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Research Paper—Zoology

Acute Toxicity of Sevin Concentration on Mortality and Behaviour of Freshwater Fish; Barilius barila

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A B S T R A C T

Acute toxicity of the sevin on the freshwater fish; Barilius barila was studied with different concentration of sevin and time periods. The lethal concentration LC50/96 hrs for the fish Barilius barila is 0.0070% in test solution. The behavioural response of fishes to different concentrations of sevin was noted on the basis of definite symptoms as (1) Un-coordinated swimming movements, (2) Hyper excitability, (3) Restlessness, (4) Reflected by erratic or fast swimming, (5) Increased opercular and surfacing activity, (6) Spreading of pectoral and pelvic fins.

Keywords : Acute toxicity, sevin, Barilius barila

Introduction

The pesticides produces good many results in the control of pests, their harmful effects on the non-target animals are not ruled out. The pesticides leave residues in water and soil several days after their spray. Most of the detergents and pesticides are not readily degradable and remains in water for a considerable period adversely affecting fishes and other aquatic animals. Considerable information is available on the toxicity of these compounds and chemicals to various aquatic organisms (Henderson et.al. 1959, Verma et.al. 1980) but very little work has been done in India to evaluate the acute toxicity by bioassay on freshwater fishes.

Behaviour is usually a very complicated phenomenon through which the animal capable of adjusting it various functions to a constant or changing environment. Physiologists have mainly approached this phenomenon by starting at the bottom with detailed studies of relatively simple behavioural components i.e. reflexes locomatory or vegetative automatisms and influence of definite parts of the nervous system or endocrine system. Pesticides leave residues in water and mud several days after spray in the crops fields. This gives a constant threat to the non-target organisms especially to the fishes because pesticides are known to alter their behavior pattern (Anderson 1971).

Acute toxicities have been measured for many species in a variety of ecological systems and most of the commonly used pesticides against Rainbow trout, Blue gills, Sun fish and the gaps are being filled for other species, such as channel fish, some cyprinids and salmons (Chichelter, 1965). In many cases the methods which were developed to evaluate the acute toxicity of industrial wastes to fish. Acute toxicity bioassay was found with malathion in Channa punctatus (Pandey et.al. 1976). Acute toxicity of some pesticides and a few inorganic salts to the mosquito fish Gambusia affinis have been studied (Joshi and Reg, 1980; Tilak et.al. 1980) also found LC50 values when the fish Mystus vittatus was exposed to three pesticides sumicidins; Monitor and orthenen. (Bakthavalusalam and Srinivasa Reddy 1982) studied the toxicity and behavior responses of fish, Anabus testudineus when exposed to pesticides (Sing and Srivastava, 1982) observed LC50 values of Indian catfish Heteropneustes fossilis, while exposed to mixture of Aldrin and Formalthion; Methyl parathion and formation Endosulfan and Baygon etc. (Sharma et.al., 1983) were studied the effect of Malthion on the mortality of fish Clarias batrachus.

However, on such data are available on these lines in Barilius which is found in the river Godavari near Nanded. Hence, the present study on effect of sevin on mortality and behavior was undertaken.

Material and Methods

Barilius barila were collected from river Godavari and brought to the laboratory. The fish weighing between 4 to 5 gms and of same size and weight were selected and acclimatized in plastic pools in the laboratory. Water was replaced daily after feeding the fish. They were divided into different groups each containing ten fishes. During experimentation fishes are not feeds. The method was recommended by the committee on methods for toxicity tests with aquatic organisms (1975) were followed.

The stock solution of sevin was prepared in acetone and then it was diluted with water to get the test solution of required concentrations. Static bioassays without aeration and with the toxicant added to the test medium at the beginning of the test were conducted in 20 litre glass jars containing 6 liters of de-

chlorinated water. After appropriate toxicity range of the test solutions were determined by preliminary testing. Concentrations of sevin ranging from 0.001 to 0.012 % for Barilius barila were prepared. The observations on survival were made after 24, 48, 72 and 96 hrs. LC50 (Concentration required for 50% mortality) was calculated according to (Litch-field and Willcoxon, 1949) by Graphical method.

To study the changes in behavior pattern, swimming movements, hyper excitability; opercular and surfacing activity and movements of pectoral pelvic and caudal fins were observed.

Results

Acute Toxicity with Sevin :

Table No. 1 gives the acute toxicity data with various concentrations of sevin to which Barilius barila was exposed.

Symptoms :

Sub-groups 2 and 3 :- No changes in behavior were observed in the fishes when exposed 2nd and 3rd concentrations of sevin. There was no mortality within 96 hrs.

Sub-group 4 :- The fishes exposed to subgroup 4th showed uncoordinated movements which were followed by hyperactivity with slight increase in the opercular movements and swimming movements and 10% mortality was found within 96 hrs.

Sub-groups 5 to 7 :- The fishes exposed to sub-group 5, 6 and 7 showed bottom swimming with uncoordinated movements which were followed by hyperactivity with increase in the rate of opercular movements and swimming movements and 20%, 30% and 40% mortality was found within 96 hrs.

Sub-group 8 :- The fishes when exposed to this sub group showed hyper excitability and surfacing activity for 10 to 12 hrs after exposure and also with increase in the rate of opercular and swimming movements and decrease in surfacing activity, rate of opercular movements and swimming movements after 12 hrs and found 50% mortality within 96 hrs.

Sub-groups 9 and 10 :- The symptoms similar to that of sub-group 8 with hyper excitation sudden surfacing with fast locomotary activity and rate of opercular and swimming movements increases and after 12 to 16 hrs there was change in colour of the body and found mortality 60% and 10% within 96 hrs exposure.

