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Short Communication

Acute toxicity of endosulfan and malathion on *Chironomus ramosus* (Insecta : Diptera : Chironomidae) from north Cachar hills, Assam, India

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Abstract: *Acute toxicity tests for the pesticides endosulfan and malathion on the larvae of Chironomus ramosus were conducted. Median Lethal Concentration (LC_{50}) values of endosulfan were 0.55 x 10^{-2}, 0.16 x 10^{-2}, 0.089 x 10^{-2} and 0.036 x 10^{-2} ppb respectively, while those for malathion were 0.139 x 10^{-2}, 0.054 x 10^{-2}, 0.019 x 10^{-2} and 0.0032 x 10^{-2} ppb respectively, at 24 , 48, 72 and 96 hr. Thus Chironomus ramosus larvae were more sensitive to malathion at all hours of toxicity tests than endosulfan.*

Key words: *LC_{50}, Chironomus ramosus, Endosulfan, Malathion*
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Introduction

A large number of unwanted substances reach to the fresh water systems along with agricultural runoff. Among these, pesticides play important roles in damaging fresh water ecosystems. Pesticides also reach to water bodies either by direct application or along with spray drifts, rainwater, sewage and industrial effluents. In addition to the direct impact of pesticides on aquatic life, bioaccumulation of contaminants through food chain in organisms is another important factor to be considered. Extensive investigations have been carried out all over the world including different parts of India for the effects of pesticides on both terrestrial and aquatic organisms (Ramana Rao *et al*., 1987; Cripe, 1994; Shanmugam *et al.,* 2000; Dey and Gupta, 2002; Rahman and Siddiqui, 2005; Holem *et al*., 2006; Venkataramana *et al.,* 2006; Singh and Singh, 2006, 2007; Johal *et al*., 2007; Ramaneswari and Rao*,* 2008; Choudhary *et al.,* 2008). Information on the toxic effects of xenobiotic substances on aquatic forms are rather scarce (Dey and Gupta, 2002) from North East India with no published account from North Cachar Hills district of Assam. Agriculture is the main economic activity of the district and a number of swamps, ponds and ditches are there adjoining the agricultural fields. The larvae of *Chironomus ramosus* are ubiquitous inhabitants of all types of water bodies of North Cachar Hills district. Members of the family chironomidae (Insecta: Diptera) are among the most tolerant insect groups and are considered good bioindicators of heavy metals such as Cd, Cu, Pb, Zn, acid mine drainage contaminated with As, and several pesticides (Kosalwat and Knight, 1987; Madden *et al.*, 1992; Harrahy and Clements, 1997; Martinez *et al.*, 2001; Sinha, 2001; Mousavi *et al*., 2003; De Bisthoven *et al.*, 2005). The present study, therefore, attempts to investigate the acute toxicity of an organochlorine pesticide, endosulfan and an organophosphorus pesticide, malathion, on the larvae of *Chironomus ramosus*. The farmers in the district commonly use these two pesticides to control various insect pests in the agricultural fields. It is also expected that such investigations using indigenous species would lead to the development of regional ecotoxicological databases for site-specific toxicity information (Buikema *et al.,* 1982).

Materials and Methods

Third instar larvae (6 to 7 mm) of *Chironomus ramosus* were collected from their natural habitats and acclimatized for 24 hr in laboratory conditions. The larvae were starved during this period. They were then exposed to graded concentrations of endosulfan and malathion ranging from 0.032-1.8 x 10^{-2} ppb, and 0.0018-0.56 x 10^{-2} ppb, respectively, by making appropriate dilutions from stock solutions of the two pesticides in dechlorinated water.

For determining LC_{50} values of the two pesticides, 10 larvae were placed in a PVC container of 200 ml capacity having 100 ml of the test solutions of a given concentration. No food was given during the 4-day exposure (Gupta, 1995). Mortality was recorded at 24, 48, 72 and 96 hr. Dead organisms were removed and test solutions was renewed every 24 hr. Each concentration was tested in 10 replicates.

Acute toxicities of endosulfan and malathion on *C. ramosus* were determined by estimating median lethal concentrations (LC_{50}) of each with the help of log-probit analysis (Finney, 1971; Buikema *et al.*, 1982).

