

ON THE EFFECT OF SUBLETHAL DOSES OF INSECTICIDES ON THE BIOLOGY OF *Tribolium castaneum* HERBST*

O. T. MADHAVAN, M. R. G. K. NAIR and S. CHANDRIKA

Agricultural College, Vellayani, Kerala State

Under the field conditions of insecticide applications, insects have very often to come under the stress of sublethal doses of insecticides. Sublethal doses of toxicants have been found to affect the biological and physiological activities of insects in various ways. For instance, adults of the cigarette beetle exposed to sublethal doses of pyrethrum sprays laid only half as much number of eggs as laid by a normal beetle (Tenhet 1945). The egg production per female of *Calandra* increased when sublethal doses of DDT were mixed up with wheat flour (Kuenen 1958). Shortening of life span and reductions in the number of eggs produced were reported in the pink boll-worm (Adkisson and Wellso 1962) and *Callosobruchus chinensis* (Kujoku and Tamala 1959) as a result of exposures to sublethal doses of DDT. Suppression of egg-laying by DDT was reported in the house fly (Beard 1965). Decrease in longevity, prevention of oviposition and reduction in survival of F_1 progeny resulted from the sublethal effects of DDT, toxaphene and endrin in *Coleomegilla maculata* (Atallah and Newsome 1966). The results reported are thus conflicting and a few of them only are based on objective studies. The present studies were hence undertaken to understand the effect of sublethal doses of insecticides of differing modes of action on the development, survival and fecundity of *Tribolium castaneum* Herbst.

Material and Methods

First instar larvae of *T. castaneum* emerging out of previously collected eggs were exposed to wheat flour media containing graded sublethal doses of DDT, endrin, carbaryl, endosulfan and parathion. The media were prepared by impregnating wheat flour with the insecticides from their solution in acetone.

The doses of the insecticides studied were those given in the figures representing the results. Technical grades of the insecticides were used. The results were assessed in terms of the effect of the insecticides on the duration of development, growth and fecundity of the insect, the sex ratio and the viability of the eggs laid by the adults reared out on media containing the sublethal doses of the insecticides.

Results

The pupal duration, sex ratio of the adults and the viability of the eggs laid by the adults were seen to be not affected significantly by the sublethal doses of the

* From M. Sc. (Ag.) thesis submitted to the University of Kerala in 1968.

various insecticides: well defined effects were, however, shown in the other biological processes and results of observations relating to them are represented in Figures 1 to 16.

Figures 1 to 5 depict the effect of graded sublethal concentrations of the different insecticides on the larval duration and larval mortality of *T. castaneum*. It may be seen that in general the larval duration increased as the sublethal concentration of the insecticides was increased; these increases were positively correlated. A slight speeding up of the rate of larval development was observed with some doses of DDT (10 & 20 ppm), sevin (10 ppm) and endosulfan (10, 20, 40 and 180 ppm).

Figures 6 to 10 give the fecundity of the adults which were reared out on wheat flour media containing different sublethal doses of the insecticides and which were continued to be exposed to the respective media. It may be observed that the number of eggs laid per female increased significantly, when the concentration of the insecticide in the media was increased. These increases were of a high magnitude in the case of endrin, endosulfan and parathion; they were directly proportionate to increases in the concentration of the toxicants excepting with sevin in which the increases were irregular and with parathion in which the increase in fecundity was inversely proportionate to that of the doses.

Figure 11 gives the fecundity of adults of *T. castaneum* which were reared on the media containing one selected sublethal dose of each toxicant and which were exposed to pure flour media (A) and of normal adults reared out on uncontaminated media and exposed to media containing the same sublethal concentrations of the toxicants (B). It may be observed that exposure of the immature stages of the insect to the media containing sublethal doses of DDT, endrin, sevin and thiodan resulted in the emerging adults producing much more eggs than the beetles reared on uncontaminated media. Parathion did not have any such influence on the immature stages. Direct effect of sublethal doses of DDT, endrin, endosulfan and parathion on normal adults of *T. castaneum* caused enhancement of their fecundity, while sevin had no effect.

Figures 12 to 16 show that the growth of the larvae of *T. castaneum* was suppressed considerably by the sublethal doses of the different toxicants. The reduction in the size of the larvae was greater at the higher doses of the insecticides contained in the breeding medium.

Summary

Effect of sublethal doses of DDT, endrin, sevin, endosulfan and parathion on the growth, development and fecundity of *T. castaneum* was ascertained by rearing it in wheat flour media containing graded sublethal concentrations of the insecticides.

