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BIOASSAY TRIALS WITH A FEW ORGANIC BIOCIDES ON FRESHWATER SNAIL, *LYMNAEA ACUMINATA* (MOLLUSCA : GASTROPODA)

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ABSTRACT

Biocides used for controlling the various pests ultimately enter into different water bodies and create problems for aquatic life therein. As the species of freshwater gastropod, *Lymnaea acuminata* is of much economic value, in the present work endrin and dimecron are used to know how they affect the snails when they are put in the toxic environment at different concentrations and at different time intervals, and also the relative toxicity of these biocides alongwith the susceptibility of the said species of the snail for these biocides. The values of lethal concentrations are 0.0075 and 0.009 ppm. The values of presumable harmless concentration can be considered for controlling the water pollution problem by these biocides. Metabolic changes in snails due to the effect of biocides are noted. The pH of the blood has changed to 4.3 and lactic acid accumulation increased to about 25 times as compared with that of normal snail. Due to the lowering of circulatory efficiency, the rate of heart beat dropped to seven beats per minute.

INTRODUCTION

Several biocides being effective in controlling insect pests, there has been rapid development of new ones. Ultimately these biocides find their way from different sources in the rivers, streams and ponds and create problems for aquatic life living therein. The wide use of biocides is unavoidable but the conservation of the natural water resources from pesticidal pollution is equally of utmost importance for the protection of aquatic life. Various methods have been devised to test the toxic reactions more accurately in the laboratory. Cope (1966) found that the toxic values of insecticides differ greatly from one animal to another.

A perusal of literature reveals that very little work has been done so far on the toxic effects of pesticides on molluscs. Hoffman *et al.* (1949) studied the effect of D. D. T. spray on some terrestrial snails and slugs. Loasanoff (1960) investigated the effects of pesticides on marine molluscs. Davis (1961) made observations on the effect of some pesticides on eggs and larvae of oysters (*Crassostrea virginica*) and clams (*Venus mercenaria*), but the freshwater molluscs have been left untouched so far. To fill up this lacuna, recently Agrawal (1977) studied the toxicity of nuvacron on some freshwater species of gastropods. As the species of freshwater gastropod such as *Lymnaea acuminata* is of considerable economic importance,

in the present work the bioassays have been conducted with endrin and dimecron to know how the proposed pesticides affect the snails and what metabolic changes occur in the snails when they are put in the toxic environment at different concentrations and at different time intervals. This study will also evaluate the relative susceptibility for these biocides. The study will decidedly help in controlling the pollution problem caused by these biocides.

Material and Methods

The living specimens of this freshwater gastropod were collected from Budagar tank situated on Jabalpur-Katni road (23°.20′ N. latitude and 80° E. longitude). The shells were measured with vernier callipers reading to 0.1 millimetre. Specimens were kept in a glass trough containing three litres of tap water, which was dechlorinated by evaporation method. The experiments with dimecron

