Trends in Life Sciences
An International Peer-Reviewed Journal
www.sciencejournal.in

TOXICITY EVALUATION OF THIAMETHOXAM AND TRIAZOPHOS TO THE FRESHWATER BIVALVE *LAMELLIDENS MARGINALIS* (LAMARK)

Rane Minakshi and Mahajan A. Y.
Department of Zoology, D. N. College, Faizpur, Tal.-Yawal, District: Jalgaon-425503, Maharashtra State, India.
(E-mail:minakshirane1@gmail.com, mahajan.ay@gmail.com)

ABSTRACT
Acute toxicity testing of freshwater bivalve, *Lamellidens marginalis* to Thiamethoxam, an organophosphate and Triazophos, a Neonicotenoid insecticide was carried out. The median lethal concentration (LC_{50}) of Thiamethoxam and Triazophos for 24, 48, 72 and 96 hrs. was 91.83, 61.91, 38.46 and 25.79; 28.03, 13.39, 8.833 and 7.340 ppm respectively. Analysis of results indicates that *Lamellidens marginalis* is highly sensitive to Triazophos than Thiamethoxam.

KEY WORDS: Acute toxicity, *Lamellidens marginalis*, Neonicotinoid, Thiamethoxam, Triazophos.

INTRODUCTION

Rapid industrialization and urbanization causes various environmental problems. Water pollution is one of the serious problems in most of the countries. Abundant use of fertilizers and pesticides became essential for better agricultural practices in most of the developing countries including India. Organisms living in aquatic ecosystem are exposed to contaminants that move relatively quickly through this system. Pesticides became one of the leading polluting agents of aquatic ecosystem (Phirke, 2008). The chief sources of contaminants are the industrial waste discharge, mining, agriculture, household waste disposal and fuel combustion (Swarup *et al.*, 2006; Saxena and Garg, 2011). The use of agrochemicals in the field has the potential to change the aquatic medium affecting the tolerance limit of aquatic fauna and flora as well as creating danger to the ecosystem. These agrochemicals adversely affect the non-target organisms, especially plankton and fish (Joseph and Raj, 2011). Amongst the pollutants found in agricultural wastes, insecticides are most hazardous since they have an ability to immobilize or kill the aquatic organisms at extremely low concentrations (Cope, 1965 and Eisler, 1969).

However these chemicals may reach other ecological compartments as lakes and rivers through rains and wind, affecting many other organisms away from the primary target. Only 0.1 % reaches the specific target (Lawson *et al.*, 2011). The significant increase of chemical emissions in the water resources has led to deleterious effects for aquatic organisms (Matsumoto *et al.*, 2006).Pesticides are major cause of concern for aquatic environment because of their toxicity persistency and tendency to accumulate in the organisms (Joseph and Raj, 2010). Pesticides and heavy metal salts are commonly pollutants of freshwater ecosystems where they induce adverse effects of the aquatic biota (Chourpagar and Kulkarni, 2011).

Pollution of aquatic environment form industrial, domestic and agricultural waste has exposed important aquatic organisms to contaminants which not only endanger their lives but also eventually enter the food chain leading to serious public health hazards (Ilavazhahan *et al.*, 2010). Acute toxicity test of single compounds is continually released into the aquatic ecosystem from industrial and residential areas representing a potential risk to the aquatic biota (Ebrahimpour *et al.*, 2010). Srivastava and Singh (2001) evaluated toxicity of alphamethrin, dimethoate and Carbaryl pesticides to freshwater snail, *Lymnaea acuminata*. Milam *et al.*, (2005) evaluated the effects of pesticides of highest risk to early of pesticides of highest risk to early life stages of six freshwater mussel species. Damasio *et al.*, (2010) identified major pesticides that may cause detrimental effects in bivalves species affected by agricultural pollution using freshwater clam *Corbicula fluminea*.

In present investigation, the toxicity tests of the pesticides, Thiamethoxam and Triazophos in freshwater bivalve *Lamellidens marginalis* are carried out.

