

COMPARATIVE EVALUATION OF DDT AND FENVALERATE
TOXICITY ON *PENAEUS INDICUS* (H. MILNE EDWARDS)

T. RAMESH BABU, P. SURENDRANATH AND K.V. RAMANA RAO*

Department of Marine Zoology
S. V. University, P. G. Centre
Kavali-524 202.

ABSTRACT

The toxicity of DDT and Fenvalerate to *Penaeus indicus* was evaluated by using static bioassay tests. The LC₅₀ values were found to be 0.063 ppm and 0.037 ppm for 48 h and 96 h exposure periods of DDT and 0.00054 ppm and 0.00038 ppm for 24 h and 48 h exposure periods of Fenvalerate respectively.

Key-words : *P. indicus* DDT, Fenvalerate, Dosage mortality.

Increased production and utilisation of pesticides in recent years have proved to be highly toxic to fishes and other nontarget aquatic organisms (Chambers and Yarbrough, 1974). Aquatic pollution is of serious concern compared to others as it is the major site for the origin of many food chains. Pyrethroids and their analogues have long been known as powerful insecticides (Elliot, 1977); effective on a variety of arthropods (Miskus and Andrews, 1972). Recent investigations show pyrethroids to be neurotoxic and induce knock down effect to arthropods (Scott and Matsumura, 1983). DDT is primarily a neurotoxicant, inhibiting both AChE and Mg²⁺ ATPase activities (Corbett, 1974). In a way, DDT (organochlorine) and fenvalerate (synthetic pyrethroid) are found to show similarity in their mode of action (Scott and Matsumura, 1983). Therefore, toxicity evaluation was conducted using DDT (OC1) and Fenvalerate (synthetic pyrethroid) on *P. indicus* following static bioassay method to determine LC₅₀ concentrations.

The penaeid prawn, *Penaeus indicus* of 2.5 ± 0.5g weight and 70.0 ± 5 mm length were collected from the Buckingham canal (long. 14°55' E; lat. 80°03'N) near Kavali, and acclimatised to laboratory conditions in dilute seawater (15 ± 1‰ sal. 7.3 ± 0.2 PH and 27 ± 1°C temp) under constant aeration for a week. They were fed daily with a mixture of rice bran and minced frog muscle. The water was changed twice a day to remove food particles and excretory products. A stock solution of 10 ppm (10 µg/ml) of the technical grade (97.4%) fenvalerate (α Cyano 3-Phenoxy Phenyl) methyl-4-Chloro-α Benzene-acetate) and 99% DDT (Dichloro diphenyl trichloro ethane) were prepared by dissolving these insecticides separately in 0.5 ml of acetone. The quantity of acetone used for dissolving the insecticides was very low and hence nontoxic (Pickering, Henderson and Lenke, 1962). Acetone controls were also

* For correspondence.

maintained to study its effects, if any. Before and during exposure the prawns were not fed, but continuous aeration was maintained.

Dosage-mortality studies were conducted following static bioassay method of Doudoroff, Anderson, Burdick, Galtsoff, Hart, Patrick, Strong, Surbur and Van Horn, (1951). Exposure periods were, 24 and 48 h for fenvalerate and 48 and 96 h for DDT. The stock solutions of the 2 insecticides were diluted appropriately to yield final concentrations ranging from 0.0001 to 0.001 ppm for fenvalerate and 0.034 ppm to 0.07 ppm for DDT. 10 prawns kept in 25 l. of 15%^o seawater was used for each concentration of each pesticide. The experiment was repeated six times.

The data were subjected to probit analysis, where in, the probit mortality was obtained from percent mortality. LC_{50} value, standard error, 95% confidence limits and slope values were calculated (Finney, 1964) and the graph was plotted for fenvalerate and DDT against the respective exposure periods.

