THE SIMULTANEOUS EFFECT OF BIOINSECTICIDE, CHEMICAL INSECTICIDE AND THEIR MIXTURES ON BOTH *SPODOPTERA LITTORALIS* (BOISD.) AND ITS ENDOPARASITOID; *MICROPLITIS RUFIVENTRIS* (KOK.)

SHALABY F. F. ,[*] E. H. ABD-EL- KARIM[*], S. M. RADWAN[**] AND E. S. MANSOUR[**]

* Plant Protection Dept., Faculty of Agric., Zagazig University, Benha Branch.
** Plant Protection Research Institute, Agricultural Research Center, Dokki , Giza , Egypt .

Abstract

Efficacies of a bioinsecticide (Xentari), chemical insecticide (Pyrethroid), and an I.G.R. (Mimic) and combinations of Xentari and LC_{10} of Baythroid or Mimic were assayed on parasitized and unparasitised larvae of *Spodoptera littoralis* by *Microplitis rufiventris.* Treated larvae showed lower mortality percentages, higher LC_{50} values and longer LT_{50} values than the unparasitised ones. Lowest concentration of Xentari (4 × 10^4 Diamond-back moth Units (DBMU) + LC_{10} of Baythroid caused 16.67 and 23.33 % mortalities among parasitized and unparasitised larvae, respectively, and the mixture showed potentiative effect. Also, the mixture at 4 × 10^4 DBMU of Xentari + LC_{10} of Mimic led to 30.00 and 33.33 % mortalities, respectively, and showed also potentiative effect.

INTRODUCTION

One of the most important cotton pests is the cotton leafworm, *Spodoptera littoralis* (Boisd.). The insect is active almost all the year round and polyphagous, feeding on many field and vegetable crops, ornamental, plants and weeds .

The long period, during which insecticides were widely used in Egypt, to control the cotton leafworm led to environmental pollution and toxicity of mammals and beneficial organisms. The simultaneous effect of pesticides on beneficial organisms is represented by the destruction of predators and parasitoids, for example parasitism percentage in the cotton leafworm, *S. littoralis* was as high as 75 % before the extensive use of pesticides (1934- 1941), while it reached 1.9 – 6.2 % during the period 1968 – 1977 (Attiah, 1977).

From these points of view, appears the necessity of minimizing the quantity of pesticides used to a minimum in IPM programs in which different control methods might be applied.

The presented study was carried out to determine the effect of the bioinsecticide (Xentari), the chemical insecticide (Baythroid), Insect Growth Regulator (Mimic) and combinations of different Xentari concentrations with LC_{10} level of Baythroid or Mimic to determine the potential and the additional effects of the chemical or I.G.R. on healthy *S. littoralis* larvae and those parasitized by *M. rufiventris*. This study may be considered of special importance in determining the insecticide of higher efficacy on the target pest and of lower efficiency on the beneficial parasitoid.

MATERIALS AND METHODS

1-Rearing colonies of the cotton leafworm, *Spodoptera littoralis:*

A susceptibility colony of *S. littoralis* was reared in the laboratory at 28 ± 2^oC and 65 ± 5 % R.H. . The colony was started by egg − masses collected from cotton fields at the Experimental Farm of the Faculty of Agriculture at Moshtohor, Qalubia Governorate. The   castor −bean leaves were well − washed in running water, left until dryness and offered to the hatching larvae.

2- Rearing of the parasitoid, *Microplitis rufiventris* Kok.:

The parasitoid was reared using the same method as previously described by Shalaby (1968) .

3-Materials used:

a- Chemical insecticide (Baythroid):

Baythroid 5% E.C. formulation: Emulsifiable concentrate containing 50 g. a.i. / litre.

Common name: Cyfluthrin.

Chemical name: Cyano- (4- fluoro-3- phenoxybenzylphenyl)−methyl − Z - (2,2- dichloroethenyl) −2,2 − dimethyl − cyclo − proppane carboxylate (C.A.).

Empirical formula: $C_2H_{18}Cl_2FNO_3$

Recommended rate: 37.5g. a.i /feddan.

b- Bioinsecticide (Xentari):

Xentari, a selective bacterial insecticide containing 35.000. DBMU (Diamond – back moth units) of *Bacillus thuringiensis* subsp.*aizawi* per mg. of product.

c- Insect Growth Regulator (Mimic): 24% F.L. formulation.

Common name: Tebufenozide (RH- 5992).

Chemical name: 3,5- dimethylbenzoic acid 1- (1,1 dimethyl ethyl)-2- (4- ethylbenzoyl) hydrazide.

Empirical formula: $C_{22}H_{28}N_2O_2$

4-.Acute and delayed toxicity on healthy *S. littoralis* larvae and those parasitized by *M. rufiventris*:

1- Chemical insecticide (Baythroid):

A volume of 1 ml. Baythroid 5% E.C. (5×10^4 p.p.m.) was dissolved in 100 ml. water to obtain the concentration of 500 p.p.m. as a stock solution. A volume of 3,6,9,12,15 and 18 ml. of the stock solution were diluted by a constant volume of 100 ml. water to obtain the final concentrations of 15,30,45,60,75 and 90 p.p.m., respectively.

2- Bioinsecticide (Xentari):

Weights of 0.114, 0.229, 0.343, 0.457, 0.571 and 0.686 grams of Xentari were diluted, each in a constant volume of 100 ml. water to obtain the concentrations of $4 \times 10^4, 8 \times 10^4, 12 \times 10^4, 16 \times 10^4, 20 \times 10^4$ and 24×10^4 Diamond- back Moth Units, respectively.