MATERIALS AND METHODS

The freshwater bivalves *Lamellidens marginalis* were collected from the area of Hatnur dam which is situated on Tapi river near Hatnur (nearly 35 kms away from Bhusawal city), District Jalgaon, Maharashtra state. They were brought in a container to the laboratory. Before subjecting then to the experiments they were cleaned and acclimatized to the laboratory conditions for 5 to 6 days. The adult medium sized bivalves were used for the study. The commercial grade Thiamethoxam and Triazophos were used for toxicity evaluation. Ten bivalves each were exposed to different concentrations of each pesticide in troughs containing five liters of water. The water of appropriate concentration of the pesticide from trough was changed after every 12 hours. Simultaneously, control was maintained along with each set. Three replicates were run for each concentration.

Mortality was recorded after every 24 hours and data was analyzed so as to compute 24, 48, 72 and 96 hrs. LC_{50} values for two pesticides by probit analysis (Finney, 1951).

RESULTS

The LC_{10} and LC_{50} values of pesticides to *L. marginalis* were calculated for 24, 48, 72 and 96 hours by Finney's method (1951). The results of toxicity evaluation are summarized in table no 1. It is evident from the results (Tab. 1) that the mussel *L. marginalis* was found to be highly sensitive to triazophos than thiamethoxam.

During the bio-testing, the bivalve showed response to pesticide treatment. At higher concentration, the animal secreted copious mucus due to which the test solutions appeared to be turbid.

Table: Relative Toxicity of Thiamethoxam and Triazophos to freshwater bivalve *Lamellidens marginalis.*

Sr. No.	Pollutant	Exposure period in Hrs	Regression equation $Y = \bar{y} + b(x - \bar{x})$	LC_{10} in ppm	LC_{50} in ppm	Fiducial Limits	
						M_1	M_2
1	Thiamethoxam	24	Y = 7.787792 X - 10.28742	62.87	91.83	1.9217	2.0043
		48	Y = 6.990659 X - 7.525892	40.60	61.91	1.6198	1.9638
		72	Y = 6.581944 X - 5.432569	24.57	38.46	1.5254	1.6446
		96	Y = 12.506194X -12.653045	20.37	25.79	1.4398	2.4758
2	Triazophos	24	Y = 8.308645 X - 7.028287	19.65	28.03	1.4013	1.4941
		48	Y = 6.732995 X - 2.585311	8.634	13.39	0.5472	1.7060
		72	Y = 6.740732 X - 1.377587	5.702	8.33	0.2658	1.6264
		96	Y = 7.495069 X - 1.488451	4.951	7.340	0.2741	1.4573

