Biologically Active Compounds in the Aquatic Environment: The effect of DDE on the egg viability of *Chironomus tentans*

by S. KROGH DERR[1] and MATTHEW J. ZABIK[2]
Department of Entomology-Pesticide Research Center
Michigan State University
East Lansing, Mich. 48823

The widespread contamination of the aquatic environment by 1,1'-dichloro-2,2'-bis[p-chlorophenyl]ethylene (DDE) is well documented (1,2), and its biological activity has been demonstrated at subacute levels (3,4). The occurrence of this compound in surface waters and the organic substrate acting as a partitioning reservoir would mean that this compound could act as a potential biological hazard in exhibiting deleterious effects on aquatic insect populations. This study was designed to determine the effect of p,p'-DDE residues on the egg viability of the aquatic midge, *Chironomus tentans*.

METHODS AND MATERIALS

Experimental cultures of the aquatic midge, *Chironomus tentans* (Diptera:Chironomidae) were maintained in four aerated 45 ℓ all glass aquaria with a substrate. The substrate utilized was prepared by placing 50 g of paper hand towel (Nibroc Co.) in a Waring blender with 5 g of chicken feed and 1.5 ℓ of water, this mixture was then homogenized for 5 min.

To two of the aquaria, a solution of p,p'-DDE (99.9%, Aldrich Chemical Co., Milwaukee, Wis.) in ethanol was added to give a resultant concentration of 30 ppb (parts per billion) in the water. The remaining two aquaria received an equivalent amount of ethanol and served as a control source of eggs. The ethanol concentration never exceeded 5 ppm. Three egg masses of C. *tentans* were placed in each of the four aquaria. After a developmental time of approximately one month (28-35 days) the adults emerging from these four experimental aquaria were collected separately and allowed to mate in 250 ml flasks. The egg masses from these DDE exposed and control females were collected and observed. These experimental egg masses were then incorporated into four different experimental treatments:

1) H/E*-water that contained no p,p'-DDE and one egg mass that was obtained from a DDE exposed female (contaminated egg mass).

---

[1]Graduate Research Assistant-NDEA Fellow
[2]Associate Professor of Entomology

Bulletin of Environmental Contamination & Toxicology, Vol. 7, No. 6, 1972, © by Springer-Verlag New York Inc.

2) H*/E-water that contained 20 ppb p,p'-DDE and one egg mass that was obtained from a control female.

3) H*/E*-water that contained 20 ppb p,p'-DDE and one egg mass that was obtained from a DDE exposed female (contaminated egg mass).

4) H/E-control-water that contained no p,p'-DDE and one egg mass obtained from a control female.

These experimental egg masses were placed in aerated 4 ℓ all glass aquaria with the described substrate. Each treatment was replicated three times in a completely randomized design and the experiment repeated twice. The number of adults emerging from the treatment was used as a measure of egg viability.

RESULTS

There was a significant reduction in the number of C. *tentans* adults emerging from aquaria that contained DDE contaminated egg masses (Table 1.).

However, the presence of 20 ppb p,p'-DDE in the water with control (uncontaminated) eggs did not show a significant reduction in the number of adults emerging. The combination of DDE treated water and DDE contaminated eggs also demonstrated no significant difference from DDE contaminated eggs alone.

TABLE 1.

Summary of the Effect of p,p'-DDE on the Egg Viability of Chironomus tentans.

Treatment	No. of Emergent Adults	
	Experiment No. 1	2
No DDE in water-DDE contaminated egg mass (H/E*)	167 a[1]	209 a
DDE in water-uncontaminated egg mass (H*/E)	385 b	402 b
DDE in water-DDE contaminated egg mass (H*/E*)	190 a	228 a
No DDE in water-uncontaminated egg mass (H/E)	432 b	408 b

[1] Means followed by unlike letters are significantly different at the 5% level by Tukey's W procedure.

The egg masses obtained from DDE exposed females were of a less gelatinous consistency and had a shriveled appearance compared to that of the control eggs. The number of individual eggs in both DDE contaminated and uncontaminated (control) egg masses appeared to be the same. From a previous study (5) it was shown that approximately 30-34% of an adult female burden of DDE residue is lost to the extruded egg mass, thus a significantly high amount of DDE residue is being transferred to these eggs when an adult emerged from exposure of 30 ppb in the water.

DISCUSSION

The results obtained suggest that sublethal concentrations of p,p'-DDE in the aquatic environment could have deleterious effects on Chironomidae populations. Although the initial concentration of p,p'-DDE that the stock culture of *C. tentans* was exposed to was higher (30 ppb) than found in the aquatic environment the idea that egg viability is related to pesticide burden is demonstrated. These findings emphasize the need for further study on the subacute exposure of biologically active compounds to aquatic insects in relation to their reproductive physiology.

REFERENCES

1. Lichtenberg, J.J., J.W. Eichelberger, R.C. Dressman and J.E. Longbottom, Pesticide Monit. J. 4(2), 71-86 (1970).

2. Risebrough, R.W., P. Reiche and H.S. Olcott, Bull. Environ. Contam. Tox. 4(4), 192-202 (1969).

3. Heath, R.G., J.W. Spann and J.F. Krietzer, Nature 244, 47-48 (1969).

4. Peakall, D.B., Science 168, 592 (1970).

5. Derr, S.K. and M.J. Zabik, unpublished results, (1971).

ACKNOWLEDGEMENT

This research has been supported by the Michigan Agricultural Experiment Station - Special Pesticide Funds. Michigan Agricultural Experiment Station Journal Article No. 526905.