Studies on the Toxicological Effects of Asulox-40 and Emisan-6 to Eggs and Early Life History Stages of *Sarotherodon mossambicus*

S. S. PANDYA and K. S. RAO

School of Studies in Zoology, Vikram University, Ujjain - 456 010 (M.P.)

Toxicological effects of Asulox-40 and Emisan-6 to eggs and early life history stages of *Sarotherodon mossambicus* were reported. 80% of egg hatching occurred in the controls, 1 p.p.m and 5 p.p.m concentrations of Asulox-40. 10 p.p.m. and 50 p.p.m. concentrations of the same toxicants had 70% and 60% hatchings while in Emisan-6 in the same concentrations the hatching were 70% and 40%. In 100 p.p.m. concentration of both the toxicants 20% incomplete hatching occurred. In Emisan-6 Lc 50 and Lc 100 values were recorded at 32 h and 96 h respectively in 10 p.p.m. concentrations. In Asulox-40 the same values were recorded in 24 h and 40 h respectively at 50 p.p.m. concentration. The fish activity during the experimental period showed initial hyper activity. It was established that the Emisan-6 is more harmful to *S. mossambicus* than Asulox–40. The harmless concentrations of these chemicals were 1.2 p.p.m. for Asulox–40 and 0.6 p.p.m. for Emisan-6.

Toxicity patterns of herbicides and fungicides are comparatively less understood so far. Knowledge of lethal concentration levels and toxicity patterns of new agro-chemicals is essential to establish the safe concentration levels for different fishes. Eggs and early life history stages of carps are especially prone to such toxicity. The early life stages (ELS) toxicity tests are currently being adopted as standards by the U.S. Environmental Protection Agency (EPA) (Benoit *et al.* 1982) as these provide quite sensitive evaluations of environmental contamination. These ELS studies on a wider scale would help in evolving standardised values for toxicity evaluation. The present report contributes towards these aspects and reports toxicity patterns of the previously un-tested herbicides Asulox-40 and fungicide Emisan–6 now being commonly used in agriculture in Ujjain (M.P.) India.

Materials and Methods

The herbicide Asulox-40 and the fungicide Emisan-6 were selected to study their toxicological affects to eggs and early life history stages of *Sarotherodon mossambicus*. Asulox-40 (4-amino benzene sulphanyl carbamate) belongs to the carbamate group of herbicides having 40% active ingredient and produced under the commercial name Asulox-40 by May & Baker Co. India Ltd., Bombay. Emisan-6 belongs to the organic mercurial group of fungicide having 6% active ingredient and produced under the commercial name Emisan-6 and manufactured by Excel Industries, Bombay, After several pilot experiments, the concentration, 1,5,10,50 and 100 p.p.m. were selected for both these toxicants for conducting ELS toxicity studies. Eggs of *S. mossambicus* collected at the Government Fish Farm Centre, after fertilization and water hardening were immediately subjected to the toxicity of the above chemicals. The eggs were allowed to develop continuously and hatch in the same toxicant solutions. The heart beat per minute was considered as an index of fish activity during experimentation. In long-term ELS studies the larvae were fed by dried prawn powder once in a day. The experimental waters, were analysed to study their physico-chemical characteristics as per the methods recommended by APHA, AWWA and WPCF (1975) the details of which are given in Table 1.

Table 1. *Physico-chemical characteristics of experimental waters*

Temp	pH	D.O. mg.L-1	Co_3 mg. L-1	HCo_3 mg.L-1	CL mg.L-1	Hardness mg.L-1	Calcium mg.L-1
20°C	8.6	7.5	12.00	260	31	142	14.43
(26–30)	(8–9)	(7–8)	(12–15)	(250–300)	(29–33)	(140–148)	(12–16)

Table 2. *Details of egg and ELS toxicity of Sarotherodon mossambicus due to Asulox-40 and Emisan-6*

