A. Cotton

Spodoptera littoralis (Boisd.)

Pectinophora gossypiella Saunders

Earias insulana Boisd.

Dr. Mona B. R. El-Mandarawy

Dept. of Biological Control, Plant Protection Res. Institute, ARC, Cairo, Egypt

INTRODUCTION

The present study was planned to evaluate the Bioenhancer compound in combinations with chemical insecticides and/or bio-insecticides against major cotton insect pests under Egyptian field and lab conditions. In addition, the adverse influence of these combinations on the natural enemies associated with these pests was also estimated.

MATERIALS AND METHODS

Pesticides used:

1. **Bioenhancer:** It is an insect feeding stimulant and attractant. It contains 35% active ingredients (disaccharides, hydrolyzed starch, whey and vegetable oil) and 65% inert ingredients. Application rate was 5% /feddan (feddan = acre = 0.4 hectare).
2. **Chemical insecticides:**
   - **Diazinox KZ:** Diazinox 40% WP, 4 EC, 14% granules. Formulation: (Organic phosphate insecticide), O-O- diethyl-O-(2- isopropyl-6- methyl-5 pyrimidinly) phosphorothioate. Application rate of 6 Kg/feddan. In laboratory, it was used at concentrations of 10, 20, 40, 80 and 160 ppm.
   - **Reldan:** (Chlorpyrifos-methyl) 2 EC, 25% WP, 1% G, 6 1b/gal oil. Formulation: O, O-dimethyl O-(3, 5, 6-trichloro-2-pyridimyl) phosphorothioate). Application rate of 0.005-0.75, a.i./A. In laboratory, it was used at concentrations of 0.025, .05, 0.1, 0.2, 0.4 and 0.8 ppm.
   - **Dursban:** 48% EC. Application a rate of 1liter /feddan. In laboratory, it was used at the concentrations 0.05, 0.1, 0.2, 0.4 and 0.8 ppm.
3. **Bioinsecticides:**
   - **Xentari:** (Selective bacterial insecticide) *Bacillus thuringiensis* subsp. *aizawai*

     35.000 Diamond back moth Units/ mg. Application rate was 454g / feddan. In the laboratory, it was used at concentrations of $5x10^5$,$10x10^5$, $20x10^5$, $40x10^5$, $80x10^5$ and $160x10^5$ Diamond back moth Units.
   - **Agerin:** *Bacillus thuringiensis* 32000 International Units/mg. Application rate was 250g/ feddan. The utilized concentrations, in laboratory, were $10x10^5$, $20x10^5$, $40x10^5$, $80x10^5$ and $160x10^5$ I.U. for *S.littoralis* larvae. In case of *P. gossypiella* and *E. insulana* concentrations became $5x10^4$, $10x10^4$, $20x10^4$, $40x10^4$, $80x10^4$and $160x10^4$I.U..

Laboratory Experiments:

Procedure: *Spodoptera littoralis* (Boisd.), *Pectinophora gossypiella* Saunders and *Earias insulana* Boisd. were reared under the laboratory conditions, at a constant temperature of 27±1°C and 65±5% R.H. *S. littoralis* were reared using the technique described by **Abdel Hakim (1996)** and **Ibrahim (1974)**. *P. gossypiella* and *E. insulana* rearing technique was described by **Abd El-Hafez *et al.* (1982).**

Parts of castor leaves and cotton green bolls were dipped in each compounds and left till dry, then offered to 4th *S. littoralis*, 1st instar *P. gossypiella*, and *E. insulana* larvae.

The following procedures were followed in all experiments:
1- Three replicates of ten larvae each into a cup (6x7.5cm) were fed on potato leaves contaminated with bioenhancer and bioinsecticides for a period of 48 hours. After treatment, the surviving larvae were fed on untreated foods till pupation. Mortality was recorded daily. Also, the percentage of pupation and emerged adults were observed.
2- Before introducing the larvae to treated food, they were starved for six hours in order to obtain rapid simultaneous ingestion of the offered food.
3- The control tests were conducted using foods dipped in water only and left to dry.