Sublethal doses of the insecticides prolonged the larval period roughly in direct proportion to increases in the toxicants' concentrations. The growth of the larvae was suppressed by the insecticides. Exposure of both larvae and adults to the sublethal insecticidal stresses resulted in the enhancement of fecundity of the beetle. Exposure of larvae alone showed increased fecundity with DDT, endrin, sevin and

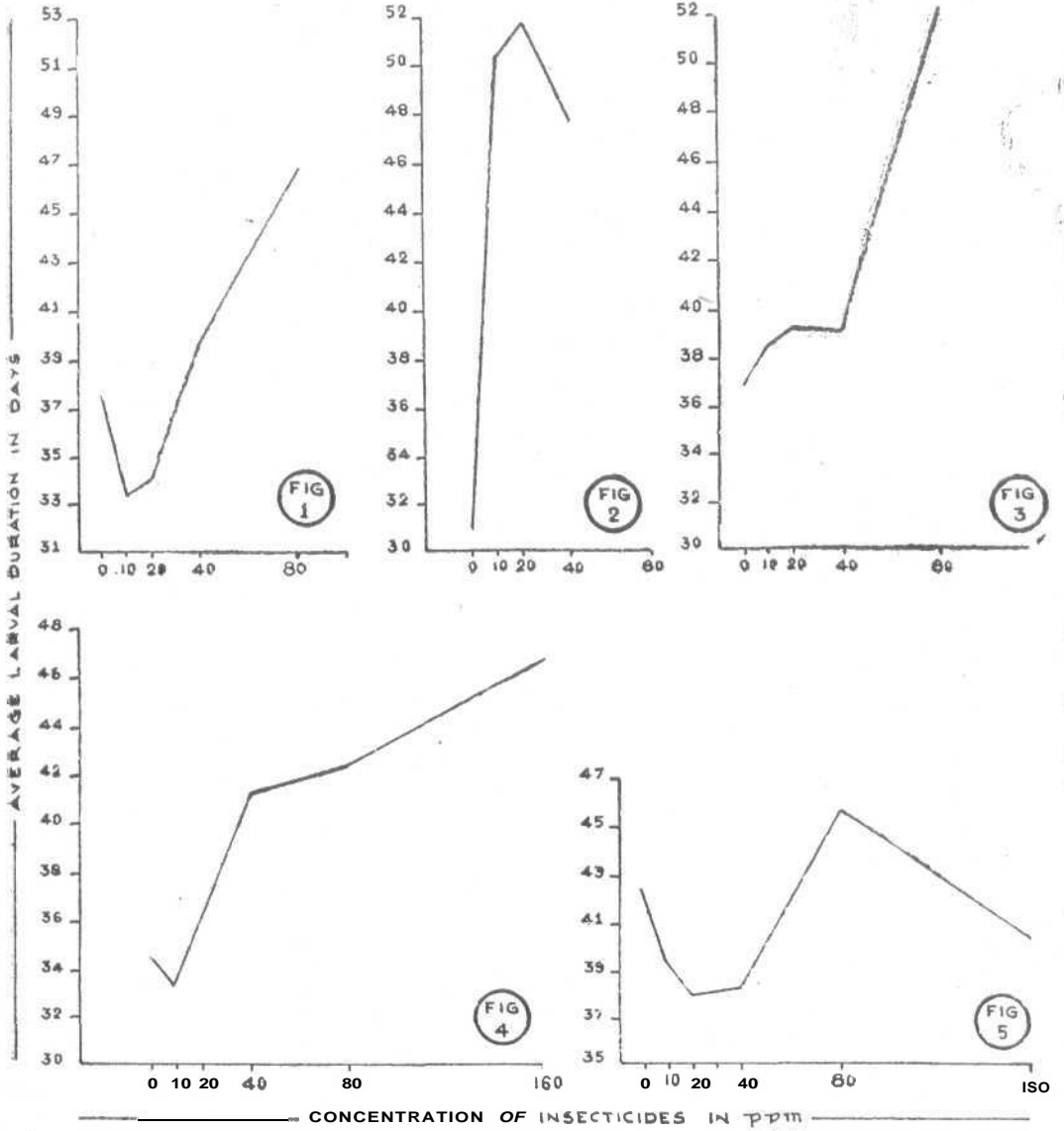
endosulfan, while **exposure** of adults alone showed increased fecundity under DDT» **parathion**, endrin and endosulfan.

