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# Toxicity to and Oxygen Consumption of the Freshwater Snail *Thiara (Stenomelania) torulosa* (Bruguiere) in Relation to Organophosphorus Insecticide Exposure

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Insecticides have been receiving tremendous attention because of the effects of pollution on the entire ecosystem. Due to the immense use of pesticides on crops and forests, the water runoff pollute the rivers, lakes and other water bodies causing serious problems to the non-target organisms.

For effective eradication of pests various formulations have come into use in recent times. The most commonly used organophosphate insecticides are phosphamidon, monocrotophos and dichlorvos. However, their effect on non-target organisms and the resulting imbalance in the ecosystem have not been well understood. It is therefore important to assess the relative toxicity levels of these insecticides on non-target organisms as well.

In the present investigation a study of the toxicity and the effect on the oxygen uptake, which is at the base of all physiological processes, has been made in relation to these pesticides on a fresh water snail Thiara torulosa.

## MATERIALS AND METHODS

Specimens of Thiara torulosa were collected from unpolluted fresh water streams and acclimatized to laboratory conditions for 1 week in glass tanks ($30\pm1^{o}C$). Toxicity tests were conducted employing renewal techniques as recommended by US EPA (1975). The technical grade phosphamidon (94.7%), monocrotophos (77.9%) and dichlorvos (97.19%) were obtained from Ciba-Geigy Ltd, Bombay. Standard solutions of 1 mg/ML (wt/vol) of each insecticide were prepared in acetone. Animals

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measuring 3.0 to 3.5 cm in length were selected for experimentation in batches of 10 at each concentration level. They were maintained in 2-L capacity glass tanks. Experiments were repeated till the percentage mortality in each experimental concentration was constant. Pilot experiments were conducted to choose concentrations which resulted in a mortality range of 5 to 95%. The periods of exposure in the study were made constant by exposing snails to insecticides for 24, 48, 72 and 96 h and the data collected accordingly were pooled. Oxygen uptake measurements were made employing the method of Ganapati and Prasada Rao (1960). Oxygen consumption was measured before and after 24 h of exposure to various concentrations of the three insecticides. Single animals were used in all the experiments. Wet weight of the snail was determined to the nearest milligram on an electrical balance. The results were expressed as the average values of ten experiments at each concentration. Students 't' test was used to find out the significant levels (Snedecor and Cochran 1967). $LC_{50}$ values were calculated by using unweighted regression method of probit analysis (Finney 1971). The difference between observed and calculated values were tested for significance applying Chi-square test.

## RESULTS AND DISCUSSION

The results obtained on dose mortality studies of the three organophosphate compounds on Thiara torulosa reveal that the animals react differently to the different insecticides. It is clear from the results (Table 1) that the $LC_{50}$ concentration was relatively high for monocrotophos and low for phosphamidon and dichlorvos.

Oxygen consumption values in respect of the three insecticides showed a significant increase ($P = 0.05$) at sub-lethal concentrations (Fig. 1). However, above the $LC_{50}$ concentrations there is a precipitous fall in oxygen consumption following a metabolic breakdown.

The percentage mortality of Thiara torulosa increased with increase in concentration of all the three insecticides tested. While it is evident that the three insecticides tested are toxic to the snail, the relative toxicity of the various compounds show an increasing trend for 96-h $LC_{50}$ values as shown below:

Phosphamidon > dichlorvos > monocrotophos

Concentrations for a 24-h period of exposure of the snails are significant. However, prolonged exposure to sub-lethal concentrations might cause disorders due

