, *MYSTUS VITTATUS*

Binesh Kumari
Department of Zoology
M.M.H. PG College Ghaziabad
Email id : vineshchaudhary99@gmail.com

Abstract

Acute toxicity bioassay tests have been conducted to evaluate the toxicity of pesticides i.e. Toxaphene (chlorinated comphene), as to work out the LC_{50} and acute toxicity range for 24, 48, 72 and 96 hr. using the test fish, Mystus vittatus. The safe concentrations, Heterogeneity factors, Fiducial limits (95%), Regression equations and slope functions, were worked out for each time interval.

Keywords: *Toxaphene, Acute toxicity, Mystu Vittatus.*

Introduction

The use of pesticide in agriculture threatens the terrestrial and aquatic environment to a great extent. These compounds find their way into aquatic ecosystem (Adelman et al, 1976). However, the data regarding the acute toxicity of these chemicals are meager (Goodnight, 1942; Jones, 1951; Trama, 1953; Van Dijk *et al*, 1977; Dalela *et al*, 1979a). To fill up this gap, the present investigations was undertaken to measure the acute toxicity of pesticides (Toxaphene) for a test fish *Mystus Vittatus.*

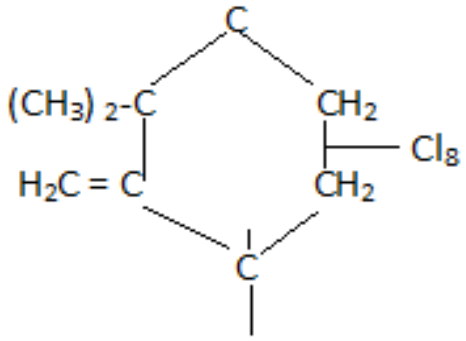
Materials & Methods

Healthy fish specimens of *Mystus vittatus* were collected from neighboring fresh water resources. The selection of this fish was made for its easy availability and long survival capacity under laboratory conditions. *Mystus vittatus* of size range 7 to 10 cm. in length and 40 to 55 gms in weight. Before using them in bioassay, they were washed with 0.0mg/ $1KMnO_4$ solution (a disinfectant) for about 15 min to avoid any possibility of external infection. They were then acclimaized to laboratory conditions for a period of 5 days in 100 lit. capacity glass

aquaria. As per recommendations of Florin and Muller (1970) for the maintenance of bioassay fish, every effort was made to provide the optimum conditions for the fish. During acclimaization, the fish were provided with an artificial 'fish food' as to avoid any malnutritional effect.

The water used as diluent was tap water supplied by the overhead tank and was analyzed for different physico-chemical characteristics as per standard methods

APHA et al, (1980). The water indicated the following physico-chemical characteristics:Dissolved oxygen between 7.2 and 7.4 mg/l; pH7.4, total solids between 12.6 and22.8 mg/l, hardness between 38 and 48 mg/l, biochemical oxygen demand 2.4 mg/l and sulphate 7.4 mg/l. The pesticide selected for the evaluation of the toxicity is **Toxaphene** (Chlorinated comphene containing 6 to 70% chlorine) with following structure formula:



95% alcohol and acetone having minimum effect on toxicological results were used as solvent. The quantity of solvent was also used in control experiment. Different experimental concentrations were prepared by using the dilution techniques as indicated in standard Methods.

Groups of 10 fishes were transferred with the help of small hand net, from the acclimatization tank into the test containers of 10 litre capacity, containing different concentrations of pesticide avoiding any possibility of mechanical injury to the test fish. No diet was provided to the fish during experiment because the production of excretory substances might influence the toxicity of test solutions. During the experiment the physical behaviour of the fish was observed and considered dead when they gave no response while probing with glass rod. The dead fish was removed immediately because such mortality in static bioassays may deplete the DO, affecting tolerance limits (Schreck and Brouda, 1975).

LC_{50} was obtained by the interpolation of concerntrations on the logarithmic scale and mortality percentage on arithmetic scale of the semi-log paper and reading directly the concentrations where the 50% mortality line crosses the logarithmic axis. The acute toxic

ranges were determined on the lines given by the Sprague (1969). The regression equations for mortality number (Y) and concentrations (X) were processed by a standard regression formula (Snedecor, 1961). Fiducial limits (95%) and heterogeneity factor (X^2) were calculated on the lines of Finney (1952), while slope function (S) was calculated as per methods given by Litchfield and Wilcoxan(1949). Further, the safe concentrations were computed by using the formula of Hart et al (1945)and application factor (0.05) as suggested by Warner (1967).

Table 1: Acute toxicity range LC_{50} and slope function for Toxaphene for test fish *M. vittatus*

CHEMICAL	24hr.		48hr.		72hr.		96hr.	
	LC_{50}	S	LC_{50}	S	LC_{50}	S	LC_{50}	S
TOXAPHENE	0.41 (0.38 - 0.46)	1.56	0.37 (0.34 - 0.38)	1.62	0.31 (0.28 – 0.34)	1.71	0.28 (0.25 – 0.30)	1.82

Values given in parenthesis are acute toxic range.

