RESULTS AND DISCUSION

Section 1: Laboratory studies.

1. Effect of bioinsecticide (Xentari), chemical insecticide (Baythroid), I.G.R. (Mimic) and mixtures:

1.1. On *S. littoralis* larvae; healthy and parasitized by *M. rufiventris*:

The second instar *S. littoralis* larvae (4 days old) were treated after (5 days) of individual parasitism (9 days old) with castor-bean leaves dipped in 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 Tables (2 &3).

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 ranging from 16.67 to 73.33 at the concentrations of 4×10^4 to 24×10^4 Diamond- back moth units (DBMU). While, percentages in case of healthy larvae at the same age and concentrations ranged from 20.00 to 86.67, respectively (Table, 1).

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			
	1st	2nd	3rd	4th	6th	1st	2nd	3rd	4th
DBMU ***	Bio- insecticide (Xentari)								
0.00	0.00	0.00	3.33	3.33	100	0.00	0.00	0.00	3.33
$4x10^4$	0.00	6.67	16.67	23.33	100	3.33	10.00	20.00	33.33
$8x10^4$	3.33	10.00	26.67	33.33	100	6.67	16.67	36.67	46.67
$12x10^4$	10.00	20.00	36.67	46.67	100	16.67	30.00	50.00	56.67
$16x10^4$	20.00	33.33	50.00	63.33	100	26.67	46.67	63.33	70.00
$20x10^4$	26.67	46.67	63.33	70.00	100	36.67	56.67	76.67	83.33
$24x10^4$	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 vaiues 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	Confidence limits at P0.05 of 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): Comparative toxicities of unparasitized and parasitized *S. littoralis* larvae fed on treated castor- bean leaves with different concentrations of Xentari, Baythroid, Mimic and the combinations.

Treatment	LC_{50}	Slope	Confidence limits at ($P_{0.05}$) LC_{50}	Slope
Unparasitized larvae				
Xentari	10.5×10^4 °	2.39	$7.84 \times 10^4 - 14.07 \times 10^4$	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	7.8×10^4*+ 6.6 ppm*	2.44	6.09×10^4+6.6 – 9.98×10^4 +6.6	1.95 – 3.05
Xentari + LC_{10} Mimic	6.8×10^4° + 19.0 ppm *	2.21	5.35×10^4+19.0 – 8.64×10^4 + 19.0	1.58 – 3.09
Parasitized larvae				
Xentari	15×10^4	2.73	$11.81 \times 10^4 - 19.05 \times 10^4$	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	12×10^4 *+15.4 ppm	3.08	9.52×10^4+10.4 – 15.12×10^4 +10.4	1.81 – 5.24
Xentari + LC_{10} Mimic	8.6×10^4 + 30 ppm	2.81	6.77×10^4+30.0– 10.92×10^4 + 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.

However, as shown in Table (3) and Fig. (1), the LC_{50} values were 15 x 10^4 DBMU for parasitized larvae, while this value was lower, reaching 10.5 x 10^4 in case of healthy *S. littoralis* larvae.

These results indicated that the parasitized larvae were less suscep-tible 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 fed on foliage of *Abies balsamea* sprayed with a commercial formulation of *B. thuringiensis*. Also, **Mc Donald *et al.* (1990)** on 4 th instar larvae of *Pieris rapae* parasitized by the braconid *Cotesia rubecula* treated with *B. thuringiensis kurstaki* delta- endotoxin. They found that after day 2 of parasitism LC_{50} was 30 times higher than those of parasitized larvae and by day 4 it was 180 times higher. Also, **Kares (1991b)** found the same result on the 2 nd instar larvae of *Phthorimaea operculella* parasitized by *Apanteles litae* var. *operculella* and fed on potato leaves contaminated with dipel. **Matter (1993)** on 3 rd instar larvae of *Pieris rapae* parasitized by the solitary parasitoid *Hyposoter ebeninus* which were fed on *B. thuringiensis* (Delfin) – treated cabbage leaves. Also, **Idris and Grafius (1993)** indicated that the diamond-back moth *Plutella xylostella* larvae parasitized by *Diadegma insulare* were significantly less sensitive to ingested *B. thuringiensis* than non parasitized ones 48 hours after treatment. On the other hand, **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

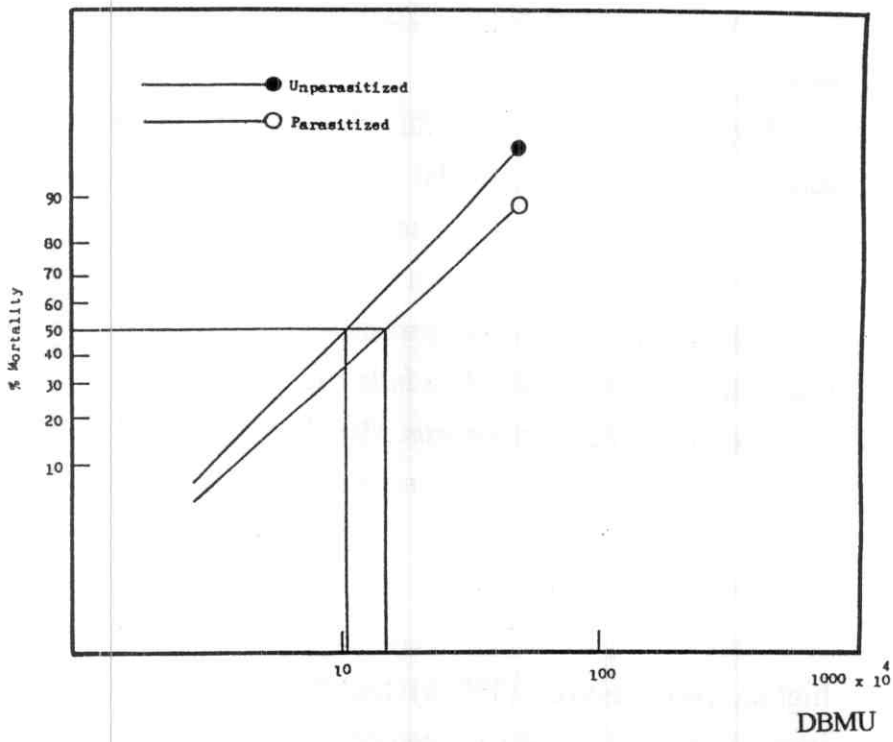

Fig. (1): Concentration mortality probit lines showing the susceptibility of unparasitized and parasitized 9 days-old *S. littoralis* larvae fed for 2days on castor-bean leaves treated with different concentrations of Xentari.

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.

Also, from Table (2) and Figs. (2&3) it could be observed that the LT_{50} values were longer in case of parasitized larvae than those required for the unparasitized larvae, at the same concentration of the bioinsecticide (Xentari). A negative relationship could be also detected between the bioinsecticide concentrations and the LT_{50} values; i.e. shorter LT_{50} occurred by increasing Xentari concentration. These 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 **Moawad *et al.* (1982/1983)** studied the effect of two commercial preparations of *B. thuringiensis* (Bactospeine and Dipel powders) against the larvae of *Earias insulana* (Boisd.) They indicated that there was a negative relationship between the concentration used and the LT_{50}, where LT_{50} values decreased by increasing the concentration. Also, **Kares *et al.* (1992)** 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 applied 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 –

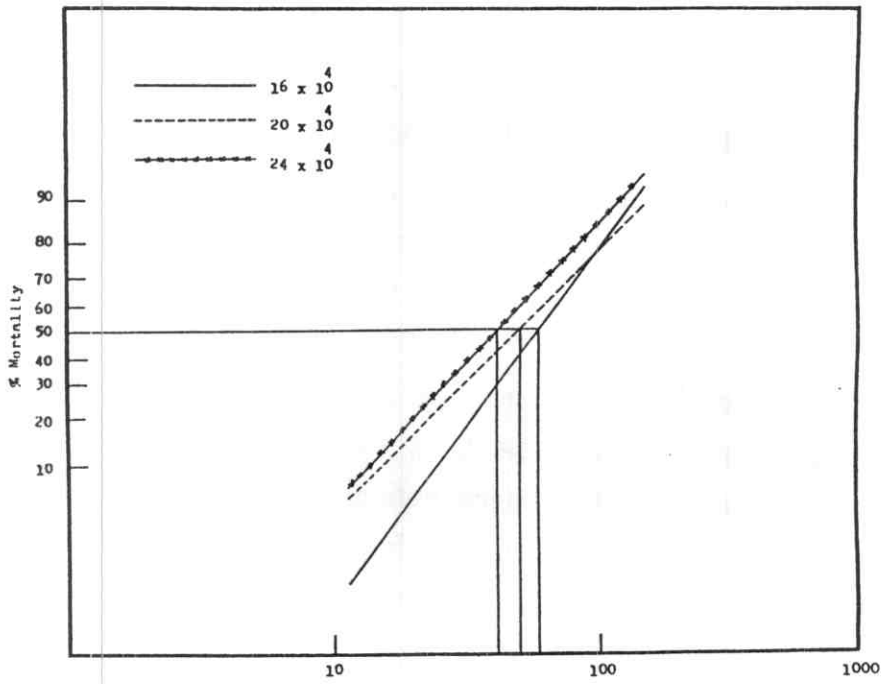

Fig. (2): Probit- regression mortality- time lines showing response of parasitized *S. littoralis* larvae fed for 48 hours on castor- bean leaves treated with different concentrations of Xentari.

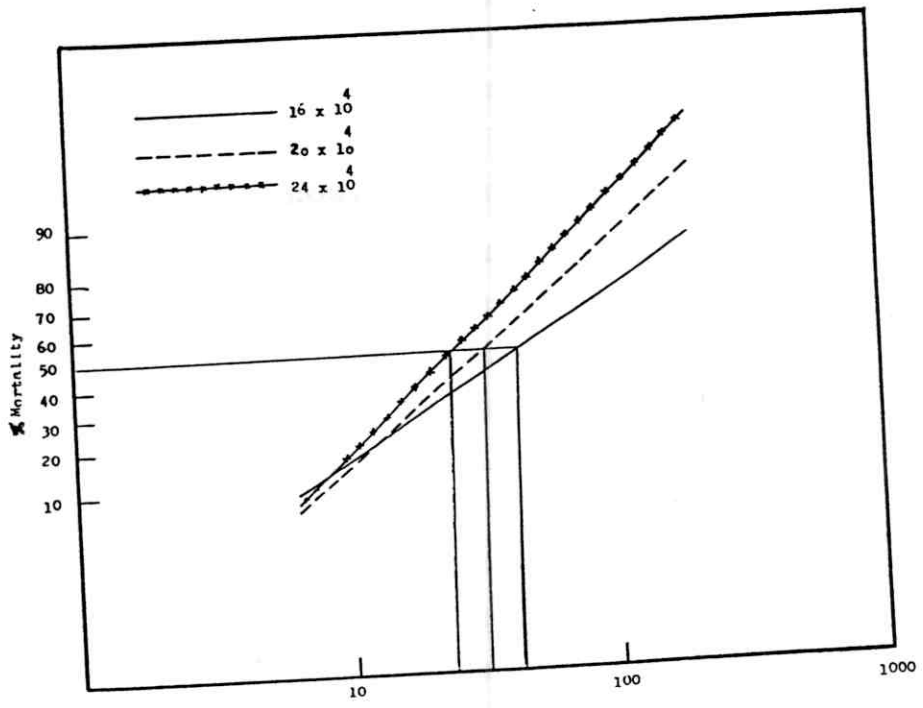

Fig. (3): Probit- regression mortality- time lines showing response of unparasitized *S. littoralis* larvae fed for 48 hours on castor- bean leaves treated with different concentrations of Xentari.

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 (Table 3 and Fig.4) . These data revealed that the parasitized larvae were less susceptible to the chemical insecticide treatments than the unparasitized larvae.

The LT_{50} values being 38 and 24 hours for unparasitized larvae; 78 and 44 hours for parasitized larvae at the concentration of 30 and 45 ppm, respectively. Thus indicating longer LT_{50}'s for the parasitized than the unparasitized larvae at the same concentration. Also, these periods shortened, generally by increasing the tested concentration (Table, 2 and Figs. 5 & 6).

These results agree with those of **Kares (1978)** who revealed that *S. littoralis* larvae parasitized by *M. rufiventris* were more tolerant than the unparasitized larvae for Tamaron LC, Cyolane EC and Tokuthion EC and the same results were obtained by *Chelonus inanitus* on its host *S. littoralis* larvae which were treated by the previous compounds. **Nasr (1979)** found that the formulations of microencapsulated insecticides (RUP 951& Penncap M) were less toxic than those of the emulsifiable concentrates (Ethyl parathion, RUP 95, Methyl parathion and Penncap E) on unparasitized *S. littoralis* larvae and those parasitized by *M. rufiventris*

Shalaby *et al.* (1986) indicated that *S. littoralis* larvae parasitized by *M. rufiventris* were less susceptible to Bolstar 720 EC treatments than the unparasitized ones of the same age. Also, **Idris and Grafius (1993)** noticed that diamond-back moth, *Plutella xylostella* larvae parasitized by *Diadegma insulare* were significantly less sensitive to ingested insecticides (Azinphos

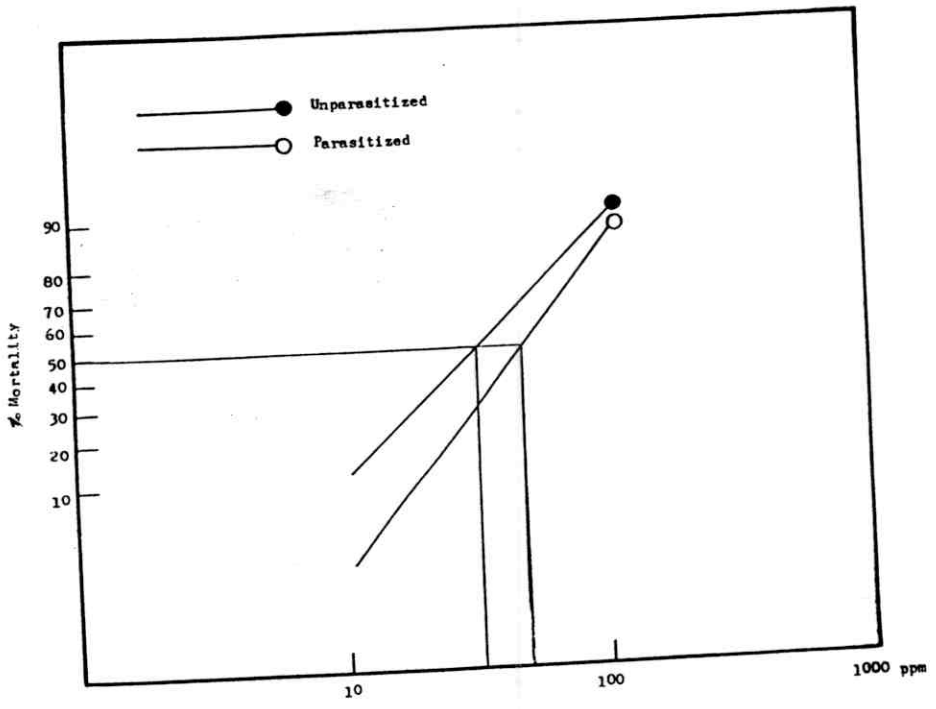

Fig. (4): Concentration mortality probit lines showing the susceptibility of unparasitized and parasitized 9 days-old *S. littoralis* larvae fed for 24 hours on castor-bean leaves treated with different concentrations of Baythroid.

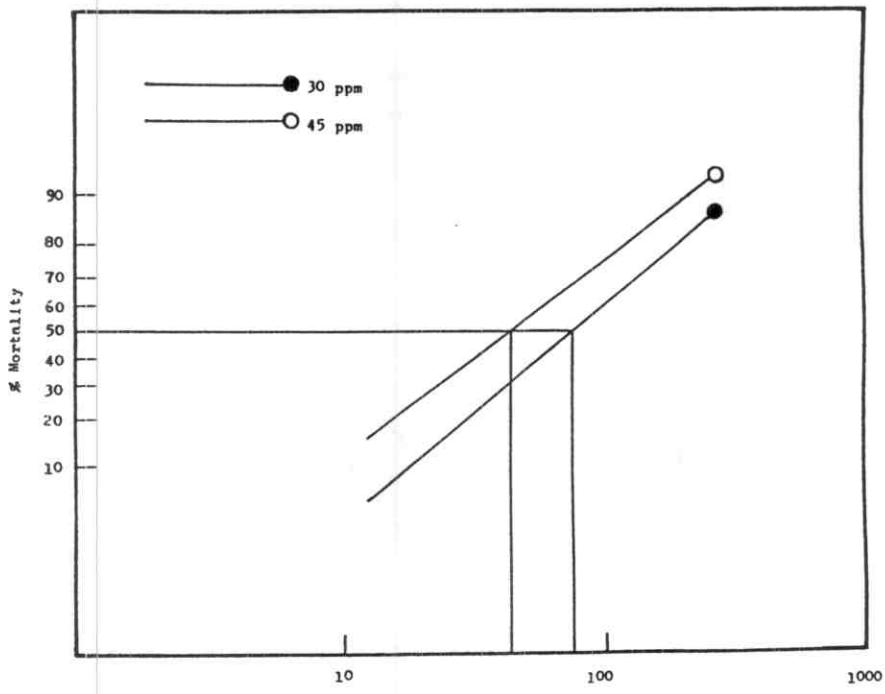

Fig. (5): Probit- regression mortality- time lines showing response of parasitized *S. littoralis* larvae fed for 24 hours on castor- bean leaves treated with different concentrations of Baythroid.

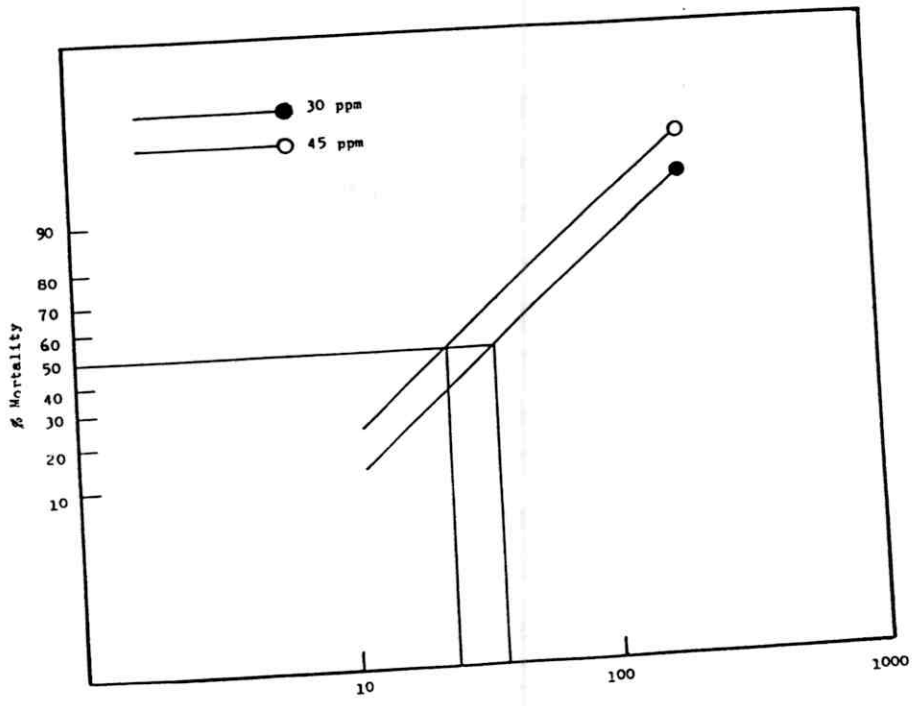

Fig. (6): Probit- regression mortality- time lines showing response of unparasitized *S. littoralis* larvae fed for 24 hours on castor- bean leaves treated with different concentrations of Baythroid.

methyl, Permethrin, Methomyl and Chlorothalonil) than the unparasitized larvae.

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 (Table 3 and Fig. 7). These data indicated the lower susceptibility of parasitized larvae to Mimic treatments than the unparasitized ones.

These results agree with those of **Kares (1990a)** who studies the effect of Diflubenzuron on the late second instar larvae of *S. littoralis* parasitized by *Zele nigricornis*. The obtained results indicated that Diflubenzuron caused higher mortality rates among unparasitized larvae, but the parasitized larvae were found to be less susceptible to Diflubenzuron treatment.

It could be also regarded that the LT_{50} values (Table 2 and Figs. 8 & 9) 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 be also observed that the LT_{50}'s shortened the applied concentrations were increased.

These results are in agreement with those of **Kares (1990 a)** who found that the LT_{50} values among late second instar of *S. littoralis* parasitized by *Zele nigricornis* and treated by

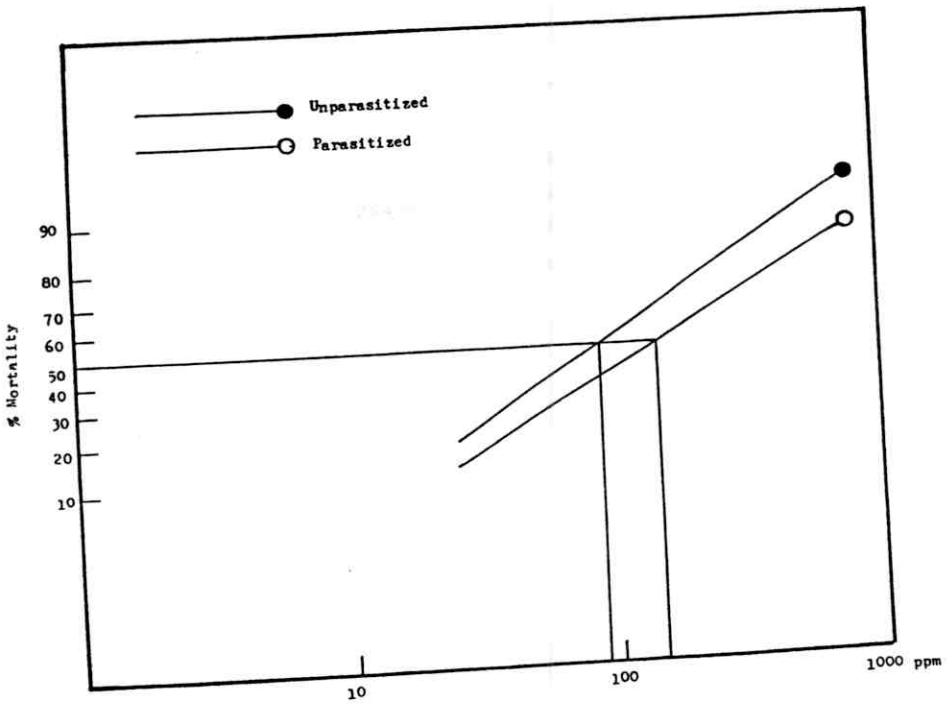

Fig. (7): Concentration mortality probit lines showing the susceptibility of unparasitized and parasitized 9 days-old *S. littoralis* larvae fed for 24 hours on castor-bean leaves treated with different concentrations of Mimic.

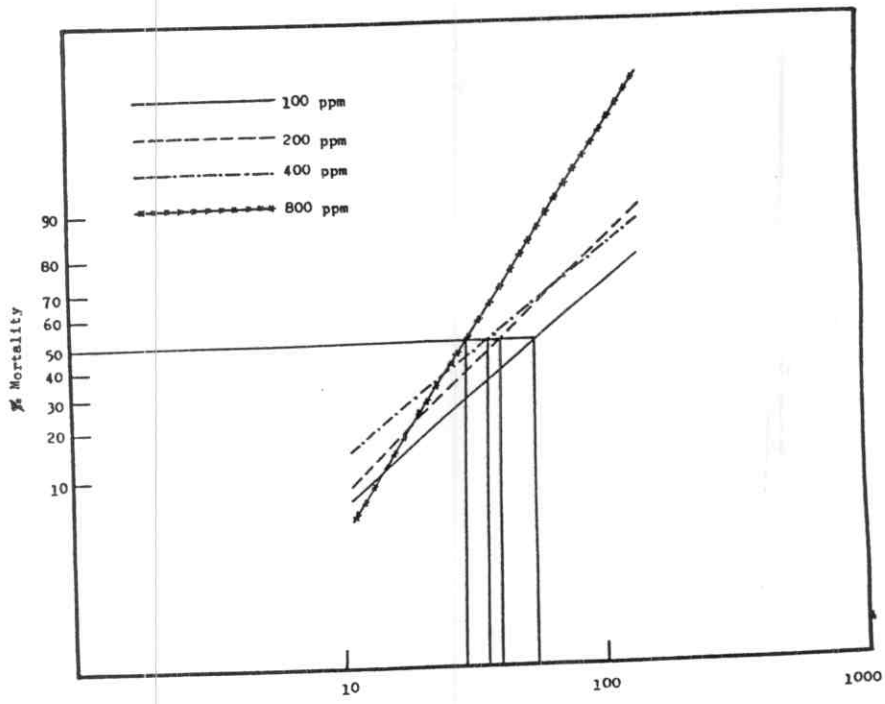

Fig. (8): Probit- regression mortality- time lines showing response of unparasitized *S. littoralis* larvae fed for 24 hours on castor- bean leaves treated with different concentrations of Mimic.

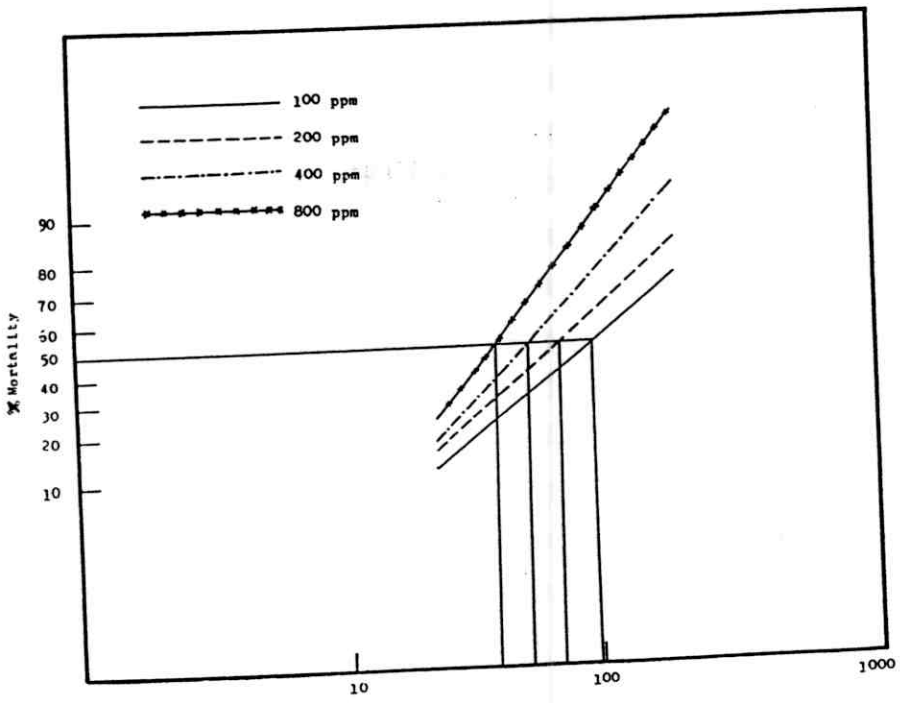

Fig. (9): Probit- regression mortality- time lines showing response of parasitized *S. littoralis* larvae fed for 24 hours on castor- bean leaves treated with different concentrations of Mimic.

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. littor*larthe unparasitized ones may be due to the amount of toxic food ingested, since the parasitized larvae cease feeding and therefore ingest less toxicant. **Watanabe (1938), Hafez (1951), Shalaby (1968) and 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 **Rahman (1970)** indicated that the larvae of *Pieris rapae* parasitized by the solitary endoparasite *Apanteles rubecula* ate less than half of the quantity taken by the unparasitized larvae. **Ahmad *et al.* (1978)** found that *Lymantria dispar* parasitized by *A. melanocelus* between the 3 rd and 17 th days, consumed less diet than the unparasitized larvae. **Brewer and King (1978)** observed that *Diatraea sacharalis* larvae parasitized by *Lixophaga diatracea* consumed less food and gained less weight than unparasitized larvae. **Kares (1991b)** reported that the parasitized *Phthorimaea operculella* larvae between the 5 th and 14 th days ate less food than the unparasitized ones. Also, **El-Sheikh *et al.* (1993)** indicated that *Mythimna* (=*Leucania*) *loreryi* (Dup.) larvae parasitized by *Meterous gyrator* Thun consumed less food and gained less weight than healthy 5, 7 and 9 days old larvae. **Kares *et al.* (1998)** studied the effect of parasitization by *Microplitis rufiventris* on the body length, body weight and the amount of food eaten by *S. littoralis* larvae. The authors indicated that the two days after emergence of full grown larval parasitoid,

the body length, body weight and the amount of food eaten were higher and different significantly between the healthy and parasitized *S. littoralis* larvae. However, the parasitized larvae stopped feeding on the eighth day after emergence of full grown larval parasitoid till the host mortality. Their findings agree with those of **Swan (1964)** who indicated that the gypsy moth *L. dispar* larvae parasitized by *A. melanoscelus* ceased feeding before death. **Rahman (1970)** noticed that when *P. rapae* larvae were parasitized by *A. rubecula*, consumption index started declining above 2 days before the parasitoid's emergence. **El-Sheikh *et al.* (1993)** showed that *Mythimna loreyi* parasitized by *M. gyrator* stopped feeding about 1-2 days before the parasitoid's emergence. Also, **Kares *et al.* (1998)** indicated that the total ratio of the amount of food eaten between the parasitized *S. littoralis* larvae by *M. rufiventris* and the unparasitized ones was 1: 3.16.

d. Combination treatments:

Two methods were followed to determine the combined effect of different Xentari concentrations 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 the 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_{50} of Baythroid.

The LC_{50} values (Table, 3 and Fig., 10) 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 larvae than those required for unparasitized ones.

