A LABORATORY STUDY OF THE EFFECTIVENESS OF METHOXYCHLOR, FENTHION AND CARBARYL AGAINST BLACKFLY LARVAE (DIPTERA:SIMULIIDAE) [1]

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INTRODUCTION. The effectiveness of blackfly larvicides in troughs with running water was studied a few years ago by several workers including Gjullin *et al.* (1949) and Lea & Dalmat (1954). Inherent difficulties and disadvantages of this method of testing blackfly larvicides have made it less popular over the years than the less cumbersome and less costly jar tests described by Muirhead-Thomson (1957) and Jamnback (1962). Recently, however, improvements in the method of trough testing have been reported by Wilton & Travis (1965) and by Jamnback & Frempong-Boadu (1966). In troughs, the larvae are exposed to toxicants in running water simulating creeks in which blackflies breed in nature. A minimum amount of handling of the test larvae is necessary, since the experimenter has only to place stones or vegetation with numerous larvae attached into the troughs. The larvae then detach and reattach. If a number of troughs are used, it is possible to run a large series of tests at the same time. Larval behavior in response to the toxicant can also be observed.

In this study the concentration-detachment lines for three insecticides, methoxychlor, fenthion and carbaryl, which showed promise in earlier tests (Jamnback and Frempong-Boadu, 1966), were determined.

MATERIALS AND METHODS. The study was conducted at the Cambridge Fish Hatchery Laboratory through the courtesy of the New York State Conservation Department. A series of 18 "Jamnback" troughs were used in the study. Tests were run in 9 of them each day. Of these, 8 were treated with toxicant, the ninth, used as control, was treated with an equivalent concentration of acetone. The remaining 9 troughs were prepared for tests the following day by scrubbing with detergent solution to remove residues of toxicant. They were then rinsed thoroughly and stocked with blackfly larvae collected from nearby streams. A description of the troughs, their arrangement in the laboratory and the general methodology of the experiments was reported in a previous study (Jamnback & Frempong-Boadu, 1966). The concentrations of insecticides used were calculated on the basis of a 5-minute exposure period, as a fraction of a million milliliters, facilitating easy calculation of the concentration in parts per million (ppm.). Only 1 percent formulations of insecticide in acetone solutions were used in the study.

Blackfly larvae were collected from several breeding spots in a creek about five miles from the laboratory. It was not practical to use only one species of *Simulium* for the tests, since larvae collected from the same spot in the creek included several species. The predominant species were *Prosimulium mixtum, P. magnum, Simulium venustum* and *S. tuberosum* in different proportions so that species composition of larvae for each test was variable. Consequently, the results of the tests could be affected by the differential species composition of the larvae used in each test.

Twenty-five to 40 medium and large

[1] This study was conducted in the field laboratory of the New York State Museum and Science Service, Albany, New York, as part of their *Simulium* control research program, and was done with the aid of a grant from the World Health Organization.

larvae were used in each replicate. After recording the number of larvae attached, the toxicant was pipetted into the water at the upper end of the trough. After 24 hours a count of the larvae still alive and attached at the lips of the troughs was made and the percent detachment rate for each concentration of insecticide calculated. The larvae which pupated were not included in this calculation. The effectiveness of each insecticide was measured by its detachment-concentration relationship. All of the experiments were carried out at 54° F. to 58° F. (12.2° C.–14.4° C.).

DETERMINATION OF DC_{50} (DETACHMENT-CONCENTRATION) OF THE INSECTICIDES. The DC_{50} was defined as the concentration of insecticide capable of causing detachment of 50% of the test larvae within 24 hours after exposure.

After several preliminary experiments in which all three insecticides seemed to induce the same reactions in the larvae resulting in hyperexcitability, thrashing, detachment and finally paralysis, four concentrations were selected for each toxicant to study the detachment-concentration relationship. Each concentration tested was replicated 4 or 5 times. The percent detachment rate for the concentration was calculated by dividing the total number of larvae detached in all replicates by the total number of larvae used in the tests, multiplied by 100. This observed percent detachment for each concentration was then adjusted using Abbott's formula. The rate of detachment of larvae in troughs in which an equivalent concentration of solvent alone was used was considered as the control detachment rate (See Table 1). The logarithms of the concentration were plotted against the probits of the detachment rate and a straight regression line fitted by eye (Figure 1).