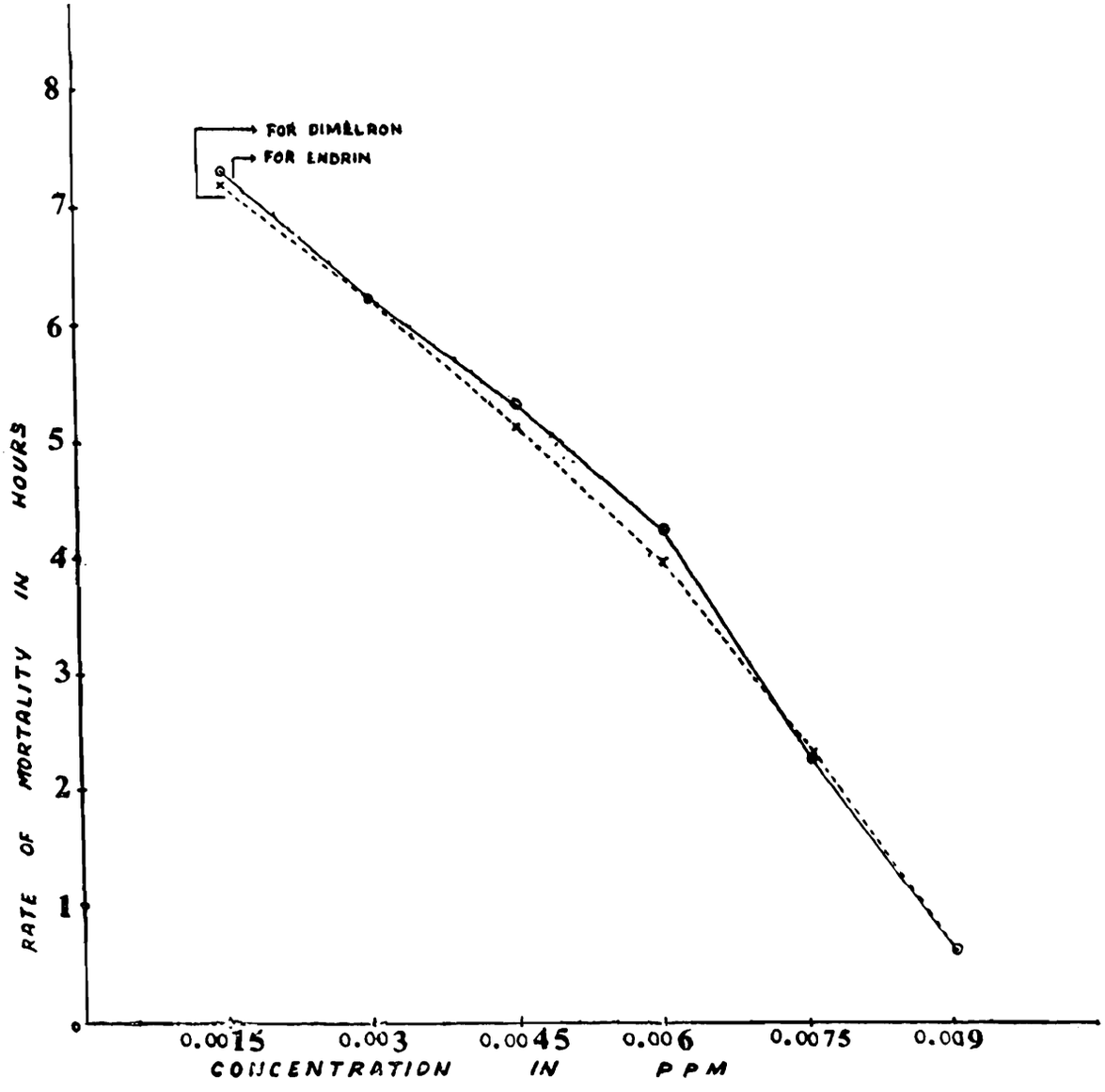

Fig. 1. Graph showing the rate of mortality in *Lymnaea acuminata* at varying concentrations of Endrin and Dimecron

were performed at room temperatures (18°C to 22.5°C) and with endrin at temperatures (22.5°C to 32°C) to which the test gastropods were acclimatized for two to three days. The test animals were not allowed to feed during the test period with an idea that such feeding might increase the rate of metabolism and the excretory substances may influence the toxicity of the test solution. These specimens of different sizes were exposed to various concentrations of endrin and dimecron and their responses were observed for 24 to 48 hours. Simultaneously control experiments were also undertaken with the same number of snails, but with no insecticide. The experimental media were not renewed and they were not aerated artificially during the investigation. Replicate experiments were also done. The biocide was thoroughly mixed with water and sprayed by syringe.

For the study of metabolic changes in the snail, the lactic acid content was determined by the method of Barker and Summerson (1941) and glycogen by the method recommended by Good *et al.* (1933). pH of the blood was seen on pH meter.

OBSERVATIONS

When varying concentrations of these chemicals were sprayed (see tables 1 and 2) they produced lethal effects. The snails respond immediately after their introduction into the water. The behavioural response to gastropods on contact with these insecticides is immediate at higher concentration and slow at lower concentration. The immediate reaction at higher concentration involves excitement and swimming becomes irregular. The respiration rate becomes much slower preceding death. The response to touch also decrease progressively. Animals showing the first sign of insecticide poisoning did not survive after it is transferred to freshwater. Before the spray, the snails show normal behaviour, protruding their organs such as foot, tentacles, visceral mass etc. Some of them got attached to the walls of the glass trough while some others were found sticking with other specimens. As soon as the insecticides were sprayed, there was a brisk reaction—some of the snails toppled down from the walls of the glass trough and got separated from each other. They started retracting inside the shell immediately. In all such cases the epithelial tissue of the gill lamellae becomes thicker.

It was observed that the animal lost the sense of equilibrium and orientation. The effect of toxicity is more marked in smaller specimens having thinner shells. In lower concentrations of both the biocides. all the above mentioned effects were visible but to lesser extent.

With dimecron (Table 1), it was observed, that animals excreted more faecal matter after the spray of chemical. Some of the specimens were seen floating with their expanded organs even after 1½ hours of the spray. The snails tried to crawl up the walls of the trough.

The behaviour of snails after the spray of endrin (Table 2) was different. All the specimens secreted slimy substance. Snails were seen floating with their expanded organs even after two hours of the spray.

However, in the control experiments, no mortality of the snail was observed. The snails showed normal behaviour.