Statistical analysis:
The LC_{50} was determined by using Finney (1952) and corrected according to Abbott's formula (1925).

Field experiments:

Experiment (1) : Planting date was 24 Mars 2000 with Cotton variety "Giza 88".

Target Pests: ***S. littoralis***, ***P. gossypiella*** and ***E. insulana***

Design: An area of about a feddan was chosen and divided into 24 equal plots in randomized complete blocks. Each plot was about $42m^2$ (6m x 7m). The plots were specified for 8 treatments with 3 replicates and the untreated (control). Treatments included the Bioenhancer, Agerin, Biofly, the chemical insecticides (Reldan for leafworm & Dursban for bollworms) and their combinations with Bioenhancer (½ Bioenhancer+ ½ Agerin, ½ Bioenhancer+ ½ Biofly and ½ Bioenhancer+ ½ each of the chemical insecticide).

Procedure: The cumulative damage caused by ***S. littoralis*** larvae was estimated by scoring the damage (0 to 5) of each of 100 randomly chosen leaves in each treatment, according to the size of eaten part of the leaf. The rate of infestation was then, calculated according to the formula given by **Kasopers (1965)**. As for the damage caused by bollworms, 50 green cotton bolls were randomly chosen from each treatment and inspected for any symptoms of infestation, and the percentage of infested bolls subsequently calculated. For predators, samples were taken by 5 randomly double sweeping net strokes/plot (10-strokes/ treatment). The collected predators were transferred to the laboratory for identification and counting.

Spray applications:

Different pesticides were applied by means of 20L. knapsack sprayer using a total volume of 200 L/feddan. Different treatments were applied in bi-weekly interval in the second experiment.

Statistical analysis:

Data were statistically analyzed by ANOVA and mean values were separated by the least significant difference (L.S.D.) procedure **(Snedecor and Cochran, 1980)** at P = 5%. An estimate for percent reduction for each treatment was calculated using Henderson's formula **(Henderson & Tilton, 1955).**

RESULTS AND DISCUSSION

Laboratory experiments
Table (1) shows that the LC_{50} values of 4^{th} instar ***S. littoralis*** larvae were 0.00, $70.25x10^5$ I.U., 0.062 ppm for bioenhancer, agerin (after 72 hours of treatment) and reldan (after 24 hours of treatment) alone. While these values were $40.96x10^5$ I.U. and 0.056 ppm for the combinations of

different agerin and reldan concentrations with 5% of bioenhancer, respectively. For newly hatched ***P. gossypiella*** and ***E. insulana*** larvae, the LC_{50} values were 0.00&0.00, $10.72x10^4$&$8.51x10^4$ I.U., 0.081&0.095 ppm, $6.72x10^4$&$4.63x10^4$ I.U. and 0.057&0.068 ppm for bioenhancer; agerin; dursban; agerin + bioenhancer and dursban + bioenhancer, respectively.

Obtained results indicated that bioenhancer was exhibited a high degree of efficiency against target lepidopterous larvae when combined with chemical insecticide and with bioinsecticides. But when it was used alone, it had no obvious effects.

These results agree with those of **Naguib *et al.* (1994)** who indicated that *E. insulana* larvae were more susceptible to bio-compounds than *P. gossypiella*. While *P. gossypiella* larvae were more susceptible to Esfenvalerate as insecticide than *E. insulana* larvae.

Field experiments

1- Effect of bioenhancer and combinations on target pests

- **Cotton leafworm and bollworms**

Cotton leaves damaged by the cotton leafworm were significantly higher in the control compared with the treatments. Reduction in the pests damage (monthly) reached 12.87, 22.40, 17.49, 34.98, 42.16, 30.42 and 26.35% for bioenhancer, agerin, biofly, reldan, ½ bioenhancer + ½ reldan, ½ bioenhancer + ½ agerin and ½ bioenhancer + ½ biofly, respectively. In case of bollworms, reldan and other combined treatments were significantly different from the untreated control. Neither bioenhancer treatment was significantly different from either agerin and biofly treatments or the untreated control. The damage of bollworms (monthly) was reduced by 18.54, 38.76, 29.22, 61.81, 69.09, 56.76% and 50.86 at different treatments, respectively (Table, 2 & Fig.1).