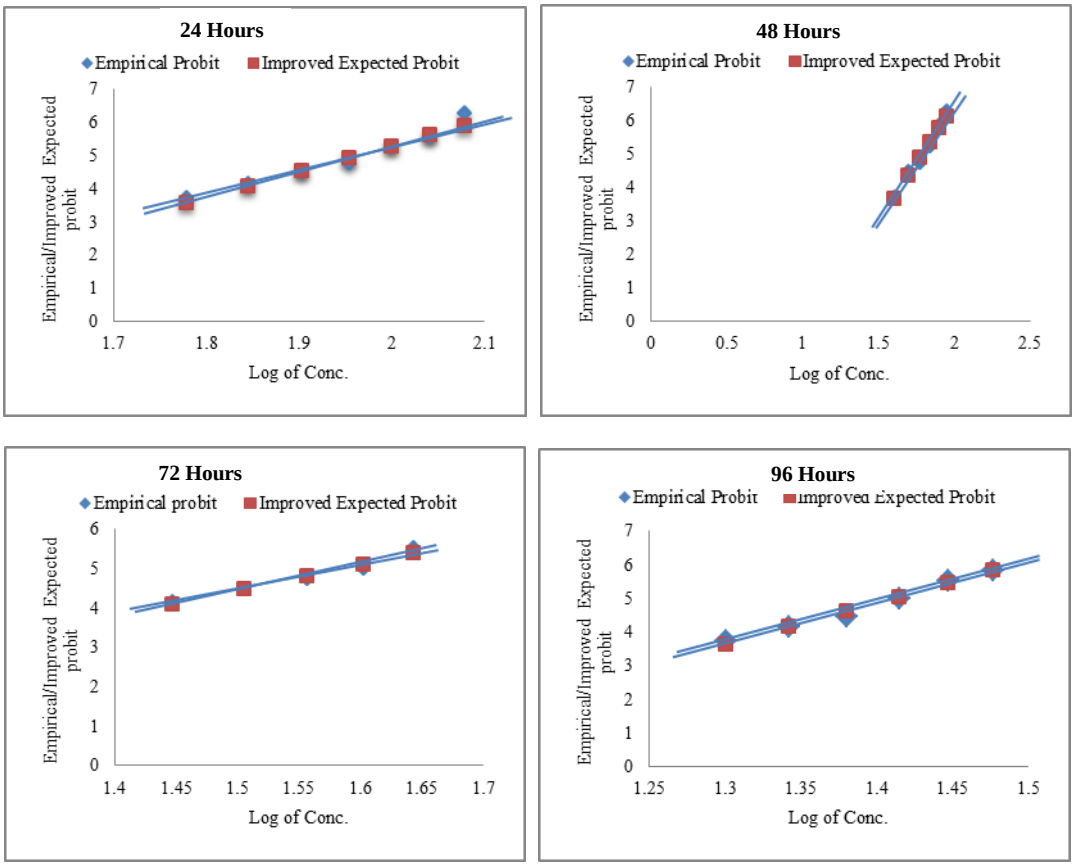

Figure 1. Regression equation for LC_{10} and LC_{50} values of freshwater bivalve, *Lamellidens marginalis* after acute exposure to Thiamethoxam