3- Insect Growth Regulator (Mimic):

A volume of 1.00 ml. Mimic 24% EC was dissolved in 100 ml. water to obtain the concentration of 2400 p.p.m. as a stock solution. Volumes of 1.04, 2.08, 4.17, 8.33, 16.67 and 33.33 ml. of stock solution were diluted, each by a constant volume of 100 ml. water to obtain the final concentrations of 25, 50, 100, 200, 400 and 800 p.p.m., respectively.

5.Effect of combinations of different bioinsecticide concentrations and LC_{10} of the chemical insecticide or I.G.R. on healthy *S. littoralis* larvae and those parasitized by *M. rufiventris*:

Different concentrations of Xentari (4×10^4, 8×10^4, 12×10^4, 16×10^4, 20×10^4, and 24×10^4 Diamond-back Moth Units) were prepared and mixed with LC_{10} of Baythroid or Minic for unparasitised and parasitized larval treatments.

The following procedures were followed in all experiments:

1-The second instar *S. littoralis* larvae (4 days old) were exposed to the parasitoid, and treatments took place after 5 days of individual parasitism. Also, the unparasitised *S. littoralis* larvae were treated at the same age (9 days after hatching).

2- For each treatment, three replicates, each of ten larvae, placed in a cup (6x7.5 cm.), were allowed to feed on the treated castor-bean leaves for a period of 24 hours for chemical insecticide and I.G.R. treatments. The larvae were allowed to feed for 48 hours in case of Xentari or the combination of bioinsecticide with LC_{10} of either the chemical insecticide or I.G.R. compound. The mortality rates were recorded daily. Larvae that survived after treatment were transferred to other cups containing untreated castor-bean leaves on which they were fed till emergence of the full grown larvae of parasite.

3- Before exposing the larvae to treated food, they were starved for 6 hours in order to obtain rapid simultaneous ingestion of the contaminated food

4- Control test was conducted by dipping clean castor-bean leaves in water, left to dry and then offered to the experimental larvae.

5- Each experiment was carried out under the laboratory conditions of 28 ± 2ºC and 65 ± 5% R.H.

Statistical analysis:

1- As larval mortality percentages, in control treatments, ranged from 5-20%, the obtained data were corrected according to the formula of Abbot (1925).

2- The LC$_{50}$ and LT$_{50}$ values at 5% confidence limits and slopes of regression lines were represented and interpreted using probit analysis statistical method of Litchfield and Willcoxon (1949).

3-Combination treatments:

To find out the joint toxicity of various insecticide mixtures, the simple method of Sun and Johnson (1960) was followed.

Co-toxicity factor = Observed % mortality – Expected % mortality
                              Expected % mortality

This factor was used to differentiate the results into three different categories. A positive factor of 20 or more meant potentiation, a negative factor of 20 or less meant antagonism, and any intermediate value between -20 and +20 was considered only additive effect.

RESULTS AND DISCUSION

1. **Effect of bioinsecticide (Xentari), chemical insecticide (Baythroid), I.G.R. (Mimic) and selected mixtures: 1.1. On *S. littoralis* larvae**

The second instar *S. littoralis* larvae (4 days old) were treated after (5 days) of individual parasitism (9 days old) with castor-bean leaves treated with different concentrations of Xentari, Baythroid, Mimic and combinations of Xentari and LC$_{10}$ of Baythroid or Mimic (calculated from LC$_{10}$ level of Baythroid or Mimic derived from the probit line for both healthy and parasitized larvae).

The differences in percentages of daily larval mortality of both healthy and parasitized *S. littoralis* larvae are presented in Table 1, while the calculated LT$_{50}$ and LC$_{50}$ values are shown in Table 2 .

a-Bioinsecticide treatments:

The corrected mortality percentages after 72 hours (at which LC$_{50}$'s were estimated) for the parasitized *S. littoralis* larvae treated with Xentari increased by increasing bioinsecticidal concentrations and ranged from 16.67 to 73.33 at the concentrations of 4×10^4 to 24×10^4 DBMU were considered. While, percentages in case of healthy

larvae at the same age and concentrations ranged between 20.00 to 86.67, respectively Table, 1.

However, as shown in Fig. 1, the LC_{50} values were 15×10^4 for parasitized larvae, while this value was lower, reaching 10.5×10^4 in case of treated healthy *S. littoralis* larvae, indicating that the parasitized larvae were less susceptible to bioinsecticidal treatments than the healthy ones at same age. These results agree with those of Nealis and Van Frankenhuyzen (1990) on 3 [rd] and 4 [th] instar larvae of *Choristoneura fumiferana* parasitized by *Apanteles fumiferanae* that were fed on foliage of *Abies balsamea* and sprayed with a commercial formulation of *B. thuringiensis* , also Kares *et al.* (1998), on 2 [nd] instar larvae of *S. littoralis* parasitized by *M. rufiventris* which were fed on castor bean leaves contaminated with Delfin, found during the first 48 hours after parasitism, slight differences occurred in the body length, body weight and the amount of food eaten by the unparasitized and parasitized larvae, but gradually, these differences increased in case of parasitized larvae till the emergence of the parasites.

The data tabulated in Table 2 it could be observed that ,after Xantari treatments,the LT_{50} values were longer in case of parasitized larvae than those needed for the unparasitized larvae. LT_{50} values were 44, 34 and 26 hours for the unparasitized larvae and 60, 52 and 42.5 hours for parasitized larvae by using the concentrations 16×10^4 , 20×10^4 and 24×10^4, respectively.