2- Effect of bioenhancer and its combinations on predators

- **In cotton field**

The predaceous species collected during the period of the experiment were six coleopterous; *Cocinella undecimpunctata*, *Cydonia vicina* var. *nilotica* Muls and *Scymnus* spp. (*interruptus* Goeze, *syriacus* Mars. and *globossus* var. *pieceus* Ws.) (Cocinellidae) and *Paederus alfierii* Koch (Staphylinidae); two hemipterous *Orius* spp. (*albidipennis* Reut. and *laevigatus* Fieb.) (Anthocoridae); one neuropterous *Chrysoperla carnea* Steph. (Chrysopidae).
The (monthly) mean number of predators collected from bioenhancer, agerin, biofly, reldan, ½ bioenhancer + ½ reldan, ½ bioenhancer + ½ agerin and ½ bioenhancer + ½ biofly treated plots, were 12.98, 12.25, 11.39, 7.22, 8.56, 12.59 and 11.78 individuals. Correspondent, number in the control was 13.53 predators. Obtained results showed that bioenhancer and the bioinsecticide had the least harmful effect on the entomophagous insect populations. Bioenhancer, agerin and biofly treatments were insignificantly different from either their combined treatments or the untreated control. While significant difference between control or bioenhancer treatment and the chemical insecticides alone or in combination with bioenhancer were found.

The safety of bacterial bio-insecticide on different predatory species was previously reported by **McCutcheon *et al.* (1990), Samy (1999).** Also, the effect of insecticides on predaceous insects was discussed by **Abo-Elghar *et al.*(1985)** indicated that *Coccinella* and *Chrysoperla* tolerated to the insecticidal treatments compared with *Scymnus* and *Paederus*, while **Farag *et al.* (1989)** indicated that insecticides highly affected *Scymnus* spp., followed by *Orius* spp.

CONCLUSION

Finally, it could be concluded that in laboratory tests, bioenhancer had no obvious effects when used alone. On the contrary, in the field application, it relatively succeeded to control pests alone indirectly, probably because of its low harmful effect on the entomophagous insects. Besides, bioenhancer had a high degree of efficiency against lepidopterous larvae when combined with bio-and chemical insecticides, in both lab. and field applications.

Table (1): Comparative toxicity of bioenhancer, bioinsecticides (after 72 hours of treatments), chemical insecticides(after 24 hours of treatments) and combinations of bioenhancer with different insecticides against *S. littoralis*, *P. gossypiella*, *and E. insulana* larvae.

Treatments	LC_{50}	Slope
S. littoralis		
Bioenhancer	**0.00**	**0.00**
Agerin	**10.72×10^4**	**1.18**
Reldan	**0.081**	**1.82**
Agerin+ Bioenhancer	**6.72×10^4**	**1.17**
Reldan+ Bioenhancer	**0.057**	**1.74**
P. gossypiella		
Bioenhancer	**0.00**	**0.00**
Agerin	**10.72×10^4**	**1.18**
Dursban	**0.081**	**1.82**
Agerin + Bioenhancer	**6.72×10^4**	**1.17**
Dursban+ Bioenhancer	**0.057**	**1.74**
E. insulana		
Bioenhancer	**0.00**	**0.00**
Agerin	**8.51×10^4**	**1.20**
Dursban	**0.095**	**1.69**
Agerin + Bioenhancer	**4.63×10^4**	**1.42**
Dursban+ Bioenhancer	**0.068**	**1.76**

Fig.(1): Percent reduction in cotton leafworms damage, bollworms and associated predatory species at different treatments, in Egypt cotton fields, 2000.

