STUDIES ON RESISTANCE OF THE AMERICAN BOLLWORM, *Heliothis armigera* (Hbn), TO CERTAIN INSECTICIDES

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By

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ARABIC SUMMARY

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1- I N T R O D U C T I O N

The American bollworm is one of the major pests attacking several economic crops all over the world and causing severe damage to them. The yield of plants are vigorously reduced by the infestation of this insect, and could be clearly seen in cotton plants.

In Egypt, the American bollworm, (Heliothis armigera, Hbn.) (Helicoverpa armigera, H.), (Hardwick, 1970), was considered as a secondary pest of minor importance infesting many crops as corn, sorghum and tomatoes (Willcocks and Bahgat, 1937). However, it was reported for the first time as a major pest on cotton in the year 1972 in a limited area in Fayoum Governorate. Thenafter, the infestation with this insect spread rapidly in cotton fields in many parts all over the country. The control of this pest, therefore, necessitated the application of the chemical control in cotton fields, which consequently might lead to a resistance of this pest to insecticides.

The problem of tolerance and resistance of the American bollworm to insecticides had attracted the attention of many investigators all over the world. However, in Egypt, a very little work had been performed on the resistance of the

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American bollworm to certain insecticides.

This work was designed, therefore, to throw a beam of light on the effect of different insecticides on the American bollworm , *H. armigera*, the study included:-

1. The rate of development of resistance to different organophosphorus insecticides, recommended and used for its control.

2. Cross-resistance of different strains to certain insecticides representing different groups of insecticides.

3. Effect of the development of resistance on some biological aspects of the produced progeny of the American bollworm.

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II- REVIEW OF LITERATURE

A- Development of insects resistance to insecticides:-

Brown (1960) reported that in mosquitoes, Ld-p lines for increasing vigor tolerance could shift to the right and remained parallel in slope. Degrees of resistance of only a few folds were usually results of vigor tolerance.

Georghiou *et al*. (1961) selected two sub-colonies of a house fly strain with Isolan and (3-isopropylphenyl-N-methyl carbamate) during 20 generations. They found that selection with Isolan resulted in a 19.5-fold resistance, and with the other compound resulted in 7.5-fold resistance in larvae.

Graves *et al*. (1963) indicated that high levels of resistance of the bollworm larvae, *Heliothis zea* (Boddie), to DDT and Endrin were developed in some areas of Louisiana.

Grayson (1963) found that steep regression lines were obtained after 15 to 16 generations of selection of a laboratory selected strain of *Blatella germanica* L. with Malathion. The "b" values of these regression lines were much greater than those for the lines associated with the original normal strain. The levels of resistance obtained at the LC_{50} was 13.3-fold in the F_9 generation , and 115.6-fold in the F_{15} generation.

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Brazzel (1964) in his laboratory tests with the bollworm, *H. zea*, collected in several areas of Texas in 1962 indicated that populations in some areas were highly resistant to DDT. Bollworms from College Station, LaGrange, and Eaglepass were 50 to 100 times harder to kill with DDT than those from Elpaso and the Lower Valley.

Lingren and Bryan (1965) found that the bollworms, *H. zea*, were becoming resistant to DDT, while the budworm, *H. virescens*, were generally more tolerant than the bollworm to DDT, Sevin and Telodrin. However, one strain of the budworm was quite susceptible to Telodrin, and showed relatively little, if any resistance to Sevin.

Lowry and Robertson (1965) tested for resistance of the bollworm, *H. zea*, to DDT and found an irregular pattern ranging up to a 15-fold increase from least to most resistant strains.

Adkisson (1967) studied the development of resistance by the tobacco budworm, *H. virescens*, in Texas, to Toxaphene + DDT and Strobane + DDT which occured during the period 1963-65. The LD_{50} values indicated an increase in resistance of approximately 6-fold to Toxaphene + DDT and 22-fold to Strobane + DDT.

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Clark and Cole (1967) reported that when a strain of body lice with 7-fold resistance to Lindane was subjected to increasing concentrations of Lindane for 73 generations, resistance to Lindane was developed to more than 8000 times than that of the regular susceptible strain of lice.

The tobacco budworm, H. virescens, in Texas, had developed high degree of resistance to Endrin and Carbaryl during 1961-65, (Adkisson, 1968). The LD_{50} values indicated an increase in resistance of the tobacco budworm to Endrin of slightly more than 200-fold and was approximately 180-fold to Carbaryl.