These results are in agreement with the findings of Kares et al. (1992) who studied the efficacy of Bactospeine on the 2 [nd], 3 [rd] and 4 [th] larval instars of *Artogeia rapae* (L.). The authors found a negative correlation between the recommended concentration and the LT_{50} values.

b. Chemical insecticide treatments:

The corrected mortality percentages of parasitized larvae after 24 hours of treatment with Baythroid concentrations between 15 to 90 ppm, ranged from 13.33 to 80.00 %, opposed to 30.00 − 93.33 % for the unparasitized larvae. The LC_{50} values were 52 (43.70 − 61.88) ppm and 33 (26.83- 40.59) ppm for the parasitized and unparasitized

larvae, respectively Fig.2. These data revealed that the parasitized larvae were less susceptible to the chemical insecticide treatments than the unparasitized larvae.

The LT_{50} values were 38 and 24 hours for unparasitised larvae and78 and 44 hours for parasitized larvae at the concentration of 30 and 45 ppm, respectively, thus underwent longer LT_{50}'s for the parasitized than the unparasitized larvae. Also, these periods shortened, generally by increasing the tested concentration Table, 2 .

These results are in agreement with those of   Shalaby *et al.* (1986) who concluded that *S. littoralis* larvae parasitized by *M. rufiventris* were less susceptible to Bolstar 720 EC treatments than unparasitized ones of the same age.

C. Insect Growth Regulator treatments:

The corrected mortality percentages of parasitized larvae after 72 hours of treatment with insect growth regulator (Mimic) concentrations (25 to 800 ppm) ranged from 16.67 to 83.33 %. While in case of unparasitized larvae, these percentages ranged between 30.00 to 93.33 %. The LC_{50} values were 150 (109.5- 205.5) ppm for parasitized larvae and 95 (67.86 − 133.00) ppm for unparasitized ones Fig. 2. These data indicated the lower susceptibility of parasitized larvae to Mimic treatments than the unparasitized ones.

These results were in agreement with findings of Kares (1990) who found that Diflubenzuron caused higher mortality rates among unparasitised *S. littoralis* larvae than parasitized ones

When, the LT_{50} values Table 2 were longer, in case of parasitized larvae (88, 67, 49 and 38 hours at concentrations 100, 200, 400 and 800 ppm, respectively) than unparasitized ones at the same concentrations (58, 43, 39 and 30 hours, respectively). It could appear that the LT_{50}'s shortened as the applied concentrations were increased. These results agree with Kares (1990) who found that the LT_{50} values among late second instar of *S. littoralis* parasitized by *Zele nigricornis* and treated by Diflubenzuron were longer than those of the unparasitized larvae at the same concentration.

The differences in LC_{50} and LT_{50} values between the parasitized *S. littoralis* unparasitized ones may be due to the amount of toxic food ingested, since the parasitized larvae cease feeding and therefore ingest less toxicant. Lewis (1970) found that parasitized host larvae of *Porthesia similis* (Fuessly) by *Microplitis cerurae; S. littoralis* by *M. demolitor, S. littoralis* by *M. rufiventris* and *Heliothis zea* by *M. croceips,* respectively had small body size, body length and body weight Kares et al. (1998) found also that *S. littoralis* larvae parasitized by *Microplitis rufiventris* had less body length, body weight and the amount of food eaten were comparatively less than those of healthy larvae.

d. Combination treatments:

Two methods were followed to determine the combined effect of different Xentari concentrations mixed with sublethal concentration (LC_{10}) of Baythroid or I.G.R. (Mimic). The first, by determining the LC_{50} values and the second, by estimating the Co-toxicity factor.

d.1. Mixture of different concentrations of Xentari with LC_{10} of Baythroid:
   First method:

After 72 hours from treatment with combination of different concentrations of Xentari and calculated LC_{10} of Baythroid (= 6.6 ppm for the unparasitized or 10.4 ppm for the parasitized larvae),the corrected mortality percentages were 23.33, 50.00, 70.00, 80.00, 86.67 and 90.00 % for unparasitized larvae, and 16.67, 33.33, 50.00, 60.00, 70.00 and 73.33 % for the parasitized larvae, at concentrations of 4, 8, 12, 16, 20 and 24 x 10^4 DBMU of Xentari + LC_{10} of Baythroid.

The LC_{50} values Fig., 4 were 7.8 x 10^4 DBMU + 6.6 ppm Baythroid and 12 x10^4 DBMU + 10.4 ppm Baythroid for unparasitized and parasitized larvae, respectively.

Generally, the parasitized larvae showed lower mortality rates than the unparasitized ones at different experiments. In addition, the LC_{50} values were higher in case of parasitized than those required for unparasitised ones larvae.

Moreover, chemical insecticides caused higher mortality percentages among unparasitized and parasitized larvae than in those treated with the bioinsecticides, but for larvae treated with the combination of the bioinsecticide with calculated LC_{10} level of chemical insecticide, the mortality percentages were higher than each of bioinsecticide or chemical insecticide alone.

Second method:

Data in Table 3 (a,b) show that treatment with combination of Xentari at low concentrations of 4 and 8×10^4 with LC_{10} level of Baythroid for unparasitized larvae caused mortalities of 23.33 and 50.00 % and the values of Co-toxicity factor were + 33.31 and + 22.94, respectively, indicating potentiation in their effect. While, the higher concentrations of Xentari (12, 16, 20 and 24×10^4) combined also with the LC_{10} of Baythroid and offered to the unparasitized larvae, led to corrected mortality percentages of 70.00, 80.00, 86.67 and 90.00 % and the Co-toxicity factor values were + 18.64, +11.11, +7.44 and + 3.49, respectively, indicating additive effects. While in case of parasitized larvae, Xentari at the lowest concentration (4×10^4), the Co-toxicity factor was potentiative (+ 44.96). While, mixing Xentari at higher concentrations (8, 12, 16, 20 and 24×10^4 DBMU) with LC_{10} of Baythroid caused 33.33, 50.0, 60.00, 70.00 and 73.33 % corrected mortalities, respectively, and the Co-toxicity factor values were (+ 18.32, + 14.94, + 10.09, +7.97 and + 4.01), respectively indicating additive effect of the used combinations.