Moreover, chemical insecticides showed 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 (4) show results of combination of Xentari at low concentrations of 4 and 8 x 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. These results indicated that the combinations of bio and chemical insecticides at the mentioned concentrations showed potentiation on their effect on the unparasitized larvae. While, the higher concentrations of Xentari mixed also (12, 16, 20 and 24 x10^4) when combined with the LC_{10} of Baythroid and offered to the unparasitized larvae, the corrected mortality percentages were 70.00, 80.00, 86.67 and 90.00 % and the Co-toxicity factor values

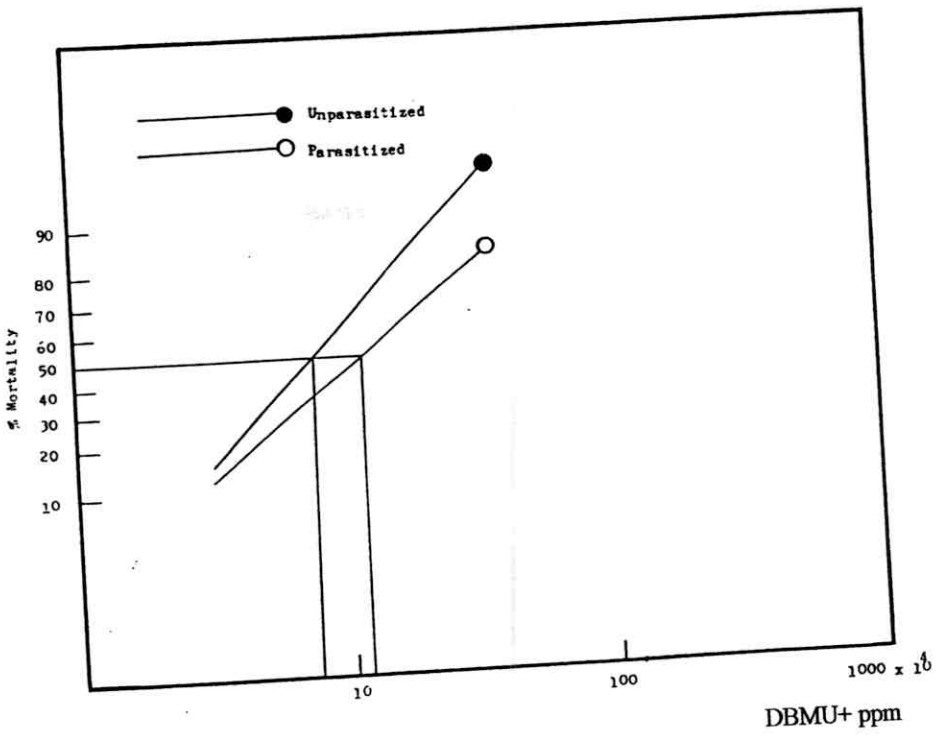

Fig. (10): Concentration mortality probit lines showing the susceptibility of unparasitized and parasitized 9 days-old *S. littoralis* larvae fed for 2days on castor-bean leaves treated with combination of different concentrations of Xentari and LC_{10} of Baythroid.

Table (4): Efficacy of mixtures of Xentari and LC_{10} of Baythroid on the unparasitized and parasitized *S. littoralis* larvae and those parasitized by *M. rufiventris*.

Larvae	Concentration		Calculated % mortality from Lc-plines		Expected % mortality	Observed % mortality	Co-toxicity factor	Combined effects
	Xentari DBMU	Baythroid LC_{10} (p.p.m.)	Xentari	Baythroid				
Unparasitized								
	4×10^4	6.60	13.50	4.00	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	0 0
	16×10^4		68.00		72.00	80.00	11.11	0 0
	20×10^4		76.67		80.67	86.67	7.44	0 0
	24×10^4		83.00		87.00	90.00	3.49	0 0
Parasitized								
	4×10^4	10.40	10.00	1.50	11.50	16.67	44.96	++
	8×10^4		26.67		28.17	33.33	18.32	0 0
	12×10^4		42.00		43.50	50.00	14.94	0 0
	16×10^4		53.00		54.50	60.00	10.09	0 0
	20×10^4		63.33		64.83	70.00	7.97	0 0
	24×10^4		69.00		70.50	73.33	4.01	0 0

0 0 = Addition.
++ = Potentiation.

were + 18.64, +11.11, +7.44 and + 3.49, respectively, indicating that these four concentrations produced additive effects. While in case of parasitized larvae, Xentari at the lowest concentration (4 $x10^4$) combined with LC_{10} of Baythroid caused 16.67% mortality among the treated larvae and the Co-toxicity factor was potentiative (+ 44.96). While, mixing Xentari at higher concentrations (8, 12, 16, 20 and 24 $x10^4$ 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 combination 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 $x10^4$ 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 larvae, respectively

(Table, 5). The LC_{50} values (Table,3 and Fig., 11) 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 from Tables (3 &5) 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 in those treated with the bioinsecticide but for 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 (5) shows 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 factor values were + 12.75, + 7.00, + 4.08 and + 0.70, respectively. From these results, it is clear that these four concentrations produced additional effects for unparasitized larvae. While in case of parasitized larvae, the mixture of Xentari at lowest (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)

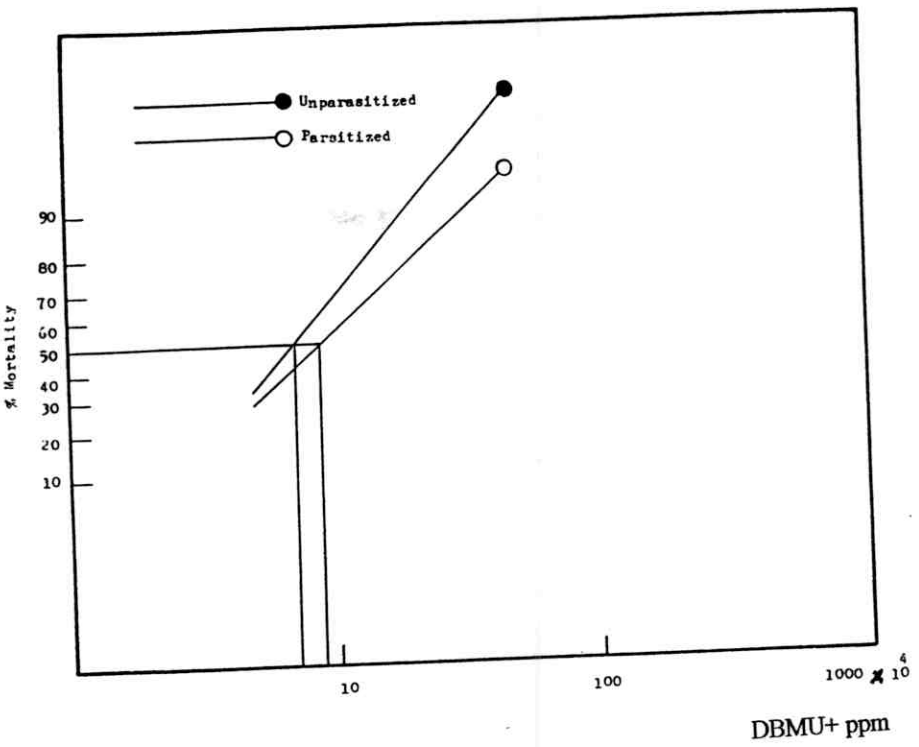

Fig. (11): Concentration mortality probit lines showing the susceptibility of unparasitized and parasitized 9 days-old *S. littoralis* larvae fed for 2days on castor-bean leaves treated with combination of different concentrations of Xentari and LC_{10} of Mimic.

Table (5): The susceptibilty of unparasitized and parasitized *S.littoralis* larvae against a mixture of Xentari and LC_{10} of Mimic.

Larvae	Concentration		Calculated % mortality from LC-plines		Expected % mortality	Observed % mortality	Co-toxicity factor	Combined effects
	Xentari DBMU	Mimic LC_{10} (p.p.m.)	Xentari	Mimic				
Unparasitized								
	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	19.0	55.00	13.00	68.00	76.67	12.75	0 0
	16×10^4		68.00		81.00	86.67	7.00	0 0
	20×10^4		76.67		89.67	93.33	4.08	0 0
	24×10^4		83.00		96.00	96.67	0.70	0 0
Parasitized								
	4×10^4		10.00		25.00	30.00	20.00	++
	8×10^4		26.67		41.67	46.67	13.83	0 0
	12×10^4	30.0	42.00	15.00	57.00	63.33	11.11	0 0
	16×10^4		53.00		68.00	73.33	7.84	0 0
	20×10^4		63.33		78.33	83.33	6.38	0 0
	24×10^4		69.00		84.00	86.67	3.18	0 0

0 0 = Addition
++ = Potentiation

DBMU were combined with LC_{10} of Mimic, the corrected mortality percentages were 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 cases of unparasitized and parasitized larvae.

These results agree 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 degree when the second instar larvae of *S. littoralis* were fed on treated leaves for five days. While the binary mixtures of 500 grm. 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 occurred. They, also, found a

potentiation effect resulted when the 4 th instar larvae were fed for 24 hours on treated leaves sprayed at 250 grm. 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 grm. 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. k*urstaki*) 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 (1.5×10^4 and 3×10^4 I.U.) with LC_{10} of Cyanophos (16 ppm) or Fenvalerate (8 ppm) produced potentiation, but mixing Bactospeine or Thuricide at higher concentrations of (4.5×10^4, 6×10^4 and 7.5×10^4 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 author indicated that chemical insecticide showed higher mortality than the bioinsecticide, but for larvae treated with the combination of the bioinsecticide with calculated LC_{10} level of chemical insecticide, the percent mortality was in between the two values. When Delfin at high concentrations of 16×10^4, 20×10^4 and 24×10^4 S.U. was combined with LC_{10} level of Baythroid for unparasitized and parasitized larvae, the mortalities were 73.33, 80.00 &90.00 in the former case and 66.66, 76.66 & 83.33 % in the later one, respectively. The Co-toxicity factor values were + 17.52,

+ 15.84 and + 9.22 for unparasitized and + 16.95, + 9.00 and + 3.73 for parasitized larvae, respectively. Thus indicated additive effects of the mixture.

Section II: Field applications:

The extensive use of pesticides led to environmental pollution and also to the toxicity of mammals and benfical organisms (**El- Sebae, 1981).** From this point of view, appears the necessity of minimizing the quantity pesticides used to a minimum in IPM programs in which different control methods might be applied, so two experiments were applied in this study. The first experiment was conducted to study the impact of using either bacterial preparation (Xentari) or insect growth regulator (Mimic) or plant extract (*Clerodenderon inerme*) or recommended chemical insecticides. The second experiment was applied to study the impact of sex pheromones for controlling cotton leafworm and bollworms, in two experiments, the populations of the most dominant entomophagous insects were determined in cotton fields, and also the rate of damage with each of the mentioned pests due to the application.

The first experiment:

Sampling started on May, 29 th and continued, weekly until September, 25 th 1998 and on May, 28 th until September, 24 th 1999 cotton seasons (18 samples). Samples were taken from each plot, at random, by 10 double strokes of a regular insect sweeping net on the whole parts of cotton plants.

1. Numbers of adult predators:

Thirteen predaceous species belonging to five families were considered in this study; two hemipterous, *Orius spp.* (mainly *albidipennis* Reut. and *Laveigatus* Fieb.) [Anthocoridae]; one neuropteran, *Chrysoperla carnea* (Steph.) [chrysopidae]; six coleopterous, *Scymnus spp.* (mainly *interruptus* Goeze and

syriacus (Mars.), *Coccinella undecimpunctata L.*, *Cydonia vicina* var. *nilotica* Muls. And *Cydonia vicina* var. *isis* Muls. [Coccinellidae]; and *Paederus alfierii* Kock.

[Staphylinidae] ; and four dipterous, *Syrphus corollae* F., *Sphaerophoria flavicauda* Zett., *Xanthogramma aegyptium* Wiel. and *Paragus aegyptius* Macq. [Syrphidae].

Counts of adults of each species, in different treatments, are recorded in Tables (6-21). The recorded data can be explained **as follows:**

1-1-Ladybird beetles [Coleoptera: Coccinellidae]:

Among this group, *Coccinella undecimpunctata L.* was the dominant species. While, the two other coccinellids were captured, but in few numbers during September (Tables, 6-11).

a- *C. undecimpunctata:*

This ladybird beetle was found during the two years of study (1998 and 1999 cotton seasons) as the most abundant coccinellid species on cotton plants. Adults of this predator were detected in the sweeping net in all treatments.

This predator was the third in the order of adundance after *Orius spp.* and *Paederus alfierii* (Tables, 6-21). In untreated treatment, the active period covered from the beginning of the season (May, 29 th 1998 & May, 28 th 1999) up to August, 7 th 1998 & August, 13 th 1999 and again during Sepember. Two peaks of abundance were detected on July, 3 rd (average 7.3 adults/ 10 double strokes) and on September, 11 th (4.7 adults/ 10 double strokes) in 1998 cotton season. In the subsequent season, two peaks of abundance could be also detected, on July, 9 th (7.7 adults / 10

Table (6): Averages in numbers of *Coccinella undecimpunctata L.* /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			3.7			
June, 5 th			5.3			
June, 12 th			6.7			
June, 19 th			6.0			
June, 26 th			6.3			
July, 3 rd			7.3			
July, 10 th			3.7			
		First treatment (15/7)				
July. 17 th	2.3	1.3	2.3	2.0	1.3	9.2
July, 24 th	1.3	0.3	1.0	1.0	0.7	4.3
		Second treatment (30/7)				
July, 31 st	1.0	0.0	0.7	0.7	0.3	2.7
Aug., 7 th	0.3	0.0	0.3	0.3	0.0	0.9
Aug., 14 th	0.0	0.0	0.0	0.0	0.0	0.0
		Third treatment (15/8)				
Aug., 21 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 28 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 4 th	1.0	0.3	1.0	1.0	0.3	3.6
Sep., 11 th	4.7	3.3	4.3	4.7	3.7	20.7
Sep., 18 th	4.0	2.3	3.7	3.3	2.7	16.0
Sep., 25 th	2.7	1.7	2.3	2.3	1.7	10.7
Total	56.3	48.2	54.6	54.3	49.7	263.1
Mean	3.13 A	2.68 B	3.03 A	3.02 A	2.76 B	14.62
L.S.D. $_{0.05}$(treat.)			0.1709			

Table (7): Averages in numbers of *Coccinella undecimpunctata L.* /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			0.7			
June, 4 th			1.3			
June, 11 th			1.7			
June, 18 th			2.7			
June, 25 th			5.0			
July, 2 nd			5.0			
July, 9 th			7.7			
			First treatment (15/7)			
July. 16 th	4.3	3.3	4.0	3.7	3.7	19.0
July, 23 rd	3.7	3.0	3.3	3.0	3.0	16.0
			Second treatment (30/7)			
July, 30 st	3.0	2.3	3.0	2.7	2.3	13.3
Aug., 6 th	1.7	0.3	1.7	2.0	0.3	6.0
Aug., 13 th	0.7	0.0	0.3	0.7	0.0	1.7
			Third treatment (15/8)			
Aug., 20 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 27 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 3 rd	0.7	0.3	0.7	0.7	0.3	2.7
Sep., 10 th	4.7	4.3	4.3	4.7	4.3	22.3
Sep., 17 th	3.7	3.0	3.7	3.3	3.3	17.0
Sep., 24 th	2.3	1.7	2.0	1.7	1.3	9.0
Total	48.9	42.3	47.1	46.6	42.6	227.5
Mean	2.72 A	2.35 B	2.62 A	2.59 A	2.37 B	12.64
L.S.D. $_{0.05}$(treat.)			0.1629			

Table (8): Averages in numbers of *Cydonia vicina* var. *isis* Muls. /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			0.0			
June, 5 th			0.0			
June, 12 th			00			
June, 19 th			0.0			
June, 26 th			0.0			
July, 3 rd			0.0			
July, 10 th			0.0			
		First treatment (15/7)				
July. 17 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 24 th	0.0	0.0	0.0	0.0	0.0	0.0
		Second treatment (30/7)				
July, 31 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 7 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 14 th	0.0	0.0	0.0	0.0	0.0	0.0
		Third treatment (15/8)				
Aug., 21 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 28 th	2.7	2.3	2.3	2.3	2.0	11.6
Sep., 4 th	4.3	3.3	4.3	4.0	3.0	18.9
Sep., 11 th	3.7	3.0	4.0	4.0	3.0	17.7
Sep., 18 th	3.0	2.0	3.3	3.3	2.3	13.9
Sep., 25 th	2.7	2.0	2.3	2.3	2.7	12.0
Total	16.4	12.6	16.2	15.9	13.0	74.1
Mean	0.91 A	0.70 B	0.90 A	0.88 A	0.72 B	4.12
L.S.D. $_{0.05}$(treat.)			0.1546			

Table (9): Averages in numbers of *Cydonia vicina* var. *isis* Muls. /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			0.0			
June, 5 th			0.0			
June, 11 th			0.0			
June, 18 th			0.0			
June, 25 th			0.0			
July, 2 nd			0.0			
July, 9 th			0.0			
			First treatment (15/7)			
July. 16 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 23 rd	0.0	0.0	0.0	0.0	0.0	0.0
			Second treatment (30/7)			
July, 30 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 6 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 13 th	0.0	0.0	0.0	0.0	0.0	0.0
			Third treatment (15/8)			
Aug., 20 th	1.3	0.0	1.0	1.3	0.0	3.6
Aug., 27 th	2.7	1.3	2.3	2.3	1.7	10.3
Sep., 3 rd	3.7	2.7	3.7	3.7	3.0	16.8
Sep., 10 th	4.0	4.0	4.0	3.7	4.0	19.7
Sep., 17 th	3.3	3.0	3.7	3.3	3.0	16.3
Sep., 24 th	3.0	2.7	3.0	3.0	2.7	14.4
Total	18.0	13.7	17.7	17.3	14.4	81.1
Mean	1.00 A	0.76 B	0.98 A	0.96 A	0.80 B	4.51
L.S.D. $_{0.05}$(treat.)			0.1517			

Table (10): Averages in numbers of *Cydonia vicina* var. *nilotica* Muls./10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			0.0			
June, 5 th			0.0			
June, 12 th			0.0			
June, 19 th			0.0			
June, 26 th			0.0			
July, 3 rd			0.0			
July, 10 th			0.0			
		First treatment (15/7)				
July. 17 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 24 th	0.0	0.0	0.0	0.0	0.0	0.0
		Second treatment (30/7)				
July, 31 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 7 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 14 th	0.0	0.0	0.0	0.0	0.0	0.0
		Third treatment (15/8)				
Aug., 21 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 28 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 4 th	1.7	0.7	1.7	1.7	1.0	6.4
Sep., 11 th	3.3	2.7	3.0	3.0	2.7	14.7
Sep., 18 th	2.3	2.3	2.3	2.3	2.3	11.5
Sep., 25 th	2.3	2.3	2.3	2.3	1.7	10.3
Total	9.6	7.4	9.3	9.3	7.4	42.9
Mean	0.53 A	0.41 B	0.52 A	0.52 A	0.41 B	2.38
L.S.D. $_{0.05}$(treat.)			0.1009			

Table (11): Averages in numbers of *Cydonia vicina* var. *nilotica* Muls./10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			0.0			
June, 4 th			0.0			
June, 11 th			0.0			
June, 18 th			0.0			
June, 25 th			0.0			
July, 2 nd			0.0			
July, 9 th			First treatment (15/7)			
July. 16 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 23 rd	0.0	0.0	0.0	0.0	0.0	0.0
July, 30 st			Second treatment (30/7)			
Aug., 6 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 13 th	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0
			Third treatment (15/8)			
Aug., 20 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 27 th	1.3	0.0	1.3	0.0	0.0	2.6
Sep., 3 rd	2.3	1.3	2.3	2.3	1.3	9.5
Sep., 10 th	3.3	2.7	3.0	3.7	3.0	15.7
Sep., 17 th	2.7	2.3	2.7	3.0	2.3	13.0
Sep., 24 th	2.7	2.3	2.7	2.7	2.3	12.7
Total	12.3	8.6	12.0	11.7	8.9	53.5
Mean	0.68 A	0.48 B	0.67 A	0.65 A	0.49 B	2.9
L.S.D. $_{0.05}$(treat.)			0.1531			

double strokes) and September, 10 th (4.7 adults / 10 double strokes). In treated treatments, the averages of total number of counted *C. undecimpunctata* adults were 56.3, 48.2, 54.6, 54.3 and 49.7 adults in 1998 and 48.9, 42.3, 47.1, 46.6 and 42.6 adults for 1999 cotton seasons for the control, chemical insecticides, plant extract, bioinsecticide and insect growth regulator treatments, respectively. (Tables, 6 &7).

The present results agree with **Hassan *et al.* (1960)** who found that *C. undicmpunctata* was present in cotton fields throughout the growth season of cotton. **Abbas and El-Deeb (1993)** mentioned that the population density of the same species on cotton plants was high in July, then decreased gradually until the end of the season. **Nassef *et al.* (1996)** reported 3 peaks of *C. undicmpunctata* abundance on cotton plants throughout the period from May to October.

b- Cydonia vicina var. *isis* Muls.:

In untreated treatment, this predator was found in few numbers, although it was, generally, more abundant than *Cydonia vicina* var. *nilotica* (total average 16.4 & 18.0 adults / 10 double strokes for *C. vicina* var.*isis* opposeto 9.6 and 12.3 adults for *C. vicina nilotica* in 1998 and 1999 cotton seasons, (Tables, 8& 9). Tactive period of this predator extended from (August, 20 th) unit the end of the cotton season, with highest averages of counts / 10 double strokes (4.3 adults on September, 4 th 1998 and 4.0 adults on September, 10 th 1999). In treated treatments, the seasonal average of total number of counted adults were 16.4, 12.6, 16.2, 15.9 and 13.0 adults in 1998 and 18.0, 13.7, 17.7, 17.3 and 14.4 adults in 1999 cotton seasons for control, chemical insecticides, plant

extract, bioinsecticide and insect growth regulator treatments, respectively (Tables 8 & 9).

In harmony with the presented data, **Kares *et al.* (1993)** found this predator during September only, in cotton fields.

c- *Cydonia vicina* var. *nilotica* Muls.:

Much fewer weekly counts of *Cydonia vicina* var, *nilotica* on cotton plants than those of *C. vicina* var. *isis* occurred in both 2 years of study (Tables, 8 - 11). In untreated treatment, the averages of total seasonal counts were (9.6 & 12.3 adults/ 10 double strokes in 1998 and 1999 cotton seasons, respectively. One peak of the predator abundance reached the averages of 3.3 & 3.3 adults / 10 double strokes on September, 11 th 1998 and September, 10 th 1999, respectively. In treated treatments, the averages of total numbers of counted adults were 9.6, 7.4, 9.3, 9.2 and 7.4 adults in 1998 and 12.3, 8.6, 12.0, 11.7 and 8.9 adults in 1999 cotton seasons in control, chemical insecticides, plant extract, bioinsecticide and insect growth regulator, respectively.

These findings agree with those of **Kares *et al.* (1993)** who found this predor, *C. vicina* var. *nilotica* appeared from the last week of August until the end of cotton season. **Shalaby *et al.* (1993b)** recorded that the bioinsecticide (Delphin) had the least harmful effect on predator's populations, while chemical insecticides reduced, significantly, the numbers of predaceous species.

1-2- *Scymnus spp.* [Coleoptera: Coccinellidae]:

Two species of *Scymnus* (*syriacus* and *interruptus*) are well known as common predators in Egyptain fields **kares (*et al.*1993).** In untreated treatment, the active period of *Scymnus spp.*

extended from the beginning of the season until July, 24 th 1998 and July, 30 th 1999 (Table, 13) cotton seasons. The highest average of number of *Scymnus spp.* / 10 double net strokes occurred on July, 10 th 1998 (4.7 adults) & on July, 9 th 1999 (4.3 adults). In treated treatments, the average of total numbers of counted were 23.1, 19.0, 22.8, 22.4 and 19.4 adults in 1998 and 17.4, 13.7, 17.4, 17.0 and 13.7 adults in 1999 cotton season in control, chemical insecticides, plant extract, bioinsecticide and insect growth regulator, respectively (Tables, 12 & 13).

In agreement with the present results **Abbas and El-Deeb (1993)** mentioned that the population of *Scymnus spp.* Was high in July than decreased gradually until the end of the season. **Kares *et al.* (1993)** recorded that *Scymnus spp.* were encounted from the beginning of the season to the end of July, with a peak on July, 8 th and added that no more *Scymnus* adult was captured during August and September. On the other hand, these results disagree with **Hassan *et al.* (1960)** who reported that *Scymnus spp.* were common on cotton plants between April and September. Also, **Nassef *et al.* (1996)** recorded three peaks of abundance of *Scymnus spp.* from May to October.

1.3. *Paederus alfierii* koch. [Coleoptera : Staphylinidae]:

Adults of *Paederus alfierii* were detected in all of the samples collected in both seasons. This predator came the second in order of predator's abundance after *Orius spp.* in the two seasons of this study. As shown in Tables (14 & 15), spraying of cotton plants by either conventionally recommended chemical insecticides or insect growth regulator caused reductions in *P. alfierii* populations (The averages of total numbers of counted were 66.9 &

Table (12): Averages in numbers of *Scymnus spp.* /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			2.3			
June, 5 th			2.7			
June, 12 th			1.3			
June, 19 th			2.7			
June, 26 th			2.0			
July, 3 rd			1.7			
July, 10 th			4.7			
			First treatment (15/7)			
July. 17 th	4.0	1.3	3.7	3.3	1.3	13.6
July, 24 th	1.7	0.3	1.7	1.7	0.7	6.1
			Second treatment (30/7)			
July, 31 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 7 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 14 th	0.0	0.0	0.0	0.0	0.0	0.0
			Third treatment (15/8)			
Aug., 21 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 28 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 4 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 11 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 18 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 25 th	0.0	0.0	0.0	0.0	0.0	0.0
Total	23.1	19.0	22.8	22.4	19.4	106.7
Mean	1.28 A	1.06B	1.27 AB	1.24 AB	1.08 AB	5.93
L.S.D. $_{0.05}$(treat.)			0.2265			

Table (13): Averages in numbers of *Scymnus spp.* /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			0.7			
June, 4 th			1.0			
June, 11 th			1.7			
June, 18 th			1.0			
June, 25 th			1.3			
July, 2 nd			2.7			
July, 9 th			4.3			
			First treatment (15/7)			
July. 16 th	2.7	0.3	2.7	2.3	0.3	8.3
July, 23 rd	1.3	0.7	1.3	1.3	0.7	5.3
			Second treatment (30/7)			
July, 30 st	0.7	0.0	0.7	0.7	0.0	2.1
Aug., 6 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 13 th	0.0	0.0	0.0	0.0	0.0	0.0
			Third treatment (15/8)			
Aug., 20 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 27 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 3 rd	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 10 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 17 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 24 th	0.0	0.0	0.0	0.0	0.0	0.0
Total	17.4	13.7	17.4	17.0	13.7	79.2
Mean	0.97 A	0.76 B	0.97 A	0.94 AB	0.76 B	4.40
L.S.D. $_{0.05}$.(treat.)			0.2050			

Table (14): Averages in numbers of *Paederus alfierii* Koch. /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			2.7			
June, 5 th			3.7			
June, 12 th			4.7			
June, 19 th			8.3			
June, 26 th			5.7			
July, 3 rd			7.0			
July, 10 th			8.7			
			First treatment (15/7)			
July. 17 th	9.0	7.3	8.7	8.7	7.7	41.4
July, 24 th	6.7	6.0	7.0	6.7	6.3	32.7
			Second treatment (30/7)			
July, 31 st	3.7	2.7	3.7	3.3	3.0	16.4
Aug., 7 th	2.3	2.0	2.3	2.3	2.3	11.2
Aug., 14 th	2.0	1.7	2.0	2.0	1.7	9.4
			Third treatment (15/8)			
Aug., 21 st	3.3	1.3	3.3	3.3	1.7	12.9
Aug., 28 th	2.0	1.7	2.0	2.0	1.7	9.4
Sep., 4 th	1.7	1.3	1.3	1.7	1.3	7.3
Sep., 11 th	1.0	1.0	0.7	1.0	1.0	4.7
Sep., 18 th	0.7	0.7	0.7	0.7	0.7	3.5
Sep., 25 th	0.3	0.3	0.7	0.3	0.3	1.9
Total	73.4	66.9	73.1	72.7	68.5	354.4
Mean	4.08 A	3.71 B	4.06 A	4.04 A	3.80 B	19.69
L.S.D. $_{0.05}$(treat.)			0.1962			

Table (15): Averages in numbers of *Paederus alfierii* Koch. /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			2.3			
June, 4 th			2.7			
June, 11 th			3.3			
June, 18 th			6.3			
June, 25 th			5.7			
July, 2 nd			6.7			
July, 9 th			8.3			
			First treatment (15/7)			
July. 16 th	9.0	7.0	8.0	7.7	7.3	39.0
July, 23 rd	5.7	4.7	6.3	6.7	5.3	28.7
			Second treatment (30/7)			
July, 30 st	2.7	2.7	3.0	3.0	2.7	14.1
Aug., 6 th	2.3	1.3	2.3	2.0	1.3	9.2
Aug., 13 th	3.0	2.3	2.7	2.7	2.3	12.0
			Third treatment (15/8)			
Aug., 20 th	2.3	1.7	2.3	2.0	1.3	9.6
Aug., 27 th	1.7	1.7	1.3	1.7	1.7	8.1
Sep., 3 rd	1.3	1.3	1.3	1.3	1.3	6.5
Sep., 10 th	1.0	1.0	1.0	1.0	1.0	5.0
Sep., 17 th	0.7	0.7	0.7	0.7	0.7	3.5
Sep., 24 th	0.3	0.3	0.7	0.3	0.3	1.9
Total	65.3	60.0	64.9	64.4	59.5	314.1
Mean	3.63 A	3.33 B	3.61 A	3.58 A	3.31 B	17.45
L.S.D. $_{0.05}$(treat.)			0.2039			

60.0 adults in case of chemical insecticides in 1998 and 1999 seasons, respectively, while, the averages were (68.5 & 59.5 adults in insect growth regulator for 1998 and 1999 cotton seasons, respectively). While significantly, higher average of total counts of *P. alfierii* were detected by using plant extract (73.1 & 64.9 adults), insect pathogen (72.7 & 64.4 adults) and control (73.4 & 65.3 adults), respectively. In untreated treatment, the weekly counts of *P. alfierii* adults, indicated one peak of adults abundance (9.0 adults) that occurred on July, 10 th in 1998 and (9.0 adults) on July, 16 th in 1999 cotton season/ 10 double strokes.

In previous studies on the seasonal population abundance of *P. alfierii*, **Naguib (1980)** found that the population of *P. alfierii* in cotton fields fluctuated sharply showing several peaks during June. **Abbas and El-Deeb (1993)** found that the population density of *P. alfierii* was high in July then decreased gradually until the end of the season. While, **Nassef *et al.* (1996)** reported that three peaks of *P. alfierii* abundance were observed from May to October.