Brader (1968) stated that, although Endrin and DDT had been used on cotton in Chad for only a comparatively short time, the bollworm, H. armigera, and Diparopsis watersi (Roths), were developing resistance to them, but the resistance did not extend to Endosulfan.

Carter and Phillips (1968) conducted studies to determine Methyl parathion resistance capabilities of laboratory population of H. zea. Ten cycle of selection with Methyl parathion were carried out in the 11 successive generations of bollworms reared in the laboratory. Results indicated that the response of the bollworm to Methyl parathion had progressed through vigor tolerance, periods of increases

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in LD_{50} and decreases in slope of the Ld-p line to the period showed a sharp increase toward homogeneity and a marked shift of the Ld-p line to the right. The final population showed an approximate 8 to 10-fold level of resistance to Methyl parathion.

Georghiou and Calman (1969) showed that laboratory selection of Culex pipiens fatigans, and Anopheles albimanus, under Sumithion pressure for 30 and 25 generations, respectively, resulted in only 2.2 and 1.1 fold increase in tolerance.

Hassan et al. (1970) confirmed that the strains of Spodoptera littoralis (Boisd), were usually more tolerant during the period when the insecticides were intensively applied in cotton fields, and less tolerant when application was on a minor scale.

Salem (1970) studied the development of resistance in the Egyptian cotton leafworm, S. littoralis, when was topically exposed every other generation to increasing doses of Fenitrothion during 15 generations in the laboratory. He stated that, the LD_{50} and LD_{90} values were increased gradually during the first 8 generations and rapidly during the last 7 generations, and by the 15th generation the resistant Fenitrothion strain was 20.67-fold.

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Wolfenbarger *et al.* (1970) did not succeed to select for resistance in laboratory strain of the bollworm, *H. zea*, with Monocrotophos and Methyl parathion by topical application, where strain demonstrated susceptibility.

Atallah (1971) tested for resistance of the cotton leafworm, *S. littoralis*, to Carbaryl and DDT. He obtained a 30-fold Carbaryl resistant strain after 15-generations, while the tolerance to DDT reached 6-fold after 18 generations of alternative selections.

Plapp (1971) compared the toxicity of several OP-insecticides to the budworm, *H. virescens*, and the bollworm, *H. zea*, larvae tolerant to chlorinated and carbamate insecticides. The budworm was far less susceptible than the bollworm to most of the materials tested. However, several insecticides were of nearly equal toxicity to larvae of both species.

Harris (1972) indicated that the resistance was increasing in the bollworm, *H. zea*, and the tobacco budworm, *H. virescens*, to Methyl parathion, and in the tobacco budworm to a mixture of Toxaphene and DDT.

Ayad (1973) conducted studies to determine Nuvacron resistance of *S. littoralis* in 13 generations. Results

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indicated that the LD_{50} was fluctuated during the first seven generations between 13.7 and 19.1 µg/g. body weight. However, a remarkable increase took place in the tenth and thirteenth generations.

Collins (1973) selected normal laboratory colony of B. germanica, for Diazinon. The selected colony developed resistance to topical Diazinon 26-fold resistance.

Wilson (1974) found that the Ord Valley strain of H. armigera compared with Heliothis punctigera (Wellen) showed a 90-fold tolerance to DDT, a 35-fold tolerance to DDT-Toxaphene, a 5-fold tolerance to Methyl parathion and a 4-fold tolerance to Endosulfan. No resistance to insecticides had so far been demonstrated with H. punctigera.

Pickens and Miller (1975) pressured the larvae of Musca domestica L. with Stirofos (Rabon), and found that the degree of resistance was 126-times for the larval pressured flies.

Harris (1976) found that the 3rd instar of the Ontario strain of Euxoa achrogaster (Guenee), was resistant to the cyclodiene insecticides and to DDT.

Abd El-Sattar (1977) selected a bollworm strain, H. zea, in laboratory with Phosvel during 12 successive

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generations. The LD_{50} values showed slight increase in the first 5 selected generations. With further selection, an obvious increase in LD_{50} value in G_6 was observed. As selection continued, the level of resistance in G_9 was only 4.1-fold tolerance as compared to the parental strain. The level of resistance to Phosvel at the end of selection in G_{12} attained a level of 10.25-fold resistance.

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