Generally, the combination of the bioinsecticide with LC_{10} of the chemical insecticide caused higher mortality for unparasitized larvae than parasitized ones. The low concentrations of the bioinsecticide produced potentiation, while the high concentrations produced additive effects for unparasitized and parasitized larvae.

d.2. Mixture of different concentrations of Xentari with LC_{10} of Mimic:
First method:

After 72 hours from feeding *S. littoralis* larvae on castor-bean leaves treated with combination of different concentrations of Xentari (4, 8, 12, 16, 20 and 24×10^4 DBMU) and calculated LC_{10} of Mimic (= 19.0 ppm for the unparasitized larvae or 30.0 ppm for parasitized ones), the corrected mortality percentages among treated *S. littoralis* larvae were 33.33, 60.00, 76.67, 86.67, 93.33 and 96.67 % for unparasitized larvae and 30.00, 46.67, 63.33, 73.33, 83.33 and 86.67 % for parasitized ones,

respectively Table, 4. The LC_{50} values Fig., 5 were 6.8 x 10^4 DBMU + 19.0 ppm and 8.6 x10^4 DBMU + 30.0 ppm for unparasitized and parasitized larvae, respectively. It is clear that the parasitized larvae showed lower mortality percentages and higher LC_{50}'s than the unparasitized ones. Moreover, insect growth regulator showed higher mortality percentages among the unparasitized and parasitized larvae than caused by with the bioinsecticide alone, although the larvae treated with the mixture of the bioinsecticide with LC_{10} of insect growth regulator, the mortality percentages were higher than either the bioinsecticide or insect growth regulator alone.

Second method:

Data in Table 4 show that feeding the unparasitized larvae of *S. littoralis* on castor-bean leaves treated by combination of Xentari at lower concentrations of 4 and 8 x10^4 with LC_{10} level of Mimic for unparasitized larvae caused mortalities of 33.33 and 60.00% and the Co-toxicity factor values were + 25.77 and + 20.80 indicating potentiative effect of these materials. While, by using Xentari at higher concentrations (12, 16, 20, 24 x10^4 DBMU to be mixed with LC_{10} level of Mimic, the corrected mortality percentages were 76.67, 86.67, 93.33 and 96.67 % and the Co-toxicity factors values were + 12.75, + 7.00, + 4.08 and + 0.70, respectively, showing additional effects. While in case of parasitized larvae, the mixture of Xentari at lowest concentration (4 x 10^4) with LC_{10} of Mimic caused mortality of 30.00 % and the Co – toxicity factor value was + 20.00 indicating potentiative effect. , higher concentrations of Xentari (8, 12, 16, 20, 24 x10^4) DBMU combined with LC_{10} of Mimic, caused corrected mortality percentages of 46.67, 63.33, 73.33, 83.33 and 86.67 % and the Co-toxicity factor values were +13.83, + 11.11, + 7.84, + 6.38 and + 3.18 which indicated additive effect of the mixture.

Generally, the combination of the bioinsecticide with calculated LC_{10} of insect growth regulator caused higher mortality percentages among unparasitized larvae than parasitized ones. The low concentrations of Xentari, when mixed with LC_{10} of Mimic produced potentiation, while the high concentrations produced additional effects in both unparasitised and parasitized larvae.

These results are in agreement with Hamilton and Attia (1977) who studied the effect of mixtures of a *B. thuringiensis* product (Dipel) and 7 pesticides (Tricyclohexyltin hydroxide, Fentin hydroxide, Phosphamidon, Dimethoate-S-methyl, Binapacryl, Demeton-S-methyl and Chlordimeform hydrochloride) against 3 [rd] instar larvae of *Plutella xylostella*. Binapacryl, Tricyclohexyltin hydroxide, Chlordimeform and Fentin hydroxide at the LC_{50} level synergised *B. thuringiensis*; while on the contrary, Demeton- S- methyl and Dimethoate were highly antagonistic. Abdel – Megeed et al.(1984/1985) reported that the binary mixtures of Dipel/ Methoxy resulted an additive or antagonistic effects in varying degrees when the second instar larvae of *S. littoralis* were fed on treated leaves for five days. While the binary mixtures of 500 gm. Dipel/300 cc. Fenvalerate resulted a potentiation effect for the 4 [th] instar larvae of *S. littoralis* by feeding for five days on treated leaves. While, in case of the 2 [nd] instar larvae feeding on the same mixture for 5 days, an antagonistic effects were achieved. They, also, found a potentiation effect resulted when the 4 [th] instar larvae fed for 24 hours on treated leaves sprayed at 250 gm. Dipel / 500 cc. Cyanophos, while on the contrary an antagonistic effect occurred when the 2 [nd] instar larvae were fed for five days on leaves sprayed at rate of 500 gm. Dipel /500 cc. Cyanophos. El-Zemaity and El-Refai (1987) also revealed potentiation of the combination of Fenvalerate at LC_{25} and Dipel (*B. thuringiensis* subsp. *kurstaki*) against larvae of *S. littoralis*. Raising the LC value of Fenvalerate revealed an additive effect. The Co-toxicity factor decreased when the LC value of Fenvalerate or Dipel were increased. Also, Kares (1991a) showed that the 4 [th] instar larvae of *P. gossypiella* treated by the combination of Bactospeine at low concentrations of bioinsecticide with LC_{10} of Cyanophos (16 ppm) or Fenvalerate (8 ppm) produced potentiation, but mixing Bactospeine or Thuricide at higher concentrations of (4.5 $\times 10^4$, 6 $\times 10^4$ and 7.5 $\times 10^4$ I.U.) with LC_{10} level of Cyanophos or fenvalerate produced additional effects. Also, El-Mandrawy (1995) studied the effect of Delfin, the chemical insecticide (Baythroid) and a combination of different Delfin concentrations with LC_{10} level of Baythroid on unparasitized and parasitized larvae of *S. littoralis* by *M. rufiventris*. The study indicated that Baythroid caused higher mortality than the bioinsecticide, but for larvae treated with the combination of the bioinsecticide Delfin with calculated LC_{10} level of chemical insecticide, the percent mortality was inbetween the two values. When Delfin at high concentrations of 16 $\times 10^4$, 20 $\times 10^4$ and 24 $\times 10^4$ S.U. was combined with LC_{10} level of

Baythroid for unparasitized and parasitized larvae, the mixture indicated additive effects of the mixture.