1.4. *Chrysoperla carnea* (Stephens) [Neuroptera: Chrysopidae]:

Data presented in Table (16 & 17) show two active periods of *C. carnea* in cotton fields, the first period extended from the beginning of season until July, 3 rd in 1998 and until July, 9 th in 1999 season, while the second period extended from August, 21 st in 1998 from August, 20 th in 1999 until the end of each cotton season. In untreated treatment, two peaks of high abundance could be determined; those were estimated by 4.3 adults on July, 11 th and 4.7 adults/ 10 double strokes on September, 10 th in the second season. In treated treatments, the averages of total numbers of counted *C. carnea* adults were 34.8, 28.8, 34.0, 33.7 and 29.4

Table (16): Averages in numbers of *Chrysoperla carnea* (Stephens) /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			2.0			
June, 5 th			3.7			
June, 12 th			4.3			
June, 19 th			1.7			
June, 26 th			2.0			
July, 3 rd			1.7			
July, 10 th			0.0			
			First treatment (15/7)			
July. 17 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 24 th	0.0	0.0	0.0	0.0	0.0	0.0
			Second treatment (30/7)			
July, 31 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 7 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 14 th	0.0	0.0	0.0	0.0	0.0	0.0
			Third treatment (15/8)			
Aug., 21 st	2.7	1.7	2.3	2.3	1.7	10.7
Aug., 28 th	2.0	1.0	2.0	2.0	1.0	8.0
Sep., 4 th	3.3	2.3	3.3	3.3	2.3	14.5
Sep., 11 th	4.7	3.7	4.3	4.0	4.0	20.7
Sep., 18 th	3.7	2.7	3.7	3.7	2.7	16.5
Sep., 25 th	3.0	2.0	3.0	3.0	2.3	13.3
Total	34.8	28.8	34.0	33.7	29.4	160.7
Mean	1.93 A	1.60 B	1.89 A	1.87 A	1.63 B	8.93
L.S.D. $_{0.05}$(treat.)			0.1629			

Table (17): Averages in numbers of *Chrysoperla carnea* (Stephens) /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			1.0			
June, 4 th			2.3			
June, 11 th			3.3			
June, 18 th			1.3			
June, 25 th			2.3			
July, 2 nd			1.7			
July, 9 th			1.3			
			First treatment (15/7)			
July. 16 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 23 rd	0.0	0.0	0.0	0.0	0.0	0.0
			Second treatment (30/7)			
July, 30 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 6 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 13 th	0.0	0.0	0.0	0.0	0.0	0.0
			Third treatment (15/8)			
Aug., 20 th	1.7	1.0	1.7	1.7	1.3	7.4
Aug., 27 th	2.7	2.3	2.7	2.3	2.3	12.3
Sep., 3 rd	3.3	3.3	3.3	3.3	2.7	14.9
Sep., 10 th	4.7	3.0	4.3	4.3	3.3	19.9
Sep., 17 th	4.3	2.7	4.0	4.0	3.0	18.3
Sep., 24 th	3.7	2.7	3.7	3.7	2.3	16.1
Total	33.6	27.8	32.9	32.5	28.1	154.8
Mean	1.87 A	1.54 B	1.83 A	1.81 A	1.56 B	8.61
L.S.D. $_{0.05}$ (treat.)			0.1747			

adults in 1998 and 33.6, 27.8, 32.9, 32.5 and 28.1 adults in 1999 season in the control, chemical insecticides, plant extract, bioinsecticide and insect growth regulator treatments, respectively.

These findings agree with those of **Hafez (1960), Shalaby *et al.* (1983 b)** and **Kares *et al.* (1993)** who detected two peaks of high abundance of *C. carnea* in cotton fields.

1.5.*Orius spp.* [Hymenoptera: Anthocoridae]:

Two species belonging to genus *Orius*, namely *albidipennis* and *laveigatus* are known as the most common predators belonging to this genus in cotton and corn plantations in Egypt **[Hassan *et al.* (1960), Kares *et al.*(1993)** and **Hassan (1998)]**.

Data presented in Tables (18 &19) indicate that *Orius spp.* was the highest abundant predaceous insect on cotton plants in the two seasons of study. In untreated treatment, the averages of total counts of adults, throughout the whole periods of the two cotton seasons were 103.1 &102.0 adults for 1998 and 1999, respectively. Spraying of cotton plants by either conventionally recommended chemical insecticides or insect growth regulator caused, significant, reductions in *Orius spp.* populations (the total numbers counted were 92.7 & 93.0 adults in 1998 and 90.9 &91.9 adults in 1999 in cases of chemical insecticides and insect growth regulator, respectively. One peak of adults abundance was estimated by 111.5 adults on July, 3 rd of 1998 and 108.5 adults on July, 2 nd of 1999. The adults in plant extract and bioinsecticide treatments, respectively in 1998 season. While in 1999 cotton season, that was 102.0 adults in control, followed by 100.3 and 101.0 adults in plant extract and bioinsecticide, respectively.

Table (18): Averages in numbers of *Orius spp.* /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			3.7			
June, 5 th			4.7			
June, 12 th			8.0			
June, 19 th			13.7			
June, 26 th			17.3			
July, 3 rd			22.3			
July, 10 th			16.7			
			First treatment (15/7)			
July. 17 th	6.3	2.7	6.3	6.0	3.0	24.3
July, 24 th	4.0	1.3	3.7	3.7	1.3	14.0
			Second treatment (30/7)			
July, 31 st	2.7	1.3	2.7	2.7	1.3	10.7
Aug., 7 th	1.7	0.7	1.7	1.3	0.7	6.1
Aug., 14 th	1.0	0.3	0.7	1.0	0.3	3.3
			Third treatment (15/8)			
Aug., 21 st	0.7	0.0	0.7	0.7	0.0	2.1
Aug., 28 th	0.3	0.0	0.3	0.0	0.0	0.6
Sep., 4 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 11 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 18 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 25 th	0.0	0.0	0.0	0.0	0.0	0.0
Total	103.1	92.7	102.5	101.8	93.0	493.1
Mean	5.73 A	5.15 B	5.69 A	5.66 A	5.17 B	27.39
L.S.D. $_{0.05}$(treat.)			0.3557			

Table (19): Averages in numbers of *Orius spp.* /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			3.0			
June, 4 th			4.3			
June, 11 th			8.7			
June, 18 th			14.0			
June, 25 th			17.3			
July, 2 nd			21.7			
July, 9 th			14.3			
			First treatment (15/7)			
July. 16 th	7.7	3.0	6.7	7.0	3.3	27.7
July, 23 rd	4.3	2.3	4.3	4.3	2.7	17.9
			Second treatment (30/7)			
July, 30 st	2.7	1.0	2.3	2.7	1.3	10.0
Aug., 6 th	1.3	0.3	1.0	1.0	0.7	4.3
Aug., 13 th	1.7	0.7	1.7	1.7	0.3	6.1
			Third treatment (15/8)			
Aug., 20 th	0.7	0.3	0.7	0.7	0.3	2.7
Aug., 27 th	0.3	0.0	0.3	0.3	0.0	0.9
Sep., 3 rd	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 10 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 17 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 24 th	0.0	0.0	0.0	0.0	0.0	0.0
Total	102.0	90.9	100.3	101.0	91.9	426.1
Mean	5.67 A	5.05 B	5.57 A	5.61 A	5.11 B	27.00
L.S.D. $_{0.05.}$(treat.)			0.3821			

Working on the same predaceous species, **Hassan *et al.* (1960)** reported *Orius spp.* as common predators found on cotton during its season. **Kares *et al.* (1993)** detected the highest abundance of *Orius spp.* on July, 1 st .

1.6.Syrphids [Diptera : Syrphidae]:

Syrphus corollae was found as the most abundant amongst the collected syrphid species. Adults of this group were captured throughout the whole season except the last week of July and the first week of August in 1998 cotton season, and the first week of August in 1999 cotton season when syrphids adults were not captured in the sweeping net. In untreated treatment, two peaks of abundance were detected, those were estimated by 1.7 adults on July, 3 rd and 1.7 adults / 10 double strokes on September, 4 th of the first season, by 2.3 adults on July,2 nd and only 1.0 adults on , 3 rd of 1999 . The maximum whole season avera16.1 aduoccurred in control treatment in the two successive years of study, followed by 15.8, 15.5, 12.7 and 11.9 adults in 1998 cotton season, and by 15.6, 15.0, 12.2 and 11.8 adults in 1999 cotton season in plant extract, bioinsecticide, insect growth regulator and chemical insecticides, respectively (Tables, 20 &21).

These results agree with **Kares *et al.* (1993)** who reported that syrphids'adults were captured throughout the whole season, but in relatively low numbers; a maximum of 5.9 adults / 30 double strokes was recorded on June, 24 th; at 26°C 57 % R.H. in cotton fields of Qualubia Governorate (Eygpt).

Data presented in Tables (6-21) show the total numbers of these Predators, *C. undecimpunctata, Cydonia vicina* var. *isis, Cydonia vicina* var. *nilotica, Scymnus spp., P. alfierii, Chrysoperla*

Table (20): Averages in numbers of Syrphids /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			0.7			
June, 5 th			0.7			
June, 12 th			1.0			
June, 19 th			1.3			
June, 26 th			1.3			
July, 3 rd			1.7			
July, 10 th			1.3			
			First treatment (15/7)			
July. 17 th	0.3	0.0	0.3	0.3	0.0	0.9
July, 24 th	1.0	0.3	0.7	0.7	0.7	3.4
			Second treatment (30/7)			
July, 31 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 7 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 14 th	0.7	0.3	0.7	0.7	0.3	2.7
			Third treatment (15/8)			
Aug., 21 st	1.0	0.3	1.0	0.7	0.7	3.7
Aug., 28 th	1.7	0.3	1.7	1.7	0.3	5.7
Sep., 4 th	1.7	1.0	0.7	1.7	1.0	7.1
Sep., 11 th	0.7	0.7	1.7	0.7	0.7	3.5
Sep., 18 th	0.7	0.7	0.7	0.7	0.7	3.5
Sep., 25 th	0.3	0.3	0.3	0.3	0.3	1.5
Total	16.1	11.9	15.8	15.5	12.7	72.0
Mean	0.89 A	0.66 B	0.88 A	0.86 A	0.71 B	4.00
L.S.D. $_{0.05}$(treat.)			0.1395			

Table (21): Averages in numbers of Syrphids /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			0.3			
June, 4 th			0.7			
June, 11 th			1.0			
June, 18 th			1.7			
June, 25 th			1.7			
July, 2 nd			2.3			
July, 9 th			2.0			
			First treatment (15/7)			
July. 16 th	1.7	0.3	1.3	1.3	0.7	5.3
July, 23 rd	0.7	0.3	1.0	0.7	0.3	3.0
			Second treatment (30/7)			
July, 30 st	0.3	0.3	0.3	0.3	0.3	1.5
Aug., 6 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 13 th	0.3	0.0	0.3	0.3	0.0	0.9
			Third treatment (15/8)			
Aug., 20 th	0.7	0.0	0.3	0.3	0.0	1.3
Aug., 27 th	0.7	0.3	0.7	0.7	0.3	2.7
Sep., 3 rd	1.0	0.3	1.0	0.7	0.3	3.3
Sep., 10 th	0.7	0.3	0.3	0.0	0.0	1.3
Sep., 17 th	0.3	0.0	0.0	0.3	0.3	0.9
Sep., 24 th	0.7	0.3	0.7	0.7	0.3	2.0
Total	16.1	11.8	15.6	15.0	12.2	70.7
Mean	0.89 A	0.66 B	0.87 A	0.83	0.68 B	3.93
L.S.D. $_{0.05}$(treat.)			0.1152			

carnea, Orius spp. and syrphids which, insignificantly, differed between that received plant extract or bioinsecticide treatments for controlling the cotton leafworm and bollworms, on one hand, and those counted on the control on the other hand. But, these numbers decreased, significantly, in cases of using the chemical insecticides or insect growth regulator than control. On the other hand, the difference in total count of predators was insignificant between chemical insecticides and insect growth regulator.

Data tabulated in Tables (22 & 23) show the weekly total numbers of adult predators from different treatments throughout the period from May, 29 th until September, 25 th 1998 and from May, 28 th until September, 24 th 1999 cotton season. While, those in Fig. (12) illustrate the whole season averages of total counts of each of the predaceous insect species in relation to the same treatments. It is clear that in both cotton seasons, *Oriu spp.* adults were the most common on cotton plants, followed by ladybird beetles, *Paederus alfierii, Chrysoperla carnea, Scymnus spp.* and finally syrphids which meinifested the lowest mean counts.

As shown in Tables (22 & 23), the untreated cotton plots harboured the highest whole season mean of total numbers of predators (332.8 & 313.6 adults in 1998 and 1999 seasons, respectively which were, insignificantly, higher than those recorded from cotton plants received plant extract 328.3 & 307.9 adults and bioinsecticidal applications 325.2 & 305.5 adults, respectively. On the other hand, the counts from the previous three treatments were significantly higher than those counted on plants treated with chemical insecticides (287.4 & 268.5 adults and insect growth

Table (22): Averages in total numbers of adult predators counted /50 double strokes of sweeping net on different experimental treatments throughout 1998 cotton season.

Sampling date	Av. No. of adults in treatments					Total
	Control	Insecticides	*C. inerme*	Xentari	Mimic	
May, 29th			15.1			
June, 5th			21.4			
June, 12th			25.7			
June, 19th			33.4			
June, 26th			34.6			
July, 3rd			41.7			
July, 10th			34.7			
			First treatment (15/7)			
July, 17th	22.2	13.0	21.6	20.6	13.6	91.0
July, 24th	14.7	8.2	14.1	13.8	9.7	60.5
			Second treatment (30/7)			
July, 31st	7.4	4.0	7.1	6.7	4.6	29.8
Aug., 7th	4.3	2.7	4.3	3.9	3.0	18.2
Aug., 14th	3.7	2.3	3.4	3.7	2.3	15.4
			Third treatment (15/8)			
Aug., 21st	7.7	3.3	7.3	7.0	4.1	29.4
Aug., 28th	8.7	6.0	8.3	8.0	5.7	36.7
Sep., 4th	12.7	8.6	12.3	12.0	8.6	54.2
Sep., 11th	15.1	10.4	14.7	15.0	10.4	65.6
Sep., 18th	16.4	12.1	15.7	15.0	13.1	72.3
Sep., 25th	13.3	10.2	12.9	12.9	11.6	60.9
Total	332.8	287.4	328.3	325.2	293.3	1567.0
Mean	18.49 A	15.97 B	18.24 A	18.07 A	16.29 B	87.06
L.S.D.			0.8632			

Table (23): Averages in total numbers of adult predators counted /50 double strockes of sweeping net on different experimental treatments throughout 1999 cotton seaso

Sampling date	Av. No. of adults in treatments					
	Control	Insecticides	*C. inerme*	Xentari	Mimic	Total
May, 28 th			8.0			
June, 4 th			12.3			
June, 11 th			19.7			
June, 18 th			27.0			
June, 25 th			33.3			
July, 2 nd			40.1			
July, 9 th			37.9			
			First treatment (15/7)			
July, 16 th	25.4	13.9	22.7	22.0	15.3	99.3
July, 23 rd	15.7	11.0	16.2	16.0	12.0	70.9
			Second treatment (30/7)			
July, 30 th	9.4	6.3	9.3	9.4	6.6	41.0
Aug., 6 th	5.3	1.9	5.0	5.0	2.3	19.5
Aug., 13 th	5.7	3.0	5.0	5.4	2.6	21.7
			Third treatment (15/8)			
Aug., 20 th	6.7	3.0	6.0	6.0	2.9	24.6
Aug., 27 th	9.7	5.6	8.9	7.3	6.0	37.5
Sep., 3 rd	12.0	8.2	12.0	12.0	9.3	53.5
Sep., 10 th	14.3	12.0	13.7	13.4	11.6	65.0
Sep., 17 th	16.0	12.7	15.7	15.6	13.6	73.6
Sep., 24 th	15.1	12.6	15.1	15.1	12.2	70.1
Total	313.6	268.5	307.9	305.5	272.7	1468.2
Mean	17.42 A	14.92 B	17.11 A	16.97 A	15.15 B	81.57
L.S.D.			0.8652			

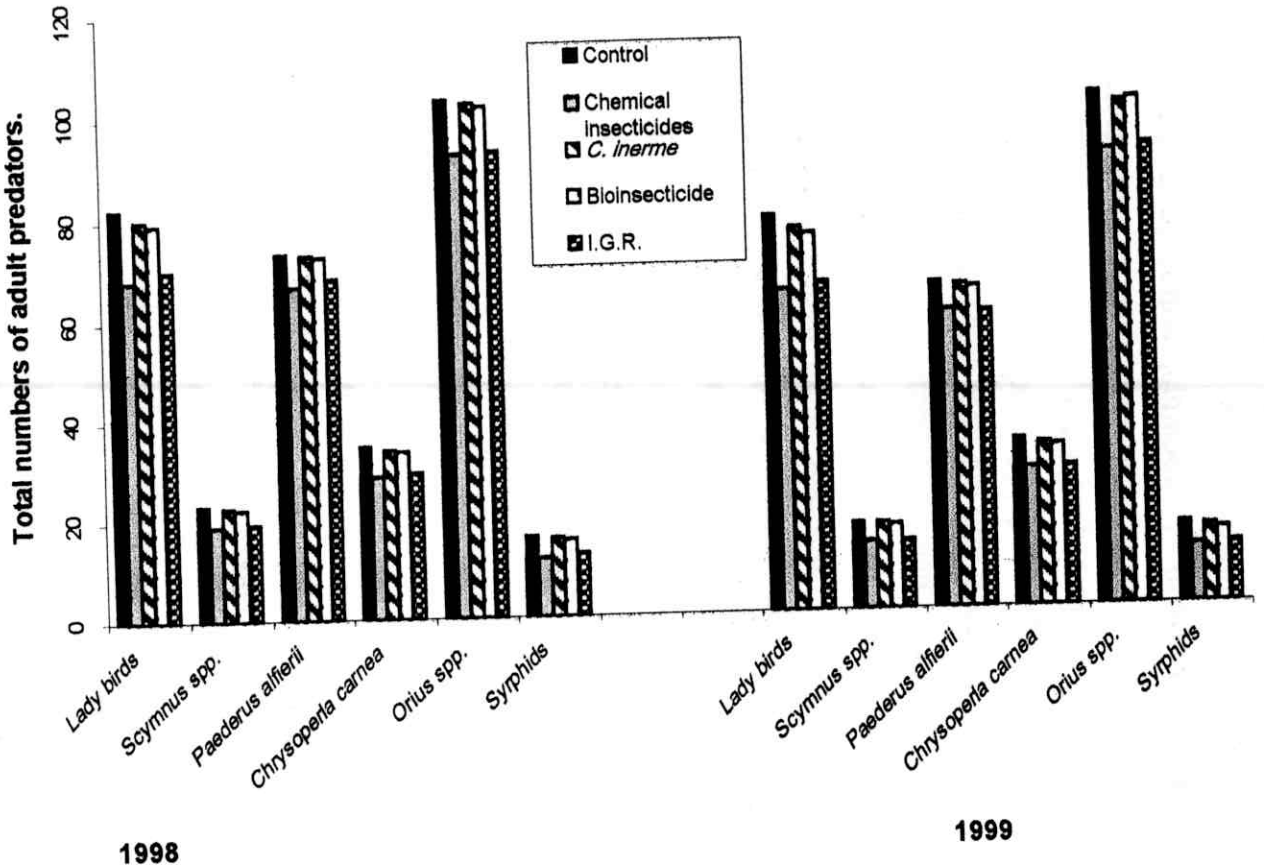

Fig (12): Total numbers of adult predators counted from different treatments during the whole period throughout 1998 and 1999 cotton seasons.

regulator 293.3 & 272.7 adults in 1998 and 1999 cotton seasons, respectively).

These results may confirm the acute harmful effect of insecticidal application in cotton fields on the predator populations, so the weekly counts on cotton plants received the conventional chemical insecticide spraying were affected. Data, also indicated that the insect growth regulator had the same effect as that chemical insecticides, although higher counts of predators occurred on plants that received IGR treatment, but with insignificant difference than in case of applying the traditional chemical insecticides.

These findings agree with **Salama and Zaki (1984)** who mentioned that the population curve of the most important predators of *S. littoralis (Coccinella undecimpumctata, Scymnus interuptus* and *S.syriacus, P. alfierii, Orius spp.* and *Chrysoperla carnea)* were slightly affected with Dipel (*B. thuringiensis* var. *Kurstaki)*. **Hussein and Amira (1986)** indicated that, the number of *C. undecimpunctata* was highly affected by RUP 962, DC 702 and Coracron than other predators. The effect of RUP 962 on *P. alfierii* was noticed two weeks after treatment by a sharp drop in their number in all treatments than control. *Chrysoperla carnea* was severely affected after the first treatment with RUP 962. These species of predators showed high susceptibility to tested pesticides. Also, **Shalaby *et al.* (1986)** reported that the organophosphorous insecticide, Bolstar 720 E.C. had a destructive effect on the predators of cotton leafworm, *S. littoralis*. **Abbas and El-Deeb (1993)** reported that the insecticidal application decreased the numbers of predators in cotton fields. On the other hand, **Shalaby**

et al. **(1993b)** found that the bioinsecticide (Delfin) had the least effect on entomophagous insect numbers, but, chemical insecticide applications reduced, significantly, the numbers of predaceous species.

II- Numbers of adult parasitoids:

Six parasitic species were concerned in this study: Four hymenopterous; *Microplitis rufiventris* kok., *Zele spp.* [*chlorophthalma* (Ness) and *migricornis* (Walk)] (Braconidae) and *Exeristes* (= *Pimpla) roborator* F. *(Ichneumonidae), and two dipterous species;* Tachina larvarum L. and *Periboea orbata* Wield [= *Strobliomyia aegyptia*] (Tachinidae) were concerned in this study. Counts of adults of each species, on different treatments, are recorded in tables (24- 33).

I-1-*Microplitis rufiventris* kok. [Hymenoptera: Braconidae]:

M. rufiventris is a solitary endoparasite on the larvae of *S. littoralis* and *S. exigua* **(Hammad *et al.*, 1965).** The second and third instars of *S. littoralis* larvae were recorded as the most preferred for oviposition larvae **(Hammad *et al.*, 1965** and **Shalaby, 1968). Gerling (1971)** stated that *M. rufiventris* has been recorded in both the Middle East and Europe parasitizing on several species of noctuid larvae, including *H. armigera,* and *S.littoralis.* **Hegazi (1972)** claimed that *M. rufiventris* may facilitate any biological control program in the future against the cotton leafworm and other noctuids in Alexandria district.

In this present study, data recorded in Tables (24-33) show that, amongst all of the collected samples, numbers of *M. rufiventris* adults dominated those recorded for all other *S. littoralis* parasitoids. Fig. (13) shows also that the mentioned parasite was of

Table (24): Averages in numbers of *Microplitis rufiventris* Kok./10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			1.3			
June, 5 th			1.7			
June, 12 th			2.3			
June, 19 th			3.0			
June, 26 th			2.3			
July, 3 rd			2.0			
July, 10 th			1.3			
			First treatment (15/7)			
July. 17 th	0.7	0.3	0.3	0.7	0.3	2.3
July, 24 th	1.0	0.7	0.7	0.7	0.3	3.4
			Second treatment (30/7)			
July, 31 st	1.3	0.7	0.3	1.0	0.7	4.0
Aug., 7 th	1.3	0.7	1.3	0.7	0.7	4.7
Aug., 14 th	1.7	1.0	1.7	1.3	1.3	7.0
			Third treatment (15/8)			
Aug., 21 st	2.0	1.0	2.0	1.0	2.0	8.0
Aug., 28 th	2.7	1.7	3.0	3.0	2.3	12.7
Sep., 4 th	1.7	1.3	2.3	2.3	1.3	8.9
Sep., 11 th	2.3	1.7	2.7	2.7	1.7	11.1
Sep., 18 th	1.0	1.3	1.0	1.3	1.0	5.6
Sep., 25 th	0.7	1.0	0.7	1.0	0.7	4.1
Total	30.3	25.3	29.9	29.6	26.2	141.3
Mean	1.68 A	1.41 B	1.66 A	1.64 A	1.46 B	7.85
L.S.D. $_{0.05}$(treat.)			0.1846			

Table (25): Averages in numbers of *Microplitis rufiventris* Kok./10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			2.0			
June, 4 th			2.7			
June, 11 th			3.3			
June, 18 th			4.3			
June, 25 th			3.3			
July, 2 nd			3.0			
			First treatment (15/7)			
July, 9 th	2.7	2.7	2.7	2.7	2.7	13.5
July. 16 th	2.7	2.0	2.3	3.0	2.7	12.7
July, 23 rd	2.0	1.3	2.0	2.3	2.0	9.6
			Second treatment (30/7)			
July, 30 st	2.3	1.3	2.7	2.0	1.0	9.3
Aug., 6 th	3.0	1.7	3.0	1.7	1.7	11.1
Aug., 13 th	3.3	2.3	3.0	2.7	2.3	13.6
			Third treatment (15/8)			
Aug., 20 th	2.0	1.7	1.7	1.7	1.0	8.1
Aug., 27 th	3.0	3.0	2.7	2.7	2.7	14.1
Sep., 3 rd	3.0	2.7	3.3	3.0	3.0	15.0
Sep., 10 th	2.7	2.3	3.0	3.3	2.3	13.6
Sep., 17 th	2.3	2.0	2.0	2.3	2.0	10.6
Sep., 24 th	2.0	1.3	1.7	1.3	1.7	8.0
Total	49.6	42.9	48.7	47.3	43.7	232.2
Mean	2.76 A	2.38 B	2.71 A	2.63 A	2.43 B	12.90
L.S.D. $_{0.05}$(treat.)			0.1973			

the highest populations, in all treatments than the other 4 parasitic species. In untreated treatment, two peaks of adults abundance could be detected on June, 19 th (av. 3.0 adults/ 10 double strokes) and August, 28 th (2.7 adults) for 1998 season and on June, 18 th (av. 4.3 adults) and September, 3 rd (3.0 adults/10 double strokes) for 1999 cotton season (Tables, 24 & 25).These data on *M. rufiventris* abundance are in accordance with those recorded by **Kares *et al.* (1993).** The authors found the highest numbers were recorded on June, 17 th 11.8 adults/30 double strokes and August, 19 th (10.1 adults). In treated treatments, the averages of total number of counted of *M. rufiventris* adults were 30.0, 25.3, 29.9, 29.6 and 26.2 adults for 1998 cotton season for treatments: control, chemical insecticides, plant extract (*C. inerme),* bioinsecticide (Xentari) and IGR(Mimic) [Tables, 24 & 25 and Fig., 13].

Data in Tables (24 &25) show that the total number of *M. rufiventris* adults swept from cotton plants of the control (30.3 and 49.6 adults) were higher than those counted from either of the 4 treatments (insecticides, plant extract, bioinsecticide and IGR). However, these averages of seasonal total count in control were, insignificantly, higher than plant extract and bioinsecticide treatments, and total counts on these three treatments were, significantly, higher than those counted on insecticides and IGR treatments (Tables, 24 & 25 and Fig., 13).

II- 2- *Zele spp.* [Hymenoptera : Braconidae]:

Kamal (1951b) reported that *Z. chlorophthalma* and *Z. nigricornis* are widely distributed in Egypt, and that the seasonal abundance of both parasitic species appeared to the same **Kares (1985)** indicated that *Z. nigricornis* was active, in Egypt, all the

year round and the percentages of parasitism were, generally, higher on *A. ipsilon* larvae (av. 7.92; ranging from 2.9 % in June to 10.19 % in August) than on *S.littoralis* larvae, where the whole percentage of parasitism averaged 1.75 % (zero in January and July to 3 % in May). *Z, nigricornis* is a solitary on *S. littoralis* larvae. The same author found that the sex-ratio was 1 male to 1.3 females amongst adults emerged from the obtcocoons.

According to Tables (26 & 27), *Zele* . adults were detected in all collected samples except the last two samples of the second half of September which were free from any *Zele spp.* adults in both seasons of study. In control treatment, it appears also that this parasitoid was, generally more abundant in 1999 (total of 31.9 adults) than 1998 season (26.0 adults). Two peaks of population abundance of *Zele spp.* may be observed in each of the two seasons of study. Those were estimated by 3.0 & 3.0 adults / 10 double strokes on June, 19 th and August, 7 th 1998 and 4.0 & 3.0 adults/ 10 double strokes on June, 18 th and August, 6 th in 1999 cotton season.

Regarding the average of total numbers of *Zele spp.* adults collected throughout the whole period of the season, in treated treatments, those were highest (26.0 adults in 1998 and 31.9 adults in 1999 cotton season in control followed, insignificantly, by *C. inerme* (23.7 & 31.5 adults) and Xentari (22.8 & 31.3 adults) in the two cotton seasons, respectively.

While, significant reductions in the averages of total seasonal numbers of captured *Zelr spp.* adults, than the mentioned treatments, occurred by using chemical insecticides (16.3 & 27.2

Table (26): Averages in numbers of *Zele spp.* /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			1.7			
June, 5 th			2.0			
June, 12 th			2.7			
June, 19 th			3.0			
June, 26 th			0.7			
July, 3 rd			0.3			
July, 10 th			0.3			
			First treatment (15/7)			
July. 17 th	0.3	0.3	0.3	0.7	0.3	1.9
July, 24 th	1.3	0.3	0.7	1.0	0.7	4.0
			Second treatment (30/7)			
July, 31 st	1.7	0.3	1.3	1.0	1.3	5.6
Aug., 7 th	3.0	1.7	2.7	2.7	2.0	12.1
Aug., 14 th	2.7	1.3	2.3	2.3	1.0	9.6
			Third treatment (15/8)			
Aug., 21 st	2.3	1.0	2.3	1.7	1.0	8.3
Aug., 28 th	2.3	0.7	2.0	1.3	0.7	7.0
Sep., 4 th	1.3	0.3	1.0	1.0	0.3	3.9
Sep., 11 th	0.7	0.0	0.7	0.7	0.3	2.4
Sep., 18 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 25 th	0.0	0.0	0.0	0.0	0.0	0.0
Total	26.0	16.3	23.7	22.8	18.0	106.8
Mean	1.44 A	0.91 B	1.32 A	1.27 A	1.00 B	5.93
L.S.D. $_{0.05}$.(treat.)			0.1881			

Table (27): Averages in numbers of *Zele spp.* /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			2.3			
June, 4 th			2.7			
June, 11 th			3.3			
June, 18 th			4.0			
June, 25 th			1.3			
July, 2 nd			0.3			
July, 9 th			1.0			
			First treatment (15/7)			
July. 16 th	1.7	1.3	1.7	1.7	1.3	7.7
July, 23 rd	2.0	1.0	2.0	1.7	1.3	8.0
			Second treatment (30/7)			
July, 30 st	2.3	1.7	2.3	2.0	1.7	10.0
Aug., 6 th	3.0	1.0	2.7	2.3	1.3	10.3
Aug., 13 th	2.7	2.3	2.3	2.7	2.3	12.3
			Third treatment (15/8)			
Aug., 20 th	2.3	2.0	2.3	2.3	1.0	9.9
Aug., 27 th	2.0	1.7	2.0	2.0	1.7	9.4
Sep., 3 rd	0.7	1.0	1.0	1.0	1.3	5.0
Sep., 10 th	0.3	0.3	0.3	0.7	0.7	2.3
Sep., 17 th	0.0	0.0	0.0	0.0	0.0	0.0
Sep., 24 th	0.0	0.0	0.0	0.0	0.0	0.0
Total	31.9	27.2	31.5	31.3	27.5	149.4
Mean	1.77 A	1.51 B	1.75 A	1.74 A	1.53 B	8.3
L.S.D. $_{0.05}$(treat.)			0.1822			

adults) and the IGR (Mimic) (18.0 & 27.5 adults) for 1998 and 1999 cotton seasons, respectively were evident (Tables, 26 & 27).