Table 2: Regression equation and heterogeneity factor (H.F.) for Toxaphene for *M. vittatus*

CHEMICAL	24hr.	48hr.	72hr.	96hr.	H.F.	Fiducial limit	Safe Conc.
TOXAPHENE	Y = 3.62 X- 4.046	Y = 23.62 X- 3.046	Y = 21.95 X- 1.541	Y = 18.98 X + 0.332	0.2061	0.219-0.383	0.0016

ISSN (P): 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919

Results and Discussion

The data regarding the acute toxicity ranges, LC_{50} values, slope function, regression equations, heterogeneity factors, fiducial limits and safe concentrations worked out are given in Tables1 and 2.

From the physico-chemical characteristics of the water it is clear, that it carries no toxic substance or factors which can harm the fish in acute condition.During bioassay studies, several changed physical behaviour have been observed as erratic opercular movement, difficulty in respiration, restlessness and body convolution. In gulping of surface air and avoidance of toxic environment is a common feature in fish exposed to pesticides. Excessive secretion by the body might be due to minimizing the irritating effects of toxicant. Impairment of the sense in experimental fish might be due to toxic effect of individual pesticide. In control jar, no such changed behavior in fish activity was observed.

From the acute toxicity results (Table1), it is evident that pesticide toxicity was a function of dosage, duration and type of active molecule used in formulating the pesticides. The LC_{50} and acute toxic range worked out in the present investigation can vary if field data are worked out, but the relationship developed in laboratory bioassay remained the same. From LC_{50} values, higher toxicity of Toxaphene might be due to presence of active ingredient as chlorine.

The death of fishes in experimental jar seems to be due to depletion in the rate of respiration as the proper exchange of oxygen through gills cannot take place due to pesticide. Excessive mucous depositions have been observed at gill outer lining. Tovell et al (1980) the death of fishes due to the deposition of high mucous contents over the outer mucous layer of the gills in a number of fish. Parker et al, (1951) and Hall et al (1933) pointed out that at lethal concentration, respiration in fishes become irregular & the circulatory mechanism can no longer keep pace with oxygen consumption and the blood become acidic due to lactate accumulation as a result of which muscular rigidity is obtained causing the dead of fish. Similar sequential stresses also occurred in *Mystus Vittatus* along with hypoxic condition causes the death of fishes during bioassay test.

Abel (1975) suggested that denaturation of protein of the gill membranes due to pesticides probably cause the death of the fishes. Protein denaturation in fishes due to pesticide were also observed by Fogg and Lodge (1945). The same might also be true in this case also.

The safe concentration of this pesticide have also been worked by using the formula of Hart et al, (1945) using the application factor (0.05) given by Warner (1967). These values are very meaningful because they can be utilize for regulating the discharge of such pesticides in various ecosystem.The values of equation heterogeneity factorare useful for correcting the experimental data

References

Abel, P.D. 1975: Toxicity of synthetic detergents to fish and aquatic invertebrates, Journal of Fish Biology 6,279.

*Adelman, I.R., Smith, L.L. Jr. and Siesennop, G.D. 1976:Acute Toxicity of Sodium Chloride, Pentachlorophenol, Guthion®, and Hexavalent Chromium to Fathead Minnows (Pimephales promelas) and Goldfish (Carassius auratus), Journal of the Fisheries Research Board of Canada**33,** 203.*

APHA, AWWA. and WPCF. 1980: Standard Methods for the Examination of Water and Waste Water. 13th.ed. APHA Inc. New York.

Chebbi, S.G. and David, M. 2010: Respiratory responses and behavioural anomelies of the carp Cyprinus carpio under qinalthos intoxication in sublethal doses of ScienceAsia, 36: 12-17.

Dalela, R.C., Rani, S. and Verma, S.R. 1979a: Evaluation, impact and remedies of water pollution in Kumaun Himalaya with reference to microorganisms, Proceedings on Symposium on Environmental Biology, 349.

*Doudoroff, P., Anderson, B.G., Burdick, C.E., Gallsoff, P.S., Hart, W.B., Patrick, R.,Strong, E.R., Surber, E.W. and Van-Horn, W.M. 1951: Evaluation of acute toxicity of phenol and its chloro and nitro compounds, Sewage Ind. Waste**23,** 130.*

David, M. 2008: Behavior and respiratory dysfunction as an index of malathion toxicity in the fresh water fish, Labeo rohita (Hamilton).Turkish Journal of Fisheries and Aquatic Sciences, 8: 233-237.

David, M.; Shivakumar, H.B., Shivakumar, R., Mushigeri, S.B. and Ganthi, B.H. 2003: Toxicity evalution of cypermethrin and its effect on oxygen consumption of the fresh water fish, Tilapia mossambica. Indian Journal of Enviornmental Toxicology, 13: 99-102.

