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MORTALITY AND BEHAVIOURAL CHANGE OF *LEPIDOCEPHALICHTHYS GUNTEA* (HAM.) AFTER EXPOSURE TO MONOCROTOPHOS (MONOCIL)

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ABSTRACT

The toxic effect produced by pesticide, Monocil to hill-stream fish, *Lepidocephalichthys guntea* (Ham.) and its behavioural responses were studied. The experiment was designed to evaluate the toxicity of Monocil for 96 hours including non-lethal, sublethal (LC_{50} 96 hrs) and lethal (LC_{50} 96 hrs) concentrations. The mortality rate of the test fish was recorded at intervals of 24, 48, 72, and 96 hours. It was recorded that 22 ppm and 25 ppm were LC_{50} 96 hrs and LC_{100} 96 hours doses respectively. The major behavioural changes were prominent at sublethal (22 ppm) and higher doses while no apparent effect was observed at non-lethal (16ppm) dose. The prominent toxic effects of the pesticide were respiratory distress, paralysis, loss of equilibrium and finally death.

INTRODUCTION

Modern agriculture and industrial activities, though result in higher food production and economy, but also affect the environment. The pesticides and other undesirable chemicals ultimately reach the water bodies along with the rain water and destroy the quality of the water media causing imbalance to the environment leading to slow but steady deterioration of ecosystems, particularly the aquatic ones resulting into unwarranted mortality of aquatic fauna, in general, and fishes in particular as revealed by Konar (1975), Sadhu & Shafi (1988) and Singh et al. (1998). Regarding the effect of contaminated waters on hill-stream fishes, very little attention has been made by ecotoxicologists. In the present study attempt has been made to find out the toxicity of pesticide, Monocil in respect to mortality and behavioural responses of test fish, *Lepidocephalichthys guntea.*

MATERIALS AND METHODS

For toxicity test adult and healthy hill stream fish, *Lepidocephalichthys guntea* locally called "Nata" were collected from nearby market of Hazaribag, Jharkhand, India (Latitude 25°59' "N' and longitude 85°22 E) and maintained in the laboratory conditions after adopting usual procedure (Sadhu & Shafi 1988). For determination of toxicity, static bioassay experiment was conducted employing standard methods (APHA et al. 1985). The mortality rates for test fish at different concentrations of Monocil including non-lethal, sublethal (LC_{50} 96 hours) and lethal (LC_{100} 96 hours) concentrations at intervals of 24, 48, 72 and 96 hours were made. The mortality was recorded daily and the dead fish were immediately removed from the aquaria.

Pesticide : In the present experiment commonly used organophosphorus insecticide Monocil (Monocrotophos) manufactured by NOCIL (India), Mumbai was used. Chemically, it is a phosphoric acid dimethyl 1-methyl-3 (methylamino)-oxo-1-propenylester, (Z)-$C_7H_{14}NO_3P$, having the molecular weight 223.2. It is a systemic as well as contact poison in nature.

RESULTS

The test fish, *L. guntea* when exposed to various doses of Monocil exhibited somewhat abnormal, exciting and agonistic behaviour. The symptoms of restlessness were evident at sublethal and higher doses. However, up to non-lethal (16ppm) dose the fish were found normal, active and without any visible stress but during the initial period of exposure of sublethal (22ppm) and higher doses, the fish were highly distressed and exhibited occasional erratic jumping movement and floating upside down with head downwards. They showed faster and irregular movements between the normal movements. They preferred to lie at one place on the bottom of the aquarium making rapid opercular movements. Another behaviour noticed was gradual loss of buoyancy resulted in floating of fish upside down horizontally with their open mouth and gill opercula. Excessive mucus was also seen spreading all over the surface of the body and gill surface. During different time periods of exposure their movement slowed down, fish lost their balance and become lethargic. Ultimately there was reduced activity evidenced by vertical position for few minutes with anterior side trying to gulp air and soon they dropped to the bottom horizontally showing lack of sensitivity to the external stimuli. After some time their bellies turned upward and finally suffocated to death. The dead fish showed stretched fins.

The toxicity of Monocil in terms of sublethal (LC_{50} 96 hrs) and lethal (LC_{100} 96 hrs) were found out as shown in the Table 1 and Fig. 1. It is evident that 22 ppm and 25 ppm concentrations of Monocil represent the approximate LC_{50} 96 hrs and LC_{100} 96 hrs doses respectively for the test fish *L. guntea*. The non-lethal dose was recorded as 16 ppm.