II-3- *Exeristes (= Pimpla) roborator* [Hymenoptera : Ichneumonidae]

In control treatment, adults of *E. roborator* started to appear in cotton fields during the last week of July of the two seasons (1998 & 1999) of study, and their exictance remained up the end of cotton seasons (Tables, 28 & 29). The parasitoid started in very low abundance (0.3 adults/ 10 double strokes) on July, 24 th 1998 and (0.3 adults/ 10 double strokes) on July, 23 rd 1999.

Generally, the first three weeks of August, and also the second and third weeks of September may be, fairly, considered as eriods of higher abundance of *E. roborator* (1.7, 1.3, 1.3, 2.0 and 1.7 adults on August, 7 th, 14 th, 21 st & September, 11 th and 18 th, respectively in the first season, and (1.0, 1.7, 1.3, 1.7 and 1.3 adults on August, 6 th, 13 th, 20 th & September, 10 th and 17 th, respectively in 1999 cotton season (Tables, 28 &29).

As for the effect of cotton treatments on the population abundance of *E. roborator*, it is clear from Tables (28 &29) and Fig. (13) that the total numbers of adults collected throughout the whole season were 12.0 11.4 and 11.0 adults in 1998 and 11.0, 10.3 and 10.1 adults in 1999 cotton season in control, plant extract and bioinsecticide treatments, respectively. Statistical analysis proved that the differences in total collected adult counts between these three treatments were insignificant. While in cases of treditional insecticides and insect growth regulator treatments, the total adult counts 7.3 and 8.6 adults in 1998 and 8.1 and 8.1 adults in 1999 cotton season, where the difference between these values was

Table (28): Averages in numbers of *Exeristes* (= *Pimpla*) *roborator* F. /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			0.0			
June, 5 th			0.0			
June, 12 th			0.0			
June, 19 th			0.0			
June, 26 th			0.0			
July, 3 rd			0.0			
July, 10 th			First treatment (15/7)			
July. 17 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 24 th	0.3	0.0	0.7	0.3	0.0	1.3
			Second treatment (30//7)			
July, 31 st	0.7	0.3	0.7	0.7	0.3	2.7
Aug., 7 th	1.7	0.7	1.3	1.0	1.0	5.7
Aug., 14 th	1.3	1.0	1.7	1.3	1.3	6.6
			Third treatment (15/8)			
Aug., 21 st	1.3	1.0	1.3	1.3	1.3	6.2
Aug., 28 th	1.0	0.7	1.0	1.0	1.0	4.7
Sep., 4 th	0.7	0.3	0.7	0.7	0.7	3.1
Sep., 11 th	2.0	1.7	1.7	1.7	1.3	8.4
Sep., 18 th	1.7	1.3	1.3	1.7	1.0	7.0
Sep., 25 th	1.3	0.3	1.0	1.3	0.7	4.6
Total	12.0	7.3	11.4	11.0	8.6	50.3
Mean	0.67 A	0.41 B	0.63 A	0.61 A	0.48 B	2.80
L.S.D. $_{0.05}$(treat.)			0.1152			

Table (29): Averages in numbers of *Exeristes* (=*Pimpla*) *roborator* F. /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			0.0			
June, 4 th			0.0			
June, 11 th			0.0			
June, 18 th			0.0			
June, 25 th			0.0			
July, 2 nd			0.0			
July, 9 th			0.0			
			First treatment (15/7)			
July. 16 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 23 rd	0.3	0.3	0.3	0.7	0.3	1.9
			Second treatment (30/7)			
July, 30 th	0.7	0.7	1.0	0.7	0.7	3.8
Aug., 6 th	1.0	0.7	0.7	1.0	0.7	4.1
Aug., 13 th	1.7	0.7	1.3	1.3	1.0	6.0
			Third treatment (15/8)			
Aug., 20 th	1.3	1.0	1.0	1.0	0.7	5.0
Aug., 27 th	1.0	1.0	0.7	0.7	0.3	3.7
Sep., 3 rd	0.7	0.7	1.0	0.7	0.7	3.8
Sep., 10 th	1.7	1.3	1.3	1.7	1.7	7.7
Sep., 17 th	1.3	1.0	1.7	1.3	1.0	6.3
Sep., 24 th	1.3	0.7	1.3	1.0	1.0	5.3
Total	11.0	8.1	10.3	10.1	8.1	47.6
Mean	0.61 A	0.45 B	0.57 A	0.56 A	0.45 B	2.64
L.S.D. $_{0.05}$(treat.)			0.1073			

statistically insignificant, while results from these two treatments were, significantly, lower than those recorded from the three former treatments. Thus indicating that chemical insecticides and IGR applications reduced, significantly, the numbers of *E. roborator* in cotton fields. While, on the contrary, the effects of plant extract and bioinsecticide were very slight.

II- 4 - *Tachina larvarum L.* [Diptera : Tachinidae]:

Hafez (1953) aimed to disclose the exact role of *T. larvarum* in the biological control of the cotton leafworm in Egypt, which doubtful before. The author stated that although *S. exigua, Plusia gamma, P. circumflexa* and *Anadiase undata* klog. Were fairly attacked hosts by *T. larvarum*, the cotton leafworm was the main host.

In control treatment, *T. larvarum* adults were absent from all the samples collected throughout the period extended from July, 17 th until August, 7 th 1998 and from July, 16 th to August, 6 th in 1999. Before and after this period, the parasitoid adults were found in the swept samples in, relatively, few numbers that ranged from 0.3 – 2.0 adults in 1998 season and from 0.3 – 1.7 adults / 10 double strokes in 1999 cotton season. Regarding the total weekly numbers of *T. larvarum* adults, two peaks of abundance may be discerned / year. Those occurred on June, 19 th (1.7 adults) and September, 18 th (2.0 adults) in 1998, and on June, 18 th (1.3 adults) and September, 17 th (1.7 adults) in 1999 cotton season (Tables, 30 &31).

On *T. larvarum*, **Kamal (1951b)** mentioned that this parasitoid is widely distributed allover Egypt. The author indicated that it begins to appear in few numbers in June and July of every

Table (30): Averages in numbers of *Tachina larvarum* (l.) /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			0.3			
June, 5 th			0.7			
June, 12 th			1.0			
June, 19 th			1.7			
June, 26 th			1.0			
July, 3 rd			1.3			
July, 10 th			0.7			
			First treatment (15/7)			
July. 17 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 24 th	0.0	0.0	0.0	0.0	0.0	0.0
			Second treatment (30/7)			
July, 31 st	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 7 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 14 th	0.7	0.0	0.3	0.7	0.3	2.0
			Third treatment (15/8)			
Aug., 21 st	1.3	0.0	1.0	1.0	0.0	3.3
Aug., 28 th	1.0	0.3	1.3	0.7	0.7	4.0
Sep., 4 th	1.3	1.0	1.3	1.0	1.0	5.6
Sep., 11 th	1.7	1.3	1.7	1.3	1.3	7.3
Sep., 18 th	2.0	1.7	2.0	1.7	1.0	8.4
Sep., 25 th	1.7	1.3	1.3	1.7	1.3	7.3
Total	16.4	12.3	15.6	14.8	12.3	71.4
Mean	0.91 A	0.68 B	0.87 A	0.82 A	0.68 B	3.97
L.S.D. $_{0.05}$(treat.)			0.1347			

Table (31): Averages in numbers of *Tachina larvarum* (L.) /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			0.3			
June, 4 th			0.7			
June, 11 th			1.0			
June, 18 th			1.3			
June, 25 th			1.0			
July, 2 rd			0.7			
July, 9 th			0.3			
			First treatment (15/7)			
July. 16 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 23 rd	0.0	0.0	0.0	0.0	0.0	0.0
			Second treatment (30/7)			
July, 30 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 6 th	0.0	0.0	0.0	0.0	0.0	0.0
Aug., 13 th	0.3	0.0	0.3	0.3	0.0	0.9
			Third treatment (15/8)			
Aug., 20 th	1.0	0.3	0.7	0.3	0.3	2.6
Aug., 27 th	0.7	0.7	0.3	0.7	0.7	3.1
Sep., 3 rd	0.3	0.3	0.3	0.3	0.3	1.5
Sep., 10 th	0.7	0.3	0.7	0.7	0.3	2.7
Sep., 17 th	1.7	0.7	1.3	1.3	0.7	5.7
Sep., 24 th	1.3	0.3	1.3	1.0	0.3	4.2
Total	11.3	7.9	10.2	9.9	7.9	47.2
Mean	0.63 A	0.44 B	0.57 A	0.55 A	0.44 B	2.62
L.S.D. $_{0.05}$(treat.)			0.1171			

year, and reaches its maximum abundance during September to November, and added that the population of this parasite begins to slow down from November until almost the end of December when the fly enters into hibernation as a pupa.

Comparing the effect of different treatments on the attractiveness of *T. larvarum* adults, (Tables, 30 & 31 and Fig. (13)) indicated no significant differences between control, plant extract and bioinsecticide treatments, indicating that these two later treatments had slight effect on the population of this parasitoid. However, on the other hand, the numbers of *T. larvarum* adults counted on these treatments were, significantly, higher than those recorded for the remaining two treatments (insect growth regulator and chemical insecticides), but no significant difference between insect growth regulator and chemical insecticides. Thus proving that using chemical insecticides or the IGR (Mimic) for controlling the cotton leafworm and bollworms had detrimental effect on *T. larvarum.*

II-5–*Periboea orbata* Wied (=*Stirobliomya aegytia* (Villen) [Diptera :Tachinidae]:

This parasite was reported as useful fly, and was much more numbers, and more widely distributed in almost all the provinces of Egypt **(Kamal 1951b).**

As shown in Tables (32 &33 and Fig., 13), the population of *P. orbata* adults relatively, low as in the control treatment, the average number of adults swept/ 10 double strokes was 0.0 - 1.7 in 1998 and 0.0 – 2.0 adults in 1999 cotton season. While, by regarding the weekly averages of total collected adults, the parasitoid reached high abundance on June, 19 th 1998 and June, 18

Table (32): Averages in numbers of *Periobea orbata* Wied . /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			0.0			
June, 5 th			0.7			
June, 12 th			1.0			
June, 19 th			1.7			
June, 26 th			1.0			
July, 3 rd			0.3			
July, 10 th			0.0			
			First treatment (15/7)			
July. 17 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 24 th	0.0	0.0	0.0	0.0	0.0	0.0
			Second treatment (30/7)			
July, 31 st	0.7	0.0	0.3	0.3	0.0	1.3
Aug., 7 th	0.7	0.3	1.0	1.0	0.7	3.7
Aug., 14 th	1.0	0.7	0.7	0.7	0.7	3.8
			Third treatment (15/8)			
Aug., 21 st	1.3	1.0	1.0	1.0	1.0	5.3
Aug., 28 th	1.7	1.3	1.3	1.3	1.0	6.6
Sep., 4 th	1.3	1.0	1.7	1.3	1.0	6.3
Sep., 11 th	1.0	0.7	1.3	1.0	0.7	4.7
Sep., 18 th	0.7	0.3	0.7	0.7	0.3	2.7
Sep., 25 th	0.0	0.0	0.0	0.0	0.0	0.0
Total	13.1	10.0	12.7	12.0	10.1	57.9
Mean	0.73 A	0.56 B	0.71 A	0.67 A	0.56 B	3.22
L.S.D. $_{0.05}$.(treat.)			0.0941			

Table (33): Averages in numbers of *Periobea orbata* Wied. /10 double strokes of sweeping net from cotton cultivated in different treatments throughout 1999 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 28 th			0.0			
June, 4 th			0.7			
June, 11 th			1.3			
June, 18 th			1.7			
June, 25 th			0.7			
July, 2 rd			0.3			
July, 9 th			0.0			
			First treatment (15/7)			
July. 16 th	0.0	0.0	0.0	0.0	0.0	0.0
July, 23 rd	0.0	0.0	0.0	0.0	0.0	0.0
			Second treatment (30/7)			
July, 30 th	0.3	0.0	0.3	0.3	0.0	0.9
Aug., 6 th	0.7	0.0	0.3	0.7	0.3	2.0
Aug., 13 th	1.0	0.3	0.7	1.0	0.7	3.7
			Third treatment (15/8)			
Aug., 20 th	1.3	0.7	1.3	1.0	1.0	5.3
Aug., 27 th	1.7	1.3	1.7	1.7	1.3	7.7
Sep., 3 rd	2.0	1.7	2.0	1.7	1.3	8.7
Sep., 10 th	1.3	1.0	1.7	1.3	1.0	6.3
Sep., 17 th	1.0	0.7	1.0	1.0	1.0	4.7
Sep., 24 th	0.0	0.0	0.0	0.0	0.0	0.0
Total	14.0	10.4	13.7	13.4	11.3	62.8
Mean	0.78 A	0.58 B	0.76 A	0.74 A	0.63 B	3.49
L.S.D. $_{0.05}$(treat.)			0.0964			

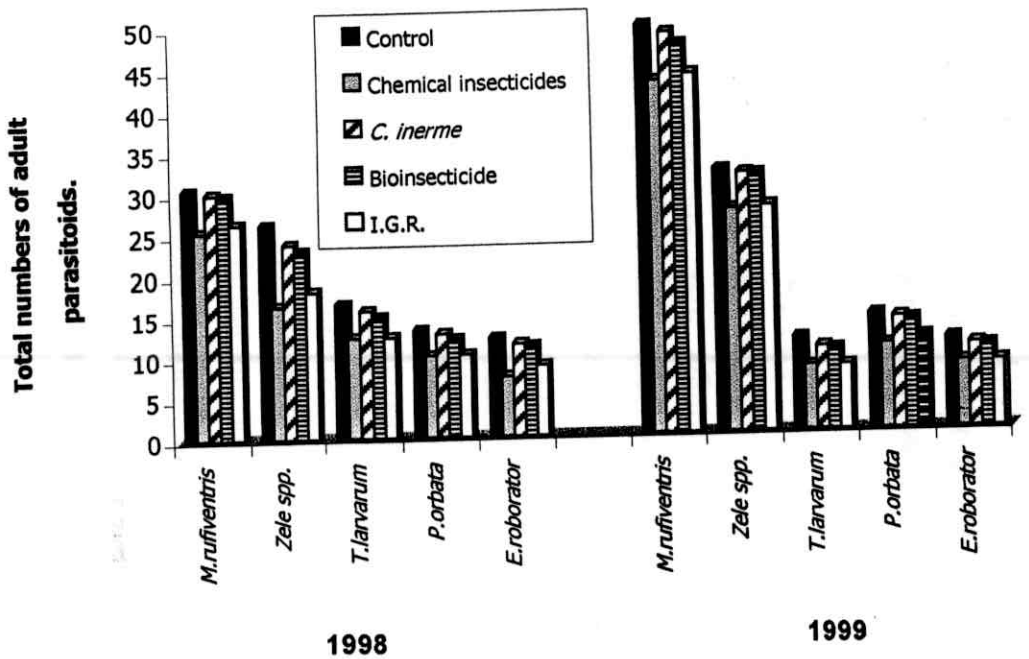

Fig (13): Total numbers of adult parasitoids counted from different treatments during the whole period throughout 1998 and 1999 cotton seasons.

th 1999 (1.7 adults/ 10 double sweeping net strokes), and also on August, 28 th 1998 (1.7 adults) and September, 3 rd 1999 (2.0 adults / 10 double strokes). The parasitoid seems to has two periods of existence in cotton fields; the first during the month of June and the first week of July, while the second occupied longer period during the month of August and the first half of September. In this respect, **Hegazi (1973)** reported that the parasitoid was active in cotton fields only during August and the beginning of September.

Comparing the abundance of *P. orbata* adults on cotton plants after different treatments, it is clear from Tables (32 &33) and Fig. (13) that the highest average of total population collected throughout the season occurred on plants of the control (13.1 and 14.0 adults in 1998 and 1999 season, respectively). But., these total counts were insignificantly higher than the total counts on plants treated by *C. inerme* extract (12.7 and 13.7 adults) and Xentari (12.0 and 13.4 adults in 1998 and 1999 seasons, respectively). While these averages of total counts on control, plant extract and bioinsecticide were, significantly, higher than those counted on plants treated by the chemical insecticides (10.0 and 10.4 adults) and IGR (10.1 and 11.3 adults on plants of 1998 and 1999 seasons, respectively.

The whole seasonal counts of adults of different parasitoids that were swept on cotton plants of different treatments are shown in Fig. (13). From this figure, it is clear that *M. rufiventris* was the dominant parasitoid, followed descendingly by *Zele spp.* ,*T. larvarum*, *P. orbata* and *E. roborator*. The two tachinid parasitoids, *T. larvarum* and *P. orbata* were much less

common than *M. rufiventris* and *Zele spp.* , but the ichneumonid *E. roborator* was the least common parasitoid in cotton.

In is evident, from (Tables 34 & 35), that the untreated cotton plants harbored the highest numbers of parasitoids (mean total of 97.9 and 114.5adults in 1998 and 1999 cotton seasons, resp). These numbers were insignificantly, than those refrom cotton plants received plant extract 93.3 and 111.1 adults and bioinsecticide applications 92.2 and 109.0 adults in 1998 and 1999 seasons, respectively. But, the values recorded for these treatments were, significantly, higher than those counted on plants treated with chemical insecticides 72.2 and 92.2 adults and IGR (Mimic) 75.3 and 95.2 adults in 1998 and 1999 cotton seasons, respectively.

This may confirm the detrimental effect of chemical insecticides application in cotton fields on the parasites' populations **(Ridgway and Lindquest, 1966; Metcalf *et al.* , 1967; Ridgway *et al.*,1968; Cate *et al.*, 1972 and Shalaby *et al.*, 1993).** Also, insect growth regulators display a delayed and latent toxicity against the parasite progenies; that was recorded by **Madrid and Stewart, 1981; Zaki *et al.*, 1987; Kares *et al.*, 1990 a and Dejiu *et al.*, 1992.** On other hand, bioinsecticides has a slight effect on entomophagous insect numbers; that was recorded by **Kares (1991 b), Morallo – Rejesus *et al.*,1992; Shalaby *et al.*, 1993 b and Atwood *et al.*, 1997.**

III- Percentages of parasitism:

III –1 – Parasitoids emerged from *S. littoralis*:

Larvae of *S. littoralis* were weekly collected from the experimental plots of each treatment, from the first week of June to the last week of September. The collected larvae were transported

Table (34): Averages in total numbers of adult parasitoids counted /50 double strokes of sweeping net on different experimental treatments throughout 1998 cotton season.

Date	Treatments					
	Control	Insecticides	*C.inerme*	Xentari	Mimic	Total
May, 29 th			3.3			
June, 5 th			5.1			
June, 12 th			7.0			
June, 19 th			9.4			
June, 26 th			4.3			
July, 3 rd			3.6			
July, 10 th			2.3			
			First treatment (15/7)			
July. 17 th	1.7	0.6	0.6	1.4	0.6	4.9
July, 24 th	2.6	1.0	2.1	2.0	1.0	8.7
			Second treatment (30/7)			
July, 31 st	4.4	2.0	3.3	5.7	2.3	17.7
Aug., 7 th	6.7	3.4	6.3	5.4	4.4	26.2
Aug., 14 th	7.4	4.0	6.7	6.3	5.3	29.7
			Third treatment (15/8)			
Aug., 21 st	8.2	3.0	7.6	6.0	5.3	30.1
Aug., 28 th	8.8	4.7	8.6	7.3	5.7	35.1
Sep., 4 th	6.3	4.9	7.0	6.3	4.3	28.8
Sep., 11 th	7.7	5.4	8.1	7.4	5.3	33.9
Sep., 18 th	5.4	5.6	5.0	5.4	3.3	24.7
Sep., 25 th	3.7	2.6	3.0	4.0	2.7	16.0
Total	97.9	72.2	93.3	92.2	75.3	416.8
Mean	5.44 A	4.01 B	5.18 A	5.12 A	4.18 B	23.16
L.S.D. Treat. 0.5			0.5330			

N.B. Data from starting of sampling up to July 10 th are before any application of the assayed materials.

Table (35): Average in number of adult parasites counted /50 double strokes of sweeping net on different experimental treatments throughout 1999 cotton season.

Sampling date	Av. No. of adults in treatments					Total
	Control	Insecticides	*C. inerme*	Xentari	Mimic	
May, 28 th			4.6			
June, 5 th			6.8			
June, 11 th			5.6			
June, 18 th			11.3			
June, 25 th			6.3			
July, 2 nd			4.3			
July, 9 th			4.0			
			First treatment (15/7)			
July, 16 th	4.4	3.3	4.0	4.7	4.0	20.4
July, 23 rd	4.3	2.6	4.3	4.7	3.6	19.5
			Second treatment (30/7)			
July, 30 th	5.6	3.7	6.3	5.0	3.4	24.0
Aug., 6 th	7.7	3.4	6.7	5.7	4.0	27.5
Aug., 13 th	9.0	5.6	7.6	8.0	6.3	36.5
			Third treatment (15/8)			
Aug., 20 th	7.9	5.7	7.0	6.3	4.0	30.9
Aug., 27 th	8.4	7.7	7.4	7.8	7.1	38.4
Sep., 3 rd	6.7	6.4	7.6	6.7	6.2	33.6
Sep., 10 th	6.7	4.2	7.0	7.7	6.0	31.6
Sep., 17 th	5.9	4.0	6.0	5.9	4.3	26.1
Sep., 24 th	.5	2.7	4.3	3.6	3.4	19.0
Total	114.5	92.2	111.1	109.0	95.2	522.0
Mean	6.36 A	5.12 B	6.17 A	6.06 A	5.29 B	29.00
L.S.D.			0.4618			

to the laboratory and reared on castor-bean leaves until pupation and adults emergence. Five parasitoids species were found to emerge from *S. littoralis* larvae. Those included *M. rufiventris, Zele spp. [chlorophthalma* (Ness) and *nigricornis* (Walk)], *Chelonus inanitus* [Hymenoptera : Braconidae], and *T. larvarum* and *P. orbata* [Diptera : Tachinidae].

Data concerning the percentages of parasitism, by each of the mentioned species, in different treatments are recorded in Tables (46 – 45), summarized in Tables (46 &47) and graphically illustrated in Figs. (14 &15).

The recorded data can be explained as follows:

III- 1-1- *M. rufiventris* [Hymenoptera : Braconidae]

In all treatments, the percentages of parasitism by *M. rufiventris* were higher than those recorded for all other parasitoids found during this study (Tables, 36 – 45).

Two peaks of parasitism occurred from larvae collected from the control plants in each of the two cotton seasons, the first could be detected on June, 20 th 1998 (20.8%) and on June, 19 th 1999 (19.5%). The second peak occurred on August 15 th 1998 (21.4%) and on August, 14 th 1999 (20.8%). From *S. littoralis* larvae collected from plants that received plant extract and Xentari applications, the highest percentages of parasitism reached 21.4 and 21.1%, respectively on August, 15 th 1998, and 21.9 and 18.4%, respectively on August, 14 th 1999. While, after applications of chemical insecticides or the IGR, *M. rufiventris* disappeared until the last three weeks of the two cotton seasons when it appeared, but in much lower percentages of parasitism that reached the maximum of 3.6 and 3.1 % on September, 12 th 1998

Table (36): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from control treatment throughout 1998 cotton season.

Sampling date	No. of collected larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch.inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	0.0%	No.	%
June, 6 th	52	7	13.5	1	1.9	1	1.9	1	1.9	0	0.0	10	19.2
June, 13 th	61	10	16.4	2	3.3	2	3.3	3	4.9	0	0.0	17	27.9
June, 20 th	72	15	20.8	2	2.8	2	2.8	2	2.8	0	0.0	21	29.2
June, 27 th	59	12	20.3	1	1.7	1	1.7	1	1.7	0	0.0	15	25.4
July, 4 th	46	9	19.6	0	0.0	0	0.0	1	2.2	0	0.0	10	21.7
July,11 th	51	8	15.7	0	0.0	0	0.0	0	0.0	0	0.0	8	15.7
July, 18 th	66	7	10.6	0	0.0	0	0.0	0	0.0	1	1.5	8	12.1
July, 25th	82	11	13.4	1	1.2	0	0.0	1	1.2	2	2.4	15	18.3
Aug., 1st	70	12	17.1	2	2.9	0	0.0	4	5.7	2	2.9	20	28.6
Aug., 8 th	58	10	17.2	1	1.7	0	0.0	2	3.4	3	5.2	16	27.6
Aug., 15 th	42	9	21.4	1	2.4	0	0.0	1	2.4	4	9.5	15	33.3
Aug., 22 nd	24	5	20.8	1	4.2	0	0.0	1	4.2	2	8.3	9	37.5
Aug., 29 th	36	7	19.4	1	2.8	1	2.8	1	2.8	2	5.6	12	33.3
Sep., 5 th	49	9	18.3	1	2.0	1	2.0	3	6.1	3	6.1	17	34.7
Sep., 12 th	62	10	16.1	2	3.2	3	4.8	2	3.2	6	9.7	23	37.1
Sep., 19 th	74	11	14.9	2	2.7	3	4.1	2	2.7	6	8.1	24	32.4
Sep., 26 th	86	8	9.3	0	0.0	1	1.2	2	2.3	5	5.8	16	18.6
Overall	990	160		18		15		27		36		256	

Table (37): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from control treatment throughout 1999 cotton season.

Sampling date	No. of collected larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch. inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 5 th	58	9	15.5	1	1.7	1	1.7	1	1.7	0	0.0	12	20.7
June, 12 th	75	13	17.3	2	2.7	2	2.7	3	4.0	0	0.0	20	26.7
June, 19 th	82	16	19.5	3	3.7	2	2.4	3	3.7	0	0.0	24	29.3
June, 26 th	60	11	18.3	2	3.3	1	1.7	2	3.3	0	0.0	16	26.7
July, 3 rd	67	12	17.9	1	1.5	0	0.0	2	3.0	0	0.0	15	22.4
July,10 th	85	14	16.5	0	0.0	0	0.0	0	0.0	0	0.0	14	16.5
July, 17 th	140	20	14.3	0	0.0	0	0.0	0	0.0	3	2.1	23	16.4
July, 24th	160	19	11.9	0	0.0	0	0.0	3	1.9	4	2.5	26	16.3
July, 31st	103	13	12.6	2	1.9	0	0.0	6	5.8	4	3.9	25	24.4
Aug., 7 th	65	9	13.8	2	3.1	0	0.0	2	3.1	3	4.6	16	24.6
Aug., 14 th	24	5	20.8	1	4.2	0	0.0	1	4.2	2	8.3	9	37.5
Aug., 21st	18	3	16.7	1	5.6	0	0.0	1	5.6	1	5.6	6	33.3
Aug., 28th	32	5	15.6	1	0.3	1	3.1	1	3.1	1	3.1	9	28.1
Sep., 4th	48	7	14.9	1	2.1	2	4.2	2	4.2	2	4.2	14	29.2
Sep., 11th	66	9	13.6	3	4.5	4	6.1	2	3.0	6	9.1	24	36.4
Sep., 18th	72	9	12.5	2	2.8	4	5.6	2	2.8	6	8.3	23	31.9
Sep., 25th	88	9	10.2	1	1.1	3	3.4	2	2.3	3	3.4	18	20.5
Overall	1183	183		23		20		33		35		294	

Table (38): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from chemical insecticides treatment throughout 1998 cotton season.

Sampling date	No. of collected larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch. inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 6 th	52	7	13.5	1	1.9	1	1.9	1	1.9	0	0.0	10	19.2
June, 13 th	61	10	16.4	2	3.3	2	3.3	3	4.9	0	0.0	17	27.9
June, 20 th	72	15	20.8	2	2.8	2	2.8	2	2.8	0	0.0	21	29.2
June, 27 th	59	10	16.9	1	1.7	1	1.7	1	1.7	0	0.0	13	22.0
July, 4 th	46	6	13.0	0	0.0	0	0.0	1	2.2	0	0.0	7	15.2
July,11 th	51	5	9.8	0	0.0	0	0.0	0	0.0	0	0.0	5	9.8
July, 18 th	20	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
July, 25th	21	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 1 st	28	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 8 th	31	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 15 th	47	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 22 nd	56	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 29th	18	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sep., 5 th	27	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sep., 12th	28	1	3.6	1	3.6	1	3.6	1	3.6	3	1.1	7	25.0
Sep., 19 th	35	1	2.9	0	0.0	1	2.9	1	2.9	2	5.7	5	14.3
Sep., 26 th	58	1	1.7	1	1.7	1	1.7	1	1.7	2	3.4	6	10.3
Overall	710	56		8		9		11		7		91	

Table (39): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from chemical insecticides treatment throughout 1999 cotton season.

Sampling date	No. of collected Larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch. inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 5 th	58	9	15.5	1	1.7	1	1.7	1	1.7	0	0.0	12	20.7
June, 12 th	75	13	17.3	2	2.7	2	2.7	3	4.0	0	0.0	20	26.7
June, 19 th	82	16	19.5	3	3.7	2	2.4	3	3.7	0	0.0	24	29.3
June, 26 th	60	10	16.7	2	3.3	1	1.7	2	3.3	0	0.0	15	25.0
July, 3 rd	67	8	11.9	1	1.5	0	0.0	2	3.0	0	0.0	11	16.4
July,10 th	85	7	8.2	0	0.0	0	0.0	0	0.0	0	0.0	7	8.2
July, 17 th	0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
July, 24th	32	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
July, 31st	0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 7 th	14	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 14 th	26	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 21st	21	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 28th	18	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sep., 4th	32	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sep., 11th	64	2	3.1	1	1.6	1	1.6	1	1.6	3	4.7	8	12.5
Sep., 18th	89	2	2.2	0	0.0	1	1.1	1	1.1	3	3.4	7	7.9
Sep., 25th	96	1	1.0	0	0.0	1	1.0	1	1.0	2	2.1	5	5.2
Overall	819	68		10		9		14		8		109	

Table (40): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from plant extract (*C. inerme*) treatment throughout 1998 cotton season.

Sampling date	No. of collected larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch. inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 6 th	52	7	13.5	1	1.9	1	1.9	1	1.9	0	0.0	10	19.2
June, 13 th	61	10	16.4	2	3.3	2	3.3	3	4.9	0	0.0	17	27.9
June, 20 th	72	15	20.8	2	2.8	2	2.8	2	2.8	0	0.0	21	29.2
June, 27 th	59	12	20.3	1	1.7	1	1.7	1	1.7	0	0.0	15	25.4
July, 4 th	46	9	19.6	0	0.0	0	0.0	1	2.2	0	0.0	10	21.7
July,11 th	51	8	15.7	0	0.0	0	0.0	0	0.0	0	0.0	8	15.7
July, 18 th	60	8	13.3	0	0.0	0	0.0	0	0.0	1	1.7	9	15.0
July, 25 th	73	8	11.0	0	0.0	0	0.0	1	1.4	2	2.7	11	15.1
Aug., 1 st	66	10	15.2	1	1.5	0	0.0	3	4.5	3	4.5	17	25.8
Aug., 8 th	57	10	17.5	2	3.5	0	0.0	2	3.5	2	3.5	16	28.1
Aug., 15 th	42	9	21.4	1	2.4	0	0.0	1	2.4	4	9.5	15	35.7
Aug., 22 nd	30	6	20.0	1	3.3	0	0.0	1	3.3	2	6.7	10	33.3
Aug., 29 th	33	6	18.2	0	0.0	1	3.0	1	3.0	2	6.1	10	30.3
Sep., 5 th	49	8	16.3	1	2.0	1	2.0	2	4.1	4	8.2	16	32.7
Sep., 12 th	56	8	14.3	2	3.6	2	3.6	2	3.6	5	8.9	19	33.9
Sep., 19 th	67	7	10.4	2	3.0	2	3.0	2	3.0	3	4.5	16	23.9
Sep., 26 th	78	6	7.7	1	1.3	1	1.3	2	2.6	2	2.6	12	15.4
Overall	952	147		17		13		25		30		232	

Table (41): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from plant extract (*C. inerme*) treatment throughout 1999 cotton season.

