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TOXIC EFFECT OF COMMONLY USED SYNTHETIC PESTICIDES ON FRESH WATER FISH *CLARIAS BATRACUS*

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ABSTRACT
Deltamethrine, butachlore and mancozeb, synthetic pesticides contaminating aquatic ecosystems as a pollutant, was investigated in the present study for toxic effect. Toxicity tests are conducted to measure the effects of different pollutants on one or more species of organisms and in the form of LC50s, assist in the development and application of water quality criteria for the protection of the aquatic environment. Freshwater cat fish *Clarias batrachus* was exposed to these pesticides for 24 hrs, 48 hrs, 72 hrs and 96 hrs at 4 different concentrations. The 96h LC50 of Deltamethrine, butachlore and mancozeb are 0.06mg/l, 0.80mg/l and 33.43mg/l respectively.

KEY WORDS: Deltamethrine, butachlore, mancozeb, *Clarias batrachus*, toxicity

INTRODUCTION

The widespread use of pesticides in public health and agricultural programs has led to environmental pollution and health hazards, including cases of severe acute and chronic human poisoning, Bradberry *et al*., (2005). Pesticides are meant to kill a very narrow range of undesirable organisms but they are capable of harming non-target organisms inhabiting treated ecosystems where fish encounter with them and develop various metabolic abnormalities, Boateng *et al*,(2006). Fishes can serve as bioindicators of environmental pollution and therefore can be used for the assessment of the quality of aquatic environment (*Lopes et al*., 2001; Vernet, 2004) since they are directly exposed to chemicals resulting from agricultural production via surface runoff of water or indirectly through the food chain of ecosystem, Ateeq *et al*., (2002). The walking catfish, (*Clarias batrachus*), is a species of freshwater air-breathing catfish. It is a voracious eater which consumes food rapidly and this habit makes it a particularly harmful invasive species, Rajput *et al*., (2012). *Clarias batrachus* is generally considered to be one of the most important catfish species for aquaculture as well as for its economic value as food in almost all over India.

The widespread use of chemicals to control pest weeds has been recognized in agricultural practices, Farombi *et al*., (2008). Butachlor was the first rice herbicide to be introduced in India. Butachlor 2-chloro-N-(2, 6-diethylphenyl) acetamide is an herbicide that is widely used to control perennial grasses and some broad leaf weeds, Geng *et al*., (2005). The synthetic pyrethroids are among the most potent and effective insecticides available (Casida *et al*., 1983; Smith and Stratton, 1986). Synthetic pyrethroids such as azodrin, cypermethrin, deltamethrin, fenvalerate and mancozeb are used to protect many fruit, vegetable, nut and field crops against a wide spectrum of fungal diseases and rust. Deltamethrin and other pyrethroids have been found to be extremely toxic to fish (Balint *et al*., 1995; Datta, and Kaviraj, 2003; Delistraty, 2000; Eells *et al*., 1993; Svobodova *et al*., 2003; Szegletes, 1995; Viran *et al*., 2003), zooplankton communities (Gliwiez and Sieniauwska,1986; Kaushik *et al*., 1986; Tidou, 1992) and some beneficial aquatic arthropods, for example, lobster and shrimp (Bradbury and Coats, 1989; Srivastav *et al*., 1997). It has very broad spectrum control and is considered the most powerful of the synthetic pyrethroids because it is relatively stable and non persistent in the environment, Boateng *et al*., (2006). Mancozeb is a polymeric complex of zinc and manganese salts of ethylenebisdithiocarbamate (EBDC). It is commonly used for foliar application and seed-treatment in agriculture. It has been reported that mancozeb is not mutagenic (U.S. Environmental Protection Agency, 1987) or is only weakly mutagenic (E.I. DuPont de Nemours, 1983), and that is not carcinogenic, although it has caused cancer in experimental animals exposed to high doses (U.S. Environmental Protection Agency, 1987 and 1988).

MATERIALS AND METHODS

Experimental Pesticides:
Butachlore, a herbicide
Deltamethrine, an insecticide
Mancozeb, a fungicide.

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Experimental Animal

Freshwater catfish *C. batrachus* (35±5 g in weight and 16±2 cm in length) were collected from local outlets of Gorakhpur Distict. The collected fishes were maintained in glass aquaria containing 100 l de-chlorinated tap water for acclimatization to laboratory conditions for 1 week. The water in aquaria was aerated continuously and change every day. The fishes were fed daily on commercial fish food. Fish were subjected to a prophylactic treatment by bathing twice in 0.01% KMnO4 for 30 min at intervals of 24 h. The dead animals were removed from the aquaria to avoid any contamination. The physio-chemical properties of experimental water are- temperature-150C, pH-6.80-7.05, Dissolved oxygen-6.5-7.2 mg/L, Free carbon dioxide-4.5-6.5 mg/L, Bicarbonate alkalinity-105-109 mg/L.