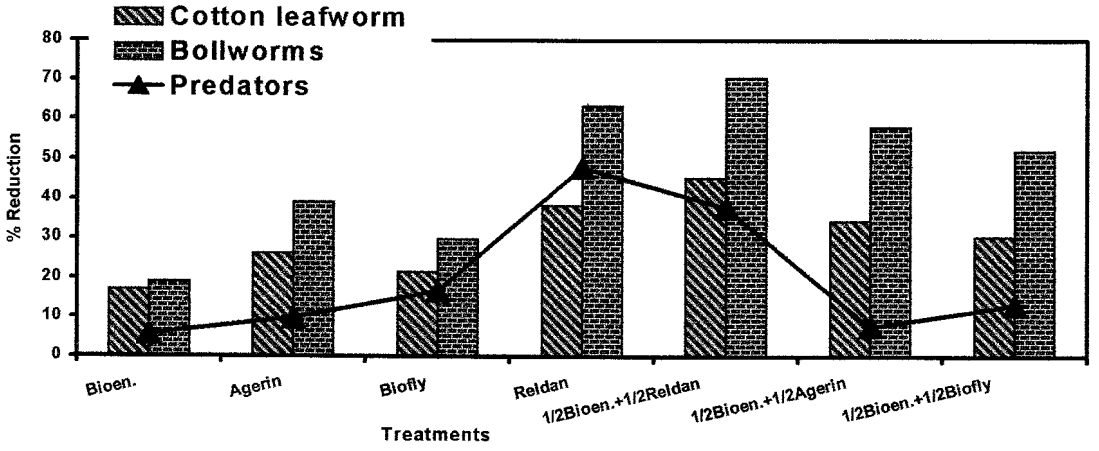

Table (2): Effect of bioenhencer and its combinations in reducing the damage rate caused by cotton leafworm and bollworms in Egypt cotton field, season 2000 .

Months	% of average damage in different treatments							
	Control	Bioen-hancer	Agerin	Biofly	Reldane or Dursban	½ Bioen.+ ½ Reldane or Dursban	½ Bioen. + ½ Agerin	½ Bioen.+ ½ Biofly
Cotton Leafworm								
June	25.36	24.86	22.00	23.50	19.00	17.17	20.80	21.60
July	34.74	29.47	26.03	27.93	22.63	19.76	23.56	24.81
Aug.	43.86	36.23	32.64	34.34	25.95	23.18	27.96	30.16
Overall	36.99	31.43	28.00	29.78	23.42	20.72	24.86	26.43
% Reduction		-17.05	-26.09	-21.40	-38.19	-45.32	-34.38	-30.28
L.S.D.	4.3019							
Bollworms								
July	9	6.5	4.5	6	3.5	3	3	4.5
Aug.	30	24	18	20.5	9.5	7.5	11.50	13.25

Sept.	50	42	32	36.5	21	17	24	26
Overall	29.75	24.13	18.13	20.88	10.88	8.75	12.50	14.25
% Reduction		-18.90	-39.08	-29.83	-63.45	-70.59	-57.98	-52.10
L.S.D.	11.6428							

Table (3): Effect of bioenhencer and its combinations on the average numbers of predators counted in different treatments in Egypt cotton fields, season 2000.

Months	Control	Bioen-hancer	Agerin	Biofly	Reldane or Dursban	½ Bioen.+ ½ Reldane or Dursban	½ Bioen.+ ½ Agerin	½ Bioen. + ½ Biofly
July	19.50	18.75	17.84	16.67	11.00	12.17	18.17	17.00
Aug.	11.25	10.84	10.25	9.34	5.50	6.83	10.42	10.00
Sept.	9.84	9.34	8.67	8.17	5.17	6.67	9.17	8.33
Mean	12.96	12.29	11.75	10.88	6.79	8.12	12.04	11.33
% Reduction		-5.59	-9.76	-16.48	-47.84	-37.61	-7.52	-13.00
L.S.D.	3.9602							