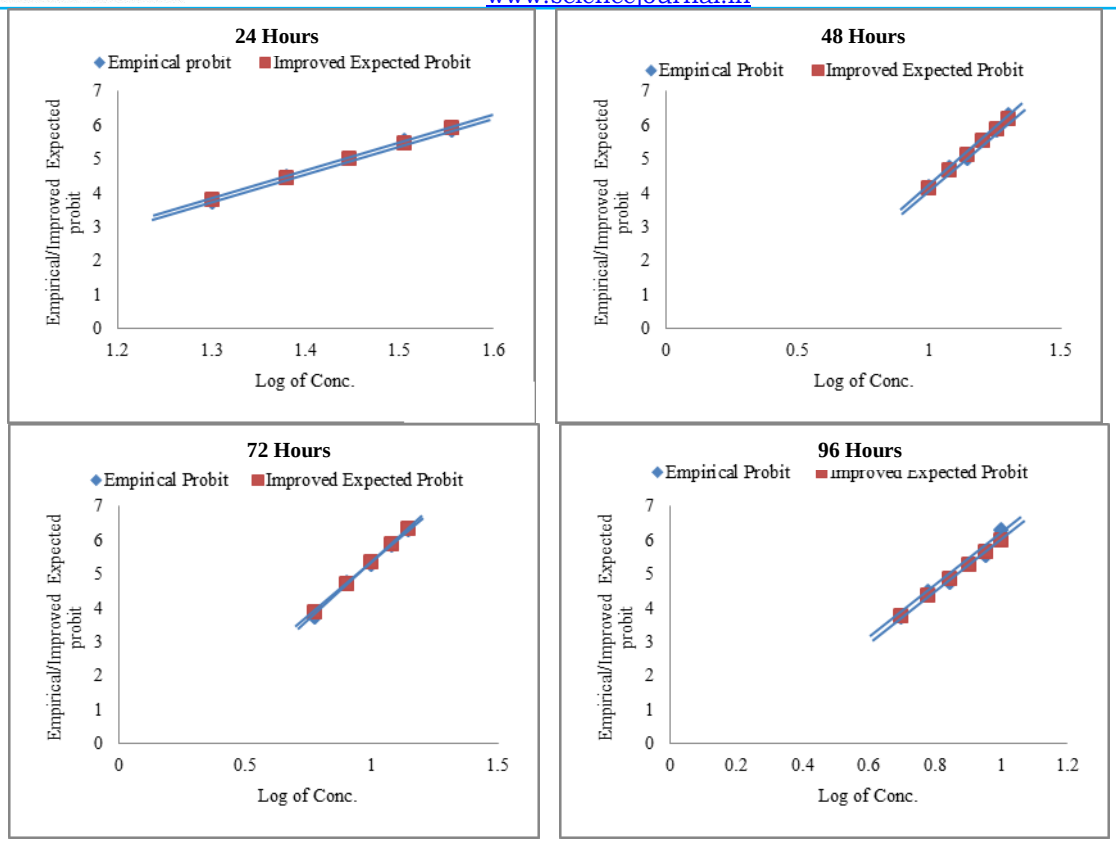

Figure 2. Calculation of Regression equation for LC_{10} and LC_{50} values of freshwater bivalve, *Lamellidens marginalis* after exposure to Triazophos

DISUSSION

The problem of pollution of the water where the wastes are usually discharged has increased to a great extent in recent years. On the other hand, all industries discharge their effluents indiscriminately in the adjoining water areas and frequently cause serious hazard to aquatic life (Selvanathan *et al.*, 2011).There are ample reports dealing with mortality and pollution (Barak, 1955).

Experiments conducted during recent years have shown that pesticides are injurious to molluscs. The evaluation of LC_{50} concentrations of pollutant is an important step before carrying further studies on physiological changes in animals. In the aquatic habitation, the pollutant affect the non-target organism adversely, *Lamellidens marginalis* is one such non-target organism. (Milan and Mulla, 1991) studied the effect of pyrithroid insecticides on non-target invertebrates in aquatic ecosystem and noticed the population recovery or affected species to pretreatment levels. The susceptibility of animals varies from pollutant to pollutant.

The poisoning by pesticides from agricultural fields is a serious water pollution problem and its environmental long term effect may result in the incidence of poisoning of fish and other aquatic life forms (Jothi and Narayan, 1999). Owing to the excessive use of pesticides, the environment and water resource are being polluted, thus endangering aquatic life directly and human life indirectly (Gill *et al.*, 1988). Chaudhari (1988) reported many behavioral changes and tremendous mucus secretion in pesticide exposed snail *Bellamya (v) bengalensis*. Mucus secretion was observed in *Corbicula striatella* on exposure to pesticides (Jadhav, 1993). In the present study it was observed that copious mucus secretion was seen in animal exposed to triazophos, while little mucus was secreted in thiamethoxam exposed bivalves.

The determination of the LC_{50} values is of immense importance since it provides fundamental data for the design of more complex disposal model. Pesticide affects behavior and get accumulate in the test animals and reduce their survival rate. Extensive studies have been carried out all over the world on for the effects of pesticides on aquatic organism (Cripe, 1994; Shanmugam *et al.*, 2000). Many investigations have reported the toxicity of pesticides to different species of animals. Results of pesticide toxicity are reported by other authors (Galli *et al.*, 1994; Kaiser and Devillers, 1994; Ruiz *et al.*, 1997; Amoros *et al.*, 2000). Variations in the degree of toxicity of different pesticides have been reported by other workers (Ramana Rao *et al.*, 1987).

Phirke (2008) studied the toxicity of pesticides quinalphos and thiodan on freshwater bivalve *Parreysia corrugata.* Patil (2010) reported LC_{50} values for the pesticides indoxacarb and thiamethoxam exposed to freshwater bivalve *Parreysia cylindrica*. Mane and Mule (1984) reported the toxicity of endosulfan to two freshwater bivalves. *Lamellidens corrianus* and *Lamellidens marginalis* in different seasons. Prasad Rao *et al.,* (1994) reported increased rate of mortality with increase of concentration and period of exposure to endosulfan in snail, *Lymnaea luteola*.