Name of toxicant	Conc.	Lc 50 values in h	Lc 100 values in h	Percentage of hatching eggs
Asulox–40	Control	NR	NR	80
	1 p.p.m.	NR	NR	80
	5 ,,	104	NR	80
	10 ,,	64	136	70
	50 ,,	24	40	60
Emisan–6	1 ,,	120	NR	80
	5 ,,	88	NR	80
	10 ,,	32	96	70
	50 ,,	5	8	40

Harmless concentrations were calculated on the basis of the formula proposed by Heart *et al.* (1945).

$$C = (48 \text{ Lc } 50 \times A)$$

where

C = presumably harmless concentration
A = application factor
S = 24 h Lc 50/48 h Lc 50
A = 0.3

Results and Discussion

Eggs of *S. mossambicus* were kept in each aquarium. After few hours the unfertilized eggs became opaque and subsequently fungal growth could be seen on them. In the controls 80% of hatching could be recorded (Table 2).

The present data shows a reduction in the percentage of egg hatching from 80% in the control to 60% in the 50 p.p.m. concentration of Asulox-40. In Emisan-6, percentage of hatching ranged between 80% to 40%. while the basic toxicity patterns of herbicide were well explained by Hughs & Davis (1963), Hall (1967), Kearny & Kaufmann (1975), Walker (1964, 1965), Wellbrone (1969), Akiyama (1970) and Macek *et al.* (1976), the ELS toxicity tests, their methodologies and sensitivity rates to some extent were well discussed by Mckim (1977), Mecek & Sleight (1977), Eaton *et al.* (1978) Benoit *et al.* (1982) Gillnet & Roubaud (1983). Interesting observations were reported by Rao & Dad (1979) where the MEC (Most Effective Concentration) values were reported at far lower concentrations than in higher concentration with the herbicide Dalapon. Greater susceptibility of *Cyprinus carpio* eggs and ELS toxicity were reported earlier by Subdhedar & Rao (1980). In the present study the postgastrulation stages seem to be the most highly susceptible at higher concentration of Asulox-40 and Emisan-6 as it was observed that in most eggs the development gets impaired after this stage. ELS tests under long-term toxicity with Asulox-40 have recorded Lc-50 values at 104 h, 64 h and 24 h and Lc-100 values Nil, 136 h and 40 h at 5, 10 and 50 p.p.m. concentrations respectively. They show a comparatively lesser percentage of mortality of hatchings when

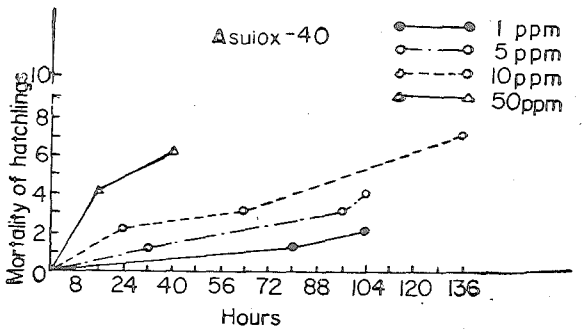

Fig. 1. Mortality of eggs and ELS toxicity with ASULOX–40

compared to eggs. The higher susceptibility of *S. mossambicus* eggs to Auslox-40 when compared to ELS toxicity stages has been established in this study.

Toxicity of Emisan-6, the organic mercurial fungicide has basically the same pattern as the herbicide Asulox-40 but is more toxic as the egg hatching has been reduced to 40% at 50 p.p.m. concentration of Emisan-6. Gillnet & Roubaud (1983) reported pre-hatching survival rates of trout and carp eggs with the fungicide carbondazim to be several grades higher when compared to the adult stages. High mortalities of eggs before activation and epiboly of egg were reported by the same authors. In the