Sampling date	No. of collected larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch. inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 5 th	58	9	15.5	1	1.7	1	1.7	1	1.7	0	0.0	12	20.7
June, 12 th	75	13	17.3	2	2.7	2	2.7	3	4.0	0	0.0	20	26.7
June, 19 th	82	16	19.5	3	3.7	2	2.4	3	3.7	0	0.0	24	29.3
June, 26 th	60	11	18.3	2	3.3	1	1.7	2	3.3	0	0.0	16	26.7
July, 3 rd	67	12	17.9	1	1.5	0	0.0	2	3.0	0	0.0	15	22.4
July,10 th	85	14	16.5	0	0.0	0	0.0	0	0.0	0	0.0	14	16.5
July, 17 th	100	13	13.0	0	0.0	0	0.0	0	0.0	2	2.0	15	15.0
July, 24th	110	15	13.6	0	0.0	0	0.0	2	1.8	3	2.7	20	18.2
July, 31st	86	12	14.0	2	2.3	0	0.0	4	4.7	4	4.7	22	25.6
Aug., 7 th	56	9	16.1	1	1.8	0	0.0	2	3.6	3	5.4	15	26.7
Aug., 14 th	32	7	21.9	2	6.3	0	0.0	1	3.1	3	9.4	13	40.6
Aug., 21 st	14	3	21.4	0	0.0	0	0.0	0	0.0	1	7.1	4	28.6
Aug., 28th	30	6	20.0	1	3.3	1	3.3	1	3.3	2	6.7	11	36.7
Sep., 4th	51	9	17.6	1	2.0	2	3.9	2	3.9	3	5.9	17	33.3
Sep., 11th	66	9	13.6	2	3.0	3	4.5	2	3.0	5	7.6	21	31.8
Sep., 18th	74	7	9.5	2	2.7	3	4.1	2	2.7	2	2.7	16	21.6
Sep., 25th	86	6	7.0	1	1.2	2	2.3	1	1.2	2	2.3	12	14.0
Overall	1132	171		21		17		28		30		267	

Table (42): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from bionsecticide(Xentari) treatment throughout 1998 cotton season.

Sampling date	No. of collected larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch. inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 6 th	52	7	13.5	1	1.9	1	1.9	1	1.9	0	0.0	10	19.2
June, 13 th	61	10	16.4	2	3.3	2	3.3	3	4.9	0	0.0	17	27.9
June, 20 th	72	15	20.8	2	2.8	2	2.8	2	2.8	0	0.0	21	29.2
June, 27 th	59	12	20.3	1	1.7	1	1.7	1	1.7	0	0.0	15	25.4
July, 4 th	46	9	19.6	0	0.0	0	0.0	1	2.2	0	0.0	10	21.7
July,11 th	51	8	15.7	0	0.0	0	0.0	0	0.0	0	0.0	8	15.7
July, 18 th	58	5	8.6	0	0.0	0	0.0	0	0.0	1	1.7	6	10.3
July, 25th	74	8	10.8	0	0.0	0	0.0	1	1.4	3	4.1	12	16.2
Aug., 1 st	63	8	12.7	1	1.6	0	0.0	3	4.8	3	4.8	15	23.8
Aug., 8 th	51	8	15.7	1	2.0	0	0.0	1	2.0	4	7.8	14	27.5
Aug., 15 th	38	8	21.1	1	2.6	0	0.0	1	2.6	4	10.5	14	36.8
Aug., 22nd	24	5	20.8	1	4.2	0	0.0	1	4.2	2	8.3	9	37.5
Aug., 29th	29	5	17.2	0	0.0	1	3.4	1	3.4	2	6.9	9	31.0
Sep., 5 th	40	6	15.0	1	2.5	1	2.5	2	5.0	3	7.5	13	32.5
Sep., 12th	48	6	12.5	2	4.2	2	4.2	2	4.2	4	8.3	16	33.3
Sep., 19th	56	5	8.9	1	1.8	1	1.8	2	3.6	2	3.4	11	19.6
Sep., 26th	67	5	7.5	1	1.5	1	1.5	1	1.5	1	1.5	9	13.4
Overall	889	130		15		12		23		29		209	

Table (43): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from bioinsecticide (Xentari) treatment throughout 1999 cotton season.

Sampling date	No. of collected larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch. inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 5 th	58	9	15.5	1	1.7	1	1.7	1	1.7	0	0.0	12	20.7
June, 12 th	75	13	17.3	2	2.7	2	2.7	3	4.0	0	0.0	20	26.7
June, 19 th	82	16	19.5	3	3.7	2	2.4	3	3.7	0	0.0	24	29.3
June, 26 th	60	11	18.3	2	3.3	1	1.7	2	3.3	0	0.0	16	26.7
July, 3 rd	67	12	17.9	1	1.5	0	0.0	2	3.0	0	0.0	15	22.4
July,10 th	85	14	16.5	0	0.0	0	0.0	0	0.0	0	0.0	14	16.5
July, 17 th	91	11	12.1	0	0.0	0	0.0	0	0.0	1	1.1	12	13.2
July, 24th	99	12	12.1	0	0.0	0	0.0	2	2.0	3	3.0	17	17.2
July, 31st	80	12	15.0	2	2.5	0	0.0	4	5.0	6	7.5	24	30.0
Aug., 7 th	54	7	13.0	1	1.9	0	0.0	2	3.7	5	9.3	15	27.8
Aug., 14 th	38	7	18.4	1	2.6	0	0.0	1	2.6	4	10.5	13	34.2
Aug., 21st	18	3	16.7	1	5.6	0	0.0	0	0.0	1	5.6	5	27.8
Aug., 28th	26	4	15.4	1	3.8	1	3.8	1	3.8	1	3.8	8	30.8
Sep., 4th	50	6	12.0	1	2.0	2	4.0	2	4.0	3	6.0	14	28.0
Sep., 11th	71	8	11.3	1	1.4	4	5.6	2	2.8	5	7.0	20	28.2
Sep., 18th	80	8	10.0	2	2.5	2	2.5	2	2.5	2	2.5	16	20.0
Sep., 25th	92	8	8.7	1	1.1	1	1.1	1	1.1	2	2.2	13	14.1
Overall	1126	161		20		16		28		33		258	

Table (44): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from insect growth regulator (Mimic) treatment throughout 1998 cotton season.

Sampling date	No. of collected larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch. Inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 6 th	52	7	13.5	1	1.9	1	1.9	1	1.9	0	0.0	10	19.2
June, 13 th	61	10	16.4	2	3.3	2	3.3	3	4.9	0	0.0	17	27.9
June, 20 th	72	15	20.8	2	2.8	2	2.8	2	2.8	0	0.0	21	29.2
June, 27 th	59	12	20.3	1	1.7	1	1.7	1	1.7	0	0.0	15	25.4
July, 4 th	46	9	19.6	0	0.0	0	0.0	1	2.2	0	0.0	10	21.7
July,11 th	51	8	15.7	0	0.0	0	0.0	0	0.0	0	0.0	8	15.7
July, 18 th	23	1	4.3	0	0.0	0	0.0	0	0.0	0	0.0	1	4.3
July, 25th	26	1	3.8	0	0.0	0	0.0	0	0.0	0	0.0	1	3.8
Aug., 1 st	35	0	0.0	0	0.0	0	0.0	0	00	0	0.0	0	0.0
Aug., 8 th	57	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 15 th	67	0	0.0	1	1.5	0	0.0	0	0.0	0	0.0	1	1.5
Aug., 22nd	20	0	0.0	1	5.0	0	0.0	0	0.0	0	0.0	1	5.0
Aug., 29th	30	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sep., 5 th	20	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sep., 12th	38	1	2.6	0	0.0	1	2.6	2	5.3	4	10.5	8	21.1
Sep., 19th	48	1	2.1	1	2.1	1	2.1	2	4.2	3	6.3	8	16.7
Sep., 26th	60	1	1.7	0	0.0	1	1.7	2	3.3	2	3.3	6	10.0
Overall	765	66		9		9		14		9		107	

Table (45): Numbers and percentages of parasitoids emerged from *S.littoralis* larvae collected from insect growth regulator (Mimic) treatment throughout 1999 cotton season.

Sampling date	No. of collected larvae.	Larvae produced parasitoids										Total	
		M.rufiventris		*Zele spp.*		*T.larvarum*		*P. orbata*		*Ch. inanitus*			
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 5 th	58	9	15.5	1	1.7	1	1.7	1	1.7	0	0.0	12	20.7
June, 12 th	75	13	17.3	2	2.7	2	2.7	3	4.0	0	0.0	20	26.7
June, 19 th	82	16	19.5	3	3.7	2	2.4	3	3.7	0	0.0	24	29.3
June, 26 th	60	11	18.3	2	3.3	1	1.7	2	3.3	0	0.0	16	26.7
July, 3 rd	67	12	17.9	1	1.5	0	0.0	2	3.0	0	0.0	15	22.4
July,10 th	85	13	15.3	0	0.0	0	0.0	0	0.0	0	0.0	13	15.3
July, 17 th	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
July, 24 th	26	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
July, 31 st	24	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 7 th	8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 14 th	21	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 21 st	21	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Aug., 28 th	22	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sep., 4 th	26	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sep., 11 th	54	1	1.9	1	1.9	2	3.7	2	3.7	4	7.4	10	18.5
Sep., 18 th	72	1	1.4	0	0.0	1	1.4	1	1.4	3	4.2	6	8.3
Sep., 25 th	81	1	1.2	0	0.0	1	1.2	1	1.2	2	2.5	5	6.2
Overall	782	77		10		10		15		9		121	

and September, 11 th 1999 in case of chemical insecticides and 2.6 % on September, 12 th 1998, and 1.9% on Sept., 11 th 1999 in case of applying the IGR (Mimic).

As shown in Tables (36- 45), in 1998 cotton season, the highest average rate of parasitism by *M. rufiventris* was 16.2% in larvae from the control treatment. This percentage was 15.5% in the subsequent season. Those percentages were followed by 15.4, 14.6, 18.6 and 7.9 % in 1998 and 15.1, 14.3, 7.8 and 8.3 % in 1999 in cases of using the plant extract, bioinsecticide, IGR and finally the chemical insecticides which caused higher reductions in the percentages of parasitism.

The higher rate of parasitism by *M. rufiventris* on *S. littoralis* larvae than all other parasitoida, that recorded in this investigation, may be due to what **Hegazi (1976)** reported that the adults of the larval parasite, *M. rufiventris* Kok. (Hymenoptera, Braconidae) are generally nectar feeders, and, the extensive usage of insecticides on cotton fields, may create the cotton nectar to be toxic to these adults. Consequently, these adults are exposed successively to certain doses of insecticides, and that may develop resistance in this parasite. This may be also due to the short life cycle of this parasite, compared with the life cycle of its host, *S. littoralis*, where *M. rufiventris* has two generations / one generation of its host **(Hegazi, 1972).**

Shalaby (1968) mentioned that the percentages of parasitism in the fields of the high Agricultural Institute of Edfina, varied according to temperature and the use of insecticides. This ratio reached 28 % during June and decreased due to the use of Diptrex (1.25 Kg. Per feddan) until it reached 0.5% during July and

the beginning of August. In the beginning of October, the percentage of parasitism reached 22.6% and decreased gradually with the drop temperature until it was nit during December.

III–1–2–*Zele spp.* [chlorphthalma (Ness) and *nigricornis* (Walk)] (Hymenoptera: Braconidae):

The percentages of parasitism by *Zele spp.* on *S. littoralis* larvae were low, during this study, in all treatments. The average rates of parasitism ranged from 0.0 to 4.2 % in 1998 and from 0.0 to 5.6 % in 1999 in control treatment (Tables, 36 & 37).

Three peaks of parasitism observed from larvae collected from the control treatment in each of the two cotton seasons, the first detected on June, 20 th 1998 (2.8 %) and on June, 19 th 1999 (3.7%). The second occurred on August, 22 nd (4.2 %) and on September, 12 th (3.2%) for 1998 season, while it was 5.6 % on August, 21 st and 4.5 % on September, 11 th 1999.

Concerning the data recorded from chemical insecticides and insect growth regulator treatment (Tables, 38 & 39 and 44 & 45), it is clear that no *Zele spp.* were found parasitizing *S. littoralis* larvae after the insecticidal applications throughout the two cotton seasons.

As for the whole percentages of parasitism by these two species, data in (Tables, 46 & 47) and graphically illustrated in Fig .(14) indicated that the highest average rate of parasitism by *Zele spp.* was 1.8 % in both 1998 and 1999 seasons in control treatment, followed by 1.8, 1.7, 1.2 and 1.1 % in 1998 and 1.9, 1.8, 1.3 and 1.2 % in 1999 in plant extract, bioinsecticide, IGR and chemical insecticides, respectively.

Table (46): Records of total numbers and percentages of parasitized *S. littoralis* larvae collected from different treatments throughout 1998 cotton seasons.

	Treatments									
	Control		Chemical insecticides		Plant extract (*C. inerme*)		Bioinsecticide (Xentari)		IGR (Mimic)	
No. of collected larvae	990		710		952		889		765	
Emerged parasitoids	No.	%	No.	%	No.	%	No.	%	No.	%
M. rufiventris	160	16.2	56	7.9	147	15.4	130	14.6	66	8.6
Zele spp.	18	1.8	8	1.1	17	1.8	15	1.7	9	1.2
Ch. Inanitus	36	3.6	7	1.0	30	3.2	29	3.3	9	1.2
T. larvarum	15	1.5	9	1.3	13	1.4	12	1.3	10	1.3
P. orbata	27	2.7	11	1.5	25	2.6	23	2.6	14	1.8
Total	256	25.8	91	12.8	232	24.4	209	23.5	108	14.1
Mean	51.2	**5.16 A**	18.2	**2.56 C**	46.4	**4.88 AB**	83.6	**4.70 AB**	21.6	**2.82 BC**
L.S.D.	2.133									

Table (47): Records of total numbers and percentages of parasitized *S. littoralis* larvae collected from different treatments throughout 1999 cotton seasons.

	Treatments									
	Control		Chemical insecticides		Plant extract (*C. inerme*)		Bioinsecticide (Xentari)		IGR (Mimic)	
No. of collected larvae	1183		819		1132		1126		782	
Emerged parasitoids	No.	%	No.	%	No.	%	No.	%	No.	%
M. rufiventris	183	15.5	68	8.3	171	15.1	161	14.3	77	9.8
Zele spp.	23	1.9	10	1.2	21	1.9	20	1.8	10	1.3
Ch. Inanitus	35	3.0	8	1.0	30	2.7	33	2.9	11	1.4
T. larvarum	20	1.7	9	1.1	17	1.5	16	1.4	10	1.3
P. orbata	33	29	14	1.7	28	2.5	28	2.5	15	1.9
Total	294	24.9	109	13.3	267	23.6	258	22.9	123	15.7
Mean	58.8	5.00 A	21.8	2.66 C	53.4	**4.74 AB**	51.6	**4.58 AB**	24.6	**3.14 BC**
L.S.D.					1.738					

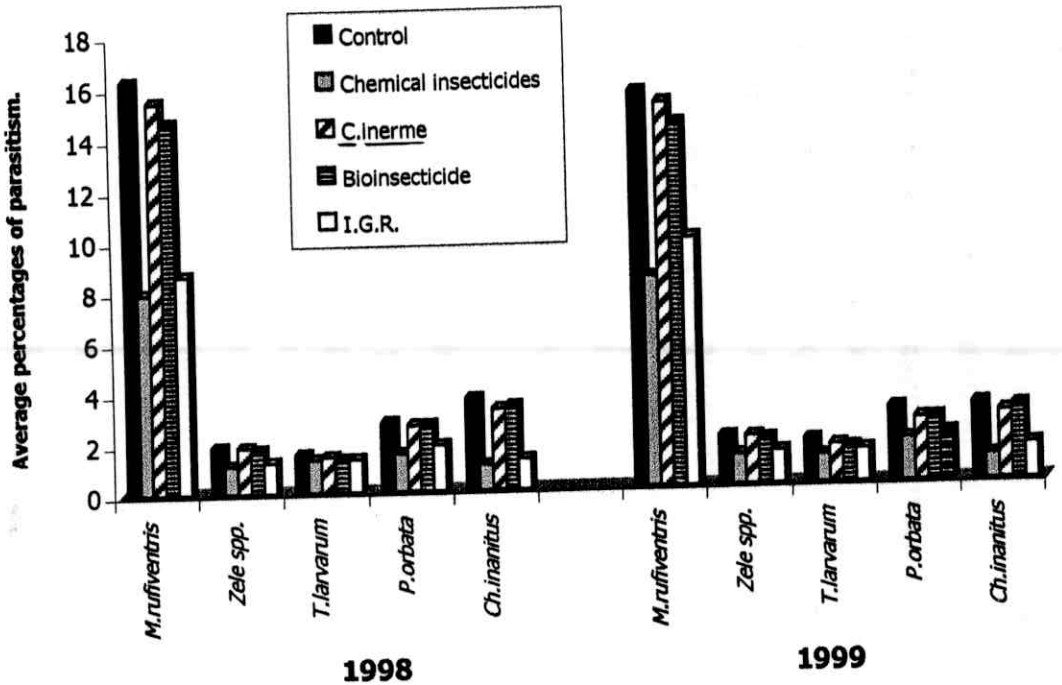

Fig. (14): Average percentages of parasitoids emerged from *S. littoralis* larvae in different treatments during the whole period throughout 1998 and 1999 cotton seasons.

These results agree with **Hagazi *et al.* (1977 b)** who found the rates of parasitism of *Zele spp.* were very low. **Kolaib (1978)** recorded *Z. chlorophthalma* larvae, during August, September and October, but generally, at low rates of parasitism.

III –1- 3- *Tachina larvarum* L. [Diptera : Tachinidae]:

The larvae of *S. littoralis* were found to be parasitized by *T. larvarum,* in different treatments, during two periods, the first period extended from June, 6 th to June, 27 th 1998 and from June, 5 th to June, 26 th 1999 with a peak 3.3 % in the second week of June in all treatments. The 2 nd period extended from August, 29 th to September, 26 th 1998 and from August, 28 th to September, 25 th 1999 with a peak (4.8, 3.6 and 4.2 %) on September, 12 th 1998, while in the subsequent year it was (6.1, 4.5 and 5.6%) on September, 11 th in control, plant extract and bioinsecticide treatments, respectively.

From data tabulated in Tables (38 & 39 and 44 & 45) showed that no *T. larvarum* were found parasitizing *S. littoralis* larvae after the insecticidal applications throughout the two cotton seasons. The highest average rate of parasitism by *T. larvarum* was (3.6 & 2.6 % occurred on September, 12 th 1998, while it was (1.6 & 3.7%) on September, 11 th 1999 cotton season in chemical insecticides and IGR treatments, respectively.

Data represented in [Tables, 46 & 47] and illustrated in Fig . (14) led to conclusion that the highest whole average rate of parasitism by *T. larvarum* was (1.5 & 1.7 %) in control treatment in 1998 and 1999 cotton seasons, respectively, followed by (1.4, 1.3, 1.2 and 1.3 %) in 1998 and (1.5, 1.4, 1.3 and 1.1 %) in

1999 cotton season in plant extract, bioinsecticide, IGR and chemical insecticides treatments, respectively.

These findings agree with **Kamal (1951 b)** who mentioned that parasitism during September to November reache50 – 60 % among the falbrood of cotton leafworm which attacks maize and clover. **Hafez (1953)** mentioned the high percentage of parasitism by *T. larvarum* in *S. littoralis* larvae in the field occurred during September and October, which was 6.2 – 7.1 %.

III – 1- 4- *Periboea orbata* Wield [Diptera : Tachinidae]:

The recorded percentages of parasitism of *P. orbata* in all treatments (Tables, 46-45) were higher than those estimated for the other tachinid, *T. larvarum.* In control treatment, *S. littoralis* larvae were parasitized by *P. orbata* during two active periods, the first period extended from June, 6 th to July, 4 th 1998 with a peak 4.9 % on June, 13 th and from June, 5 th to July, 3 rd 1999 with a peak 4.0 % on June, 12 th, the second period extended from July, 25 th to September, 26 th 1998 with two peaks; the first was 5.7 % on August, 1 st, and the second was 6.1 % on September, 5 th, respectively. In the followed year, the second period extended from July, 24 th to September, 25 th with two peaks; the first peak was 5.8 % on July, 31 st, and the second was 4.2 % on September, 4 th. After treatments with plant extract and bioinsecticide, the second period extended from July, 25 th to September, 26 th 1998 with two peaks; the first peak was (4.5 and 4.8 %) on August, 1 st and the second was (4.1 and 5.0 %) on September, 5 th, respectively, the second period, in the subsequent year, extended from July, 24 th to September, 25 th with two peaks; the first peak was (4.7 and 5.0 %) on July, 31 st and the second was (3.9 and 4.0 %) on September, 4

th, respectively. After spraying with both chemical insecticides and IGR, no *P. orbata* found except the last three weeks of September in the two seasons of study.

Data obtained from (Tables, 46 & 47 and Fig.. 14) indicate that the highest rate was (2.7 & 2.9%) in control treatment of 1998 and 1999 seasons, respectively, followed by (2.6, 2.6, 1.8 and 1.5 % in 1998 and 2.5, 2.5, 1.9 and 1.7 % in 1999) in plant extract, bioinsecticide, insect growth regulator and chemical insecticides.

These results agree with **Kamal (1951 b)** who found that the average percentage of parasitism by *P. orbata (S. aegyptia)* was 3.2 %. **Hegazi *et al.* (1973)** mentioned that the percentage of parasitism by *P. orbata* was generally low during the two years of study, where the maximum percentage of parasitism during 1971 was 3.3 on August, 2 nd, while during 1972 it was 1.8 on September, 2 nd, also added that the parasite was active only during August and the beginning of September in both two years of study (1971 and 1972) from field in the experimental farm of Alexandria University.

III – 1 – 5- *Chelonus inanitus* [Hymenoptera : Braconidae]:

The egg - larval parasits, *Ch. inanitus* is a solitary parasitoid on *S. littoralis* **(Gerling, 1971).** In control treatment, the active period extended from July, 18 th 1998 and July, 17 th 1999 to the end of two successive seasons with two peaks; the first was 9.5 % on August, 15 th 1998 and 8.3 % on August, 14 th 1999, while the second peak was 9.7 % on September, 12 th 1998 and 9.1 % on September, 11 th 1999. In plant extract and bioinsecticide treatments the same active period with two peaks, the first peak

(9.5 % 10.5%) on August, 15 th 1998 and (9.4 & 10.5 %) on August, 14 th 1999, respectively, while the second (8.9 & 8.3 %) on September, 12 th 1998 and (7.6 & 7.0 %) on September, 11 th 1999, respectively. In both chemical insecticides and insect growth regulator treatments, the weekly samples of collected larvae were found free of parasitism by *Ch. inanitus* until the last three weeks of both two seasons.

Data presented in (Tables, 46 & 47) and graphically illustrated in Fig . (14) indicate that the highest rate of parasitism in 1998 was 3.6 % in control, followed by 3.3 % in bioinsecticide, 3.2 % in plant extract, 1.2 % in insect growth regulator and 1.0 % in chemical insecticides. While, in 1999 season, it was (3.0, 2.9, 2.7, 1.4 and 1.0 %) in control, plant extract, bioinsecticide, insect growth regulator and chemical insecticides respectively.

These findings agree with **Gerling (1971)** who mentioned that parasite, *Ch. inanitus* attacked the egg – masses of cotton leafworm, *S.littoralis* and many Lepidopterous eggs in cotton and clover fields in Israel.

It is evident, from (Tables, 46 &47) in the two seasons of study, that the untreated cotton harboured the highest rate of parasitism by *M. rufiventris, Ch. Inanitus, P. orbata, Zele spp.* and *T. larvarum* was insignificantly, higher than those recorded on *S. littoralis* larvae which collected from plant extract and bioinsecticide applications. But, the rate of parasitism recorded for these treatments was significantly, higher than those recorded on *S. littoralis* larvae collected from chemical insecticides. On other hand, the percentages of parasitism in plant extract treatment were,

insignificantly, higher than those recorded on *S. littoralis* larvae, which collected from bioinsecticide and insect growth regulator treatments. Also, it was in insect growth regulator treatment insignificantly, higher than those recorded in chemical insecticides treatment.

III – 2 – Parasitoids emerged from infested cotton bolls:

Sixty infested cotton bolls were weekly collected from the plots of each treatment, from July, 15 th unit September, 23 rd 1998 cotton season and from July, 14 th until September 22 nd 1999 cotton season. The infested cotton bolls were dissected in the laboratory. Both *P. gossypiella* and *E. insulana* larvae were counted and individually reared on fresh uninfested bolls in glass vials until emergence of parasitoids. Two parasitoids were found, those included *Apanteles sp.* [Hymenoptera: Braconidae] which emerged from *P. gossypiella* larvae, which the other parasitoid *Periboea orbata* [Diptera: Tachinidae] emerged from *E. insulana* larvae.

Data concerning the percentages of parasitism, in different treatments, with each species, are recorded in Tables (48 – 52) and graphically illustrated in Fig. (15). The recorded data can be explained as follows:

III – 2 – 1 – *Apanteles* sp. [Hymenoptera: Braconidae]:

This parasitoid developed as a gregarious endoparasite on *E. insulana* larvae. A total number of (12 – 19) cocoons were counted from one host larvae. Tables (48 – 52), show the parasitism occurred during September only in both 1998 & 1999 cotton seasons.

Table (48): Percentages of parasitism occurred in *P. gossypiella* larvae parasitized by *Apanteles* sp. and *E. insulana* larvae parasitised by *P. orbata* from 60 infested cotton bolls from control treatment.

1998							1999						
Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism	Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles* sp.	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism
July, 15 th	35	0	0.0	0	0	0.0	July, 14 th	33	0	0.0	0	0	0.0
July, 22 nd	41	0	0.0	4	0	0.0	July, 21 st	39	0	0.0	3	0	0.0
July, 29 th	45	0	0.0	10	0	0.0	July, 28 th	44	0	0.0	8	0	0.0
Aug., 5 th	39	0	0.0	16	0	0.0	Aug., 4 th	41	0	0.0	13	0	0.0
Aug., 12 th	40	0	0.0	16	1	6.3	Aug., 11 th	40	0	0.0	15	1	6.7
Aug., 19 th	41	0	0.0	15	1	6.7	Aug., 18 th	42	0	0.0	14	1	7.1
Aug., 26 th	43	0	0.0	13	1	7.7	Aug., 25 th	43	0	0.0	13	2	15.4
Sep., 2 nd	43	5	11.6	11	2	18.2	Sep., 1 st	44	5	11.4	11	1	9.1
Sep., 9 th	52	6	11.5	4	1	25.0	Sep., 8 th	51	5	9.8	6	1	16.7
Sep., 16 th	57	4	7.0	0	0	0.0	Sep., 15 th	58	4	6.9	0	0	0.0
Sep., 23 rd	59	3	5.1	0	0	0.0	Sep., 22 nd	58	3	5.2	0	0	0.0
Overall	495	18		89	6		Overall	493	17		83	6	

Table (49): Percentages of parasitism occurred in *P. gossypiella* larvae parasitized by *Apanteles* sp. and *E. insulana* larvae parasitised by *P. orbata* from 60 infested cotton bolls from chemical insecticides treatment.

1998							1999						
Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism	Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles sp.*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism
July, 15 th	33	0	0.0	0	0	0.0	July, 14 th	31	0	0.0	0	0	0.0
July, 22 nd	26	0	0.0	0	0	0.0	July, 21 st	24	0	0.0	0	0	0.0
July, 29 th	46	0	0.0	0	0	0.0	July, 28 th	42	0	0.0	0	0	0.0
Aug., 5 th	40	0	0.0	8	0	0.0	Aug., 4 th	41	0	0.0	7	0	0.0
Aug., 12 th	41	0	0.0	8	0	0.0	Aug., 11 th	40	0	0.0	8	0	0.0
Aug., 19 th	40	0	0.0	9	0	0.0	Aug., 18 th	40	0	0.0	9	0	0.0
Aug., 26 th	41	0	0.0	5	0	0.0	Aug., 25 th	35	0	0.0	10	0	0.0
Sep., 2 nd	31	2	6.5	10	0	0.0	Sep., 1 st	34	2	5.9	9	0	0.0
Sep., 9 th	33	2	6.1	9	1	11.1	Sep., 8 th	34	2	5.4	7	1	14.3
Sep., 16 th	35	3	8.6	8	0	0.0	Sep., 15 th	42	3	7.1	3	0	0.0
Sep., 23 rd	44	1	2.3	0	0	0.0	Sep., 22 nd	46	1	2.2	0	0	0.0
Overall	410	8	2.0	57	1	1.8	Overall	412	8	1.9	53	1	1.9

Table (50): Percentages of parasitism occurred in *P. gossypiella* larvae parasitized by *Apanteles* sp. and *E. insulana* larvae parasitised by *P. orbata* from 60 infested cotton bolls from plant extract (*C. inerme*) treatment.

1998							1999						
Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism	Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles sp.*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism
July, 15 th	35	0	0.0	0	0	0.0	July, 14 th	33	0	0.0	0	0	0.0
July, 22 nd	40	0	0.0	4	0	0.0	July, 21 st	39	0	0.0	2	0	0.0
July, 29 th	38	0	0.0	12	0	0.0	July, 28 th	38	0	0.0	8	0	0.0
Aug., 5 th	32	0	0.0	18	0	0.0	Aug., 4 th	37	0	0.0	14	1	7.1
Aug., 12 th	31	0	0.0	18	1	5.6	Aug., 11 th	34	0	0.0	18	1	5.6
Aug., 19 th	32	0	0.0	18	2	11.1	Aug., 18 th	33	0	0.0	19	1	5.3
Aug., 26 th	34	0	0.0	16	1	6.3	Aug., 25 th	36	0	0.0	15	1	6.7
Sep., 2 nd	38	3	7.9	11	1	9.1	Sep., 1 st	45	4	8.9	10	1	10.0
Sep., 9 th	47	4	8.5	7	1	14.3	Sep., 8 th	50	5	10.0	6	1	16.7
Sep., 16 th	54	5	9.3	1	0	0.0	Sep., 15 th	56	3	5.4	2	0	0.0
Sep., 23 rd	58	3	5.2	0	0	0.0	Sep., 22 nd	59	3	5.1	0	0	0.0
Overall	439	15		105	6		Overall	460	15		94	6	

Table (51): Percentages of parasitism occurred in *P. gossypiella* larvae parasitized by *Apanteles sp.* and *E. insulana* larvae parasitised by *P. orbata* from 60 infested cotton bolls from bioinsecticide treatment .

