THE EFFECTS OF DIELDRIN ON DIATOMS

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Information concerning the effects of insecticides upon algae is quite limited although they are found in many aquatic habitats. Although a fish kill resulting from an overdose of insecticide is usually more dramatic than a diatom kill, one must also recognize that application parameters should be designed to protect the entire aquatic ecosystem since a gross effect upon any major group of organisms will produce changes in the entire system. Obviously survival of fish is meaningless if their food supply is wiped out or contaminated. This latter point is particularly important since submerged plants may concentrate insecticides to several times their original levels. This had been reported by Hoffman and Drooz (1953) for DDT particles in a small Pennsylvania stream. In addition the algae and other primary producers are important because they transform energy into forms utilizable by other aquatic organisms.

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METHODS. The diatom species used in these experiments was *Navicula seminulum* var. *Hustedtii* Patr., a moderately sensitive fresh-water diatom common to many unpolluted streams.

The diatoms were cultured for several months prior to the test period in nutrient solution with the following composition:

Compound	Grams per liter
$Ca(NO_3)_2 \cdot 4H_2O$	0.076
$NaSiO_3 \cdot 9H_2O$	0.177
KCl	0.020
$MgSO_4 \cdot 7H_2O$	0.040
$CaCO_3$	0.010
$NaHCO_3$	0.040
K_2HPO_4	0.008
$FeC_6H_5O_7 \cdot 5H_2O$	0.0018
$ZnSO_4 \cdot 7H_2O$	0.002
$MnSO_4 \cdot H_2O$	0.0015
$AlCl_3 \cdot 6H_2O$	0.0036
H_3BO_3	0.002
LiCl	0.001
$CoCl_2 \cdot 6H_2O$	0.001
Soil Extract	4 ml. per liter

The stock cultures were maintained at $20 \pm 1°$ C. Light was provided by two 85-watt daylight fluorescent lamps located about six inches below a glass shelf on which the flasks were placed. In every 24-hour period stock cultures received illumination of approximately 250–350 foot-candles for 16 hours. During the remaining 8 hours there was no measurable illumination. Cultures were aerated constantly to insure even distribution of diatoms throughout the flasks.

Tests were conducted in 125 ml. Erlenmeyer flasks with a total of 50 ml. liquid in each, and all test concentrations were run in duplicate. This provided a relatively large surface-to-volume ratio and thus allowed a free exchange of gases with air. Each flask was inoculated with one ml. of a culture of diatoms which was well mixed to insure a uniform inoculum. At the time of inoculation a cell count was made of the inoculum to determine the number of diatoms per microscopic field introduced into each flask. A count was again made at the end of the 5-day test period to determine how much growth, measured by the number of living cells, had occurred. This growth was compared with the amount in the control flasks containing only dilution water and none of the dieldrin sample.

In calculating the toxic effect of any sample, the concentration which produces a 50 percent reduction in growth may be regarded as a median response somewhat comparable to the TL_m used for fish. In most cases no concentration used in a test series resulted in a precise 50 percent reduction in growth, and it was usually necessary to estimate this concentration by graphic interpolation of the experimental results. This testing procedure has been described in greater detail by Cairns, Scheier and Hess (1964).

The dieldrin sample used in these experiments was obtained from the Technical Service Department of the Shell Chemical Company. Since it will not dissolve readily in water, one gram of dieldrin was first dissolved in 10 ml. of acetone, and distilled water was then added to reach a total volume of one liter. Appropriate amounts of this stock solution were added to the test containers to produce the desired concentrations of dieldrin. The concentrations listed in this paper are based on the amount of dieldrin introduced into a given volume of water—*at higher concentrations all the dieldrin may not remain in solution.*

RESULTS. At a dieldrin concentration of 12.8 p.p.m. the number of diatoms was only half that in the controls at the end of the 5-day growth period (Fig. 1). Note that there was no increase in the number of cells at 32.0 p.p.m., and that a concentration of 1.8 p.p.m. was only 10.6 percent different from the controls.

DISCUSSION. The diatom species tested was able to survive in concentrations of dieldrin considerably greater than the fractions of a p.p.m. reported in the literature for fish (Cairns and Scheier, 1964; Mount 1962) and for aquatic invertebrates (Jensen and Gaufin, 1964; Anderson 1960). This would be particularly significant if the tendency to concentrate, as with DDT (reported by Hoffman and Drooz, 1953), is a general phenomenon for certain other persistent insecticides. In this

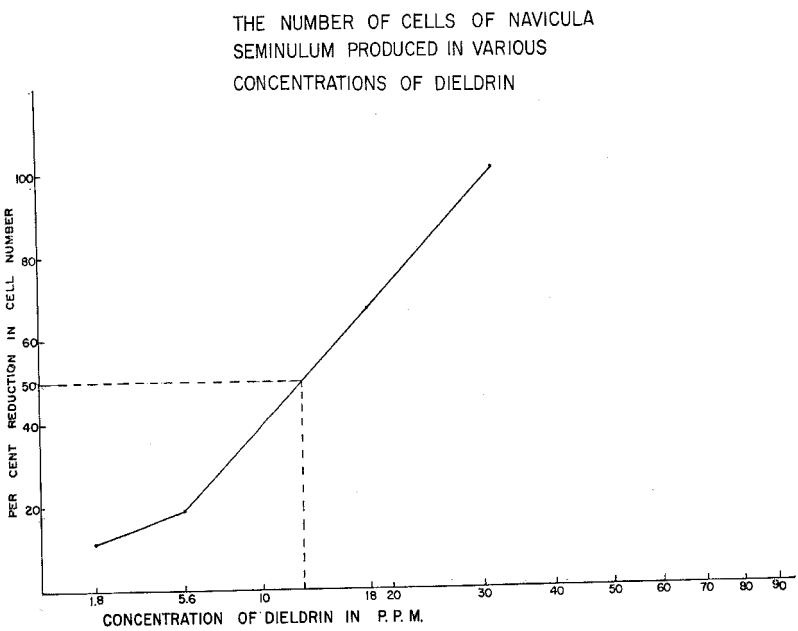

FIG. 1

event, diatoms and other algae, growing in swamp areas where mosquito control sprayings are carried out, might accumulate considerable quantities of insecticide and then wash into the streams after a rain. Since some fish species feed directly on planktonic algae, this might have an immediate effect particularly in view of Mount's (1962) suggestion that absorption of endrin occurred in the intestines of fish.

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