DDT :

At 48 h exposure period, no mortality was observed in 0.034 ppm DDT concentration, but at 0.07 ppm 100% mortality was observed (Fig. 2). Similarly no mortality was recorded at 0.02 ppm DDT but 100% mortality recorded at 0.04 ppm DDT for 96 h exposure period. At 0.04 ppm 10% mortality is observed at 48 h, while the same concentration brought about 100% mortality at 96 h. The average LC_{50} values obtained by Probit and graphic methods were found to be 0.063 ppm/48h and 0.037 ppm/96h. The slope (regression co-efficient) of the probit regression line of DDT to *P. indicus* for 48h was 10.0 which was less compared to slope value of 21.29 for 96 h, exposure period. Similarly the 95% confidence limits for 48h was 0.037 ppm and for 96h is 0.023 ppm (Table I).

Table I — The 24, 48 and 96h LC_{50} values, slope and 95% confidence limits of Fenvalerate and DDT imposed *P. indicus*

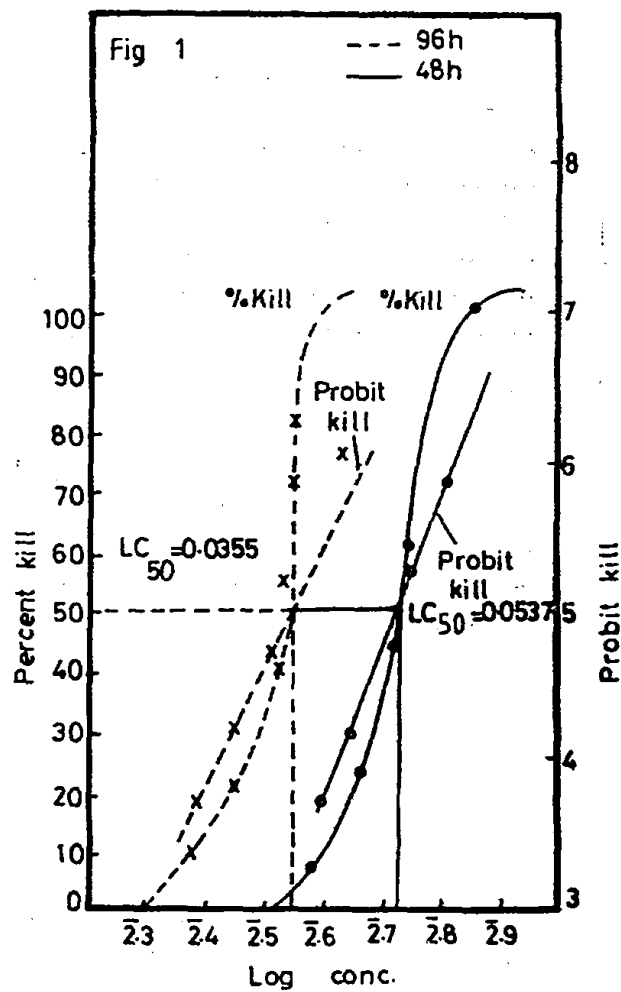
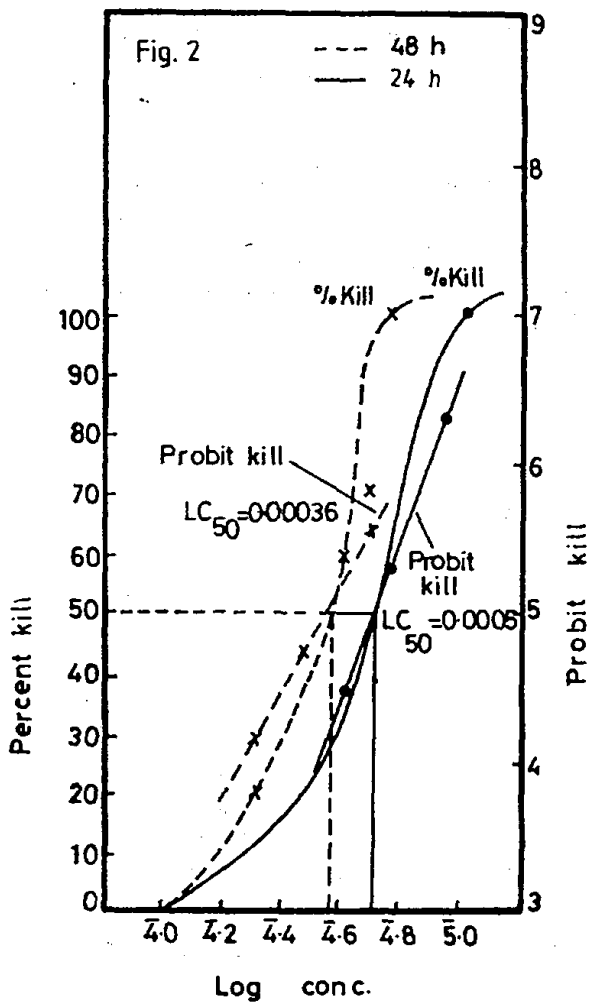
Pesticide	Exposure period (h)	LC 50 (ppm)	S.E.	Slope	95% Confidence limits	
					Lower limit	Upper limit
DDT	48	0.063	0.009	10.0	0.045	0.082
	96	0.037	0.005	21.3	0.026	0.049
Fenvalerate	24	0.00054	0.00006	4.4	0.0004	0.0006
	48	0.00038	0.00004	4.0	0.00028	0.0004

