ENVIRONMENTAL TOXICOLOGY OF THE COTTON LEAF WORM Prodenia litura (Fab.)

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C O N T E N T S

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INTRODUCTION

It is hardly necessary to emphasize the importance of the cotton leaf-worm, Prodenia litura (Fab.)= Spodoptera littoralis(Boisd.), as a source of injury to the cotton crop, in addition; it attacks more than sixty different crops.

The chief method to control this pest up till now, is by picking of the egg-masses. This method can be considered practical and successful especially in normal infestation years. In years of severe infestation there is a need for chemical control. Chemical control with organic insecticides started during the 1945 season. The increase in the application of insecticides created many problems such as, resistance of pests to insecticides. The wide occurrence of resistant insects in nature after several generations of insecticide applications was explained as an example of rapid evolution. The insecticides are acting as a powerful selective sieve for concentrating resistant mutants that were present in low frequencies in the original population. This is a strong evidence that the development of resistance is preadaptive rather than post adaptive.

It seems that the study of ecological problems of

this pest in the presence of the toxicant applications may help to clarify many of the unexplained phenomena. In that respect the real effect of sub-lethal doses of pesticides on the population dynamics of the pest is not clearly known.

The effect of the sub-lethal doses on the reproductive potential seems too important from the economic point of view, since it directly affects the population density of the pest.

The present work aims to study the effect of the environmental toxicity of insecticides applied in the field, or the relationship between the residual effects of Dipterex and the population density of the different larval instars of cotton leaf-worm under field conditions; The detection of sensitivity of field strain samples to Endrin, Dipterex and Sevin before, during and after chemical control with the different insecticides, also measuring the combined toxicity resulted from the chemical control with different insecticides and the effect of the ecological factors on this toxicity, in addition to the effect of sub-lethal doses on the biology and the egg production of the same pest were studied.

REVIEW OF LITERATURE

The nomenclature of the concerned insect under investigation and its distribution all over the world represents an international complex. The recently recognized name for this pest as Spodoptera littoralis (Boisduval) was announced in 1963 by Viette for this insect known before as Prodenia litura (Fab.). His identification was based on the morphology of the male genitalia.

Measurments of Population Density :-

Different methods have been tried for the assessment of populations of insects according to the type of vegetation under test; forests (Weese, 1924), prairie (Shekleford, 1929), grassland (Whittaker, 1952) and low-growing herbaceous crops (Moussa, 1953). The methods involved the sampling of aerial insects as well as soil inhabiting forms. The method of Abdel-Salam, 1967 was used in the present work to estimate the population density for different larval instars of cotton leafworm and its relation with residual insecticides under field conditions.

Effect of Dipterex on Spodoptera littoralis (Boisd.):

El-Khishin and Zeid (1962)in their results of laboratory

and field experiments stated that Dipterex was more efficient than sevin against the late larval instar of the cotton leaf-worm. Henien (1964) results of laboratory experiments confirmed that Dipterex gave 100 % Kill against different larval instars of cotton leaf-worm on the 1st day with short residual effect as percentages of kill were 25, 10, 0 against the 3rd instar on the 4th, 7th and 10th days respectively. Also Ayyad (1968) found that the effect of Dipterex on four days old larvae of cotton leaf-worm is more effective than on one and two days old larvae of the same strain.

Tolerance of S. littoralis (Boisd.) to Pesticides :

Tests conducted in Behera Governorate in 1961 by Maher Ali et al., showed that resistance to Toxaphene have developed in the population of the cotton leaf-worm. The same workers proved that elsewhere in the Delta, the tolerance level to Dipterex Endrin, Sevin and Toxaphene were consistently higher than in the untreated areas such as the kharga Oasis. A year later, they proved that there was no change in the status of resistance to Toxaphene; and more tolerant races in Fayoum were also recorded.

El-Toubgi et al.,(1965) working on Prodenia litura collected during the control season 1963 found that there was highly significant correlation between the LC_{50} values of Toxaphene and sevin to the cotton leaf-worm, Confirming that the development of tolerance to Toxaphene seems to predispose the larvae to became resistant to Sevin.

According to Maher Ali et al., (1965) as shown before, there was a seasonal variation in the tolerance of the cotton leaf-worm, Prodenia litura to Toxaphene, Sevin and Dipterex in laboratory tests during 1962-1963 season. They assumed that Toxaphene predisposes the cotton leaf-worm population to become Sevin-resistant.

Effect of the Kind of Food on the Resistance:-

Swingle (1939) stated that resistance of army-worms Prodenia eridania (Gram) to lead arsenate could be controlled to a considerable degree by rearing the larvae on certain species of plants. It was also observed by McGovran and Gersdroff (1945) that house flies fed on milk were more tolerant to DDT and Pyrethrum than those fed on sugar. An interesting nutritional effect has been observed by Bridges and Cox (1959) in a Dieldrin resistant strain of Musca domestica. He suggested that the nutritional effects on the insecticidal tolerance can be more

striking if the insecticides were present at sub-lethal levels in the insect body during the feeding period. Adaptive changes that increase tolerance af an individual insect to a specific toxicant are more likely to occur and to be influenced by diet if the toxicant is chronically present.