References

- Adkisson, P. L. and Wellso, S. G. 1962. Effect of DDT poisoning on the longevity and fecundity of the pink boll worm. *J. econ Ent.* 55: 842-45
- Atallah**, Y. H and Newsome, L. D. 1966. Ecological and nutritional studies on *Coleomegilla maculata* Degeer. **III**. The effect of DDT, toxaphene and endrin on the reproductive and survival potentials. *J. econ. Ent.* 59: **1181-87**
- Beard**, R. L. 1965. Ovarian suppression by DDT and resistance in the housefly (*Muscadomestica* L.). *Ent. exp. appl.* 8: 193-204
- Kuenen, D. J. 1958. Influence of sublethal doses of DDT upon the multiplication rate of *Sitophilus granarium* *Ent. exp,appl.1* (2): **147-152**
- Kujoku, M. and **Tamala**, H. 1959. Modification in biotic potentials of **insects** surviving exposure to an **insecticide**. *Sci. Rept. Foc. Agri. Okayama Univ.* 14-15
- Tenhet, J. N. 1947. Effect **of** sublethal doses **of pyrethrum** on oviposition of cigarette beetle. *J. econ Ent.* 40 (6) : **910-911**

(Accepted: 7-1-1970)

Effect of **sublethal** doses of insecticides



Figs. 1 to 5. Larval duration of *T. castaneum* reared on media containing sublethal doses of insecticides.

1-DDT 2-Endrin 3-Parathion 4-Sevin 5-Endosulfan.