In present investigation, the freshwater bivalve *Lamellidens marginalis* established its LC_{10} and LC_{50} values, safe concentration and lethal dose of thiamethoxam and triazophos. In the present study the rate of mortality of freshwater bivalve *Lamellidens marginalis* has increased with increasing concentration and the time of exposure to thiamethoxam and triazophos i.e. mortality rate is directly proportional to the time of exposure and concentration of the pesticides. Since the LC_{50} value of triazophos for 96 hrs. is less (7.340 ppm) than that of thiamethoxam (25.79 ppm), it is further concluded that, freshwater bivalve *Lamellidens marginalis* is more susceptible to organophosphate pesticide triazophos than neonicotinoid pesticide thiamethoxam. It might be due to greater residual property of triazophos than that of thiamethoxam in freshwater bivalve. This study has clearly indicated that any pollutant present in the aquatic environment is toxic. It directly or indirectly harms the food chain but their mode of action could be different.

REFERENCES

Amoros I., Connon R., Garelick H., Alonso J.L. and Carrasco J.M. (2000). An assessment of the toxicity of some pesticides and their metabolites affecting a natural aquatic environment using the microtox system. Water Science and Technology.

Barak (1955). Concentration of Zinc and Copper in some Fauna from Basrab, Iraq. *Mar. Res.* 4: 1-6.

Chaudhari, T.R. 1988. Pesticidal impact on some physiological aspect of *Bellamya (viviparous) bengalensis.* Ph.D. thesis Dr. B.A.M.U., Aurangabad.

Chourpagar A.R. and Kulkarni G.K. (2011). Heavy metal toxicity to a freshwater crab *Barytelphusa cunicularis* (Westwood) from Aurangabad region. *Rec. Res. Sci. Tech.* 36:01-05.

Cope, O. B. (1965). Researches in pesticides Ed. C. O. Chichester. Academic Press, New York, London, p.p. 115 – 127.

Cripe, G.M. 1994. Coparative acute toxicants of several pesticides and metals to *Mysidopsis bahia* and post laval *Panaeus duorarum*. *Environ. Toxicol. Chem.* 13:1897-72.

Damasio, J., Navarro-Ortega, A., Tauler, R., Lacorte, S., Barcelo, D., Soares, A.M., Lopez, M.A., Riva, M.C., Baratac, 2010. Identifying major pesticides affecting bivalve species exposed to agricultural pollution using multi biomarker and multivariate methods. *Ecotoxicol.* 19(6): 1084-1094.

Ebrahimpour M., Mosavisefat M. and Mohabbati R. (2010). Acute Toxicity bioassay of mercuric chloride: An alien fish from a river. Toxicol.Environ. Chem. 92:169-173.

Eisler R. (1969). Acute toxicities of insecticides to Marine Decapod Crustaceans. Crustaceana. 16(3):302-310.

Finney D.J. (1951). 'Probit Analysis' Cambridge University Press, London.

Galli R., Rich H.W. and Scholtz R. (1994). Toxicity of organophosphate insecticides and their metabolites to the water flea *Daphnia magna*, the Microtex test and acetyl cholinesterase inhibition test.Aquatic Toxicology. 30, 259-269.

Gill T. S., Pant J. C. and Pant Jaishree (1988). Gill, liver and kidney lesions associated with experimental exposures to carbaryl and dimethoate in the fish (*Puntius conchonius* Ham.). Bull. Environ. Contam. Toxicol. 41, 71 – 78.

Ilavazhahan M., Tamil Selvi R. and Jayaraj S.S. (2010). Determination of LC50 of the bacterial pathogen pesticide and heavy metal for *Catla catla*. *Global. J. Environ. Res.* 4(2): 76-82.

Jadhav S.M. 1993. Impact of pollutants on some physiological aspects of the freshwater bivalve, *Corbicula striatella*. Ph.D. Thesis, Marathwada University, Aurangabad. (M. S.).

Joseph B. and Raj S.J. (2010). Effect of Curacron toxicity on the total serum protein content of *Cyprinus carpio*. *Toxicol. Environ. Chem.* 92:1889-1893.

Joseph, B. and Raj, S.J. 2011. Impact of pesticide toxicity on selected biomarkers in fishes. Int.J.Zool.Res.7 (2): 212-222.

Jothi B. and Narayanan G. (1999). Certain pesticide induced carbohydrate metabolic disorders in the serum of freshwater fish *Clarias batrachus*. Food and Chemical Toxicology, 37(4): 417-421.