1998							1999						
Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism	Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles sp.*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism
July, 15 th	34	0	0.0	0	0	0.0	July, 14 th	32	0	0.0	0	0	0.0
July, 22 nd	42	0	0.0	2	0	0.0	July, 21 st	41	0	0.0	0	0	0.0
July, 29 th	37	0	0.0	10	0	0.0	July, 28 th	35	0	0.0	9	0	0.0
Aug., 5 th	31	0	0.0	16	0	0.0	Aug., 4 th	35	0	0.0	14	0	0.0
Aug., 12 th	30	0	0.0	16	0	0.0	Aug., 11 th	36	0	0.0	15	1	6.7
Aug., 19 th	33	0	0.0	14	0	0.0	Aug., 18 th	38	0	0.0	15	1	6.7
Aug., 26 th	31	0	0.0	15	2	13.3	Aug., 25 th	41	0	0.0	12	2	16.7
Sep., 2 nd	37	0	0.0	9	2	22.2	Sep., 1 st	45	4	8.9	9	1	11.1
Sep., 9 th	46	4	8.7	6	1	16.7	Sep., 8 th	49	4	8.2	6	0	0.0
Sep., 16 th	54	5	9.3	0	0	0.0	Sep., 15 th	57	3	5.3	0	0	0.0
Sep., 23 rd	57	4	7.0	0	0	0.0	Sep., 22 nd	58	3	5.2	0	0	0.0
Overall	432	13		88	5		Overall	467	14		80	5	

Table (52): Percentages of parasitism occurred in *P. gossypiella* larvae parasitized by *Apanteles.* and *E. insulana* larvae parasitised by *P. orbata* from 60 infested cotton bolls from insect growth regulator treatment.

1998							1999						
Sampling date	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism	Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles sp.*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism
July, 15 th	33	0	0.0	0	0	0.0	July, 14 th	32	0	0.0	0	0	0.0
July, 22 nd	39	0	0.0	0	0	0.0	July, 21 st	34	0	0.0	0	0	0.0
July, 29 th	40	0	0.0	1	0	0.0	July, 28 th	40	0	0.0	0	0	0.0
Aug., 5 th	36	0	0.0	7	0	0.0	Aug., 4 th	41	0	0.0	2	0	0.0
Aug., 12 th	35	0	0.0	7	0	0.0	Aug., 11 th	38	0	0.0	8	0	0.0
Aug., 19 th	36	0	0.0	12	0	0.0	Aug., 18 th	42	0	0.0	4	0	0.0
Aug., 26 th	38	0	0.0	12	1	8.3	Aug., 25 th	37	0	0.0	11	0	0.0
Sep., 2 nd	38	1	.6	9	0	0.0	Sep., 1 st	41	2	4.9	8	1	12.5
Sep., 9 th	39	2	5.1	8	0	0.0	Sep., 8 th	43	3	7.0	6	0	0.0
Sep., 16 th	46	3	6.5	0	0	0.0	Sep., 15 th	50	3	6.0	0	0	0.0
Sep., 23 rd	47	3	6.4	0	0	0.0	Sep., 22 nd	52	2	3.8	0	0	0.0
Overall	427	9		56	1		Overall	450	10		39	1	

The obtained data seem to conclude that the highest average rate of parasitism by *Apanteles* sp. in both 1998 and 1999 cotton seasons in control treatment (3.6 & 3.4 %) followed by plant extract (3.4 & 3.3%), bioinsecticide (3.0 & 3.0%), insect growth regulator (2.1 & 2.2%) and chemical insecticides (2.0 & 1.9%), respectively.

These results agree with **Abbas and El – Deeb (1993)** who recorded that parasitoid, *Apanteles sp.* Parasitized on *P. gossypiella,* but in few rate of parasitism during September and October.

III – 2- 2- *Periboea orbata* [Diptera: Tachinidae]:

Data presented in (Tables, 48 – 52) and Fig. (15) show the parasitism by *P. orbata* occurred during August and September in the two seasons of study. After applications of either chemical insecticides or insect growth regulator, *P. orbata* disappeared until September during the two seasons of study.

From the previous Tables, the highest average rate of parasitism by *P. orbata* in 1998 and 1999 cotton seasons in control treatment (6.7 & 7.2 %) followed by (5.7 & 6.4%) plant extract, (5.7 & 6.3 %) bioinsecticide, (1.8 & 2.6%) insect growth regulator and (1.8 & 1.9 %) in chemical insecticides treatments, respectively.

Hegazi *et al.*(1997b) recorded that the percentage of parasitism by *P. orbata,* which appeared during August and September in cotton fields was low.

It could be, generally, observed from data in Table (53) that the untreated cotton plants harbored the highest percentage of parasitism in 1998 season which was insignificantly, higher than those recorded from both plant extract and bioinsecticide

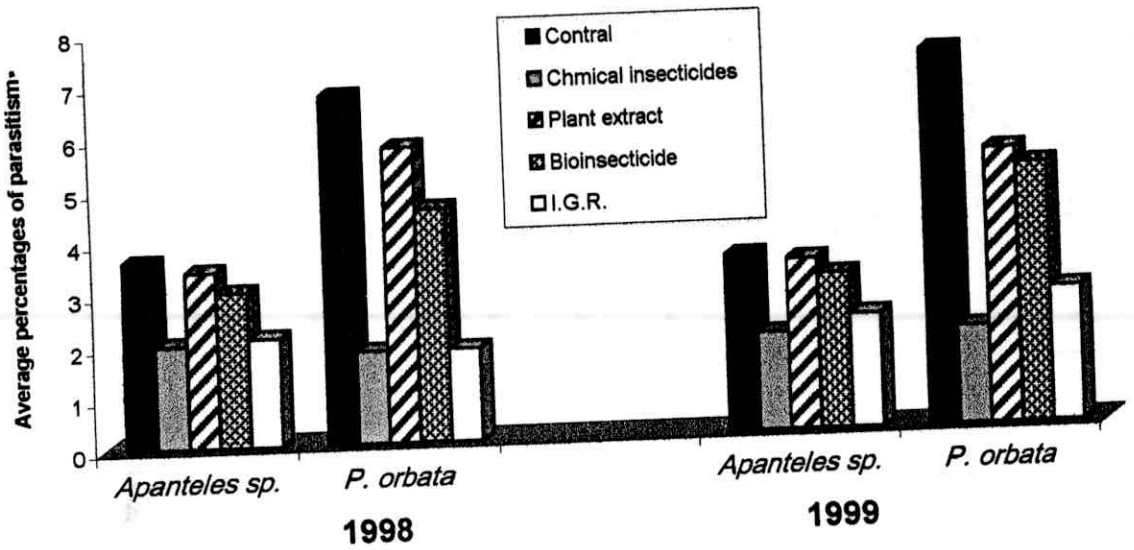

Fig (15) : Average percentages of parasitoids emerged from infested cotton bolls in different treatments during the whole period throughout 1998 and 1999 cotton seasons.

Table (53): Records of total numbers and percentages of parasitized bollworms (*P. gossypiella* and *E. insulana*) larvae emerged from infested bolls from different treatments throughout 1998 cotton season.

Sampling date	Control			Chemical insecticides			Plant extract			Bioinsecticide			IGR		
	Total No. of *P. +E.* larvae	Total No. of parasitized larvae	Total No. of % parasitism	Total No. of *P. +E.* larvae	Total No. of parasitized larvae	Total No. of % parasitism	Total No. of *P. +E.* larvae	Total No. of % parasitism	Total No. of % parasitism	Total No. of *P. +E.* larvae	Total No. of parasitized larvae	Total No. of % parasitism	Total No. of *P. +E.* larvae	Total No. of % parasitized larvae	Total No. of % parasitism
July, 15 th	35	0	0.0	33	0	0.0	35	0	0.0	34	0	0.0	33	0	0.0
July, 22 nd	45	0	0.0	26	0	0.0	44	0	0.0	44	0	0.0	39	0	0.0
July, 29 th	55	0	0.0	46	0	0.0	50	0	0.0	47	0	0.0	41	0	0.0
Aug., 5 th	55	0	0.0	48	0	0.0	50	0	0.0	47	0	0.0	43	0	0.0
Aug., 12 th	56	1	1.8	49	0	0.0	49	1	2.0	46	0	0.0	42	0	0.0
Aug., 19 th	56	1	1.8	49	0	0.0	50	2	4.0	47	0	0.0	48	0	0.0
Aug., 26 th	56	1	1.8	46	0	0.0	50	1	2.0	46	2	4.3	50	1	2.0
Sep., 2 nd	54	7	13.0	41	2	4.9	49	4	8.2	46	2	4.3	47	1	2.1
Sep.,9 th	56	7	12.5	42	3	7.1	54	5	9.3	52	5	9.6	47	2	4.3
Sep., 16 th	57	4	7.0	43	3	7.0	55	5	9.1	54	5	9.3	46	3	6.5
Sep., 23 rd	59	3	5.1	44	1	2.3	58	3	5.2	57	4	7.0	47	3	6.4
Overall	584	24		467	9		544	21		520	18		483	10	
L.S.D. at 0.05									1.478						

treatments. Also, in bioinsecticide treatment, the percentage of parasitism was insignificantly, higher than those recorded from both IGR and chemical insecticides. But, in both control and plant, these percentages were significantly higher than those recorded in both IGR and chemical insecticides treatment. In 1999 cotton season, data in Table (54) showed that the control treatment harbored the highest percentage of parasitism which was insignificantly , higher than both plant extract and bioinsecticide. But these percentages recorded for these treatments were, significantly, higher than those recorded with both IGR and chemical insecticides treatment.

IV – Rate of damage caused by the cotton leafworm larvae:

Rate of damage caused by the cotton leafworm, *S. littoralis* larvae to cotton leaves was estimated weekly, in each treatment, according to the method of **Kasopers (1965).** The aim of these estimations was to determine the relationship between the applications of plant extract, bioinsecticide insect growth regulator, chemical insecticides and the actual rate of damage caused to cotton leaves by infesting cotton leafworm larvae.

Data presented in Tables (55 & 56) and Figs. (16 – 25) show the rate of damage caused by *S. littoralis* infestation to cotton leaves, in different treatments. These data indicate that insignificant differences between bioinsecticde and plant extract, also between insect growth regulator and chemical insecticides, but there was a significant difference between the first group (bioinsecticide and plant extract) and the second group (insect growth regulator and chemical insecticides). On the other hand, the most damaged leaves were (18.75 & 20.09%) in control treatment, while the lowest

Table (54): Records of total numbers and percentages of parasitized bollworms (*P. gossypiella* and *E. insulana)* larvae emerged from infested bolls from different treatments throughout 1999 cotton season.

	Control			Chemical insecticides			Plant extract			Bioinsecticide			IGR		
Sampling date	Total No. of *P. +E.* larvae	Total No. of parasitized larvae	Total No. of % parasitism	Total No. of *P. +E.* larvae	Total No. of parasitized larvae	Total No. of % parasitism	Total No. of *P. +E.* larvae	Total No. of parasitized larvae	Total No. of % parasitism	Total No. of *P. +E.* larvae	Total No. of parasitized larvae	Total No. of % parasitism	Total No. of *P. +E.* larvae	Total No. of parasitized larvae	Total No. of %parasitism
July, 14th	33	0	0.0	31	0	0.0	33	0	0.0	32	0	0.0	32	0	0.0
July, 21st	42	0	0.0	24	0	0.0	41	0	0.0	41	0	0.0	34	0	0.0
July, 28th	52	0	0.0	42	0	0.0	46	0	0.0	44	0	0.0	40	0	0.0
Aug., 4th	54	0	0.0	48	0	0.0	51	1	2.0	49	0	0.0	43	0	0.0
Aug., 11th	55	1	1.8	48	0	0.0	52	1	1.9	51	1	2.0	46	0	0.0
Aug., 18th	56	1	1.8	49	0	0.0	52	1	1.9	53	1	1.9	46	0	0.0
Aug., 25th	56	2	3.4	45	0	0.0	51	1	2.0	53	2	3.8	48	0	0.0
Sep., 1st	55	6	10.9	43	2	4.7	55	5	9.1	54	5	9.3	49	3	6.1
Sep., 8th	57	6	10.5	44	3	6.8	56	6	10.7	55	4	7.3	49	3	6.1
Sep., 15th	58	4	6.9	45	3	6.7	58	3	5.2	57	3	5.3	50	2	6.0
Sep., 22nd	58	3	5.2	46	1	2.2	59	3	5.1	58	3	5.2	52	2	3.8
Overall	57 6	23	4.0	465	9	1.9	554	21	3.8	547	19	3.5	489	11	2.2
L.S.D. at 0.05									0.9365						

Table (55): Percentages of damage caused to cotton leaves due to infestation by the *S. littoralis* larvae in different treatments throughout 1998 cotton season.

Sampling date	Treatments				
	Control	Insecticides	*C.inerme*	Xentari	Mimic
June, 12 th		0.0			
June, 19 th		1.3			
June, 26 th		3.3			
July, 3 rd		6.7			
July, 10 th		9.3			
			First treatment (15/7)		
July. 17 th	11.7	9.3	11.7	11.3	9.3
July, 24 th	13.0	9.3	12.7	12.3	9.3
			Second treatment (30/7)		
July, 31 st	16.7	9.3	16.3	15.7	9.7
Aug., 7 th	18.7	10.3	18.3	18.0	9.7
Aug., 14 th	21.3	12.7	20.0	19.7	11.7
			Third treatment (15/8)		
Aug., 21 st	23.7	12.7	21.7	20.3	11.7
Aug., 28 th	27.3	12.7	23.3	21.7	14.3
Sep., 4 th	28.7	13.7	25.7	23.3	16.7
Sep., 11 th	35.0	17.7	31.3	27.0	20.7
Sep., 18 th	39.3	19.7	36.0	32.7	23.3
Sep., 25 th	44.0	22.3	40.3	37.7	27.3
Total	300	170.3	277.9	260.3	184.3
Mean	18.75 A	10.64 B	17.37 A	16.27 A	11.52 B
L.S.D. Treat. 0.5			1.412		

Table (56): Percentages of damage caused to cotton leaves due to infestation by *S. littoralis* larvae in different treatments throughout 1999 cotton season.

Sampling date	Treatments				
	Control	Insecticides	*C.inerme*	Xentari	Mimic
June, 11 th			0.0		
June, 18 th			2.3		
June, 25 th			4.0		
July, 2 nd			6.0		
July, 9 th			9.3		
			First treatment (15/7)		
July. 16 th	11.3	9.3	11.3	11.3	9.3
July, 23 rd	16.3	11.7	15.3	14.3	10.3
			Second treatment (30/7)		
July, 30 th	19.7	15.0	17.7	17.7	15.7
Aug., 6 th	21.3	15.3	19.7	19.3	16.7
Aug., 13 th	23.3	18.3	21.3	21.7	18.3
			Third treatment (15/8)		
Aug., 20 th	25.0	19.0	23.7	23.7	19.0
Aug., 27 th	27.7	22.3	26.7	25.0	22.3
Sep., 3 rd	31.3	24.7	30.7	28.3	25.7
Sep., 10 th	35.0	27.0	33.3	31.3	29.3
Sep., 17 th	42.3	29.3	39.7	35.7	30.7
Sep., 24 th	46.7	30.7	43.3	43.3	32.0
Total	321.5	244.2	304.3	293.2	251.9
Mean	20.09 A	15.26 B	19.02 A	18.33 A	15.74 B
L.S.D. Treat. $_{0.5}$			1.638		

damaged leaves were (10.64 & 15.26%) in chemical insecticides in 1998 and 1999 cotton seasons, respectively.

These findings agree with **Salama and Zaki (1984)** who mentioned that *B. thuringiensis* var. *Kurstaki* (Dipel) had a significant reduction on the larval population of *S. littoralis* on cotton plants. **Khalil and Watson (1986)** used Dimilin for controlling *S. littoralis* on cotton fields. The authors stated that Dimilin caused 28 – 32% mortality with concentrations (50 – 125 a.i./ feddan) after 24hours from treatment. **Shalaby *et al.* (1993b)** recorded the overall of damage caused by *S. littoralis* was reduced by 32.42 and 18.86 % due to the chemical insecticides and the bioinsecticide, respectively.

V – Rate of damage caused by bollworms larvae:

Data in Tables (57 &58) and figs. (16 – 25) show the rate of weekly damage caused by bollworms (*P. gossypiella* and *E. insulana*) infestations to cotton bolls, in different treatments. The aim of these estimations was to study the effect of plant extract, bioinsecticide, insect growth regulator and recommended chemical insecticides on the damage caused to cotton bolls by infesting bollworms larvae.

These data indicated that insignificant difference between bioinsecticide and plant extract treatments, also between insect growth regulator and chemical insecticides treatment, but there were significant differences between the first two treatments and the other treatments. The most damaged bolls were (22.64 & 20.22 %) in control treatment, while the lowest damaged bolls were (19.50 & 16.36 %) in chemical insecticides in 1998 and 1999 cotton seasons, respectively.

Table (57): Percentages of damage caused to cotton bolls due to infestation by bollworms in different treatments throughout 1998 cotton season

Sampling date	Treatments				
	Control	Insecticides	*C.inerme*	Xentari	Mimic
June, 26 th			3.0		
July, 3 rd			4.7		
July, 10 th			7.3		
			First treatment (15/7)		
July. 17 th	10.0	7.3	8.0	8.0	7.3
July, 24 th	12.7	10.3	12.7	12.7	10.3
			Second treatment (30/7)		
July, 31 st	16.3	10.7	13.3	13.3	10.7
Aug., 7 th	18.7	13.3	17.7	17.7	15.3
Aug., 14 th	22.3	18.7	23.3	22.3	18.7
			Third treatment (15/8)		
Aug., 21 st	27.0	19.3	25.0	24.0	19.3
Aug., 28 th	31.7	25.7	32.0	32.0	26.7
Sep., 4 th	36.3	32.7	37.0	37.0	35.0
Sep., 11 th	38.7	37.7	39.0	37.0	37.7
Sep., 18 th	43.3	40.3	42.7	42.0	41.7
Sep., 24 th	45.0	42.0	44.3	44.0	43.3
Total	317	273	310	307	281
Mean	22.64 A	19.5 B	21.93 A	21.5 A	20.07 B
L.S.D. Treat. $_{0.5}$			0.8319		

Table (58): Percentages of damage caused to cotton bolls due to infestation by bollworms in different treatments throughout 1999 cotton season

Sampling date	Treatments				
	Control	Insecticides	*C.inerme*	Xentari	Mimic
June, 25 th			3.0		
July, 2 nd			3.3		
July, 9 th			4.0		
			First treatment (15/7)		
July. 16 th	5.7	4.3	4.7	4.7	4.7
July, 23 rd	8.3	6.7	7.3	7.0	6.7
			Second treatment (30/7)		
July, 30 th	12.0	9.3	10.0	10.0	9.7
Aug., 6 th	16.3	10.0	11.0	11.0	10.3
Aug., 13 th	20.7	15.7	18.0	17.0	15.3
			Third treatment (15/8)		
Aug., 20 st	25.0	16.3	19.0	18.0	16.7
Aug., 27 th	28.3	22.3	26.0	24.7	23.3
Sep., 3 rd	31.7	26.7	34.7	32.3	28.7
Sep., 10 th	36.7	32.0	43.0	40.7	32.3
Sep., 17 th	42.3	35.7	45.0	43.0	36.7
Sep., 24 th	45.7	39.7	46.0	45.0	40.3
Total	283	229	275	268	235
Mean	20.22 A	16.36 B	19.65 A	19.14 A	16.79 B
L.S.D. Treat. 0.5			1.256		

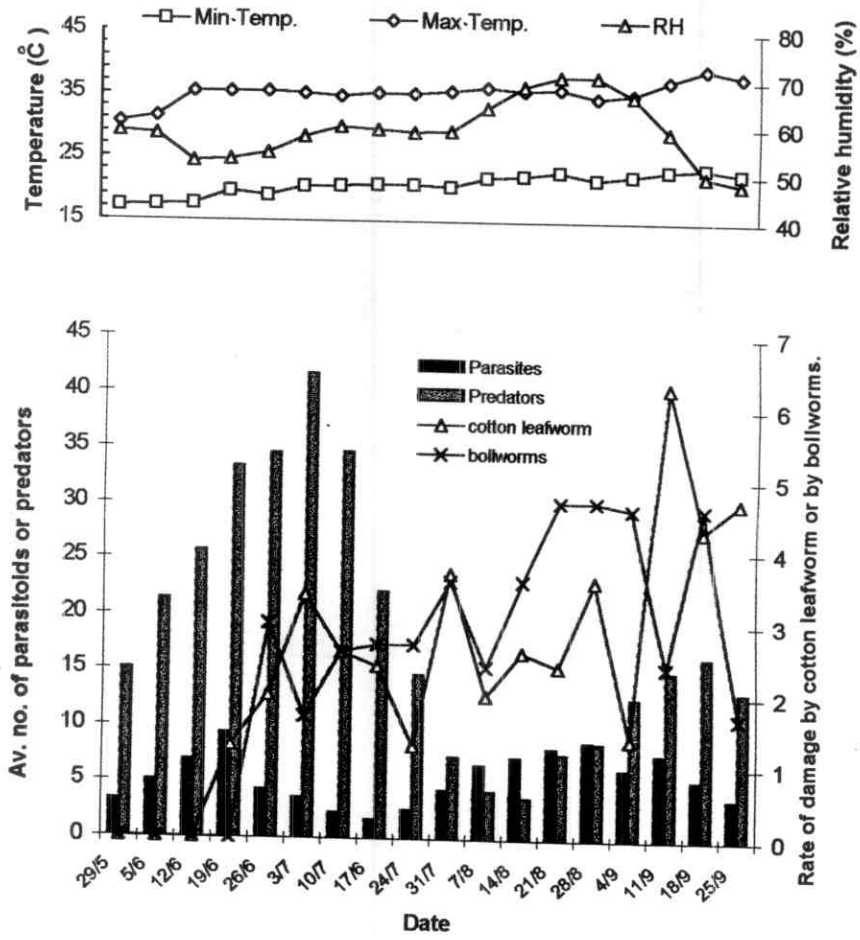

Fig (16): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm and bollworms in control treatment throughout 1998 cotton season.

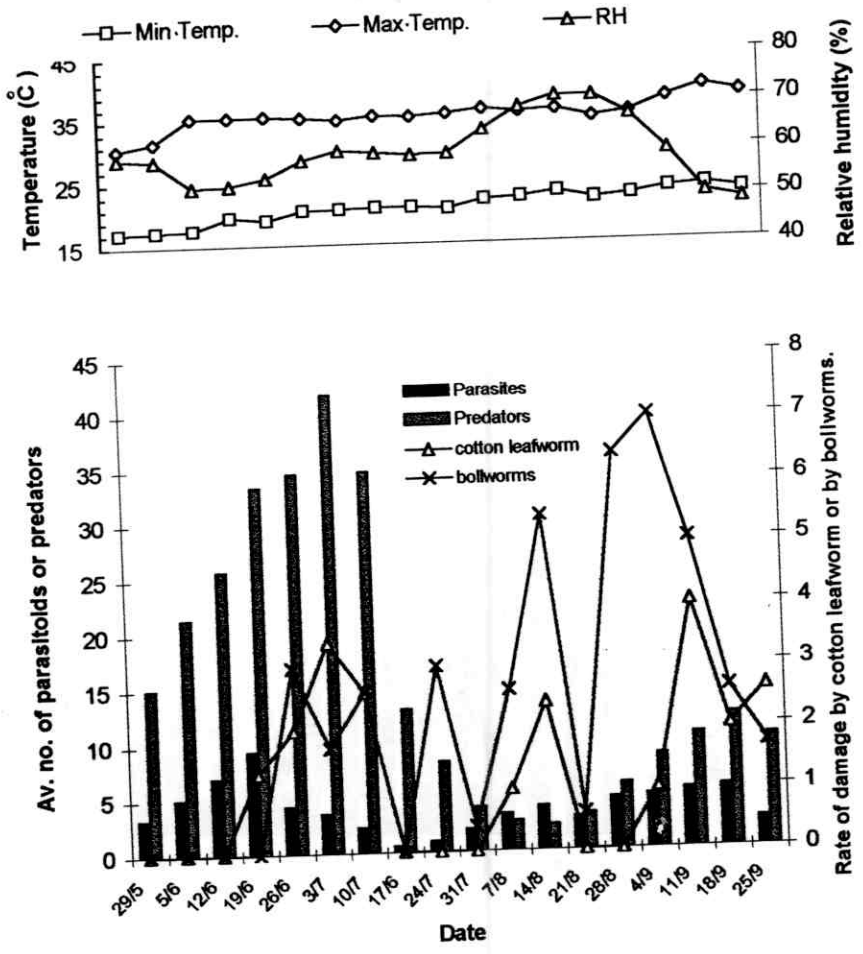

Fig (17): Relationship between the total numbers of both parasitoids and predators and weekly rate of damage by cotton leafworm and bollworms in chemical insecticides treatment throughout 1998 cotton season.

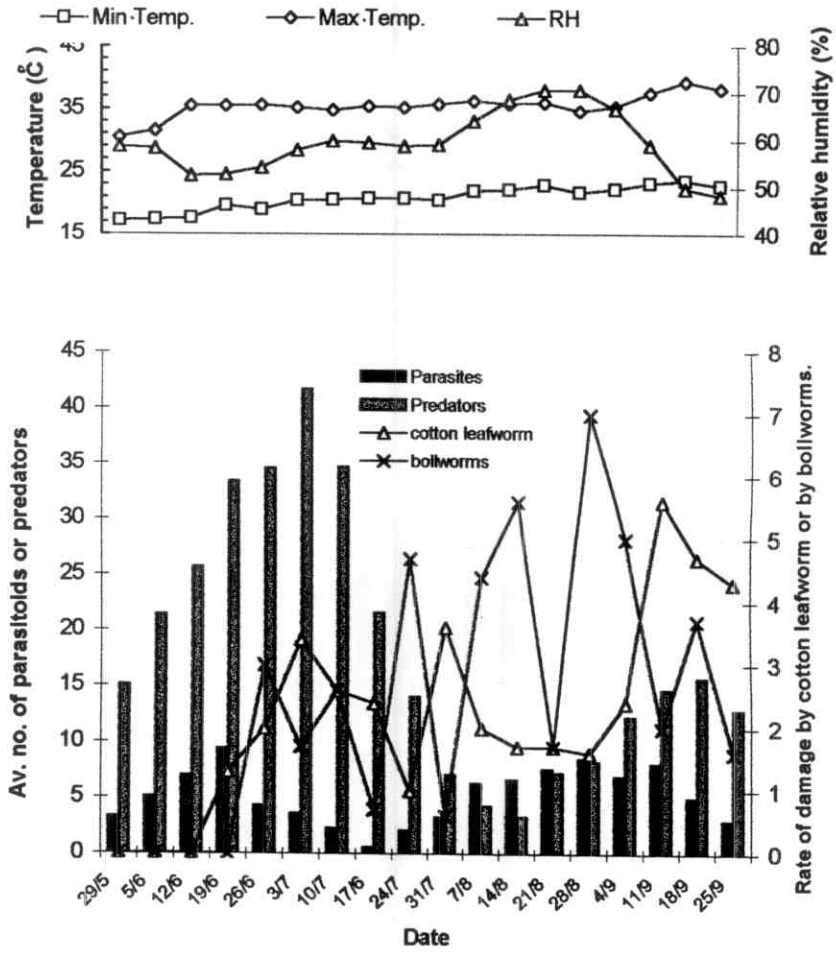

Fig (18): Relationship between the total numbers of both parasitoids and predators and weekly rate of damage by cotton leafworm and bollworms in *C. inerme* treatment throughout 1998 cotton season.

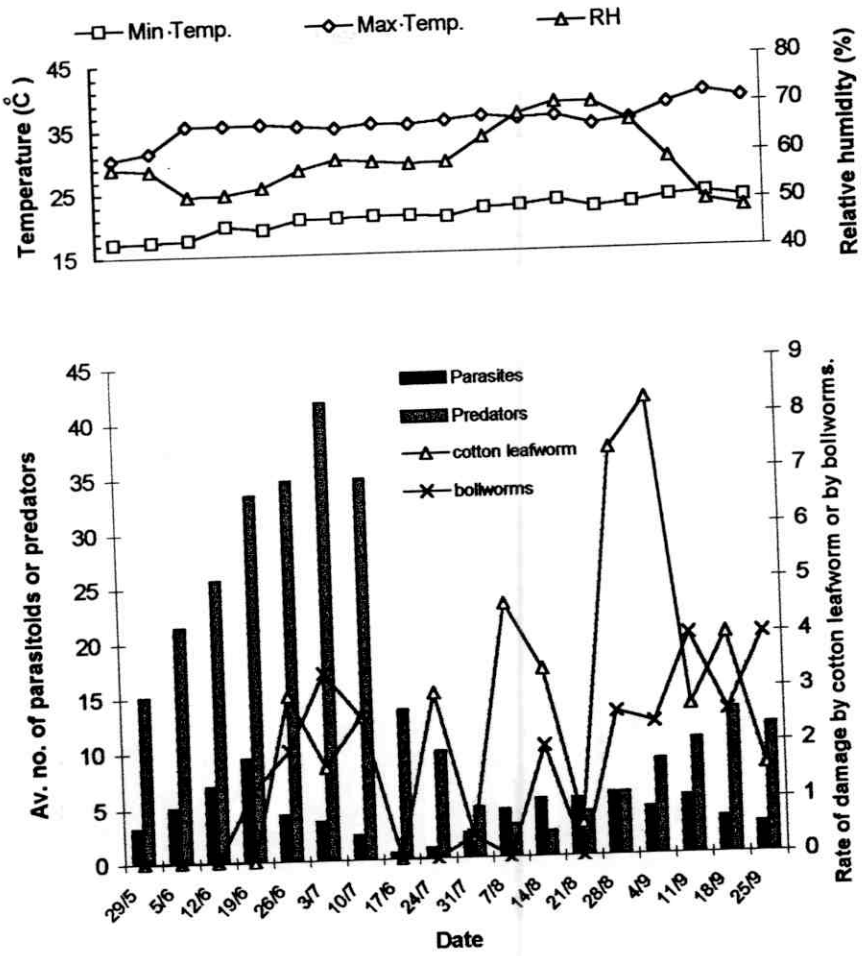

Fig (19): Relationship between the total numbers of both parasitoids and predators and weekly rate of damage by cotton leafworm and bollworms in I.G.R. treatment throughout 1998 cotton season.

