

10011/1

RESPONSE OF CERTAIN ENZYMES IN SOME
LEPIDOPTEROUS INSECTS TO SOME PESTICIDES

By

KADRY WESHAHI MAHMOUD

B. Sc. (Agric.)

Alex. Univ., 1978

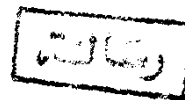
THESIS

Submitted in Partial Fulfilment of
The Requirements for the Degree of

MASTER OF SCIENCE

in

Pesticides



25953



75
W

Plant Protection Department
Faculty of Agriculture
AIN SHAMS UNIVERSITY

1987

APPROVAL SHEET

Title : Response of certain enzymes in some lepidopterous insects to some pesticides.

Name : KADRY WESHAHI MAHMOUD

Submitted in Partial Fulfilment for the Degree of

MASTER OF SCIENCE

in

(PESTICIDES)

This thesis has been Approved by:

Prof. Dr. A. A. Selim

Prof. Dr. Zidan ^{abdel-Hamid}

Prof. Dr. gadelhau

Committee in Charge

Date: 11 / 10 / 1987.



ACKNOWLEDGEMENT

I would like to express my deep appreciation and great thanks to Prof. Dr. E.M. Kamel, Prof. Dr. A.A. Selim, and Prof. Dr. M.I. Abdel Megeed, Professors of Pesticides and Toxicology, Plant Protection Department, Faculty of Agriculture for suggesting the problem, supervising the work, valuable help, advice criticism. Thanks also to Prof. Dr. Z.H. Zidan, Professor of Pesticides for reading the manuscript and to every person offered me a help.

CONTENTS

	<u>Page</u>
INTRODUCTION	1
REVIEW OF LITERATURE	3
A- Effect of age on the insecticidal action.....	3
B- Effect of insecticides on certain biochemical constituents	5
C- Effect of insecticides on acid and alkaline phosphatases activity	6
D- Effect of insecticides on ATP-ase activity....	9
E- Cholinesterase and AliE activity	12
MATERIALS AND METHODS	18
A. Maintenance of the cotton leafworm strains ...	18
B. Insecticides used	19
C. Toxicity studies	20
Protein and total lipids determination	21
D. Enzymatic studies	26
- Acetylcholinesterase and AliE activity	26
- Alkaline and acid phosphatase activity	36
- Determination of ATP-ase activity	39
RESULTS AND DISCUSSION	45
A- Relative toxicity of fenvalerate and methomyl to laboratory and field strains of the cotton leafworm	45
B. Effect of fenvalerate and methomyl on fat and protein content of laboratory and field strains of <u>Spodoptera littoralis</u>	54

	<u>Page</u>
a- Effect on fat content	53
b- Effect on protein content	60
C- Alkaline phosphatase	67
D- Acid phosphatase	79
E- ATP-ase	92
F- Acetylcholine esterase (AChE)	104
G- Aliesterase (AliE)	116
SUMMARY	127
REFERENCES	133
ARABIC SUMMARY	

INTRODUCTION

INTRODUCTION

The Egyptian cotton leafworm,, Spodoptera littoralis (Boisd.) is considered as one of the major pests in Egypt. This pest is widely distributed as a polyphagous insect, attacking 112 plant species belonging to 44 families known as hosts for the cotton leafworm. These hosts include 73 species reported from Egypt, of which 16 host plants are preferred for oviposition, 45 for food only and 12 for food and oviposition (Abd El-Hafez 1978).

Following the large scale application of insecticides against the cotton leafworm, Spodoptera littoralis (Boisd.) in Egypt; different problems started to appear. The most important of which is the failure of the chemicals to control the target pest. This has been attributed to either change in the environmental conditions, or miss application or the development of resistance.

A number of carbamate insecticides and synthetic pyrethroids have been recently introduced for large scale use against the cotton leafworm; Spodoptera littoralis (Boisd.) on cotton plants in Egypt. The relation between the toxicity of these insecticides and enzymatic activity has to be considered for better understanding of the proposed mode of action of certain insecticides and the mechanism by which this pest can tolerate these chemicals.

The present study deals with the following :

- 1- Determination of the toxicity of methomyl and fenvalerate against the 3rd and 5th instar larvae of laboratory and field strains of S. littoralis.
- 2- Effect of the tested insecticides on certain enzymatic activities including: AChE, aliesterase, alkaline and acid phosphatase and ATP-ase during larval, pupal and adult stages of S. littoralis.
- 3- Effect of the tested insecticides on the protein and lipid content of larvae, pupae and adults of S.littoralis.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

A- Effect of age on the insecticidal action :

El-Defrawi et al. (1964) demonstrated that, as the larvae of S. littoralis increased in age and weight, their susceptibility to insecticides decreased. Based on the unit of body weight, their susceptibility remained the same with slight variation throughout the successive instars.