According to Gains and Mistric (1960), the food reserves of the insect have a considerable effect upon the insect's tolerance to insecticides. These reserves are dependant on the food intake during the pre-test period.

On the other hand, Gordon, (1961), commented that all the effects of nutrition are minor and difficult to interpret even if it could be shown that a diet causes higher tolerance also causes larger body weight or higher fat content. He claimed that one could never be certain that the increased body weight or fat content is the direct cause.

The rate of losses of residual effect :-

Field experiments conducted by Kamel and Shoeb in (1960), proved that good results were obtained against the newly hatched cotton leaf-worm when using Endrin and other materials at the rate of 0.9 kg. per feddan, the

percentage of kill obtained was 92% on the day after treatment.

Hassan et al., (1962) carried out laboratory and field experiments to study the effect of certain insecticides against the cotton leaf-worm. The laboratory results of these experiments proved that the resistance of the different instars to any of the insecticides used increased consistantly as development proceeded. As contact poisons toxicants were arranged as follows in descending order of their efficiencies : Lindane > Endrin > Dieldrin > DDT > Toxaphene. Endrin seemed to give the highest kill against the 1st, 2nd, 3rd and 4th instars while lindane came second followed by Dieldrin and Toxaphene.

Hassan and Abou-El Ghar (1962) carried out field experiments on the pesticidal control of the cotton leaf-worm. Their study of the residual effect indicated that Endrin was the most persistent material, followed by Dieldrin, DDT/Lindane and Toxaphene in a descending order. They further observed that, all tested materials, gave over 80% as inital kill for the cotton leaf-worm, with exception of Toxaphene which gave only 60%. Sevin proved to have long residual effect over all the other materials tested (55%

kill after 10 days). In general materials used could be arranged in descending order according to their effect against all the larval instars as follows : Dipterex > Sevin > Lindane > DDT/Lindane > Toxaphene/Lindane. It was also proved that Dipterex had a quick knock down action with 100% against 93% for sevin.

Kamel et al., (1964) stated that Endrin 19.5% E.C., Toxaphene 60% E.C. and DDT/Lindane 30/9 when used in field experiments, gave better results than Sevin against the newly hatched cotton leaf-worm larvae as percentages of kill obtained exceeded 90%. In 1964 they observed that 95% to 100% kill could be obtained by using Endrin/Methyl Parathion or Dipterex against the larvae of P. litura in the field and in the laboratory.

Effect of Weathering Conditions on the Residual Effect :

Teotia et al., (1950), studied the loss of effectiveness of deposits of different materials. They found that both high temperature and low relative humidity had a more deleterious effect on the duration of effectiveness of the residual spray deposits than did low temperature or high relative humidity.

Decker et al., (1950) studied the rate of reduction

of the toxicity of deposits from some organic insecticides. They believed that, in the absence of rain, the rate of loss was correlated with the vapour pressure of the insecticides. Hence, the loss was activated by the increase of both temperature and wind.

Gaines and Mistric (1952) reported that high temperature, sun shine, wind, relative humidity and dew, or a combination of these factors greatly reduced the toxicity of the insecticides in the field.

Hopkin et al., (1952), carried out a series of field experiments to estimate the relative importance of rain, sunlight and wind on the loss of DDT residues. The combined effects of rain and sunlight upon the deposits were approximately additive. The effect of all three weather factors together was somewhat greater than that of any two, but not much larger than that of sun light combined with either rain or wind.

Mistric and Martin (1956), found that Parathion deposits on cotton seedlings resulting from water emulsion spray, caused an average daily mortality of 57% to the cotton aphid, Aphis gossypii Glov., when these were released on plants immediately after treatment and kept exposed

to residue for five days. The toxicity of the residue was reduced by 11% if the seedlings were kept for 24 hours after treatment at 105°F (40.5°C) in a shaded green house before the test insects were released on to them.

Kalkat et al., (1961), showed a striking effect of humidity on the insecticidal effect of residues from dilute emulsions of Aldrin, Diazinon, Heptachlor, Malathion and Parathion.

Effect of Sub-Lethal Doses on Insects :

As a major pest, much work has been published on the cotton leaf-worm S. littoralis, Boisd., however, less work has been done on its bionomics, which was mainly the effect of temperature and relative humidity on its normal development. The time taken for the development of the larvae from hatching to pupation varied greatly for each insect according to; the kind of insecticide, time of application and sort of strain (sensitive or resistant).

Larval period : A close relationship between the level of DDT resistance and the duration of the larval period in Musca domestica, L. was observed by Pimental, Dewy and Schwardt (1951) who found that there was increase in length of the larval period in insects with high level of resistance.