The following metabolic or physiological changes were noted :

(i) the pH of the blood has changed to 4.3 ;

(ii) no change in the calcium and magne-

TABLE 1. Estimation of lethal doses of dimecron for *Lymnaea acuminata*

Experiment number	Length (in mm)	Diameter (in mm)	Volume of water in which the gastropods were treated (in litres)	TL m percentage concentration ppm	Rate of mortality Hours	Minutes
1.	17.0	8.5	3	0.0015	7	15
	13.5	6.0	,,	,,	6	45
	16.5	8.5	,,	,,	7	0
2.	13.5	7.0	,,	0.003	6	10
	16.0	8.0	,,	,,	6	15
	14.5	7.5	,,	,,	6	00
3.	20.5	10.0	,,	0.0045	5	10
	17.0	8.5	,,	,,	5	00
	11.5	5.0	,,	,,	4	45
4.	17.0	8.5	,,	0.006	4	00
	15.0	7.5	,,	,,	4	00
	12.5	6.0	,,	,,	3	55
5.	16.5	8.5	,,	0.0075	2	10
	14.0	6.5	,,	,,	2	00
	13.5	7.0	,,	,,	2	00
6.	15.0	8.0	,,	0.009	0	30
	17.5	8.5	,,	,,	0	35
	13.0	6.5	,,	,,	0	25

TABLE 2. Estimation of lethal doses of endrin for *Lymnaea acuminata*

Experiment number	Length (in mm)	Diameter (in mm)	Vol. of water in which the gastropods were treated (in ltrs).	TL m percentage concentration ppm	Rate of mortality Hours	Minutes
1.	13.5	8.0	3	0.0015	7	20
	16.5	8.5	,,	,,	7	25
	14.0	6.5	,,	,,	7	20
2.	15.5	8.0	,,	0.003	6	10
	17.0	8.5	,,	,,	6	15
	12.0	6.0	,,	,,	6	00
3.	17.0	9.0	,,	0.0045	5	20
	13.5	6.0	,,	,,	5	15
	16.0	7.5	,,	,,	5	20
4.	20.0	9.5	,,	0.006	4	10
	11.5	5.0	,,	,,	3	50
	16.5	8.0	,,	,,	4	00
5.	18.0	9.0	,,	0.0075	2	15
	15.5	7.5	,,	,,	2	05
	16.0	7.5	,,	,,	2	10
6.	17.0	8.5	,,	0.009	0	35
	14.5	7.5	,,	,,	0	30
	18.0	8.5	,,	,,	0	35

sium content of the blood as compared with that of normal snail ;

(iii) an increase in the lactic acid accumulation to about 25 times as compared with that of normal snail.

To see the effect of biocides on the circulatory system, the snails subjected to biocides were opened and kept in a petri dish containing pila ringer (Lal and Agrawal, 1968). The rate of heart beat was seven beats per minute while in the normal snail the rate is about 25 beats per minute. This shows decrease in the cardiac activity. Hence one of the significant changes of the toxic effect is the lowering of the circulatory efficiency of the body fluids. This indicates the non-utilization or non-availability of the energy-producing systems needed for the physiological activity of organs such as the heart.

DISCUSSION

Both the biocides are quite toxic to *Lymnaea acuminata* (Fig. 1). In all the cases, mortality was maximum at 0.0075 and 0.009 ppm concentrations. This does not support the view of Cope (1966) who compared the relative toxicities of some insecticides to other invertebrates and fish and found that the values differ greatly from one animal to another. It is really difficult to define particular factor responsible for mortality. According to Ellis (1937) the insecticides may affect the aquatic fauna in the following ways :

(i) by causing respiratory and circulatory interference ;

(ii) by specific toxic action , and

(iii) toxic action after absorption through the gastro-intestinal wall.

Mathur (1972) pointed out that fishes, subjected to insecticides, die owing to histopathological changes. It seems that the primary target is the circulatory system where an apparent stasis and congestion is followed by the appearance of precipitated material. This material probably represents a product from damaged erythrocytes. It, probably, severely compromised the circulatory function and potentially results in anoxia as well as deficiencies of other blood functions. It can be considered that in the present study also the metabolic changes occurred due to such anoxic condition developed and the gastropods mortality by dimecron and endrin may also have occurred due to such changes. The insecticides swallowed with water, might have damaged the intestinal mucosa, due to the free exchange of ions between gut and submucosal capillaries. The respiratory epithelium of these snails was also destroyed by acute exposure.

From the observations, it is clear that both the biocides affect the snail. It is felt that whole of the aquatic population needs a thorough study and their behavioural activities towards the different pollutants. However, the observations indicate that values of lesser than 0.0075 ppm concentration are not so dangerous for the snail population.

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