Effect of sublethal doses of insecticides

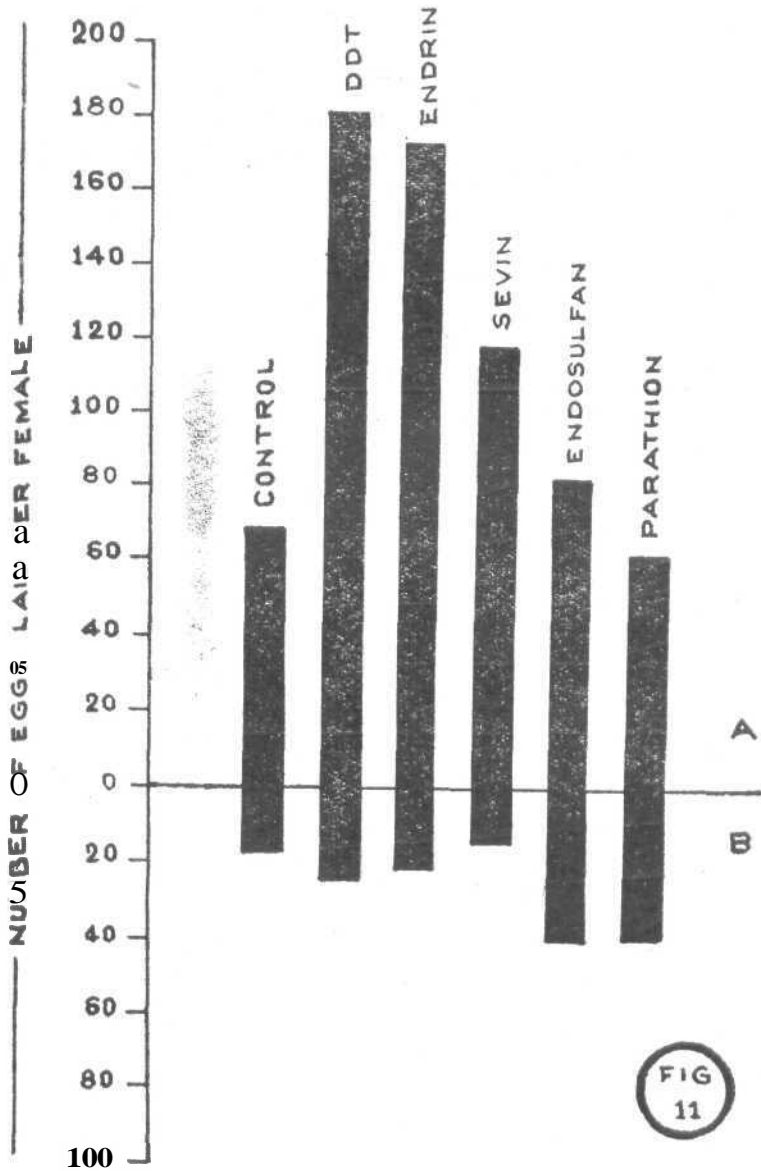
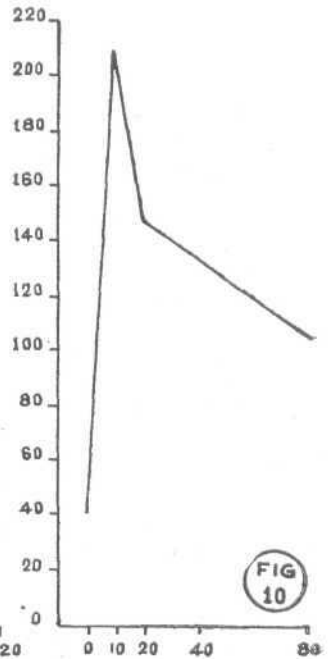
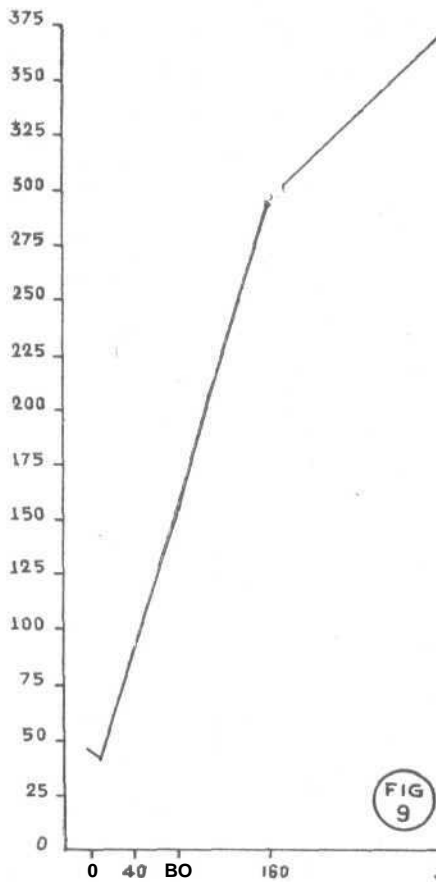
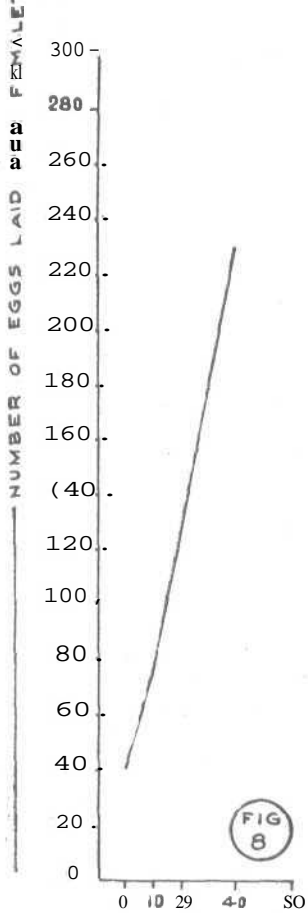
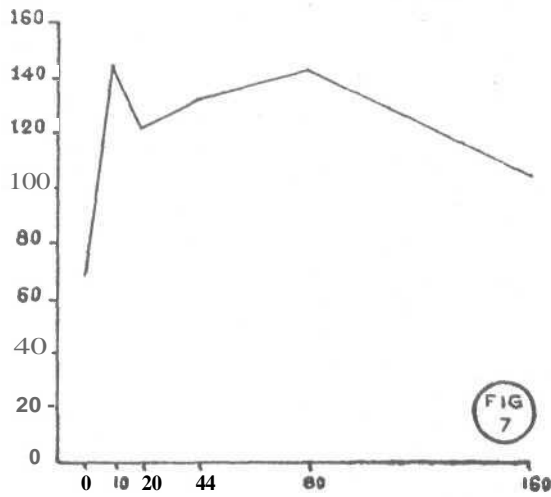
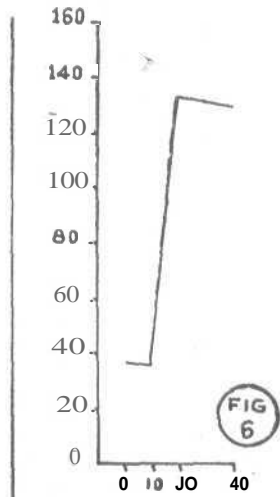


Fig. 11. Fecundity of *T. castaneum* reared on sublethal doses of insecticides and exposed to pure media (A) and reared on pure media and exposed to sublethal doses of insecticides (B).