The variation in percent mortality and LC_{50} values at different exposure periods indicate differential toxicity of DDT to *P. indicus*. The low LC_{50} for 96 h indicates higher toxicity of DDT to *P. indicus*, which might be due to either more entry of DDT or its accumulation in tissues, because DDT is known for its retention (Addison, 1976). The higher slope value and narrow confidence

limits obtained for DDT at 96 h exposure period, attunes with observations of Addison (1976).

Fenvalerate :

With fenvalerate the situation was different. At 0.0001 ppm/24 h, no mortality was observed but at 0.0001 ppm/24h, 100% mortality was recorded. Similarly at 0.00001 ppm/48h no mortality was recorded, while at 0.0006 ppm/48h, 100% mortality was noticed. The prawns exposed to 0.0002 ppm for 24h & 48h



Figs. 1 & 2. Dosage-response curve and probit line for *P. indicus* exposed to Fenvalerate and DDT respectively.

recorded 10% and 20% mortality respectively. In 0.0004 ppm, the mortality were found to be 30 and 60% for 24 and 48h exposure periods respectively. Similarly at 0.0006 ppm, 60% mortality was recorded for 24h and 100% mortality for 48h (Fig. 1).

The mean LC_{50} value obtained by employing probit and graphic methods were 0.00054 ppm/24h and 0.00038 ppm/48h respectively (Fig. 1). The slope value obtained for Fenevalerate toxicity to *P. indicus* was slightly higher at 24h than at 48h period. The confidence limits were slightly more for 24h period compared to 48h. The low LC_{50} value for fenevalerate at 48h indicates the higher toxicity than at 24h. However the concentrations of fenevalerate at 24h & 48h showed variations at 4th or 5th decimal places which indicates the concentration used were very low but highly toxic.

From the above results it is inferred that fenevalerate (Synthetic pyrethroid) is about 100 times more toxic than DDT to *P. indicus*. The slight variations observed in fenevalerate concentrations for 24h and 48h compared with DDT for 48h and 96h (when the DDT concentrations at 96h is almost half over the concentration at 48h) indicates, the synthetic pyrethroids to be short lived, while DDT to be stable and persistent (Scott, & Matsumura, 1983). It is known that the synthetic pyrethroids are rapidly broken down thus reducing toxicity of this pesticide (Glickman, Shono, Casida and Lech, 1979). A similar situation must be occurring in *P. indicus* against fenevalerate.

ACKNOWLEDGEMENT

Authors are thankful to M/S. Searle (India) Ltd., Bombay for free supply of technical grade fenevalerate (97.4%) and to Dr. N.V. Nanda Kumar for the supply of technical grade DDT, and to Prof. K. Sasira Babu for encouragement.

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