Treatment condition for toxicity testing

Water parameters were within the following ranges: temperature 27-30^{0}C, pH 7.2-7.4, dissolved oxygen 6.5-7.0 mg/l, carbon dioxide 4.0-6.0 mg/l, alkalinity 105-109 ppm. Water was changed at every 24h.

Toxicity experiments were performed by the method of Singh and Agarwal, 1988. Ten experimental animal *C. batrachus* were kept in glass aquaria containing 6 Ltrs. dechlorinated tap water. Fishes were exposed for 24 hrs, 48 hrs, 72 hrs and 96 hrs at 4 different concentrations of Butachlore, Deltamethrine and Mancozeb. Six aquaria were set up for each dose, control animals were kept in similar condition without any treatment. Mortality was recorded after every 24 hrs up to 96 hrs exposure periods. Fishes shows irregular, erratic and sometimes jerky movement that was increase as exposure period increases. Dead animals were removed to prevent the decomposition of body in experimental aquarium, which may cause rapid death in the remaining population of snail. Toxicity data obtained from this study was computation through POLO computer program of Robertson et al., 2007.

RESULTS

The toxicity of these pesticides was time and dose-dependent. There was a significant negative correlation between LC values and exposure periods. Thus with increase in exposure periods the LC_{50} values decreased from 0.97mg/l (24h) to 0.80mg/l (96h), from 0.29mg/l (24h) to 0.06mg/l (96h) and from 37.50mg/l (24h) to 33.43mg/l (96h) in case of Butachlore, Deltamethrine and Mancozeb respectively (Table 1).

Table1: LC_{50} values (mg/L) of different concentrations of butachlore, deltamethrine and mancozeb with their fiducial limits against freshwater fish *Clarias batracus* at different time intervals.

	Butachlore		Deltamethrine		Mancozeb	
Exposure Perio	LC_{50} values	Limits LCL-UCL	LC_{50} values	Limits LCL-UCL	LC_{50} values	**Limits LCL-UCL**
24h	LC_{50}= 0.97	0.89-1.09	LC_{50}= 0.29	0.19-1.47	LC_{50}= 37.50	**35.91-40.18**
48h	LC_{50}= 0.92	0.83-1.02	LC_{50}= 0.22	0.07-0.56	LC_{50}= 36.46	**34.77-38.48**
72h	LC_{50}= 0.11	0.03-0.24	LC_{50}= 0.11	0.05-0.02	LC_{50}= 35.17	**33.12-36.72**
96h	**LC_{50}= 0.80**	**0.69-0.87**	**LC_{50}= 0.06**	**0.13-0.02**	**LC_{50}= 33.43**	**30.65-34.77**

- LCL - Lower confidence limit
- UCL - Upper confidence limit
- LC_{50} - Lethal concentration for 50 percent of the exposed fish

DISCUSSION

The biological magnification leads to the presence of residues of pesticides in human food and their subsequent consumption by humans. As the fishes are directly exposed to contaminants in water, these can act as good bio-indicators for the state of pollution in water bodies (Manna and Biswas, 1986). Generally aquatic organisms are chemically affected by three different classes of pesticides viz., organochlorine, organophosphates and carbamates (Edwards, 1973; Brown, 1978; Rand and Sam, 1985). Among them, organochlorines act as contact poisons which effect the central nervous system of the organisms, whereas organophosphates and carbamates inhibit the enzyme acetylcholinesterase.

Actually, butachlor an organochlorine compound and have greater inhibitory effect on photosynthesis and respiration of macrophytes, undesirable grasses and broadleaf weeds in rice fields (Jones and Winchel, 1984; Delistraty and Hershner, 1984; Jones *et al*., 1986). However, along with run-off this herbicide enters in the nearby fish ponds and its effect on bottom fauna and fishes in ponds have also been reported (Sarkar, 1991; Farah *et al*., 2004; Tilak et al., 2007). Environmental persistence and food chain movement of pyrethroid insecticides have been reported in some studies (Bolognesi, 2003; Das and Mukherjee, 2003).

Mortality caused by all the pesticides showed a significant positive correlation between dose and mortality. It may be due to increase of compound concentration in water resulted in more intakes of their active moieties in fish body. Data also show the significant negative correlation between LC values and exposure periods. It could be due to several factors, Goodmann *et al*., (1985) which may be acting separately or conjointly. Stability (life span) of active moieties in environment and their detoxification rate in animal body also alters the mortality and exposure periods, relationship (Mitra *et al*., 1978; Matsumura, 1985).

On the basis of the present investigations it may be concluded that these pesticides have toxic effect on non target organisms and care should be taken prior to use these pesticides on large scale.

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