DISCUSSION

On exposure to Monocil at sublethal and higher doses the test fish *L. guntea* showed many behavioural changes, such changes may be on account of dissociation and recombination of the pesticide in the media as well as in the body. Such effects of chemicals have also been reported earlier by Anderson (1971), Annes (1975), Sadhu & Shafi (1988) and Sadhu (1993). The abnormal behaviour

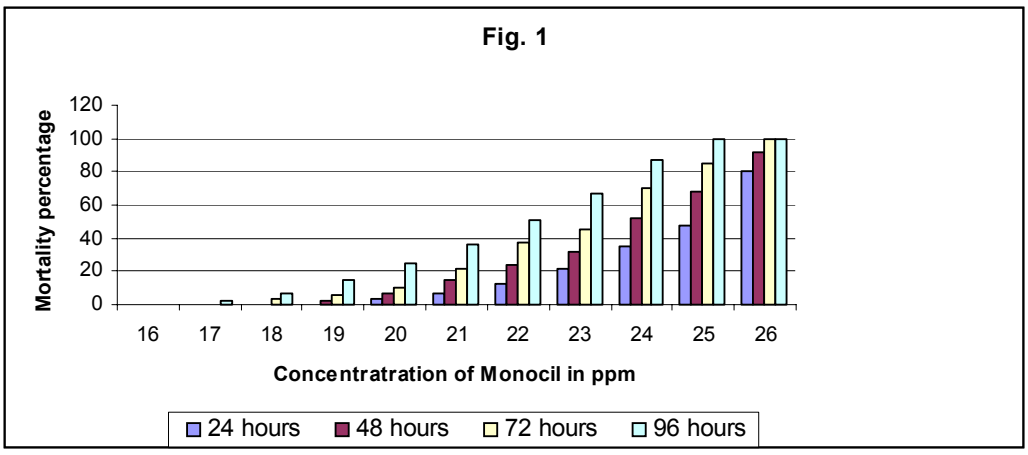

Fig. 1: Mortality percentage of *Lepidocephalichthys guntea* on exposure to different concentrations of the insecticide Monocil at 23 ± 0.34°C.

Table 1: Mortality percentage of the adult hill stream fish *Lepidocephalichthys guntea* on exposure to different concentrations of the insecticide Monocil at 23 ± 0.34°C.

Concentration in ppm	Mortality percentage average				Remarks
	24 h	48 h	72 h	96 h	
16 ppm	NIL	NIL	NIL	NIL	Non- lethal dose
17 ppm	NIL	NIL	NIL	2	
18 ppm	NIL	NIL	3	7	
19 ppm	NIL	2	6	15	
20 ppm	3	7	10	25	
21 ppm	7	15	22	36	
22 ppm	12	24	37	51	LC_{50} 96 hrs
23 ppm	22	32	45	67	
24 ppm	35	52	70	87	
25 ppm	47	68	85	100	LC_{100} 96 hrs
26 ppm	80	92	100	100	

shown by test fish may be attributed to impairment of nervous and sensory systems of the fish to pesticide as has been revealed by Schein & Cairns (1966) and Panigrahi & Konar (1990).

The movement of the fish to the bottom of the aquaria following the addition of Monocil clearly indicates the avoidance behaviour of the fish. The decrease of opercular movement and corresponding increase in frequency of surfacing of fish clearly indicate adaptive shifts towards aerial respiration. Heavy secretion of mucous over the body is attributed to the endocrine (pituitary) gland under toxic stress causing change in the number of mucus glands. The excessive secretion of mucous over the body and gill surface preventing easy exchange of dissolved oxygen, causing anoxia and death of fish. Such opinion were also been advocated by *S*ubathra & Karuppasamy (2003). Further, the accumulation and increased secretion of mucous in the fish exposed to Monocil may be adaptive response providing additional protection against corrosive nature of the pesticide to avoid its absorption by the general body surface. This agrees to the findings of Siva Kumar et al. (2006). Thus, behavioral characteristics are obviously sensitive indicators of toxicant effect. It is necessary to select behavioral indices of monitoring that relate to the organism behaviour in the field in order to drive a more accurate assessment of the hazards that contaminant may pose in natural systems.

The toxicity in terms of mortality percentage was recorded 22 ppm and 25 ppm for LC_{50} 96 hrs and LC_{100} 96 hrs respectively. The mortality percentage depends on dose, duration of exposure, type and nature of chemicals and size of species of the test fish. This report is at par with earlier findings. Palanichamy & Murugan (1991), Sadhu (1993) and Singh et al. (1998) revealed that an air breathing fish showed higher doses in comparison to gill-breathing fish. Again, the mortality in the present study increases with the increase of doses and the time period as revealed by Srivastava (1995) on *Heteropneustes fossilis*.

Whatever the degree of toxicity, it is an admissible fact that the compositional make up to the pesticide is responsible to varied results. In the present study the results obtained warranted to conclude that some preventive measures are necessary for saving the fishes, in general, and hill-stream fishes in particular.

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