CONCLUSION

Results obtained showed that the parasitized *S. littoralis* larvae by *M. rufiventris* were less affected by the assayed materials (bioinsecticide, I.G.R. and chemical insecticide)than unparasitised ones. In all treatments, the parasitized larvae showed lower mortality percentages, highest LC_{50} and longer LT_{50} than the unparasitised ones of the same age, at the same concentration. It was also evident that using mixtures of the bioinsecticide (Xentari) + LC_{10} of the chemical insecticide (Baythroid) or the I.G.R. (Mimic) to be offered for larvae treatments led to higher mortality percentages among treated larval than case of using the bioinsecticide alone. It was clear that mixing the LC_{10} of Baythroid or Mimic to the low concentrations of Xentari produced potentiative effect on the parasitized and unparasitized larvae, while additive effect on treated larvae was detected when the LC_{10} of chemical insecticide were mixed with higher concentrations of the bioinsecticide.

Fig. 1: Concentration mortality probit lines showing the susceptipility of unparasitised and parasitised 9 days old *S. littoralis* larvae fed for 2 days on castor bean leaves treated with different concentrations of Xentari.

Fig. 2: Concentration mortality probit lines showing the susceptipility of unparasitised and parasitised 9 days old *S. littoralis* larvae fed for 24 hours on castor bean leaves treated with different concentrations of Baythroid.

Fig. 3: Concentration mortality probit lines showing the susceptipility of unparasitised and parasitised 9 days old *S. littoralis* larvae fed for 24 hours on castor bean leaves treated with different concentrations of Mimic
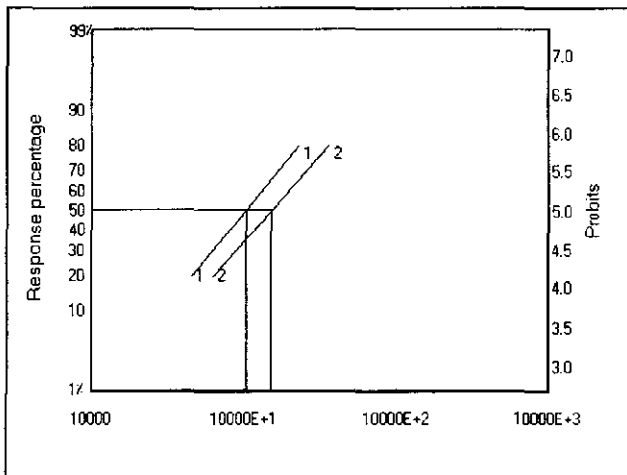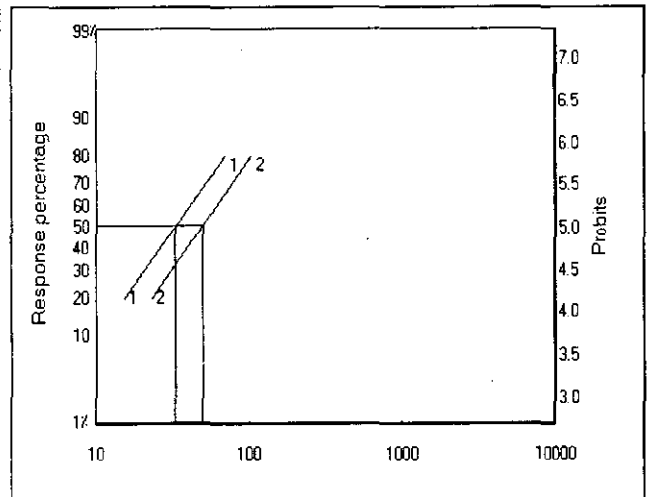
Fig. 4: Concentration mortality probit lines showing the susceptipility of unparasitised and parasitised 9 days old *S. littoralis* larvae fed for 2 days on castor bean leaves treated with combination of different concentrations of Xentari and LC_{10} of Baythroid.
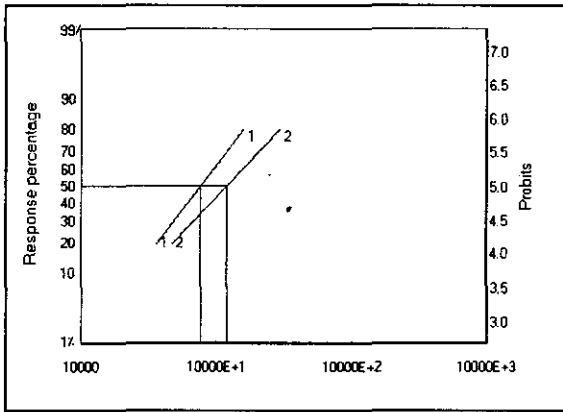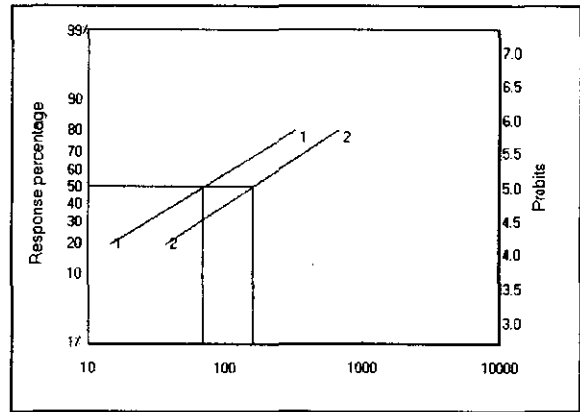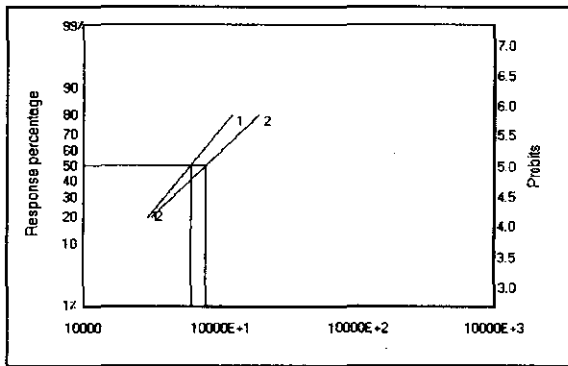