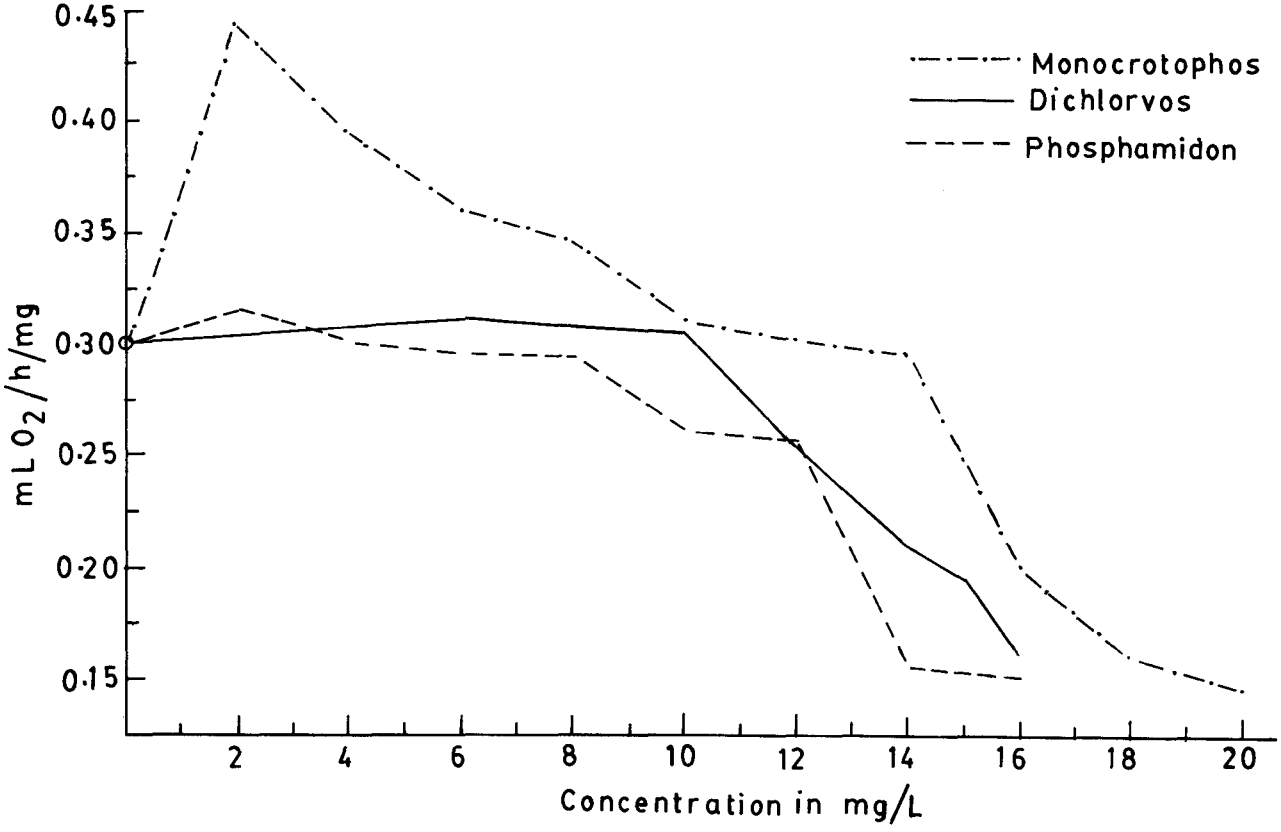


Figure 1. Oxygen consumption of Thiara torulosa after 24-h of exposure to organophosphates.

Table 1. Toxicity of phosphamidon, dichlorvos and monocrotophos to Thiara torulosa

| Duration of experiment (h) | $LC_{50}$ (mg/mL) | 95% Fiducial limits |
|---|---|---|
| Phosphamidon | | |
| 24 | 13.26 | 12.38 - 14.20 |
| 48 | 10.20 | 9.01 - 11.54 |
| 72 | 9.78 | 8.76 - 10.92 |
| 96 | 8.51 | 7.87 - 9.20 |
| Dichlorvos | | |
| 24 | 12.66 | 11.44 - 14.00 |
| 48 | 10.69 | 9.73 - 11.75 |
| 72 | 9.40 | 8.39 - 10.47 |
| 96 | 8.70 | 7.58 - 10.02 |
| Monocrotophos | | |
| 24 | 18.68 | 16.87 - 20.68 |
| 48 | 16.35 | 14.39 - 18.57 |
| 72 | 14.31 | 13.24 - 15.47 |
| 96 | 12.07 | 11.09 - 13.13 |

to cumulative effects. From the results it is possible to infer that the changes in the physiological activity of the snails caused by the exposure to various toxicants might be due to the interference of the toxicants with the respiratory enzyme chain. It is also possible that surface cells are damaged. Internal persistent poisoning possibly influences the respiratory response although the mode of action is not understood. However, the inhibition during the early period of exposure to the concentration of toxicants could be a result of initial retraction of the snails into their shells, thus reducing the tissue surface in contact with dissolved oxygen (Von Brand and Mehlmann 1951). On the other hand, the extreme and lasting inhibition of oxygen consumption of the snails exposed to higher concentrations could have resulted from some other factors rather than retraction.

It is known that organophosphate insecticides act as neurotoxins, and the increased rate of oxygen uptake may be considered as one of the earliest symptoms of pesticide poisoning. In severe cases of poisoning by organophosphate insecticides, death occurs as a result of asphyxiation and probably due to the inhibition of the respiratory center in the brain (O'Brien 1960). Initial hyperactivity and subsequent suppression in the

oxygen consumption has been reported in several organisms (Corbett 1974; Oros 1978).

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