Sub-groups 11 to 13 :- The symptoms similar to the symptoms observed in sub-groups 9 and 10 with hyper excitation, sudden surfacing, fast locomatory activity and rate of opercular and swimming movements increases upto 10 to 12 hrs and after 22 hrs the fishes came to surface and there was change in colour of the body after 48 hrs. Then there was decrease in the rate of opercular and fins movements and found mortality 80%, 90% and 100% respectively within 96 hrs.

Discussion

Acute toxicity tests are generally used to determine the level of toxic substance that produce an adverse effect on a specific percentage of the test organisms in short period of time. An acute dose of a pesticide can cause a biological system to oscillate outside its normal range of variation.

Most of the toxicological studies begin with acute toxicity test to learn the kind and duration of illness associated with fatal injury and the magnitude of the acute toxicity is basic to toxicological investigations. The 50% effect is the most reproducible measure of the toxicity of a toxic substance to a group of test organisms and 96 hrs is often a convenient reasonably useful exposure duration.

The straight forward static test has been widely adapted by many authorities (Doudroff et.al. 1951; Henderson and Taswell) concentration LC50 for the organisms to a particular test is necessary for determination of safe concentrations.

The bioassay results have shown that the toxicity of pesticide to Barilius barila was a function of a concentration and duration of exposure. The LC50 for sevin to B. barila was 0.0070% which is more resistant to sevin than Barilius Bendelisis and Barilius burna (Kamble 1984) and then Labeo rohita (Verma et.al. 1981).

The behavioural response of fishes to different concentrations of sevin was noted on the basis of definite symptoms of uncoordinated movements, hyper excitability, restlessness, reflected by erratic or fast swimming and opericular movements. These symptoms were clearly noticeable in Barilius barila in sevin higher concentrations. The fishes frequently deshed against the wall of experimental glass jars, suggesting the impairment of sense of balance and subsequently, the fish activities becomes progressively lethargic. Eventually all fish lost their balance, possibly due to disorder in central nervous system, discernible by the jerky movements of fishes before death. The fishes turned pale yellow in the higher concentration of sevin. These symptoms were more clearly noticeable in Barilius barila when exposed to sevin concentrations, similar type of observations were observed when Sacobranchus fossilis and Channa punctatus was exposed to different concentrations of syndeis (Verma et.al. 1980) same observations were recorded when fishes were exposed to organochlorine, organophosphate and carbanate compounds (Holden 1965; Kerswill and Edwards 1959; and Saunders 1969).

Behavioural responses after exposure of fishes to insecticides are in agreement with those observed earlier (Carter 1971; Wildish et.al. 1971) according to them the action of low doses of insecticides starts at sensory cells then reaches the central nerve synapses and finally influences the motor neurons while high concentrations directly act on the motor nerves.

However these studies could not establish a linear relationship between the death of fish and degree of brain inhibition. But (Miysumato et.al. 1963b) were suggested that inhibition of brain ACHE is more important for appearance of toxic symptoms with pesticides. The findings recorded here show that the activity levels of ACHE decrease at the concentrations of insecticide increase. Hence, it can be concluded that there are specific difference to tolerance for the insecticide sevin.

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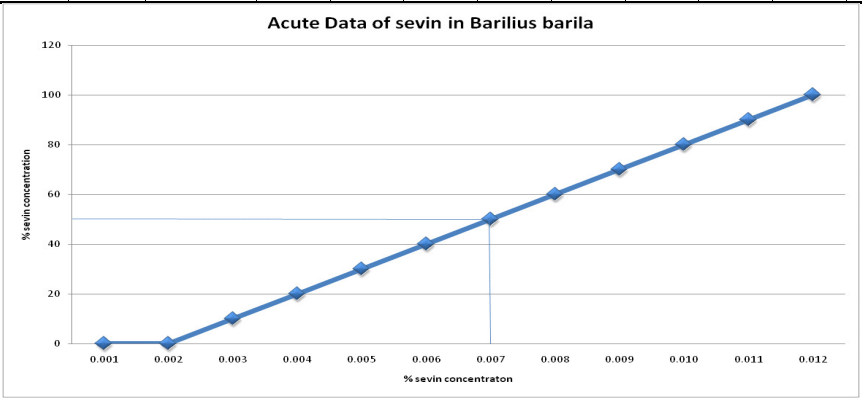
Sub-group no.	No. of fishes exposed	Sevin concentration %	Mortality noted after time intervals									%
			30	30 to 60	1 to 4	4 to 8	8 to 12	12 to 24	24 to 48	48 to 72	72 to 96	
1	10	Control	-	-	-	-	-	-	-	-	-	0
2	10	0.001	-	-	-	-	-	-	-	-	-	0
3	10	0.002	-	-	-	-	-	-	-	-	-	0
4	10	0.003	-	-	-	-	-	01	-	-	-	10
5	10	0.004	-	-	-	-	-	01	01	01	-	20
6	10	0.005	-	-	-	-	01	-	01	01	-	30
7	10	0.006	-	-	-	-	01	01	02	-	-	40
8	10	0.007	-	-	-	01	02	01	01	-	-	50
9	10	0.008	-	-	-	01	02	01	-	02	-	60
10	10	0.009	-	-	-	02	01	01	01	01	01	70
11	10	0.010	-	-	01	01	02	01	-	02	01	80
12	10	0.011	-	-	01	02	01	01	01	01	01	90
13	10	0.012	-	-	-	02	01	01	02	02	02	100



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