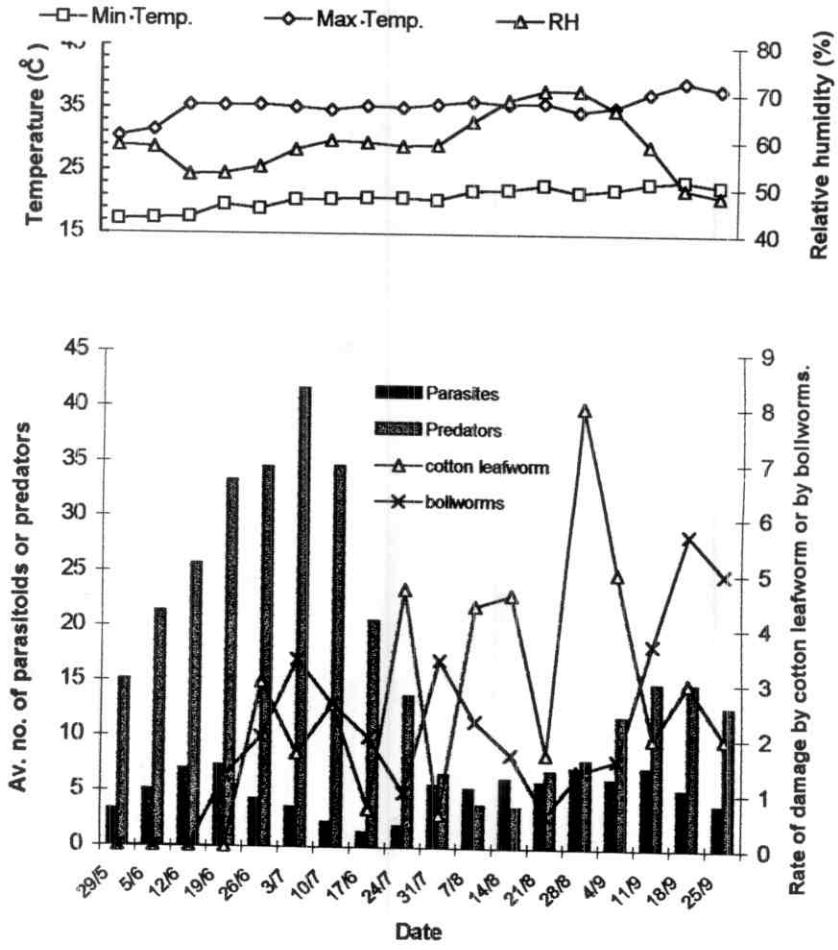

Fig (20): Relationship between the total numbers of both parasitoids and predators and weekly rate of damage by cotton leafworm and bollworms in bioinsecticide treatment throughout 1998 cotton season.

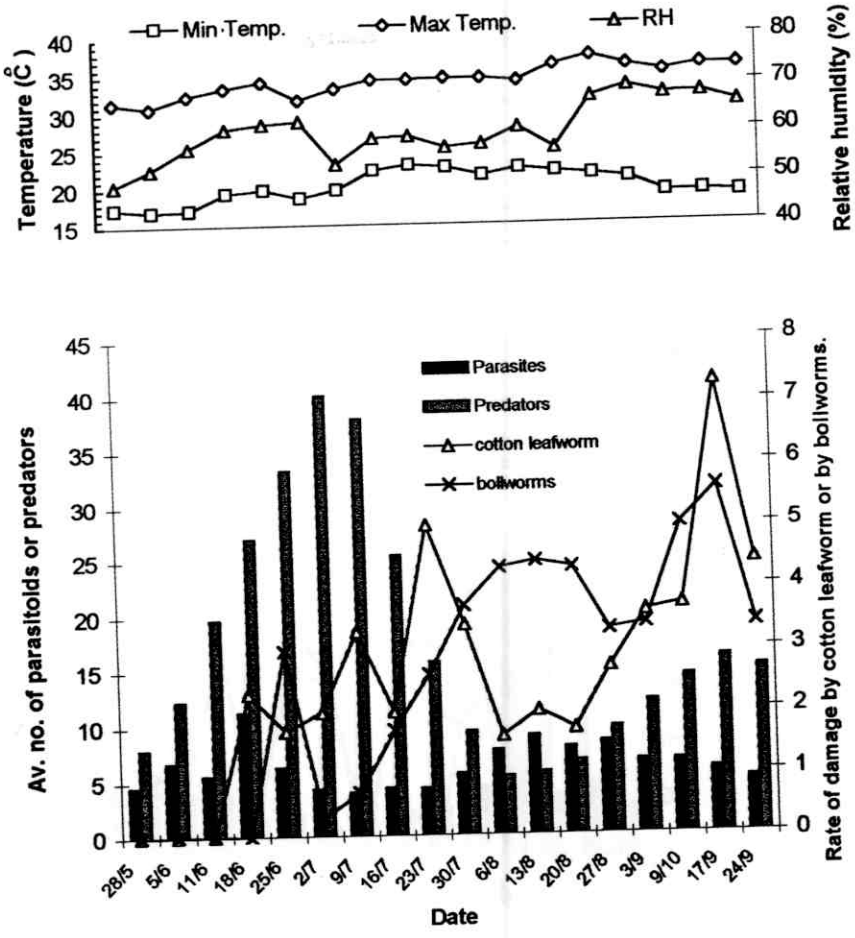

Fig (21): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm or bollworms in control treatment throughout 1999 cotton season.

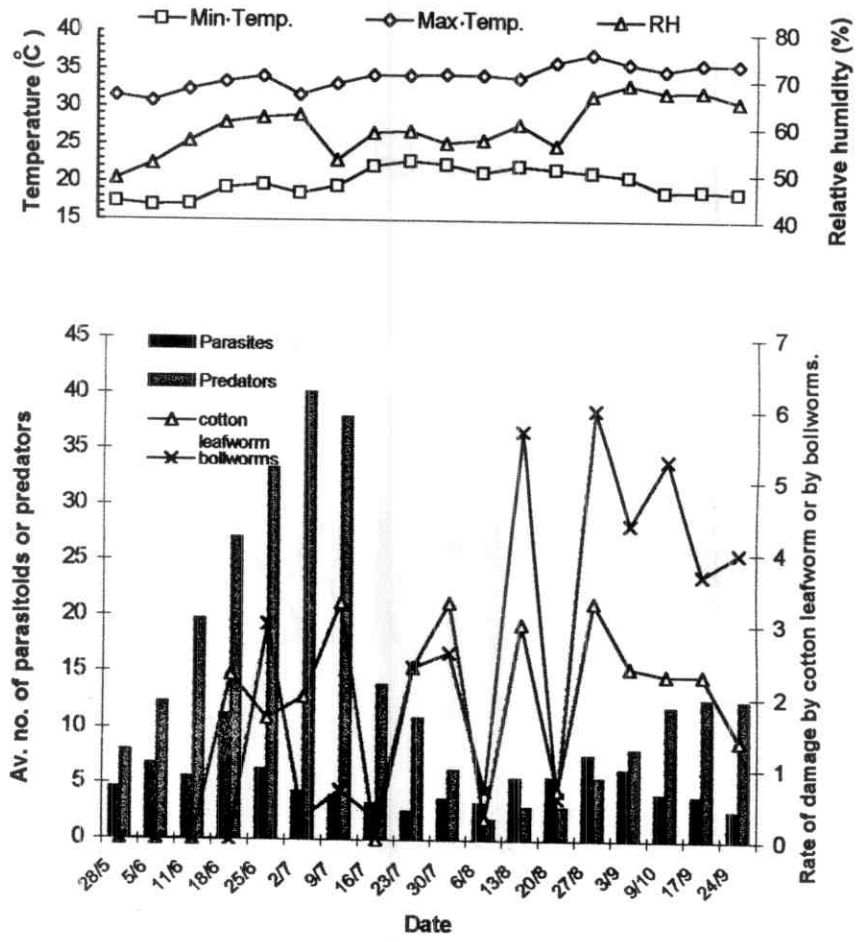

Fig (22): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm or bollworms in chemical insecticides treatment throughout 1999 cotton season.

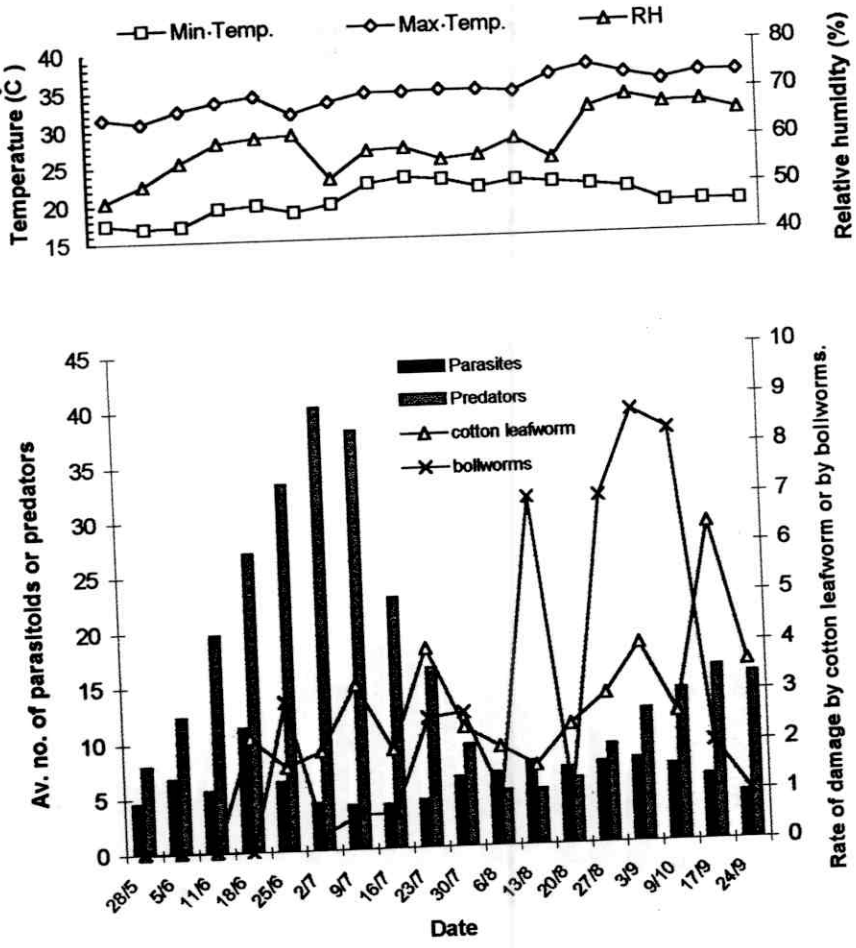

Fig (23): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm and bollworms in *C. inerme* treatment throughout 1999 cotton season.

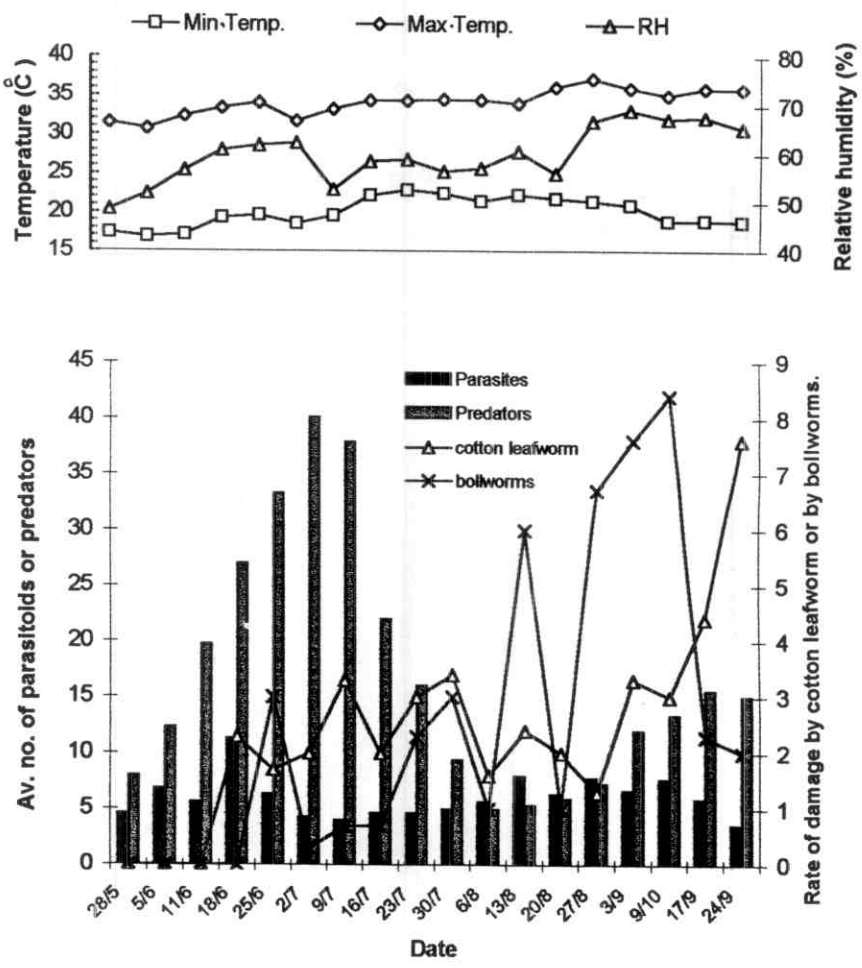

Fig (24): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm and bollworms in bioinsecticide treatment throughout 1999 cotton season.

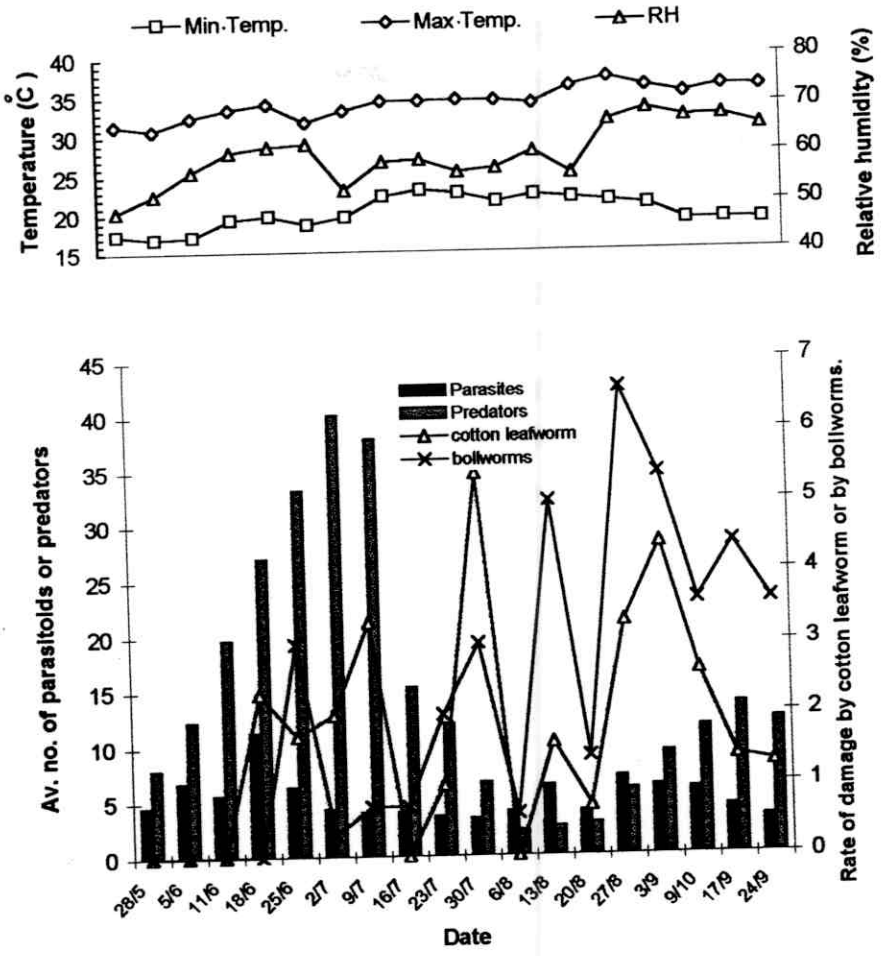

Fig (25): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm and bollworms in I.G.R. treatment throughout 1999 cotton season.

These results agree with **luo *et al.* (1986)** who found that *B. thuringiensis* subsp. *wuhanensis, B. thuringiensis* subsp. *morrisoni* and *B. thuringiensis* subsp. *Kuristaki* produced a 42.53% reduction in the number of cotton bolls infested with the gelechid, *P. gossypiella* and a 56.1 % reduction in the number of larvae in bolls. **Dhawan and Simwat (1992)** found that Neemrich and Neemark (extracted from *Azadriachta indica)* had significantly reduction of cotton bollworms *P. gossypiella, E.vittella, E. insulana* and *H. armigera.* **Gao *et al.* (1992)** reported pyrethroids and other organic insecticides e.g. Chlordimeform hydrochloride and Carbaryl had high contact toxicity to cotton bolls by the gelechiid, *P. gossypiella.* **Shalaby *et al.* (1993b)** showed the damage caused to cotton bolls by bollworms was significantly reduced by 44.72 and 22.42 % in chemical insecticides and bioinsecticide, respectively.

The second field experiment

This experiment was carried out in two areas of about quarter a feddan each and the distance between these two areas was about 200 meters. These areas were also chosen about 200 meters for from the first field experiment plots. Each area was divided into 3 plots of 126 m^2 each. In the first area, a sex-pheromone trap was placed in the middle of the three plots. The trap was provided with 3 capsules for *S. littoralis, P. gossypiella* and *E. insulana.* The pheromone capsules were renewed every 3 weeks. The captured male moths were collected, grouped and counted into weekly averages. Three week running means were used.

In both sex- pheromone trap and control treatments, the number of adult predators and parasitoids strokes of an insect sweeping net/ replicate were counted, and the percentages. Of parasitism and rate of damage by cotton leafworm and bollworms were estimated. The readings of temperature (Maximum & minimum) and relative humidity were daily recorded.

1 – Population dynamics of adults:

a – *Spodoptera littoralis* (Boisd.):

As shown in Tables (59 &60), four active periods of *S. littoralis* adults may be detected in each of 1998 and 1999 cotton seasons. In 1998 cotton season, [from April, 18 th to May, 16 th with a peak 21.7 adults (at Max. 34.2 °C, Min. 16.4 °C & R.H. 56.8%) /trap/ week on May, 9 th; from May, 23 rd to June, 20 th with a peak of 69.0 adults (at Max. 31.5°C, Min. 17.4°C & R.H. 58.2%) on June, 6 th; from June, 27 th to August,

Table (59): Weekly mean of *S. littoralis, P. gossypiellla* and *E.insulana* moth males captured in sex-pheromone trap throughout 1998 cotton season.

Sampling date	*S. littoralis*	*P. gossypiella*	*E. insulana*	Total of moths counts	Temp. C° Max.	Temp. C° Min.	%R.H.
April, 18 th	4.0	Zero	Zero	4.0	38.8	15.8	62.0
April, 25 th	17.3	Zero	Zero	17.3	35.2	16.1	60.4
May, 2 nd	19.0	0.3	Zero	19.3	34.3	15.4	57.9
May, 9 th	21.7	1.0	Zero	22.7	34.2	16.4	56.8
May, 16 th	18.0	1.7	1.3	21.0	33.9	16.8	56.2
May, 23 rd	27.7	4.0	3.0	34.7	32.0	17.6	60.0
May, 30 th	50.7	4.7	4.7	60.1	30.5	17.2	58.7
June, 6 th	69.0	5.7	5.7	80.4	31.5	17.4	58.2
June, 13 th	67.7	8.3	8.3	84.3	35.5	17.6	52.5
June, 20 th	57.0	6.3	6.3	69.6	35.5	19.6	52.8
June, 27 th	67.0	9.7	3.7	80.4	35.6	19.0	54.2
July, 4 th	73.0	14.7	1.7	89.4	35.2	20.5	57.8
July, 11 th	103.7	22.0	2.0	127.7	34.8	20.6	59.8
July, 18 th	135.0	28.7	5.0	168.7	35.4	20.8	59.3
July, 25 th	129.7	27.0	9.3	166.0	35.2	20.8	58.7
August, 1 st	114.3	22.0	27.3	163.6	35.7	20.5	59.0
August, 8 th	91.7	23.7	23.3	138.7	36.3	21.9	64.0
August, 15 th	87.0	33.0	21.0	141.0	35.8	22.2	68.7
August, 22 nd	122.3	38.7	33.0	194.0	36.1	22.9	70.8
August, 29 th	140.0	61.0	42.7	243.7	34.7	21.7	70.7
Sep., 5 th	172.7	59.0	50.7	282.4	35.4	22.3	66.7
Sep., 12 th	159.3	54.7	48.7	262.7	37.6	23.2	59.0
Sep., 19 th	144.7	40.3	35.7	220.7	39.4	23.6	49.8
Sep., 26 th	109.3	26.3	24.3	159.9	38.3	22.8	48.3
Total	2001.8	492.8	357.7	2852.3			

Table (60): Weekly mean of *S. littoralis, P. gossypiellla* and *E.insulana* moth males captured in sex-pheromone trap throughout 1999 cotton season.

Date	*S. littoralis*	*P. gossypiella*	*E.insulana*	Total of moths counts	Temp. C° Max.	Temp. C° Min.	%R.H.
April, 17 th	7.0	Zero	Zero	7.0	28.5	12.3	59.3
April, 24 th	14.3	Zero	Zero	14.3	27.0	13.3	55.0
May, 1 st	29.7	Zero	Zero	29.7	30.2	12.8	53.1
May, 8 th	56.3	Zero	Zero	56.3	33.0	24.7	55.0
May, 15 th	37.7	1.7	Zero	39.4	28.8	14.8	54.0
May, 22 nd	35.3	6.3	0.3	41.9	31.5	17.4	48.7
May, 29 th	82.3	11.0	1.7	95.0	30.8	16.9	52.0
June, 5 th	102.3	15.0	2.7	120.0	32.4	17.1	56.7
June, 12 th	135.0	13.3	5.3	153.6	33.4	19.3	60.7
June, 19 th	125.3	12.3	4.0	141.6	34.1	19.7	61.7
June, 26 t2	113.7	18.0	3.3	135.0	31.7	18.6	62.3
July, 3 rd	118.7	24.7	2.3	145.7	33.2	19.6	52.8
July, 10 th	123.3	28.3	3.7	155.3	34.3	22.2	58.5
July, 17 th	173.3	33.7	6.3	213.3	34.3	22.9	58.9
July, 24 th	122.0	30.3	11.7	164.0	34.5	22.5	56.4
July 31 st	78.3	21.7	8.3	108.3	34.4	21.4	57.1
August, 7 th	112.7	37.3	6.3	156.3	34.0	22.3	60.5
August, 14 th	125.7	53.0	9.7	188.4	36.1	21.8	56.0
August, 21 st	146.3	117.3	15.3	278.9	37.2	21.4	66.7
August, 28 th	179.7	173.7	29.7	383.1	36.0	20.9	69.0
Sep., 4 th	107.3	92.3	19.3	218.9	35.1	18.9	67.3
Sep., 11 th	120.0	58.0	18.7	196.7	36.0	19.0	67.6
Sep., 18 th	114.7	41.3	24.3	180.3	35.9	18.8	65.1
Sep., 25 th	111.3	29.7	28.7	169.7	35.3	19.2	66.4
Total	2372.2	818.9	201.6	3392.7			

15 th with a peak of 135.0 adults (at Max. 35.4°C, Min. 20.8 °C & R.H. 59.3%) on July, 18 th and from August, 22 nd to September, 26 th with a peak of 172.7 moths (at Max. 35.4°C, Min. 22.3 °C & R.H. 66.7%) on September, 5 th]. In 1999 season, these four periods could be detected from April, 17 th to May, 22 nd with a peak 56.3 adults (at Max. 33.0°C, Min. 17.7 °C & R.H. 55.0%) on May, 8 th, May, 29 th to June, 26 th with a peak of 135.0 adults (at Max. 33.4°C, Min. 19.3 °C & R.H. 60.7 %) on June, 12 th; from July, rd to July, 31 st with a peak of 173.3 adults (at Max. 34.3°C, Min. 22.9 °C & R.H. 58.9 %) on July, 17 th and from August,7 th to September, 25 th with a peak 179.7 moths (at Max. 36.0°C, Min. 20.9 °C & R.H. 69 %) on August, 28 th. In this respect, **Salem and Salama (1985),** in Egypt, detected six generations of *S. littoralis* per year by using a sex- pheromone trap. **Nada (1990),** in Sharkia Governorate, used pheromone traps to monitor the cotton leafworm attack. The author found that the onset of appearance of moths took place at the last week of May and the catch in traps increased during June representing 39.1 and 76.4 moths/fed. For 1986 and 1987 respectively.

b – *Pectinophora gossypiella* (Saund.):

Appearance of *P. gossypiella* moths started on May 2 nd in the first season (0.3 adult / trap / week); Table, 59 and on May, 15 th in 1999 cotton season (1.7 adults / trap/ week; Table, 60). In both seasons, the existence of this pest remained in the field up to the last week of September (Tables, 59 & 60). In 1998 season, three peaks of the pink bollworm moths' abundance may be detected, those were estimated by 8.3 adults

/ week / trap (at Max. 35.5°C, Min. 17.6 °C & R.H. 52.5 %) on June, 13 th; 28.7adults (at Max. 35.4°C, Min. 20.8 °C & R.H. 59.3 %) on July, 18 th and 61 moths (at Max. 34.7 °C, Min. 21.7 °C & R.H. 70.8 %) on August, 29 th. While in the subsequent season, those occurred on June, 5 th (15 adults (at Max. 32.4°C, Min. 17.1 °C & R.H. 56.7 %); July, 17 th 33.7 adults at (at Max. 34.3°C, Min. 23.9 °C & R.H. 58.9 %) and August, 28 th (173.7 moths/ week/trap at Max. 36.0°C, Min. 20.9 °C & R.H. 69 %). In similar investigation, **Cai *et al.* (1985)** detected three generations of *P. gossypiella* on cotton plants in China. The main factor affecting the population dynamics of the third generation was temperature. Damage was high in the second generation. **Taneja and Jayaswal (1986),** in India, found that the number of *P. gossypiella* adult males caught in traps increased from mid- July to a peak in September to November, then declined. The incidence of larvaon cotton flowers pein mid to late August. The incidence of larvae in bolls increased during cropping season. **Guirguis (1991b),** in Egypt, found that *P. gossypiella* had three generations with three sharp peaks on cotton during the period started early in May and extended till the first week of October.

c – *Earias insulana* (Boisd.):

Data represented in Tables (59 & 60) show that the active period of *E. insulana* extended from May, 16 th (1.3 adults/ week/ trap) until September, 26 th (24.3 adults) in 1998 cotton season and from May, 22 nd (0.3 adult/ week/ trap) until September, 25 th (28.7 moths) in 1999 cotton season. Three peaks' abundance could be detected in each season [8.3 adults

(at Max. 35.5°C, Min. 17.6°C & R.H. 52.5 %) on June, 1th; 27.3 adults (at Max. 35.7°C, . 20.5 °C & R.H. 59.0 %) oAugust, 1 st and 50.7 moths (at Max. 35.4°C,Min. 22.3 °C & R.H. 66.7 %) on September, 5 th in 1998 cotton season; while those were estimated by 5.3 adults (at Max. 33.4°C, Min. 19.7°C & R.H. 61.7 %) on June, 12 th, 11.7 moths (at Max. 34.5°C, Min. 22.5°C & R.H. 56.4 %) on July, 24 th and 29.7 moths (at Max. 36.0°C, Min. 20.9°C & R.H. 69.0 %) on August, 28 th]. In a previous investigation concerning the population abundance of *E. insulana* in cotton fields, **Makkar and Kostandy (1995),** in Fayom Governorate, found the peak number of *E. insulana* moths, in cotton fields, detected during August of 1994 and 1995 growing seasons.

II- Numbers of adult predators:

The same thirteen predaceous insect species, active periods and their population abundance were found to coincide with those reported in the first experiment. Counts of adult predators of each species on both control and sex – pheromone trap treatments are recorded in Tables (61 & 62). The recorded data can be explained in the following:

II – 1 – Ladybird beetles:

a – Coccinella unaecimpunctata L.:

As shown in Tables (61 & 62) *C. undecimpunctata* was the third in the order of total counted population after *Orius spp.* and *Paederus alfierii.* Two active periods were detected, the first extended from the beginning of the season to the first week of August with a peak of 7.7 & 8.3 adults/ 10 double strokes on control and pheromone trap treatments, respectively,

Table (61): Averages in numbers of perdators /10 double strokes of sweeping net from cotton cultivated in sex pheromone trap throughout 1998 cotton season.

sampling date	*C. undecim-punctata.*		*C.v. isis*		*C.v. nilotica*		*Scymnus spp.*		*Paederus alfierii*		*Chrysoperla carnea*		*Orius spp.*		Syrphids	
	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap
May, 29th	2.7	3.0	0.0	0.0	0.0	0.0	2.3	2.7	2.3	2.3	2.0	2.3	4.0	4.3	1.0	1.0
June, 5th	5.0	4.7	0.0	0.0	0.0	0.0	3.0	3.3	3.3	3.7	3.3	3.3	4.7	6.0	1.3	1.7
June, 12th	7.3	7.7	0.0	0.0	0.0	0.0	1.7	2.0	4.7	5.3	4.3	4.7	8.3	8.7	0.7	1.0
June, 19th	6.0	6.3	0.0	0.0	0.0	0.0	2.3	2.3	7.7	8.0	2.0	2.3	13.3	13.0	0.7	0.7
June, 26th	6.7	6.7	0.0	0.0	0.0	0.0	2.0	2.0	5.7	5.3	2.3	2.7	18.0	18.7	1.0	1.0
July, 3rd	7.7	8.3	0.0	0.0	0.0	0.0	1.7	1.7	7.3	7.0	1.7	1.3	22.7	23.0	1.7	2.0
July, 10th	4.3	5.7	0.0	0.0	0.0	0.0	4.3	4.0	8.7	8.3	0.0	0.0	17.0	17.7	1.0	1.0
July, 17th	2.7	3.0	0.0	0.0	0.0	0.0	3.7	3.3	9.3	9.7	0.0	0.0	6.3	6.7	1.0	1.0
July, 24th	1.3	1.7	0.0	0.0	0.0	0.0	2.3	2.7	6.7	7.3	0.0	0.0	4.0	4.0	0.3	0.7
July, 31st	1.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	3.7	4.3	0.0	0.0	2.3	2.3	0.7	0.7
Aug., 7th	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	2.7	3.3	0.0	0.0	1.7	1.7	0.3	0.3
Aug., 14th	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	2.3	0.0	0.0	1.0	1.3	0.3	0.3
Aug., 21st	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.3	2.3	2.3	0.7	0.7	0.3	0.3
Aug., 28th	0.0	0.0	2.3	2.7	0.0	0.0	0.0	00	2.3	2.3	1.7	1.7	0.7	0.3	1.0	1.3
Sep., 4th	0.7	0.3	4.7	4.3	1.3	1.3	0.0	0.0	1.7	1.3	3.3	3.3	0.0	0.0	2.3	2.0
Sep., 11th	4.7	3.3	3.7	3.7	3.3	3.3	0.0	0.0	1.3	1.3	5.3	5.3	0.0	0.0	1.3	1.3
Sep., 18th	3.3	2.7	3.0	3.3	2.3	2.7	0.0	0.0	1.0	1.0	4.3	4.7	0.0	0.0	1.0	1.0
Sep., 25th	1.7	1.3	2.7	2.7	2.7	3.0	0.0	0.0	0.7	1.0	3.7	3.7	0.0	0.0	0.7	0.7
Total	55.4	56.7	16.4	16.7	9.6	10.3	23.3	24.0	75.1	77.0	36.2	37.6	104.7	108.4	16.6	18.0
Mean	3.08	3.15	0.91	0.93	0.53	0.57	1.29	1.33	4.17	4.28	2.01	2.09	5.82	6.02	0.92	1.0
"T" test	N.S.		N.S.		N.S.		N.S.		N.S.		N.S.		N.S.		N.S.	