Finney, D.J. 1952: 'Probit Analysis'- A method of computing the effectiveness of an insecticide, Cambridge University Press, IInd edition, 20

*Fogg, A.H. and Lodge, R.M. 1945: The mode of antibacterial action of phenols in relation to drug-fastness, Transactions of the Faradary society, **41,** 359.*

*Goodnight, C.J. 1942: An exposure and Risk Assessment for Pentachlorophenol, Industrial and Engineering Chemistry,**34,** 868.*

*Hall, V.E., Field, J., Sahyeen, M., Cutting, W.C.and Taintes, M.L. 1953: Original, mechanistic studies on the physiology of endocrine and metabolic systems, American Journal of Physiology,**106,** 432.*

Hart, W.B., Doudoroff, P. and Greenbank, J. 1945: The evaluation of toxicity of industrial wastes, chemical and other substances to fresh water fishes. Atlantic Refining Company Philadelphia, 317 + (14).

*Jones, J.R.E. 1951: The Reactions of the Minnow, Phoxinus phoxinus (L.), to Solutions of Phenol, Ortho-Cresol and Para-Cresol, Journal of Experimental Biology,**28,** 261.*

John Ravindran,K., Daniel, R., Kumari, S., George, S. and Eapen, A. 2012: Effect of Agricultural Pesticides, Hostathion and Kitazin on the Larvivorsity of the Camatic Rice Fish, Oryzias carnaticus Jerdon, 1849. American-Eurasian Journal of Toxiological Sciences 4(2): 56-59

Kushwaha, B., Srivastava, S. K., Singh, B., Nagpure, N.S., Ponniah, A.G. 2000: Evaluation of comet assay and micronucleus test as genotoxic assay in Channa punctatus,National Academy Science Letters,23 (11/12): 177-179.

Litchfield, J.T. Jr. and WILCOXON, F. 1949: Quality assurance guidelines for biological testing, Journal of Pharmacology and Experimental Therapeutics, ***96,*** *99.*

Lemly, A.D., 2014: Teratogenic effects and monetary cost of selenium poisoning of fish in Lake Sutton, North Carolina, Ecotoxicology and Environmental Safety,104: 160-167

Maheshwari, U.K., Maheswari, N., Sharma, A., Das, R.C., Hussain, Z., Sharma, P.P., Singh, A.J. and Raj B. 2001: Toxicity of an organophosphate pesticide triarophios on an air breathing fish Clarius batrachus (Linn) and Species related MATC in the aquatic environment, Journal of Enviornmental Research, 11(2): 97-100.Vineetkumar, K.Patil.

Mir, F.A., Shah, G.H., Jan, U. and Mir, J.I. 2012: Studies on Influences of Sublethal concentrations of oraganophosphate pesticide, Dichlorvos (DDVP) on Gonadosomatic index (GSI) of female common carp, Cyprinus carpio communis. American-Eurasian Journal of Toxiocological Sciences 4(2): 67-71

Parker, V.H., Barnes, J.M. and Denz, F.A. 1951:Some Observations on the toxic properties of 3:5-Dinitro-Ortho-Cresol,British Journal of Industrial Medicine, ***8,*** *226.*

Pracheil, B.M., Hogan, J.D., Lyons, J., McIntyre, P.B. 2014: Using hard-part microchemistry to advance conservation of North American freshwater fishes. Fisheries 39(10): 451-465

*Schreck, C.B. and Brouda, P. 1975:Bulletin of Environmental Contamination and Toxicology ,The Journal of Bulletin of Environmental Contamination and Toxicology,****14,*** *148.*

Snedecor, G.W. 1961: 'Statistical Methods', Statistical methods applied to experiments in Agriculture and Biology, Allied Pacific Pvt. Ltd. Bombay.

*Sprague, J.B. 1969: Measurement of pollutant toxicity to fish. I. Bioassay methods for acute toxicity,Journal of Water Research,****3,*** *793.*

*Tagatz, M.E., Ivey, J.M. and Tobia, M. 1978: The Environmental Fate of 14C-pentachlorophenol in Laboratory Model, Pentachlorophenol,****12,*** *157.*

*Tovell, P.W.A., Hower, D. and Newsome, C.S. 1980: Behavior, Physiology and Toxicology Interactions in Fish, Toxiocology,****4,*** *17.*

*Trama, F.B. 1953: Evaluation of acute toxicity of phenol and its chloro- and nitro-derivatives to certain teleosts, Notal Nat. Acad. Phild. Abst.****30,*** *142.*

*Van Dijk, J.J., Van der Meer, C. and Wijnans, M. 1977: Pentachlorophenol: Health and Environmental Effects Profile, The Journal of Bulletin of Environmental Contamination and Toxicology,****17,*** *622.*

Vutukuru, S. S. 2005: Acute effects of hexavalent chromium on survial, oxygen consumption hematological parameters and some biochemical profiles of Indian major carp, Labeo rohita, International Journal of Environmental Research and Public Health, 2: 456462.

*Warner, R.E. 1967: Bioassays for microchemical environmental contaminants with special reference to water supplies, Bulletin of the World Health Organization,**36,**181*

ISSN: 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919