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Toxic Effects of Synthetic Pyrethroids on *Cyprinus carpio* Linn. Eggs

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The use of pesticides has increased with the growing awareness about their utility in the agriculture production, animal husbandry, post harvest technology, public health and welfare of mankind. The pesticides, even when applied in restricted areas, are washed and carried away by rains and floods to larger water bodies like ponds and rivers and alter the physico-chemical properties of water (Richardson 1988). Heavy contamination of the pesticides in water in turn leads to oxygen depletion and cases of poisoning, and mass mortality of fishes are not uncommon. The recently introduced synthetic pyrethroids with multiple beneficiary qualities have attracted farmers to use these compounds in pest control. But these compounds are found to be highly toxic to fish (Bradury et al. 1985; David and Somasundram 1985; Ghosh and Chaterji 1987; Agnihothrudu 1988). Synthetic pyrethroids are neither fully metabolized nor quickly detoxicated and therefore create serious problem of residue accumulation. The objective of the present study was to evaluate the toxic effect of three commonly used synthetic pyrethroids on the eggs of Cyprinus carpio Linn.

MATERIAL AND METHODS

Synthetic pyrethroids used in the experiment are given in Table 1. Pyrethroid concentrations (on the basis of commercial formulations) used in tests were based on preliminary tests. Test solutions (having different concentrations of pyrethroids) were prepared by diluting a known volume of freshly prepared stock solutions in tap water, since these pyrethroids are mixed with water for field applications. The temperature, dissolved oxygen, pH and total hardness of water were 24±l°C, 5.5 ± 0.5 mg/L, 7.5±0.2 and 272±2 mg/L $CaCo_3$, respectively. In the egg-larval toxicity

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Table 1. Trade name of the synthetic pyrethroids

Commercial name	Trade name
Cypermethrin	Cyperkill 25 EC
Deltamethrin	Decis 2.8 EC
Fenvalerate	Sumicidine 20 EC

EC- Emulsified concentration

tests, about 100 eggs (attached to small pieces of vegetation), at early cleavage stages were placed in cylindrical glass jars (15 cm height X 10 cm diameter) containing 1 L of the test solutions. There were three replicates for each concentration and control. Eggs were examined every twelve hr until hatching was complete. Dead eggs were recorded and removed when observed. The time when more than 50% of eggs at a given concentration had hatched, was recorded as mean hatching time. The total number of viable hatch was recorded 2d after the completion of hatching.

RESULTS AND DISCUSSION

Analysis of hatching of eggs and viable hatch (Table 2) showed concentration related effects. 100% viable hatch was observed at 0.00001 mg/L concentration of all the three pyrethroids. 100% mortality of eggs and larvae was observed at 40 mg/L concentration of cypermethrin and at 20 mg/L of both of deltamethrin and fenvalerate. Higher concentration of pyrethroids arrested the development of eggs prior to the closure of blastopore and heavy mortality of unhatched embryos occurred during these stages, thus indicating the greater sensitivity of younger embryonic stages (before gastrulation) to pyrethroids. Similar observations have also been made by Malone and Blaylock (1970) and Kaur and Dhawan (1993) in C. carpio following exposure to other pesticides.

C. carpio eggs exposed to different concentrations of three pyrethroids yielded many inactive and some abnormal (crippled and distorted) larvae, which died within 1-2 days of hatching, thus reducing the viable hatch significantly (Table 2). The abnormal larvae exhibited vertebral column flexure, enlarged yolk and pericardial sacs, and stunted tail. These morphological deformities do not seem to be pollutant specific since the similar malformations have been produced in fish embryos by heavy metals, detergents, halogenated organic compounds, some petroleum fractions and natural stress conditions such as low pH, higher temperature, high salinity and low dissolved oxygen (Rosenthal and Alderdice 1976; von Westernhagen 1988;

Table 2. Effect of synthetic pyrethroids on the eggs of C. carpio

Concentration (mg/L)	Cypermethrin		Deltamethrin		Fenvalerate	
	HA(%)	VH(%)	HA(%)	VH(%)	HA(%)	VH(%)
0.00001	100	100	100	100	100	100
0.0001	96	96	92	92	96	96
0.001	95	95	85	85	94	94
0.01	91	91	81	81	91	80
0.1	88	88	76	73	74	32
1	72	69	58	52	63	11
5	65	53	43	0	58	0
10	45	28	28	0	44	0
15	40	24	11	0	19	0
20	34	19	0	-	0	-
25	31	18	-	-	-	-
30	23	12	-	-	-	-
35	12	6	-	-	-	-
40	0	-	-	-	-	-

HA-Hatching, VH-Viable hatch

Kaur and Dhawan 1993). Little is known about the toxic mechanism of pesticides during embryonic development. Probably, these malformations and developmental abberations are ultimately caused by a blockage of the energy transfer system leading to an arrestment of respiration and differentiation or to dedifferentiation (von Westernhagen 1988).

The comparison of data pertaining to hatchability and viable hatch (Table 2) revealed that at 5 mg/L concentration of cypermethrin, 65% of eggs hatched and 53% of hatched larvae were viable but with the same concentration (5 mg/L) in case of deltamethrin and fenvalerate, respectively 43% and 58% of eggs were hatched but no larvae was viable. Further, among deltamethrin and fenvalerate, 1 mg/L concentration of deltamethrin resulted in 52% viable hatch but the same concentration (1 mg/L) of fenvalerate resulted in only 11% viable hatch. These observations and those based on a 50% viability revealed that of the three tested pyrethroids, fenvalerate was most toxic followed by deltamethrin and cypermethrin. Further, laboratory and field studies are needed for the development of selective toxicants and methods and timings of application to minimize their effects on fish.

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