Kaiser K.L.E. and Devillers J. (1994). Ecotoxicity of chemicals to *Photobacterium phosphoreum* J. Devillers (ed.) *Handbook Ecotoxicol.Data.* 2:547-548.

Lawson E.O., Ndimele P.E., Jimoh A.A. and Whwnu O.O. (2011). Acute toxicity of Lindane (Gamma Hexachloro-Cyclohexane) to African Catfish (*Clarias gariepinus*, Burchell,1822) *Int. J. Anim. Veter. Adv.* 3(2): 63-68.

Mane U. H. and Muley D. V. (1984). Acute toxicity of endosulfan 35 EC to two freshwater bivalve molluscs from Godavari River at Maharashtra State. *Toxicol. Let.* 23: 147-155.

Matsumoto S.T., Mantovani M.S., Malagutti M.I.A., Dias A.L., Fonsca I.C. and Martin- Morales M.A. (2006). Genotoxicity and mutagenicity of water contaminated with tannery effluents as evaluated by the micronucleus test and comet assay using the fish, *Oreochromis niloticus* and chromosome aberrations in onion root-tips. Genetics Mol. Biol.29: 148-158.

Milam C.D., Farris J.L., Dwyer F.J., Hardesty D.K. (2005). Acute toxicity of six freshwater mussel species (glochidia) to six chemicals : Implications for daphnids and *autter backiaimbeallis* as surrogates for protection and freshwater mussels (unionidae). *Arch. Environ. Contam. Toxicol.* 48: 166-173.

Milan L.S. and Mulla M.S. (1991). Effects of pyrethroid Insecticides on non-target Invertebrates in Aquatic Ecosystems . *J. Agric. Entomol.* 9(2): 73-96.

Patil A.G. (2010). Impact of pesticides on certain physiological aspects of freshwater bivalve, *Parreysia cylindrica*. Thesis submitted to North Maharashtra University, Jalgaon.

Phirke P.P. (2008). Effect of thiodan and quinalphos on some physiological parameters of the freshwater bivalve, *Parreysia corrugata*. Thesis submitted to Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

Prasad Rao G.D.V., JayaRaju P.B. and Sharma S.V. (1994). Ecotoxicity of pesticide, endosulfan on freshwater snail, *Lymnaea luteola. J. Aqua. Biol.* 9 (1 and2) : 67-70.

Ramana Rao K.V., Rao K.S., Sahib I.K.A. and Sivaiah S. (1987). Different toxicity of methyl parathion and malathion on some selected aquatic species. *Proc. Nat. Acad. Sci. India.* 57: 367-370.

Ruiz M.J., Lopez-Jaramillo L., Redondo M.J. and Font G. (1997). Toxicity assessment of pesticides using the Microtox test application to environmental samples. Bull .Environ. *Contam. Toxicol.* 59, 619-625.

Saxena R. and Garg P. (2011). Vitamin E provides protection against In vitro oxidative stress due to pesticide (Chlorpyrifos and Endosulfan) in goat RBC. *GERT Bull. Biosci.* (Article in Press).

Selvanathan J., Suresh Kumar M., Vincent S. (2011). Determination of Median Tolerance Limit (LC50) of *Clarias batrachus* for Calcium chloride and Mercuric chloride.Rec.Res.Sci Tech., 3(11):84-86.

Shanmugam M., Venkateswarlu M. and Naveed, A. (2000). Effect of pesticides on the freshwater crab, *Barytelphusa cunicularis* (Westwood). J. Ecotoxicol. Environ. Monit, 10: 273-279.

Srivastava U.K. and Singh A. (2001). Toxicity of alphamethrin, dimethoate and carbaryl pesticides to the freshwater snail, *Lymnaea acuminata and Indoplanorbis exustus.Iberus*19: 1-5.

Swarup D. Patra, Naresh R.C., Ram., Puneet K., Pallav S. and Balagangatharathilagar M. (2006). Efficiency of copper and cobalt in goats reared around lead zinc smelter. *Small Ruminant Res.* 63(3): 309-313.