RESULTS. The detachment-concentration lines for methoxychlor, fenthion, and carbaryl are shown in Fig. 1 and the data from which they are derived in Table 1. The concentrations at which 50% of the larvae detached (DC_{50}) were 0.054 ppm (±s.e. 0.017) for methoxychlor, 0.065 (±s.e. 0.015) for fenthion and 0.106 (±s.e.0.016) for carbaryl.

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TABLE 1.—Effectiveness of 3 insecticides causing detachment of blackfly larvae.

Concentration (ppm.)	Number of replicates	Total number of larvae used	% Detachment observed	Detachment of control using only solvent	*Adjusted % detachment	Log (+2) concentration	Probit of detachment
			Methoxychlor				
0.1	4	123	69.1	7	66.7	1.000	5.43
0.2	5	118	82.2	7	80.8	1.301	5.87
0.3	4	121	89.2	7	88.3	1.477	6.19
0.4	5	145	92.4	7	91.8	1.602	6.39
			Fenthion				
0.1	4	115	57.4	9	53.1	1.000	5.08
0.2	4	130	69.2	0	69.2	1.301	5.50
0.4	4	122	86.9	9	85.6	1.602	6.06
4.0	4	131	97.7	0	97.7	2.602	7.00
			Carbaryl				
0.2	4	128	53.1	0	53.1	1.301	5.08
0.4	4	122	75.4	9	72.9	1.602	5.61
2.0	4	126	85.7	0	85.7	2.301	6.07
4.0	4	125	90.4	9	89.4	2.602	6.24

* Adjusted % Detachment $= \frac{\text{observed detachment \%} - \text{control detachment \%}}{100 - \text{control detachment \%}} \times 100.$

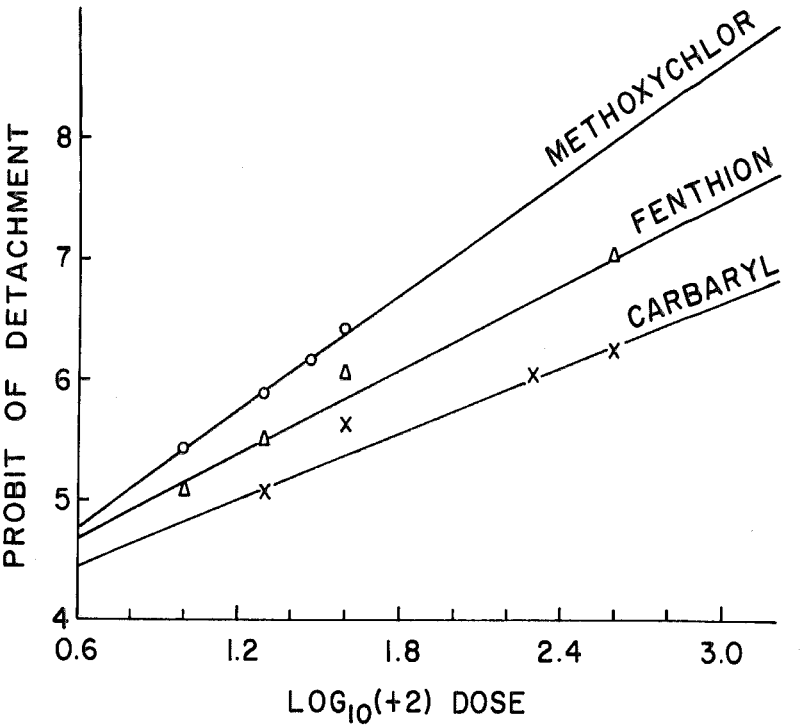

FIG. 1.—The detachment-concentration lines of three insecticides tested against blackfly larvae.

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