Results and Discussion

Mean LC_{50} values of endosulfan and malathion at 24, 48, 72 and 96 hr for *C. ramosus* are depicted in Fig. 1, which reveals that the *C. ramosus* larvae were more sensitive to malathion than to endosulfan at all hours of toxicity tests. The 24, 48, 72 and 96 hr. LC_{50} values for endosulfan were 3.96, 2.96, 4.68 and 11.25 times more than those for malathion, respectively. Thus, malathion becomes more toxic with increasing exposure time up to 96 hr. One-way analysis of variance (Table 1) between the LC_{50} values of endosulfan and malathion also reveals significant differences, indicating that the two pesticides have distinctly different toxic effects on *C. ramosus* larvae.

Variations in the degree of toxicity of different pesticides have also been reported by other workers (Ramana Rao *et al.,* 1987).

Table - 1: Results of one-way analysis of variance (ANOVA) between 24-96 hr LC_{50} values of endosulfan and malathion

Parameter	d.f.	F-ratio	p
LC_{50} values of endosulfan and malathion	1.30	8.092	< 0.05

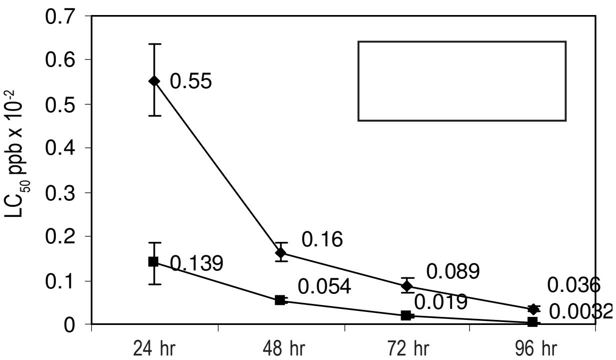

Fig. 1: Median lethal concentrations (LC_{50} + SD) of endosulfan and malathion at 24-96 hr for *Chironomus ramosus*

Thus the present study also points out the possibility that although organophosphorus pesticides may have less long term residual effects than that of organochlorines like endosulfan, their short term acute toxicity up to 96 hr is even more hazardous. *Chironomus ramosus* larvae were found to be much more sensitive to endosulfan than the tadpoles of three anurans, *viz.*, *Microhyla ornata, Limnonectes limnocharis* and *Bufo melanostictus* (Dey and Gupta, 2002). As aquatic insects are very important elements of food webs (Clements *et al.,* 1988) and *Chironomus* sp are known to be one of the most tolerant species of insects, the present investigation shows that extremely low concentrations of endosulfan or malathion in water may disturb the aquatic ecosystem as a whole. Chironomid larvae exposed to DDT and the herbicide Dacthal were found to exhibit morphological deformities (Madden *et al.*, 1992), while organochlorine, organophosphate, carbamate and pyrethroid pesticides were found to adversely effect their survival and certain biochemical processes (Ibrahim *et al.*, 1998). As the agriculture departments of this region frequently advocate the application of endosulfan and malathion at a concentration of 1.0 ppm for control of insect pests, our findings of the acute toxic effects of these two pesticides on non-target organisms at even sub-ppb levels put serious constraints on their continued use.

References

Buikema, A. L. Jr., B.R.Niederlehner and J. Cairns Jr: Biological monitoring. 4. Toxicity testing. *Water Res.*, **16**, 239-262 (1982).

Choudhary, Nisha, Rekha Goyal and S.C. Joshi: Effect of malathion on reproductive system of male rats. *J. Environ. Biol.,* **29**, 259-262 (2008).

Clements, W.H., D.S. Cherry and J. Cairns Jr: Impact of heavy metals on insect communities in streams : A comparison of observational and experimental results.*Canadian J. Fish. Aquat. Sci.,* **45**, 2017-2025 (1988).

Cripe, G.M.: Comparative acute toxicities of several pesticides and metals to *Mysidopsis bahia* and post larval *Penaeus duorarum. Environ. Toxicol. Chem.*, **13**, 1867-1872 (1994).

Dey, M. and A. Gupta: Acute toxicity of endosulfan on three anuran tadpoles. *J. Ecotoxicol. Environ. Monit.*, **12**, 61-65 (2002).