Fig. 5: Concentration mortality probit lines showing the susceptipility of unparasitised and parasitised 9 days old *S. littoralis* larvae fed for 2 days on castor bean leaves treated with combination of different concentrations of Xentari

1-Unparasised larvae
2- Parasitised larvae

Table 1. Corrected mortality rates for parasitized and unparasitized *S. littoralis* larvae treated with bioinsecticide (Xentari),chemical insecticide (Baythroid) and I.G.R. (Mimic).

Conc.*	Comulative mortality % after days of treatment											
	Parasitized larvae**						Unparasitized larvae					
	1 st	2 nd	3 rd	4 th	6 th		1 st	2 nd	3 rd	4 th		
DBMU ***	Bio- insecticide (Xentari)											
0.00	0.00	0.00	3.33	3.33	100		0.00	3.33	3.33	3.33		
4x10⁴	0.00	6.67	16.67	23.33	100		3.33	10.00	20.00	33.33		
8x10⁴	3.33	10.00	26.67	33.33	100		6.67	16.67	36.67	46.67		
12x10⁴	10.00	20.00	36.67	46.67	100		16.67	30.00	50.00	56.67		
16x10⁴	20.00	33.33	50.00	63.33	100		26.67	46.67	63.33	70.00		
20x10⁴	26.67	46.67	63.33	70.00	100		36.67	56.67	76.67	83.33		
24x10⁴	33.33	56.67	73.33	76.67	100		46.67	73.33	86.67	93.33		
Ppm	Chemical insecticide (Baythroid)											
0.00	0.00	3.33	3.33	3.33	100		0.00	3.33	3.33	3.33		
15	13.33	20.00	23.33	40.00	100		30.00	36.67	50.00	63.33		
30	23.33	33.33	36.67	56.67	100		33.33	56.67	73.33	83.33		
45	40.00	53.33	63.33	70.00	100		50.00	70.00	86.67	96.67		
60	56.67	70.00	76.67	80.00	100		73.33	86.67	93.33	100.0		
75	70.00	83.33	90.00	93.33	100		86.67	96.67	100.0	100.0		
90	80.00	93.33	96.67	100.0	100		93.33	100.0	100.0	100.0		
ppm	I.G.R. (Mimic)											
0.00	0.00	0.00	3.33	3.33	100		0.00	0.00	0.00	3.33		
25	3.33	10.00	16.67	23.33	100		6.67	16.67	30.00	43.33		
50	6.67	16.67	26.67	40.00	100		10.00	26.67	43.33	56.67		
100	13.33	20.00	43.33	53.33	100		20.00	33.33	56.67	70.00		
200	16.67	23.33	56.67	63.33	100		26.67	43.33	70.00	63.33		
400	20.00	33.33	70.00	76.67	100		33.33	50.00	80.00	93.33		
800	26.67	46.67	83.33	90.00	100		40.00	63.33	93.33	100.0		

Surviving larvae reached the pupal stage

*   Concentration
** Treatments took place after 5 days from parasitism (9 days old larvae).
*** Diamond back moth units

Table 2. Comparative mortality – time values of parasitized and unparasitized *S. littoralis* larve fed on castor bean leaves dipped in different concentrations of Xentari, Baythroid and Mimic.

Concentration	L. T 50 (hours)	Slope	Confidence limits at P0.05 of	
			LT 50	Slope
Bioinsecticide (Xentari)				
Unparasitized larvae				
6x10^4 DBMU *	44.0	4.18	61.60 : 31.43	12.54 :1.39
10x10^4 DBMU *	34.0	2.99	45.22 : 25.56	5.83 : 1.53
4x10^4 DBMU *	26.0	2.64	37.44 : 18.06	5.15 : 1.35
Parasitized larvae				
16 x10^4 DBMU *	60.0	2.00	73.80 : 48.78	3.10 : 1.29
10 x10^4 DBMU *	52.0	2.45	64.48 : 41.94	3.70 : 1.62
4 x10^4 DBMU *	42.5	2.33	52.23 : 34.55	3.15 : 1.73
Chemical inseticide (Baythroid)				
Unparasitized larvae				
30 ppm	38.0	2.87	49.40 : 29.23	5.17 : 1.59
45 ppm	24.0	2.88	32.88 : 17.52	5.76 : 1.44
Parasitized larvae				
30 ppm	78.0	3.10	100.62 : 60.47	6.82 : 1.41
45 ppm	44.0	3.40	55.0 : 35.20	8.16 : 1.42
I.G.R. (Mimic)				
Unparasitized larvae				
100 ppm	58.0	2.95	75.40 : 44.62	5.31 : 1.64
200 ppm	43.0	2.60	55.9 : 33.08	4.94 : 1.37
400 ppm	39.0	3.15	52.65 : 28.89	7.04 : 1.45
800 ppm	30.0	1.79	36.90 : 24.39	2.51 : 1.28
Parasitized larvae				
100 ppm	88.0	3.20	123.20 : 62.86	7.68 : 1.33
200 ppm	67.0	2.85	87.10 : 51.54	5.13 : 1.58
400 ppm	49.0	2.38	60.27 : 39.84	3.57 : 1.59
800 ppm	38.0	2.08	45.60 : 31.67	2.88 : 1.53