Green and Dorough (1968) working on the house fly age as a factor in their response to carbamate insecticides, found pronounced differences in the susceptibility of the female house fly to discriminating dosages of baygon, banol and carbaryl. They concluded that, the accumulation of toxicant at the site of action varied with the age of the insects.

Harris and Gore (1971) investigated the effects of topically applied pesticides on the various stages of development of the Dark-sided cutworm, Euxoa messotia (Harris). The results showed that DDT was effective against the early stages but ineffective against the later larval stages as well as against eggs, pupae and adults. However, dursban was found to be effective against the eggs, early larval instars and adults, but ineffective against both the later larval stages and the pupae.

Serghiou (1971) evaluated certain insecticides against Spodoptera littoralis larvae both in laboratory and field trails. Results of the bioassay indicated that, cyolane 25% E.C gave 90% mortality of the third instar, while gave 95% of the 5th instar.

Salama et al. (1975) reported that, the advanced larval instars of S. littoralis required higher doses of toxicants to give the same mortality level as that of the earlier instars. However, although the susceptibility calculated per unit body weight remained about constant in case of dichlorvos, trichlorofon and lannate, it varied from one instar to another in the case of the other tested insecticides. The OP insecticides in general, had the most toxic effect on the different larval instars. Edrin, the chlorinated hydrocarbon insecticide, was more toxic than some organophosphates. Carbaryl, a carbamate compound, showed a poor effect in comparison with the other tested insecticides.

Dahroug (1977) recorded that, although both the insecticides tested; cyolane and dursban were effective against all larval instars of S. littoralis, yet dursban seemed to be more toxic than cyolane at the LD levels tested. In addition, the 4th larval instar was the most tolerant. The next best performance was obtained with the second instar, while the 6th larval instar was the most sensitive of all instars to the chemicals tested.

B- Effect of insecticides on certain biochemical constituents:

Reiser et al. (1953) showed that, there was a strong correlation between the lipid content of the boll weevils, Anthonomus grandis Boh. and their resistance to toxaphene, dieldrin, EPN and methylparathion.

Bennett and Thomas (1963) studied the correlation between lipid content and rate of mortality of alfalfa weevil, Hypera postica (Gyllenhal), to heptachlor and malathion. They demonstrated that, the weevils were more susceptible to insecticides when the lipid content was low.

Essac et al. (1976) reported that, carbaryl, methylparathion, and endrin administration to cotton leafworm, Spodoptera littoralis (Boisd.) larvae induced a reduction in the concentration of the free amino acids: glutamate, glutamine, proline and serine.

C- Effect of insecticides on acid and alkaline phosphatases activity :

Beranek (1974) determined the phosphatases and esterases of field populations and laboratory colonies of Myzus persicae and Aphis fabae (Scop.) by starch gel electrophoresis. No variations in acid phosphatase activity were found in these aphids and alkaline phosphatase was not detected.

Gervelli et al. (1977) concluded that, all insecticides investigated (dichlorvos, tetrachlorvinphos, crotoxyphos, and phosphamidon) were competitive inhibitors of alkaline phosphatase. The inhibition constants depend on the substituents on the vinyl group and on their electronic influence on (P) atom.

Abd El-Samie et al. (1979) investigated the enzymes, cholinesterase, carboxyesterases, arylesterases, acid and alkaline phosphatases from hemolymph, fat body, head and integument of 6th larval instar of S. littoralis susceptible and tolerant to endrin, cytolane and lannate. Quantitative and qualitative differences were detected between susceptible and tolerant strains. The tolerant strains exhibited higher titre of these enzymes. The results revealed that, the haemolymph can be considered as a good organ for

study in resistance mechanism. The method used in this study failed to demonstrate any band characterized as alkaline phosphatase in tissues investigated.

Kansouh et al. (1981), investigated the activity of three enzyme systems in larvae of susceptible (S), matacil-resistant (Rm) and fenitrothion-resistant (Rf) strains of S. littoralis. They found that, alkaline phosphatase activity (AP-ase) in S-strain was only slightly higher than in Rm and Rf strains, leading to the conclusion that this enzyme is not a major defence mechanism in the resistant strains of S. littoralis.

Madi et al. (1981) studied the in vitro inhibition of three enzyme systems in the larvae of susceptible and resistant strains of S. littoralis by cyolane and lannate. They found that, no significant differences occurred between susceptible (S) and resistant (R) strains in the sensitivity of AP-ase to inhibition by both insecticides.

Abd El-Hafez et al. (1983) demonstrated that, the enzyme activities of the living poisoned larvae of Pectinophora gossypiella (Saunders) showed an increase in the acid and alkaline phosphatases during the first three hours post treatment, while moderate inhibition was detected at 24 hrs after treatment. The changes in alkaline phosphatase activity