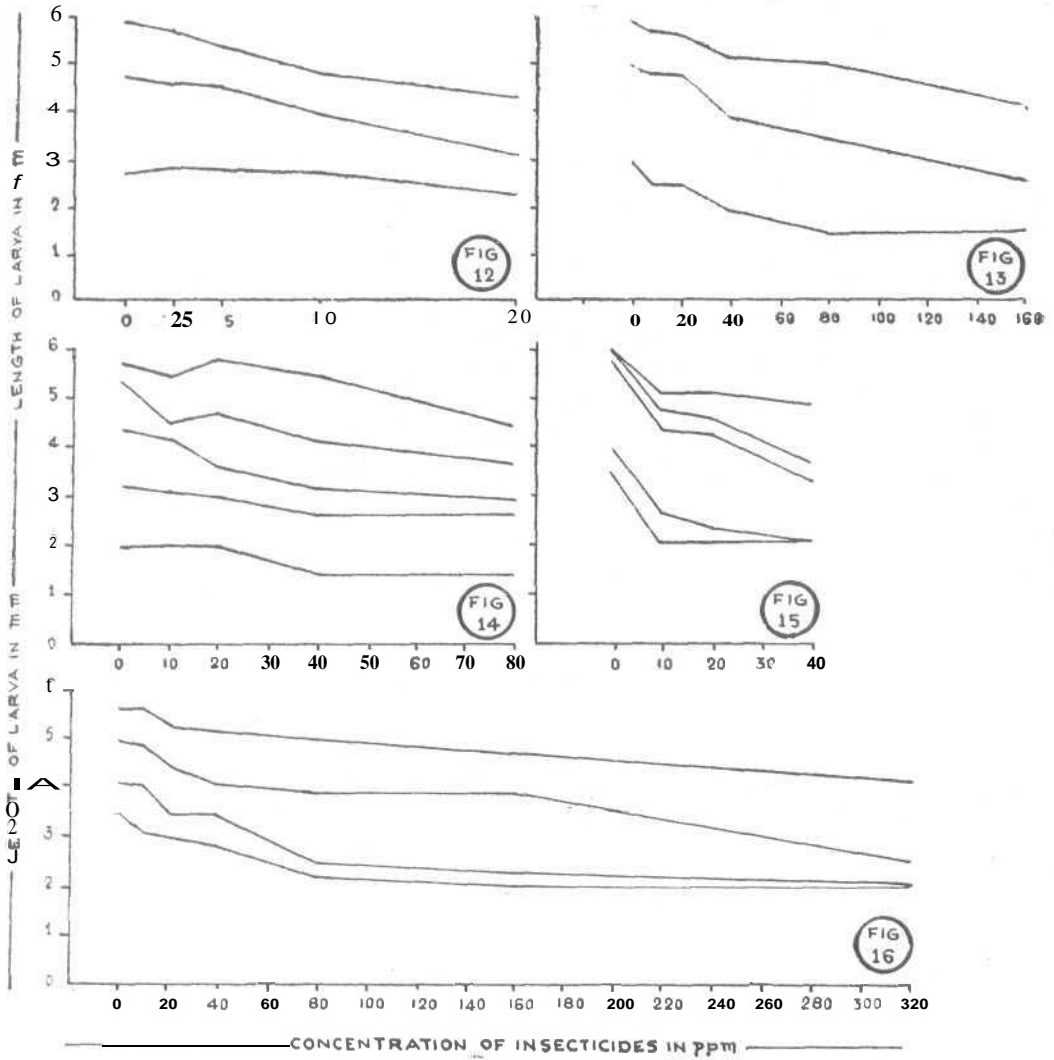
Effect of sublethal doses of insecticides



CONCENTRATION OF INSECTICIDES IN PPM

Figs. 6 to 10. Fecundity of *castaneum* reared on sublethal doses of insecticides.
6-DDT 7-Sevin 8-Endrin 9-Endosulfan 10-Parathion

Effect of sublethal doses of insecticides



Figs. 12 to 16. Length of larva of *T. castaneum* reared on sublethal doses of insecticides. 12-Parathion 13-Sevin 14-DDT 15-Endrin 16-Endosulfan