Mirex Incorporation in the Environment: Toxicity in *Hydra*

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Studies on the toxicity of mirex to animals are numerous. Mortalities were observed on crab larvae (BOOKHOUT et al. 1972); shrimp, Penaeus sp. (LOWE et al. 1971); crayfish, Procambarus blandingi, (LUDKE et al. 1971; MARKIN et al. 1972a; MUNCY and OLIVER, 1963); catfish (HYDE et al. 1974); and juvenile mullet, Mugil cephalus (LEE et al. 1975) after exposure to mirex. MCCORKLE (1972) found that peak mortality occurred on day 5 in both mosquitofish, Gambusia affinis and green sunfish, Lepomis cyanellus exposed to mirex. The house fly, Muscus domestica (PLAPP, 1973) and mosquito, Aedes triseriatus (ALEXANDER and NORMENT, 1974) were found very sensitive to mirex. In higher vertebrates, the toxicities of mirex were varied. Mallard duck, Anas platyrhynchos and ring neck pheasant, Phasianus colchicus showed decreased survival rates when fed with mirex diets (HYDE et al. 1973). Female rats fed with mirex diet gave birth to fewer offspring and still fewer offspring survive to weaning (GAINS and KIMBROUGH, 1970). CRUMP (1972) found mirex was more toxic to juvenile female rats than males. Laying hen fed with mirex exhibited decreased egg hatching (NABER and WARE, 1965). VAN VALEN et al. (1968) found that mirex caused some pathological changes in the goldfish, Carassius auratus and bluegill, Lepomis macrochirus. Mirex has also been reported to reduce the rate of photosynthesis on certain species of phytoplankton (BUTLER, 1963; DE LA CRUZ and NAQVI, 1973), respiration of certain organisms (DE LA CRUZ and NAQVI, 1973), and germination and growth of crop seeds (RAJANNA and DE LA CRUZ, 1975).

Most of the bioassay studies done with mirex were on higher animals and on economically important invertebrates. Investigations on mirex toxicity to lower (than arthropods) invertebrates are virtually non-existent in the literature. Certain invertebrates are good ecological indicators due to their lower tolerance to environmental stresses like chemical pollutants. In this paper, we studied the toxicity of technical mirex on hydra, an obiquitous freshwater cnidarian which is a characteristic littoral fauna of fairly clean small bodies of water.

This effort is a part of our series of investigations on the toxicity, physiological and ecological effects of mirex to non-target organisms supported by a grant under Cooperative Agreement No. 12-14-100-10, 935-33 with the USDA Agricultural Research Service.

Bulletin of Environmental Contamination & Toxicology,
007-4861/78/0019-0412 $1.00

METHODS

Specimens of Hydra sp. collected from a garden pond were acclimated in the laboratory for 24 hours at 25°C. Groups of 5 individuals were placed in each of 25-ml dish containing 20 ml of pond water with different concentrations of mirex solutions. Concentrations of 1.0, 0.1 and 0.01 ppm of mirex solutions were prepared by adding 1 ml of acetone-mirex solution to 1 liter of pond water according to the procedure used by ALEXANDER and NORMENT (1974). Five samples of clean pond water were determined for background residue by means of standard extraction with hexane and analysis in a gas chromatograph (MARKIN et al. 1972b). Pond water inoculated with 1 ml acetone served as an experimental control and pond water without any treatment as an environmental control. All experimental containers were kept in subdued lighting condition. The test animals in each dish were observed and the number of dead animals at each concentration were compared. LC_{30}, LC_{50}, and LC_{90} were determined by probit analysis in a UNIVAC 1100 digital computer using the program of DAUM and KILCREAS (1966).

RESULTS AND DISCUSSION

Behavioral changes were observed when individuals of Hydra sp. were exposed to various concentrations (0.01, 0.1, and 1.0 ppm) of mirex solution. The animals retracted their body tubes and tentacles about 2 days after exposure. Mortalities of 78%, 20% and 6% occurred after 144 hours of exposure to mirex solution at 1.0, 0.1 and 0.01 ppm concentrations respectively (Table 1). The peak mortality occurred on day 4 (96 hours exposure) at 1.0 ppm concentration. There was a time lag before death occurred from the time signs of behavioral changes were observed (day 2). This apparent delayed effect of mirex has been reported previously in ants (ECHOLS, 1966), crayfish (LUDKE et al. 1971) and house fly (PLAPP, 1973). Using the data summarized in Table 1, the LC_{50} (computer determined) for Hydra sp. is 23.5 ppm for 3 days. Other LC values are listed in Table 2.

No death occurred in the two types of controls during the 6 day experiments. In fact, hydra in the control dishes increased their number by budding. This reproductive phenomenon was not observed in any of the experimental group (Table 1).

Background mirex residue recovered from the pond water sample was less than 0.09 ppb (Table 3). In one monitoring study, SPENCE and MARKIN (1974) found that the highest mirex residue in natural water samples was less than 0.02 ppb, too low to have any effect on Hydra sp. Unfortunately, many aquatic invertebrates feed on suspended particles which easily absorb and concentrate pesticides dissolved in water. Zooplankton, which has been reported to concentrate pesticides and other pollutants up to more than 1000 folds, is a major food source of aquatic invertebrates especially hydra. Daphnia magna has been found to

TABLE 1

Mortalities of Hydra sp. exposed to mirex solutions (1.0, 0.1 and 0.01 ppm) for 6 days. Values represent the cumulative numbers of dead animals. A total of 50 individuals were tested in each concentration.

Days	Mirex Conc. (ppm) 1.0	0.1	0.01	Controls Experimental[1]	Environmental[2]
1	0	0	0	0	0
2	0	1	0	0	0
3	1	6	2	+2[3]	0
4	16	6	2	+2	0
5	24	10	3	+2	+1
6	39	10	3	+2	+1
% Mortality	78	20	6	0	0

1. Experimental control means pond water inoculated with the same amount of solvent (i.e., acetone) used as a carrier for mirex in the experimental solution.
2. Environmental control means clean pond water.
3. "+" represents increase in number of individuals due to budding.

TABLE 2

Predicted LC_{30}, LC_{50}, and LC_{90} values in ppm mirex determined for Hydra sp. from one to six days exposure.

No. Days	LC_{30}	LC_{50}	LC_{90}
1	*	*	*
2	126.9	681.9	41477.3
3	4.4	23.5	1430.2
4	0.7	4.1	249.2
5	0.3	1.3	80.8
6	0.1	0.5	28.2

*The concentration is higher than 100,000 ppm.

TABLE 3

Background mirex residues (ppb) recovered from pond water used as medium for Hydra sp.

Replicates	Column I	Column II
1	0.03	ND
2	0.01	ND
3	0.09	0.01
4	ND	ND
5	0.01	ND

ND = Not detectable.

accumulate DDT 16,000 to 23,000 folds during exposure to 8 ppb DDT for 24 hours (CROSBY and TUCKER, 1971). Through biological magnificantion, animals which prey on D. magna will accumulate large amount of pesticides in their tissues. The impact of pesticides on fresh water cnidarians is poorly understood. MUIR-HEAD-THOMSON (1971) reported that common hydra were not affected by Batyx (an organophosphate) at 0.025 ppm concentration. No literature is available about the impact of chlorinated hydrocarbons on hydra. Although the toxicity of mirex in this experiment appears to be low, the slow or delayed action of mirex and its biological magnification in animal tissue should not be overlooked.

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