* Diamond-back moth Units

Table 3 - a . Comparative toxicities of unparasitized and parasitized *S. littoralis* larvae fed on trcated castor- bean leaves with different concentration of bioinsecticide (Xentari), chemical insecticide (Baythroid), I.G.R. (Mimic) and the combination of Xentari

Treatment	LC$_{50}$	Slope	Confidence limits at (Po-05)	
			LC 50	Slope
Unparasitized larvae				
Xentari	10.5 10$^{4°°}$	2.39	7.84 x 10^4 – 14.07 x 10^4	1.67- 3.42
Baythroid	33 ** ppm	2.56	26.83 – 40.59	2.06 – 3.17
Mimic	95 * ppm	4.01	67.86 – 133.00	2.51 – 6.42
Xentari + LC$_{10}$ Baythroid	7.8 x10$^{4°}$+ 6.6 ppm*	2.44	6.09 x10^4+6.6 – 9.98 x 10^4 +6.6	1.95 – 3.05
Xentari + LC$_{10}$ Mimic	6.8 x 10 + 19.0 ppm *	2.21	5.35 x10^4+19.0 – 8.64 x10^4 + 19.0	1.58 – 3.09
Parasitized larvae				
Xentari	15 x 10^4	2.73	11.81 x 10^4 – 19.05 x 10^4	1.75 – 4.26
Baythroid	52	2.07	43.70 – 61.88	0.82 – 2.59
Mimic	150	4.71	109.50 – 205.50	2.98 – 7.44
Xentari + LC$_{10}$ Baythroid	12 x 10$^{4°}$ +15.4 ppm	3.08	9.52 x10^4+10.4 – 15.12 x 10^4 +10.4	1.81 – 5.24
Xentari + LC$_{10}$ Mimic	8.6 x 10^4 + 30 ppm	2.81	6.77 x10^4+30.0– 10.92 x10^4 + 30.0	1.81 – 4.36

* Computed from 72 hours of the mortality data
° Diamond back moth units
** Computed from 24 hours of the mortality data.

Table 3 – b . Efficacy of mixtures of Xentari and LC_{10} of Baythroid on the unparasitised and parasitized *S. littoralis* larvae and those parasitized by *M . rufiventrris*.

Larvae	Concentration		Calculated % mortality from Ldp lines		Expected % mortality	Observed % mortality	Co-toxicity factor	Combined effects
	Xentari DBMU	Baythroid LC_{10} (p.p.m.)	Xentari	Baythroid				
Unparasitised	4×10^4		13.50		17.50	23.33	33.31	++
	8×10^4		36.67		40.67	50.00	22.94	++
	12×10^4		55.00		59.00	70.00	18.64	00
	16×10^4	6.6	68.00	4.00	72.00	80.00	11.11	00
	20×10^4		76.67		80.67	86.67	7.44	00
	24×10^4		83.00		87.00	90.00	3.49	00
parasitized	4×10^4		10.00		11.50	16.67	44.96	++
	8×10^4		26.67		28.17	33.33	18.32	00
	12×10^4		42.00		43.50	50.00	14.94	00
	16×10^4	10.40	53.00	1.50	54.50	60.00	10.09	00
	20×10^4		63.00		64.83	70.00	7.97	00
	24×10^4		69.00		70.50	73.33	4.01	00

Table 4. The susceptibility of unparasitised and parasitized *S. littoralis* larvae and those parasitized by *M. rufiventrris*.

Larvae	Concentration		Calculated % mortality from Ldp lines		Expected % mortality	Observed % mortality	Co-toxicity factor	Combined effects
	Xentari DBMU	Baythroid LC_{10} (p.p.m.)	Xentari	Baythroid				
Unparasitised	4×10^4		13.50		26.50	33.33	25.77	++
	8×10^4		36.67		49.67	60.00	20.80	++
	12×10^4		55.00		68.00	76.67	12.75	00
	16×10^4	19.0	68.00	13.00	81.00	86.67	7.00	00
	20×10^4		76.67		89.67	93.33	4.08	00
	24×10^4		83.00		96.00	96.67	0.70	00
parasitized	4×10^4		10.00		25.00	30.00	20.00	++
	8×10^4		26..67		41.67	46.67	13.83	00
	12×10^4		42.00		57.00	63.33	11.11	00
	16×10^4		53.00		68.00	73.33	7.84	00
	20×10^4	30.0	63.00	15.00	78.33	83.33	6.38	00
	24×10^4		69.00		84.00	86.67	3.18	00

00 = Addition.

++ = Potentiation.

REFERENCES

1. Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol.. 18: 265 - 277.

2. Abd El-Megeed, M.I. , S.A., El-Refaei, A.A. Zidan, and W.M. Watson. 1984-1985. The joint action of microbial and chemical insecticide combinations on the cotton leafworm, *Spodoptera littoralis* (Boisd.). Bull ent. Soc. Egypt, Econ. Ser., 14 : 119 - 126.

