

## VI. SUMMARY

The present study deals with the evaluation of efficiency of two bacterial mosquito larvicides and a chemical one against Culex pipiens larvae when used individually or in combinations with each other under laboratory condition, as an integrated method of control.

The obtained results indicate the following :-

### (A) Susceptibility tests :

#### 1. Larvicidal activity of Bacillus thuringiensis H-14:

Results indicated that the susceptibility of the Culex pipiens larvae to this bacterial larvicide was found to be correlated with the exposure time. The  $LC_{50}$  and  $LC_{90}$  of 24, 48 and 72 hr were (0.037 ; 0.15, 0.022; 0.1 and 0.013; 0.064ppm) respectively.

#### 2. Larvicidal activity of Bacillus sphaericus 1593-4 :

The dosage levels of this bacteria have great influence in its toxicity, high concentrations evoked a rapid lethal response to the entire tested larvae, while low dosage resulted in significant mortality rates with increasing the exposure time. The  $LC_{50}$  and  $LC_{90}$  of 24, 48 and 72 hr were (2.6; 8, 1.18; 2.7 and 0.74; 1.6 ppm) respectively.

3. Larvicidal activity of dieldrin :

Susceptibility of the Culex pipiens larvae towards dieldrin was found to be correlated with the exposure time. The  $LC_{50}$  and  $LC_{90}$  of 24, 48 and 72 hr were (0.013; 0.027, 0.011; 0.022 and 0.0086; 0.018 ppm) respectively.

(B) The combined effect of the mixed formulation of the used larvicides.

On testing the larvicidal activity of combination of the three larvicides, results were represented as follows :

1. Mixture of Bacillus thuringiensis H-14 and dieldrin:

Results indicated that the larval exposure to this larvicides mixture or sequences of Bacillus thuringiensis then dieldrin or the reverse of them after 24 hr induced significantly higher larval mortality than when either of them was used individually.

2. Mixture of Bacillus sphaericus 1593-4 and dieldrin:

The obtained data revealed that the larval exposure to this larvicides mixture or sequences of Bacillus sphaericus then dieldrin or the reverse of them after 24 hr induced significantly higher larval mortality than when either of them was used alone.

3. Mixture of both bacterial larvicides :

Larval exposure to the Bacillus thuringiensis and Bacillus sphaericus mixture or sequences of Bacillus thuringiensis then Bacillus sphaericus or the reverse of them after 24 hr induced significantly the highest larval mortality than when either of them was used individually.

(C) Comparative susceptibility of Culex pipiens larvae to the larvicides when used simultaneously or in sequences:

Results indicated the following :

- The Bacillus thuringiensis H-14 and Bacillus sphaericus 1593-4 mixture was the most effective mixture followed by either of their mixture with the chemical larvicide "dieldrin".
- Comparing the effect of adding the Bacillus sphaericus ~~or~~ dieldrin to larvae pretreated for 24 hr with Bacillus thuringiensis indicated that dieldrin addition cause significant increase in larval mortality at the first 24 hr but with increasing the exposure time i.e. after 48 hr no increase in larval mortality takes place than adding B. sphaericus.
- Adding Bacillus thuringiensis H-14 to larvae pretreated with B. sphaericus for 24 hr result in a significant larval mortality than if dieldrin was added.

- There was no significance difference in larval mortality if the Bacillus thuringiensis H-14 or B. sphaericus was added to larvae pre-treated with dieldrin for 24hr.
- There was no significance difference occur to larval mortality rates when the larvae was pre-treated for 24hr with Bacillus thuringiensis or B. sphaericus and then dieldrin was added.
- Mortality resulted from pre-treating the larvae for 24 hr with Bacillus sphaericus and then B. thuringiensis was added, was found to be significant than that resulted from the reverse.
- There was no significance difference between the larval mortality occurred from pre-treating Culex pipiens larvae with dieldren for 24 hr then Bacillus sphaericus was added and the reverse.
- No significance difference of larval mortality was found between pre-treating the larvae with dieldrin for 24 hr then Bacillus thuringiensis was added and the reverse.

(D) Histopathological studies :

The pathological action of the bacterial or the chemical larvicides when used separately or in mixtures were evaluated by examining the sectioned materials. The results of this study were as follows :

1. Bacillus thuringiensis serotype H-14 :

The histopathological examination revealed that this bacterial larvicide cause damage to the epithelial mid-gut cells. In the early stages of infection the cells observed with the characteristic balloon-shaped swollen, while in the late stages the epithelial cells burst as a result of cell rupture, discharging of cell contents in the gut lumen.

The other affected tissues and cells were muscle bundle, fat body layers, Malpighian tubules, gastric caeca and the tracheal matrix. The discontinuation of the peritrophic membrane was observed only at late stages of infection.

2. Bacillus sphaericus 1593-4 :

Examining the sectioned larvae treated with this bacteria showed that the mid-gut was the site of action of this pathogen. The epithelial cells of the gut swollen, deteriorated, and finally burst. At late stage of infection the epithelial cell nucleus was heavily affected and was seen vacuolated

Muscles and fat body layers were also affected.

3. Dieldrin :

The histopathological examination indicate that this chemical larvicide caused damage to the epithelial gut cells, muscles, fat body layers, Malpighian tubules, gastric caeca and the tracheal tubes. The nerve cord was also affected, the cotical layer and the neuropile mass became very loosely packed.

4. Bacillus thuringiensis H-14 and dieldrin mixture :

The histopathological examination revealed similarity between the pathological symptoms of both Bacillus thuringiensis H-14 and its mixture with dieldrin which indicate that the larvicidal action of the Bacillus thuringiensis is not affected by dieldrin.

5. Bacillus sphaericus 1593-4 and dieldrin mixture :

Combination of Bacillus sphaericus 1593-4 and dieldrin induced a destruction of the gut epithelial cell. The posterior part of the mid-gut was extensively destroyed. Fat bodies, muscles, tracheal tubes and Malpighian tubules were also expressed the cellular hypertrophy.

6. Bacillus thuringiensis H-14 and Bacillus sphaericus 1593-4 mixture :

Mixtures of both bacterial larvicides showed pathological activity similar to that seen when either

Bacillus thuringiensis H-14 or Bacillus sphaericus was used.

Based on the experimental results of bioassaying each of the three tested larvicides individually or in combinations, as well as on studying their pathological action, it may be assumed that, it is preferable to use these biological larvicides in integration with the chemical one in mosquito control programmes particularly in larval control, instead of using each of them alone.

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