De Bisthoven, J., A. Gerhardt and A.M.V.M. Soares: Chironomidae larvae as bioindicators of an acid mine drainage in Portugal. *Hydrobiologia* **532**, 181-191 (2005).

Finney, D.T.: Probit Analysis. Cambridge University Press, London (1971).

Gupta, A.: The acute toxicity of lead to different larval stages of *Cloeon* sp (Ephemeroptera:Baetidae) and its significance in pollution revolution. *In*: Proceedings of 4th National symposium on environment (*Eds.*: A.R. Saundarrajan, L.V. Krishnan, D.S. Surya Narayanna, V. Rajagopal and R. Malhyarasu). BRNS, DAE. Govt of India.pp.75-77 (1995).

Harrahy, E.A. and W.H. Clements: Toxicity and bioaccumulation of a mixture of heavy metals in *Chironomus tentans* (Diptera: Chironomidae) in synthetic sediment. *Environ. Toxicol. Chem.,* **16**, 317-327 (1997).

Holem, R.R., W.A. Hopkins and L.G. Talent: Effect of acute exposure to malathion and lead on sprint performance of the western fence lizard (*Sceloporus occidentalis*). *Arch. Environ. Contam. Toxicol.*, **51**, 43-53 (2006).

Ibrahim, H., R. Kheir, S. Helmi, J. Lewis and M.Crane: Effects of organophosphorus, carbamate, pyrethroid and organochlorine pesticides and a heavy metal on survival and cholinesterase activity of *Chironomus riparius* Meigen. *Bull. Environ. Contam. Toxicol.,* **60**, 448-455 (1998).

Johal, M.S., M.L. Sharma and Ravneet: Impact of low dose of organophosphate, monocrotophos on the epithelial cells of gills of *Cyprinus carpio communis* Linn. – SEM study. *J. Environ. Biol.,* **28**, 663-667 (2007).

Kosalwat, P. and A.W. Knight: Chronic toxicity of copper to a partial life cycle of the midge, *Chironomus decorus*. *Arch. Environ. Contam. Toxicol.* **16**, 283-290 (1987).

Madden, C.P., P.J. Suter, B.C. Nicholson and A.D. Austin: Deformities in chironomid larvae as indicators of pollution (pesticide) stress. *Aquat. Ecol.,* **26**, 551-557 (1992).

Martinez, E.A., B.C. Moore, J. Schaumloffel and N. Dasgupta: Induction of morphological deformities in *Chironomus tentans* exposed to zinc-and-lead-spiked sediments. *Environ. Toxicol. Chem.* **20**, 2475-2481 (2001).

Mousavi, S.K., R. Primicerio and P.A. Amundsen: Diversity and structure of Chironomidae (Diptera) communities along a gradient of heavy metal contamination in a subarctic watercourse. *Sci. Total Environ.,* **307**, 93-110 (2003).

Ramaneswari, K. and L.M. Rao: Influence of endosulfan and monocrotophos exposure on the activity of NADPH cytochrome C reductase (NCCR) of *Labeo rohita* (Ham). *J. Environ. Biol.,* **29**, 183-185 (2008).

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

Rahman, M.F. and M.K.F. Siddiqui: Sub-chronic effectsof a phosphorothionate insecticide (R.P.R-II) on hemopoetic system and serum composition of male and female rats. *Toxicol. Environ. Chem.*, **87**, 107-117 (2005).

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

Sinha, R.K.: Biomonitoring of freshwater ecosystems. Water quality assessment, biomonitoring and zooplankton diversity (*Ed.*: B.K. Sharma). North Eastern Hill University. pp. 111- 117(2001).

Singh, P.B. and V. Singh: Impact of endosulfan on the profiles of phospholipids at sublethal concentration in the male *Heteropneustes fossilis* (Bloch). *J. Environ. Biol.,* **27**, 509-514 (2006).

Singh, P.B. and V. Singh: Endosulfan induced changes in phospholipids in the freshwater female catfish, *Heteropneustes fossilis* (Bloch). *J. Environ. Biol.,* **28**, 605-610 (2007).

Venkataramana, G.V., P.N. Sandhya Rani and P.S. Murthy: Impact of malathion on the biochemical parameters of gobiid fish *Glossogobius giuris* (Ham). *J. Environ. Biol.,* **27**, 119-122 (2006).

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