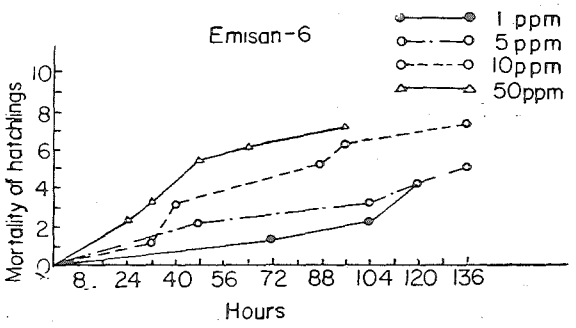

Fig. 2. Mortality of eggs and ELS toxicity with Emisan–6

present study pre-gastulation egg, mortalities did occur but post-gastrulation mortality percentage where higher. This could be due to the increasing thinness of the egg membrane which becomes more permeable for the toxicant to permeate. Kamaldeep & Toor (1980) and Mekim (1977) have well reviewed the long-term effects in the eggs of *S. mossambicus* in relation to abiotic factors. Activity of early embryos of *S. mossambicus* as recorded by heart beat and opercular movements shows the initial increase of activity in the toxicant which gradually gets stabilised. At 1 p.p.m. concentration of Asulox-40, stability of activity was achieved at slightly higher level (Figs. 3 and 4). But in 5 p.p.m, 10 p.p.m. and 50 p.p.m. concentrations the

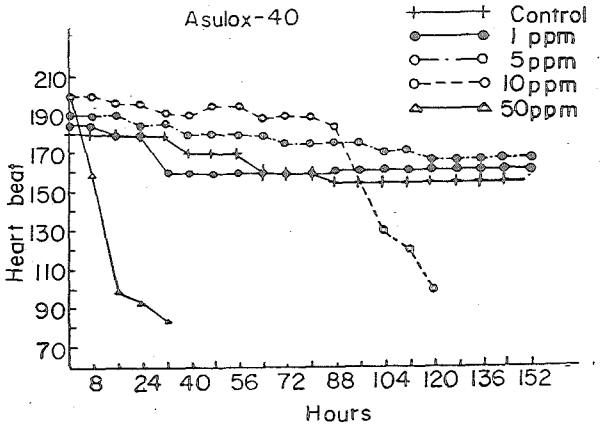

Fig. 3. Opercular movements under Asulox–40 toxicity

activity gradually decreased and stability could not be achieved. With Emisan-6 the activity decreased in all the concentrations and no activity equilibrium could be achieved by the larvae throughout the period of experimentation indicating toxicological effects of higher magnitude.

The harmless concentration of these toxicants were calculated on the basis of the formula, proposed by Heart *et al.* (1945). The harmless concentration of Asulox-40 and Emisan-6 were reported as 1.2 p.p.m. and 0.6 p.p.m. respectively in the present study.

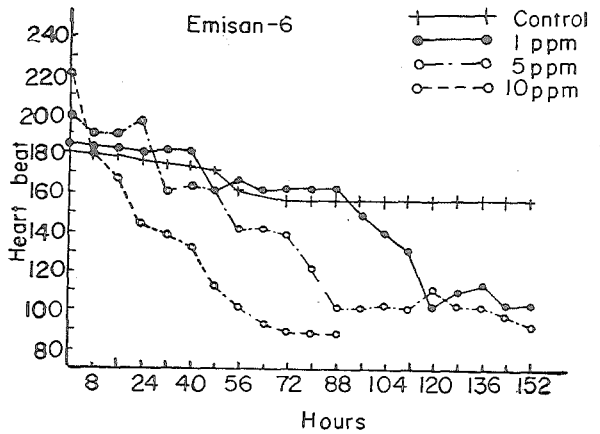

Fig. 4. Opercular movements under Emisan-6 toxicity

ELS bioassay studies on *S. mossambicus* were reported earlier (Table 2). Embryos between 2 to 4 days age are more susceptible. Similar observations were made by Pickering *et al.* (1972) in fat-head minows early life stages. Adelman (in Mayes *et al.* 1983) reported that age did not influence the sensitivity of fat-heat minows to pentachloro phenol, Mayes *et al.* (1983) while considering sensitivity to nine compounds to fat-head minows fry: and Benoit *et al.* (1982) have failed to establish any particular trend in fat-head minows ELS studies with four organic chemicals, even though pre-water hardened eggs are more sensitive to zinc exposure (Holcombe *et al.* 1979). The authors agree that particular trends of influence of age on toxicity can be established only after collecting more data for which further detailed studied are required.

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