3. Attiah, H.H. 1977. Ecological assessment of pesticide management on terrestrial ecosystem in Egypt. Proceeding of the VC / AID Univ. of Alexandria, A.R.E. Seminar /workshop in pesticide mangement. March 5 -10.

4. El–Mandarawy, M.B.R.1995. Studies on the effects of *Bacillus thuringiensis* Berliner and a chemical insecticide on *Spodoptera littoralis* (Boisd.) and its parasitoid *Microplitis rufiventris* Kok. Ph.D. Thesis, Fac. of Sci., Cairo University.

5. El–Zemaity, M.S. and S.A. El–Refai .1987. Joint action of fenvalerate mixtures against the cotton leafworm, *Spodoptera littoralis* (Boisd.). Annals of Agric. Sci., Fac. of Agric., Ain Shams 32 (3): 1741 – 1749.

6. Hamilton, J.T. and F.I. Attia . 1977. Effects of mixtures of *Bacillus thuringiensis* and pesticides on *Plutella xylostella* and the parasite *Thyraeella collaris*. J. Econ. Entomol. 70: 146 – 148.

7. Kares, E.A. 1990. Impact of diflubenzuron in *Spodoptera littoralis* (Boisd.) larvae parasitized by *Zele nigricornis* (Walk.) Zagazig, J. Agric. Res. 17 (3B): 953 – 958.

8. Kares, E.A. 1991 Effect of mixtures of *Bacillus thuringiensis* (Berliner) and chemical insecticides against larvae of the pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechidae). Egypt, J. Biol. P. Cont. 1 (2): 15 –23.

9. Kares, E.A. A.M., Abdel–Rahman A.A. El–Moursy, and M.B.R. El – Mandarawy .1992. Qualitative and quantitative studies on the haemolymph of *Artogeia rapae* L. larvae after a bioinsecticidal and gamma radiation treatment. Egypt, J. Biol. P. Cont. 2 (2): 131 – 141.

10. Kares, E.A., A.A., El–Moursy. N., Zohdy, A.M. Abd El–Rahman, and M.B.R. El–Mandarawy .1998. Biological and toxicological studies on the parasitoid *Microplitis rufiventris* Kok. Egypt, J. Agric. Res. 76 (4): 1499 – 1513.

11. Lewis, W.J. 1970. Life history and antomy of *Microplitis corceipes* (Hymenoptera: Braconidae), a parasite of *Heliothis spp.* (Lepidoptera: Noctuidae). Ann. Entomol, Soc. Amer., 63 (1): 67 – 71.

12. Litchfield, J.T. and F. Willcoxon .1949. A simplified method of evaluating dose – effect experiments. J. Pharmacol. And Exp. Therap. 96: 99 – 133.

13. Nealis, V. and K. Van Frankenhuyzen . 1990 . Interactions between *Bacillus thuringiensis* Berliner and *Apanteles fumiferanae* Vier. (Hym.: Braconidae) a parasitoid of the sprue budworm, *Christoneura fumiferana* (Clem) (Lep.: Tortricidae). Canadian Entomologist, 122 (7-8): 585 – 594.

14. Shalaby, F.F.; Ibrahim, A.A. and E.A. Kares. 1986. Effects of parsitism by *Microplitis rufiventris* Kok. On the succeptibility of *Spodoptera littoralis* (Boisd.) larvae to Bolstar 720 EC. Bull. ent. Soc. Egypt, Econ. Ser., 15: 165 – 172.

15. Sun, Y.P. and E.R. Johnson .1960. Analysis of joint action of insecticides against house flies. J. Econ. Entomol. 53: 887 – 892.

التأثير المتزامن للمبيد الحيوى والكيماوى ومخاليطهم على كل من دودة ورق القطن وطفيلها الداخلى ميكروبليتس روفيفنترس.

ْفوزى فائق شلبى ، ٌالسيد حلمى عبد الكريم ، ٌٌسمير محمد الفاتح رضوان ، ٌٌعريان شحاتة منصور

* قسم وقاية النبات – كلية الزراعة بمشتهر – جامعة الزقازيق
** معهد بحوث وقاية النباتات ، مركز البحوث الزراعية، الدقى ، الجيزة ، مصر

أجريت دراسة معملية لمعرفة كفاءة المبيد الحيوى زينتارى والمبيدات الكيميائية (بايثرويد) ، منظم النمو الحشرى(ميميك) وخليط من زينتارى مع التركيز القاتل ل ١٠ % من اليرقات المختبرة لكلا من بايـثرويد او ميمك على يرقات دودة ورق القطن الغير متطفل عليها والمتطفل عليها بالطفيل الداخلى غشائى الاجنحة ميكروبليتس روفيفنترس.

كانت نسب الموت المتحصل عليها اقل والتركيز القاتل ل ٥٠ % من اليرقات المعاملة اكبر وكذلك الفترة اللازمة لقتل ٥٠ % من اليرقات المتطفل عليها اطول بين اليرقات المتطفل عليها عن الغير متطفل عليها.

كما اوضحت التجارب ان أقل تركيز من الزينتارى(٤ × ١٠ ٤ وحدة دولية) + التركيز القاتل ل ١٠ % من اليرقات المختبرة بمبيد بايثرويد سببت موت ١٦,٦٧ ، ٢٣,٣٣ % بين اليرقات المتطفل عليها وغير المتطفل عليها على التوالى – وقد اعطى الخليط تاثيرا تنشيطيا.

وايضــا اوضـــحت التجارب عند خلط اقل تركيز من الزينتارى (٤ × ١٠ ٤ وحدة دولية)+التركيز القاتل ل ١٠ % من اليرقات المختبرة بمبيد مميك سببت موت ٣٠ ، ٣٣,٣٣ % بين اليرقات المتطفل عليها على التوالى – وقد اعطى أيضا الخليط تاثيرا تنشيطيا.