Table (62): Averages in numbers of perdators /10 double strokes of sweeping net from cotton cultivated in sex pheromone trap throughout 1999 cotton season.

Sampling date	*C. undecim-Punctata.*		*C.v. isis*		*C.v. nilotica*		*Scymnus spp.*		*Paederus alfierii*		*Chrysoperla carnea*		*Orius spp.*		Syrphids	
	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap
May, 28th	1.0	1.3	0.0	0.0	0.0	0.0	1.0	1.0	2.7	3.0	1.3	1.7	3.0	3.3	0.7	1.0
June, 4th	1.3	1.7	0.0	0.0	0.0	0.0	1.3	1.3	3.0	3.3	2.7	2.7	4.7	5.0	1.0	1.0
June, 11th	1.7	2.0	0.0	0.0	0.0	0.0	1.7	1.7	3.7	3.7	3.3	3.3	9.0	9.3	1.0	1.7
June, 18th	3.3	3.0	0.0	0.0	0.0	0.0	1.0	1.0	6.7	7.3	2.7	3.0	14.3	14.0	1.7	2.0
June, 25th	5.0	4.7	0.0	0.0	0.0	0.0	1.3	1.3	5.7	6.3	2.7	2.7	17.7	17.0	1.0	1.0
July, 2nd	6.3	6.3	0.0	0.0	0.0	0.0	2.7	3.0	6.7	6.7	2.0	2.0	22.0	22.7	2.3	2.3
July, 9th	7.7	7.3	0.0	0.0	0.0	0.0	4.3	4.7	8.3	8.3	0.0	0.0	14.7	15.0	2.0	1.7
July, 16th	4.3	4.3	0.0	0.0	0.0	0.0	2.7	2.3	9.7	9.7	0.0	0.0	7.7	7.7	1.7	1.3
July, 23rd	3.7	3.7	0.0	0.0	0.0	0.0	1.7	1.7	5.7	5.3	0.0	0.0	4.3	4.3	0.7	0.7
July, 30th	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.0	3.7	4.3	0.0	0.0	2.7	2.7	0.3	0.3
Aug., 6th	1.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	3.3	0.0	0.0	1.3	1.3	0.3	0.0
Aug., 13th	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0	1.7	1.7	0.0	0.3
Aug., 20th	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	2.3	2.0	2.0	0.7	0.7	0.7	0.7
Aug., 27th	0.0	0.0	2.3	2.7	0.0	0.0	0.0	0.0	2.0	1.7	2.3	2.3	0.3	0.3	1.0	1.0
Sep., 3rd	0.7	1.0	4.0	4.3	2.0	2.3	0.0	0.0	1.3	1.3	3.7	3.3	0.0	0.0	1.7	1.7
Sep., 10th	5.0	5.3	3.7	3.7	3.3	3.3	0.0	0.0	1.0	1.0	5.0	5.7	0.0	0.0	0.3	0.0
Sep., 17th	3.3	3.7	3.7	3.7	2.7	3.0	0.0	0.0	0.7	0.7	3.7	4.0	0.0	0.0	0.3	0.3
Sep., 24th	2.0	2.0	3.3	3.3	3.0	3.0	0.0	0.0	0.7	0.3	3.3	3.3	0.0	0.0	0.7	0.7
Total	49.3	50.0	17.0	17.7	1.0	11.6	17.7	17.9	69.6	71.5	34.7	36.0	104.1	105.0	17.4	17.7
Mean	2.74	2.78	0.94	0.98	0.61	0.64	0.98	0.99	3.87	3.97	1.93	2.00	5.78	5.83	0.97	0.98
"T" test	N.S.		N.S.		N.S.		N.S.		N.S.		N.S.		N.S.		N.S.	

on July, 3 rd 1998, and 7.7 & 7.3 adults, respectively on July, 2 nd 1999 cotton season. The period extended from the first week of September until the end of season in both two seasons with a peak of 4.7 & 3.3 adults on September, 11 th 1998 and 5.0 & 5.3 adults/ 10 double strokes on September, 10 th in control and sex – pheromone trap treatments, respectively.

b – *Cydonia vicina* var. *isis* Muls.:

This predator was higher abundance than *Cydonia vicina* var. *nilotica* in both control and sex – pheromone trap treatments in 1998 and 1999 cotton seasons (Tables, 61 & 62). The active period extended from the last week of August until the end of season for two cotton seasons, with a peak of 4.7 & 4.3 adults on September, 4 th 1998 and 4.0 & 4.3 adults on September, 3 rd 1999 cotton season in control and sex – pheromone trap treatments, respectively.

c – *Cydonia vicina* var. *nilotica* Muls.:

Adults of this ladybird beetle were found in cotton fields during September only in the two seasons with mean counts of 1.3 – 3.3 adults in both treatments in the first season (Table, 61) and 2 – 3.3 adults in control and 2.3 – 3.3 adults/ 10 double strokes in sex – pheromone treatments in 1999 (Table, 62). Average total counts swept throughout the 4 samples of this moth were only 9.6 & 10.3 adults in 1998 and 11.0 & 11.6 adults in 1999, indicating that this predator was the least abundant in cotton fields.

II- 2 – *Scymnus spp.*:

Two species of *Scymnus* (*syriacus* and *interruptus*) are known to be abundant in cotton field **(Hassan, 1988).** The

active period of *Scymnus* extended from the beginning of season until the third week of July of both seasons. However, these predaceous species were found to be absent throughout the remaining period of the season (last week of July – last week of September). One peak of abundance of 4.3 & 4.0 adults occurred on July, 10 th 1998 (Table, 61) and 4.3 & 4.7 adults on July, 9 th 1999 (Table, 62) in control and sex – pheromone trap experiments, respectively. The means of total counts of adults collected throughout the season were 23.3 & 24.0 adults in 1998 and 17.7 & 17.9 adults in 1999.

II –3 – *Paederus alfierii* koch.:

The total numbers of *P. alferii* adults collected throughout the cotton season were 75.1 & 77.0 adults in 1998 and 69.6 & 71.5 adults in control and sex – pheromone treatments, respectively to rank the second in abundance after *Orius spp.* Adults of this predator was found throughout the whole period of cotton season. Highest abundance occurred on July, 17 th 1998 (9.3 & 9.7 adults; Table, 61) and (9.7 & 9.7 adults on July, 16 th 1999/ 10 double net strokes on July, 16 th 1999 in control and sex – pheromone trap treatments, respectively; Table, 62).

II – 4 – *Chrysoperla carnea* (Stephens):

Data presented in Tables (61 & 62) indicated two active periods of *C. carnea* in cotton fields; the first extended from the beginning of season until the first week of July with one peak of 4.3 & 4.7 adults on June, 12 th 1998 and 3.3 & 3.3 adults/ 10 double strokes on June, 11 th 1999 cotton season in control and sex – pheromone trap experiments, respectively.

The second period lasted from the third week of August to the end of the season, with a peak of 5.3 & 5.3 adults on September, 11 th 1998 and 5.0 & 5.7 adults on September, 10 th 1999 cotton season in control and sex – pheromone trap experiments, respectively.

II – 5 – *Orius spp. (albidipennis* and *leavigatus):*

Orius spp. adults were the most abundant (means of total counts 104.7 & 108.4 adults in 1998; Table 61 and 104.1 &105 adults in 1999 season; Table, 62 in control and sex–pheromone trap treatments, respectively) among the surveyed predators. Adults of *Orius* were detected in cotton fields from the beginning of the season until the last week of August in both cotton seasons with one peak on July, 3 rd 1998 (22.7 & 23.0 adults) and July, 2 nd 1999 (22.0 & 22.7 adults) in control and sex – pheromone trap experiments, respectively.

II –6 – Syrphids:

Mean total counts of syrphid species adults collected throughout the two cotton seasons of study were 16.6 & 18.0 adults in 1998 (Table, 61) and 17.4 & 17.7 adults in 1999 (Table, 62), being of, relatively, low abundance. The weekly mean counts of adults/ 10 double strokes of the insect sweeping net were, relatively, few, ranging from 0.3 – 2.3 adults in control 1998 & 0.3 – 2.0 adults in sex – pheromone 1998, and from 0.3 – 2.3 adults in 1999 cotton season. But, although of this low abundance, adults of these predators were detected in all samples of cotton season (Tables, 61 & 62).

From data in Tables (61 & 62) it could be fairly stated that using the sex – pheromones for the attractiveness of males

of the cotton pests did not cause any harmful effect on the population abundance of either of the predaceous insect species which showed insignificant difference in their abundance compared to their counts on cotton plants of the control treatment.

Regarding the means of total counts of the concerned predaceous species (Tables, 61 & 62 and Fig. 26), these predators could be arranged in a descending order according to their total numbers as *Orius spp.*, ladybird beetles, *P. alfierii, Chrysoperla carnea, Scymnus spp.* and syrphids.

These results agree with **Moawad *et al.* (1996)** who used a mixture of pink bollworm females sex – pheromone and Cypermethrin (for attracting and killing male moths of *P. gossypiella)* in form of drops on the top cotton leaves. The authors found the highest numbers of these predators [*Chrysoperla carnea, Coccinella spp., Paederus alfierii, Scymnus spp. Orius spp., Syrphus corollae* and true spiders] (27 and 19 % increase during 1992 and 1993, respectively) especially during July.

III – Numbers of adult parasitoids:

The same parasitoid species which were studied in the experiment of non – chemical treatments on cotton were also concerned in this study. The results obtained on each of these parasmay be explained as follows:

III – 1 – *Microplitis rufiventris* Kok.:

As shown in Tables (63 & 64), *M. rufiventris* adults were the most abundant compared to the remaining parasitoids. Mean total of 30.7 & 31.8 and 47.6 & 49.1 adults were

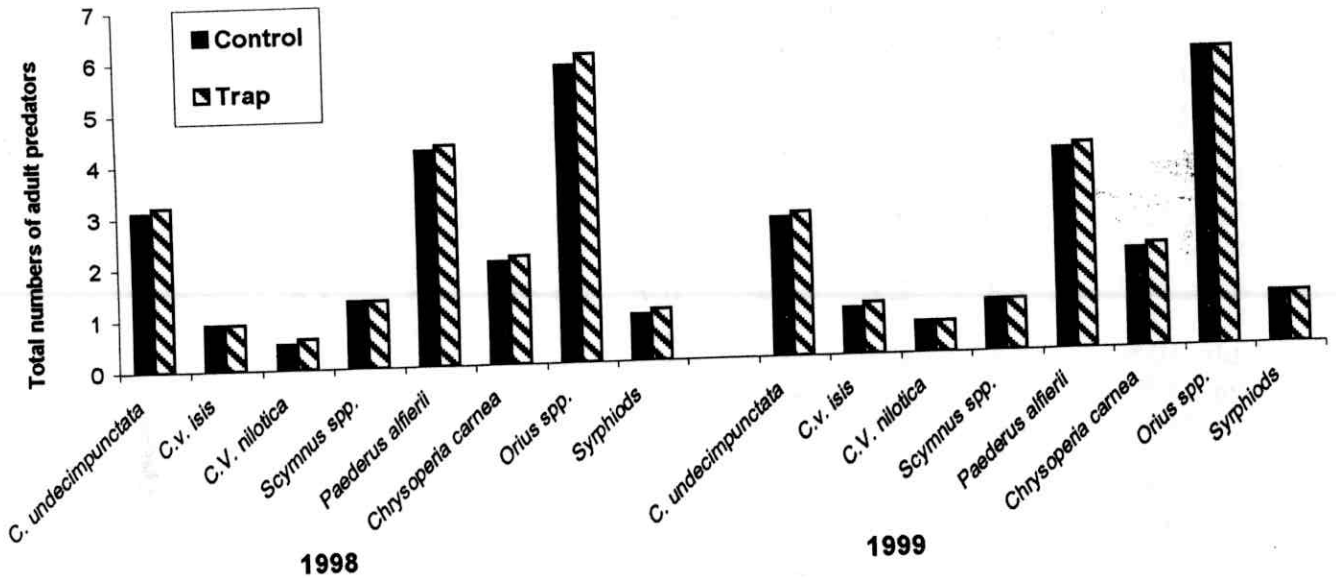

Fig. (26): Total numbers of predators counted from sex-phromone trap and control treatments throughout 1998 and 1999 cotton seasons.

Table (63): Averages in numbers of parsitoids /10 double strokes of sweeping net from cotton cultivated in sex pheromone trap throughout 1998 cotton season.

Sampling date	*M.rufiventris*		*Zele spp.*		*T. larvarum*		*P. orbata*		*Ex. roborator*	
	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap
May, 29th	1.3	1.3	1.7	1.7	0.3	0.3	0.0	0.0	0.0	0.0
June, 5 th	1.7	1.7	1.7	2.0	0.7	0.7	0.3	0.3	0.0	0.0
June, 12 th	2.0	2.0	2.3	2.3	1.0	1.0	0.7	0.7	0.0	0.0
June, 19 th	3.0	3.0	2.7	2.7	1.7	1.7	1.3	1.3	0.0	0.0
June, 26 th	2.7	2.7	0.7	0.7	1.0	1.0	1.0	1.0	0.0	0.0
July, 3 rd	2.3	2.3	0.3	0.3	1.3	1.3	0.7	0.7	0.0	0.0
July, 10 th	1.3	1.7	0.3	0.3	0.7	0.7	0.0	0.0	0.0	0.0
July, 17 th	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0
July, 24 th	1.0	1.0	1.3	1.0	0.0	0.0	0.0	0.0	0.3	0.3
July, 31 st	1.3	1.7	1.7	1.7	0.0	0.0	0.3	0.7	0.7	0.7
Aug., 7th	1.7	1.7	3.0	3.0	0.0	0.0	0.7	0.7	0.7	1.0
Aug., 14 th	2.0	2.0	2.7	2.7	0.3	0.3	1.3	1.3	1.7	1.7
Aug., 21 st	2.0	2.0	2.3	2.3	1.0	1.7	1.0	1.0	1.3	1.3
Aug., 28 th	2.3	2.3	2.0	2.7	0.7	1.3	1.7	1.7	1.3	1.7
Sep., 4 th	1.7	1.7	1.3	1.3	1.3	1.3	1.3	1.3	1.0	1.0
Sep., 11th	1.7	1.7	0.7	0.7	1.3	1.3	1.0	1.3	1.7	2.0
Sep., 18 th	1.3	1.3	0.0	0.3	1.7	1.7	0.7	0.7	1.0	0.7
Sep., 25 th	0.7	1.0	0.0	0.3	1.0	1.0	0.0	0.0	0.7	0.7
Total	30.7	31.8	24.4	25.4	14.0	15.3	12.0	12.7	10.4	11.1
Mean	1.71	1.77	1.36	1.41	0.78	0.85	0.67	0.71	0.58	0.62
"T" test	N.S.		N.S.		N.S.		N.S.		N.S.	

Table (64): Averages in numbers of parsitoids /10 double strokes of sweeping net from cotton cultivated in sex pheromone trap throughout 1999 cotton season.

Sampling date	*M.rufiventris*		*Zele spp.*		*T. larvarum*		*P. orbata*		*Ex. roborator*	
	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap	Cont.	Trap
May, 28th	2.0	2.0	2.3	2.3	0.3	0.3	0.0	0.0	0.0	0.0
June, 4 th	2.7	2.3	2.7	2.7	0.7	0.7	0.7	0.7	0.0	0.0
June, 11 th	3.7	3.7	3.3	1.0	1.0	0.7	0.3	0.3	0.0	0.0
June, 18 th	4.3	4.3	3.7	3.3	1.3	1.3	1.7	1.7	0.0	0.0
June, 25 th	3.3	3.7	2.7	2.7	1.0	1.0	0.7	0.7	0.0	0.0
July, 3 rd	3.0	3.0	0.7	0.7	0.7	0.7	0.3	0.3	0.0	0.0
July, 9 th	2.7	2.7	0.3	0.3	0.3	0.7	0.0	0.0	0.0	0.0
July, 16 th	2.3	2.3	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0
July, 23 rd	2.0	2.0	1.7	1.7	0.0	0.0	0.0	0.0	0.3	0.3
July, 30 th	2.3	2.7	2.0	2.0	0.0	0.0	0.3	0.3	0.7	0.7
Aug., 6th	3.0	3.0	7..2	2.3	0.0	0.0	0.7	0.7	1.0	1.0
Aug., 13 th	2.3	2.3	3.0	2.7	0.3	0.3	0.3	0.3	1.7	1.7
Aug., 20 th	2.3	2.7	2.3	2.3	0.7	0.7	0.3	0.3	0.7	1.0
Aug., 27 th	3.3	3.3	2.0	2.0	0.3	1.0	1.7	1.7	0.3	0.7
Sep., 3 rd	2.7	2.7	1.7	1.3	0.7	0.7	0.3	0.3	0.7	0.7
Sep., 10 th	2.0	2.7	0.7	1.0	1.0	1.0	1.0	1.3	1.7	1.7
Sep., 17 th	2.0	2.0	0.3	1.0	1.3	1.3	0.7	1.0	0.7	0.7
Sep., 24 th	1.7	1.7	0.0	0.7	0.7	0.7	0.0	0.0	0.3	0.3
Total	47.6	49.1	33.4	34.0	10.3	10.8	9.0	9.6	8.1	8.8
Mean	2.64	2.73	1.86	1.89	0.57	0.60	0.50	0.53	0.45	0.49
"T" test	N.S.		N.S.		N.S.		N.S.		N.S.	

collected from control & sex – pheromone treatments in 1998 and 1999 cotton seasons, respectively. Highest abundance of adults were detected on June, 19 th 1998 (3 & 3 adults/ 10 double net strokes; Table, 63) and on June, 18 th 1999 (4.3 & 4.3 adults; Table, 64). Two periods of higher abundance of the parasitoid may be discerned from June, 12 th to July, 3 rd (2 – 3adults/ 10 double strokes) and from August, 14 th to 28 th (2-2.3 adults) in 1998, and from the beginning of June to mid – July (2.3 – 4.3 adults) and from the beginning of August to the beginning of September (2.3 – 3.3 adults/ 10 double strokes) in the subsequent season.

III – 2 – *Zele spp. (Chlorphthalma* and *nigricornis):*

Zele adults ranked the second in general abundance in cotton fields after *M. rufiventris.* The total mean counts throughout the whole period of cotton season were 24.4 & 25.4 adults in 1998 and 33.4 & 34.0 adults in 1999 in control and sex – pheromone treatments, respectively (Tables, 63 & 64). In control, the parasitoid was of higher abundance on June, 19 th and August, 7 th (2.7 & 3.0 adults/ 10 double strokes) in 1998 and on June, 18 th August, 13 th (3.7 & 3.0 adults) in 1999 season. While in the sex – pheromone trap treatments, those occurred on the same dates, but recording different counts (2.7 & 3.0 adults in 1998; Table, 63)

III – 3 – *Exeristes* (= *Pimpla*) *roborator:*

Data presented in Tables (63 & 64) show that *Ex. roborator* adults were the least abundant compared to the remaining parasitoids (8.1 &8.8 adults as a total of mean counts in 1998 and 10.4 & 11.1 adults in 1999 from the control

and sex – pheromone trap, respectively). No adult of this ichneumonid could be detected from the beginning of the season up to mid – July. The parasitoid was of, relatively, higher abundance about mid – August of both seasons (1.7 adults/ 10 double sweeping net strokes) and the second week of September (1.7 adults/ 10 double strokes in 1998; Table, 63 and 1.7 & 2.0 adults/ 10 double strokes in 1999; Table, 64).

III – 4- *Tachina larvarum L:*

Adults of *T. larvarum* were detected in cotton fields from the beginning of the season to the first third of July, and again from mid – August to the end of the season. This parasitoid ranked the third in general abundance of adults after *M. rufiventris* and *Zele spp.* 14.0 & 15.3 adults/ 10 double strokes on control and sex – pheromone treatments, respectively in 1998 and 10.3 & 10.8, respectively in 1999 cotton season; Tables, 63 & 64). The highest weekly count of adults swept/ 10 double strokes were only 1.7 adults in 1998 cotton season on June, 19 th and September, 18 th 1998 (Table, 63), and only 1.3 adults on June, 18 th and September, 17 th 1999 (Table, 64). While, adults of *T. larvarum* were completely absent from the collected samples from mid – July to the first week of August (Tables, 63 & 64).

III – 5 – *Periboea orbata* wied [= *Strobliomyia aegyptia* (Villen)]

Adults of *P. orbata* were present in cotton fields during two periods, the first extended from the first week of June until the first week of July, and the second from the end of July to the third week of September (Tables, 63 & 64). The parasitoid

adults appeared, generally, of lower abundance than *T. larvarum* (12.0 & 12.7 adults in 1998 and 9.0 & 9.6 adults in 1999). The relative higher abundance of this tachinid was estimated by 1.3 adults/ 10 double strokes on June, 19 th and 1.7 adults on August, 28 th in 1998 cotton season (Table, 63), and by 1.7 adults on June, 18 th and on August, 27 th (Table, 64). The parasitoid adults were absent from the collected samples during the period from the second to the 4 th week of July in both seasons.

Comparing the whole season total counts of adults of each of the mentioned parasitoids in the control treatment with that in the sex- pheromone treatment, data in Tables (63 & 64) indicates the obtained differences were always insignificant. Thus confirming the safety of using sex–pheromones against cotton pests on the population abundance of parasitic insects in cotton fields, and subsequently it is expected that using these safe materials has no effect on the natural role of these beneficial insects.

According to the total of weekly mean counts of the concerned parasitoids which are recorded in Tables (63 & 64) and graphically illustrated in Fig. (27), the studied parasitoid species may be arranged descendingly according to the total population abundance as; *M. rufiventris, Zele spp., T. larvarum, P. orbata* and *E x. roborator.*

IV – Percentages of parasitism:

IV – 1- Parasitoids of *S. littoralis:*

Larvae of *S. littoralis* were weekly collected from the experimental plots of control and sex–pheromone trap

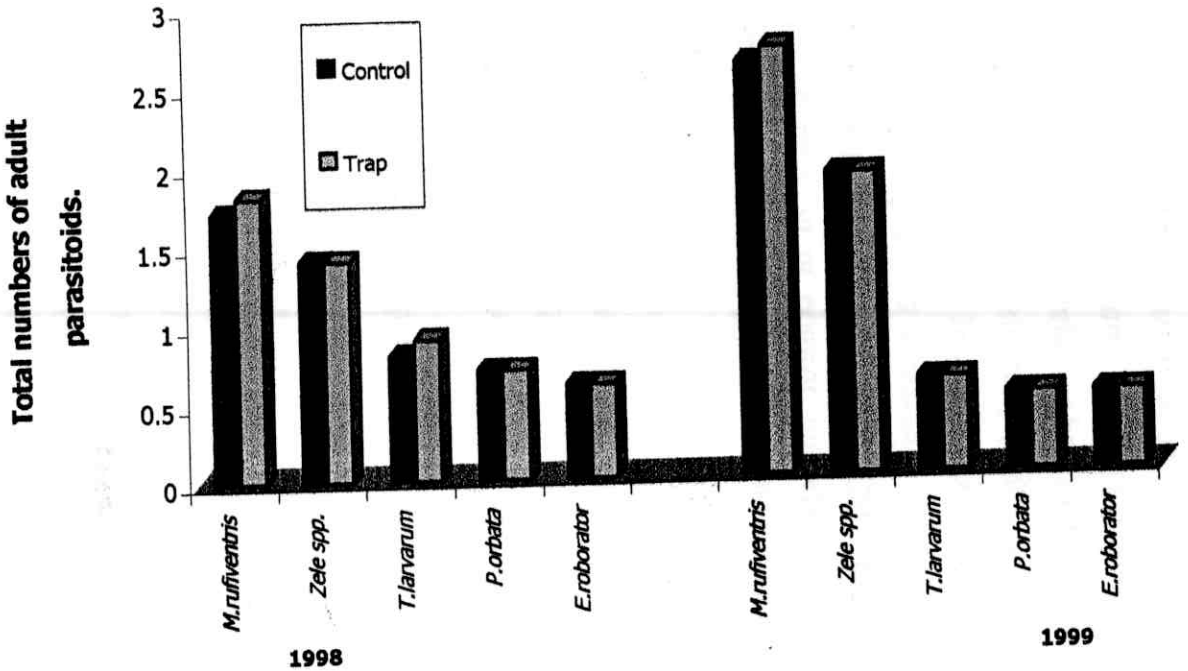

Fig. (27): Total numbers of parasitoids counted from sex-pheromone trap and control treatments throughout 1998 and 1999 cotton seasons.

treatments, from the first week of June to the last week of September in 1998 and 1999 cotton seasons. The collected larvae were transported to the laboratory and reared on castor bean leaves until pupation of any parasitoids or pupation and emergence of *S. littoralis* moths. Cocoons or puparia of parasitoids were confined, individually, in small glass tubes until emergence of adults.

Data concerning the percentages of parasitism, in control and sex – pheromone treatments are recorded in Tables (65 & 66). The recorded data can be explained as follows:

IV- 1 – 1 – *M. rufiventris* Kok.:

As shown in Tables (65 & 66) the percentages of parasitism by *M. rufiventris* were the highest (overall seasonal percentages of 12.5 & 13.4 % in 1998 and 14.4 & 15.4% in 1999 among *S. littoralis* larvae collected from control and sex – pheromone trap, respectively), compared to those recorded for all the remaining four parasitoid species found during this study, Two highest percentage of parasitized *S. littoralis* larvae (21.1 & 22.5 % in control and sex – pheromone treatments) occurred on June, 20 th 1998 and (20.2 & 20.0% on June, 19 th 1999. After that, the successive weekly samples of larvae collected from cotton plants showed a successive decrease in percentages of parasitism until August, 8 th 1998 and July, 24 th 1999 when the percentages of parasitism reached 7.7 & 11.7 in the former season and 13 & 14.5 in the latter one. The subsequent sample showed another increase in percentages of parasitism to reach another peak on August, 15 th 1998 (19.0 & 17.9 %; Table, 65) and August, 14 th 1999 cotton season (21.9

Table (65): Numbers and percentages of parasitoids emerged from *S. littoralis* larvae collected from sex-pheromone trap and control treatments throughout 1998 cotton season.

Sampling date	No of collected larvae		*M.rufiventris*				*Zele spp.*				*T.larvarum*				*P. orbata*				*Ch. inanitus*				Total			
			Control		Sex-pheromone trap		Control		Sex-pheromone trap		Control		Sex-pheromone trap		Control		Sex-pheromone trap		Control		Sex-pheromone trap		Control		Sex-pheromone trap	
	Cont.	Trap	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 6th	53	56	7	13.2	8	14.3	1	1.9	1	1.8	1	1.9	1	1.8	1	1.9	1	1.8	0	0.0	0	0.0	10	18.9	11	19.6
June, 13th	65	68	11	16.9	11	16.2	1	1.5	2	2.9	2	3.1	2	2.9	2	3.1	2	2.9	0	0.0	0	0.0	16	24.6	17	25.0
June, 20th	71	71	15	21.1	16	22.5	2	2.8	3	4.2	1	1.4	2	2.8	1	1.4	1	1.4	0	0.0	0	0.0	19	26.8	22	31.0
June, 27th	62	62	13	21.0	13	21.0	1	1.6	1	1.6	1	1.6	1	1.7	1	1.6	1	1.6	0	0.0	0	0.0	16	25.8	16	25.8
July, 4th	44	45	9	20.5	9	20.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.3	1	2.2	0	0.0	0	0.0	10	22.7	10	22.2
July, 11th	52	53	8	15.4	8	15.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	8	15.4	8	15.1
July, 18th	55	55	8	15.4	9	16.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.8	1	1.8	9	16.4	10	18.2
July, 25th	68	68	7	10.3	8	11.8	1	1.5	1	1.5	0	0.0	0	0.0	1	1.5	2	2.5	1	1.5	2	2.9	10	14.7	13	19.1
Aug., 1st	80	80	5	6.3	6	7.5	2	2.5	2	2.5	0	0.0	0	0.0	3	3.8	3	3.8	3	3.8	3	3.8	13	16.3	14	17.5
Aug., 8th	65	60	5	7.7	7	11.7	1	1.5	1	1.7	0	0.0	0	0.0	1	1.5	2	3.3	3	4.6	3	5.0	10	15.4	13	21.7
Aug., 15th	58	56	11	19.0	10	17.9	1	1.7	1	1.8	0	0.0	0	0.0	1	1.7	1	1.7	2	3.4	2	3.6	15	25.9	14	25.0
Aug., 22nd	46	43	6	13.0	5	11.6	1	2.2	1	2.3	0	0.0	0	0.0	1	2.2	1	2.3	2	4.3	3	7.0	10	21.7	10	23.3
Aug., 29th	26	26	3	11.5	3	11.5	1	3.8	1	3.8	1	3.8	1	3.8	1	3.8	1	3.8	2	7.7	2	7.7	10	38.5	8	30.8
Sep., 5th	34	34	3	8.8	3	8.8	2	5.9	2	5.9	1	2.9	1	2.9	2	5.9	2	5.9	3	8.8	3	8.8	11	32.4	11	32.4
Sep., 12th	45	45	3	6.7	4	8.9	1	2.2	2	4.4	2	4.4	2	4.4	2	4.4	2	4.4	3	6.7	3	6.7	11	24.4	13	28.9
Sep., 19th	60	60	3	5.0	4	6.7	1	1.7	1	1.7	1	1.7	1	1.7	2	3.3	2	3.3	2	3.3	3	5.0	9	15.0	11	18.3
Sep., 26th	72	72	3	4.2	4	5.6	1	1.4	1	1.4	0	0.0	1	1.4	1	1.4	2	2.8	2	2.8	3	4.2	7	9.7	11	15.3
Overall	957	954	120		128		17		20		10		12		21		24		24		28		194		212	

Table (66): Numbers and percentages of parasitoids emerged from *S. littoralis* larvae collected from sex-pheromone trap and control treatments throughout 1999 cotton season.

Sampling Date	No of collected larvae		*M.rufiventris*				*Zele spp.*				*T.larvarum*				*P. orbata*				*Ch.inanitus*				Total			
			Control		Sex-pheromone trap		Control		Sex-pheromone trap		Control		Sex-pheromone trap		Control		Sex-pheromone trap		Control		Sex-pheromone trap		Control		Sex-pheromone trap	
	Cont.	Trap	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
June, 5 th	59	60	9	15.3	9	15.0	1	1.7	1	1.7	1	1.7	1	1.7	1	1.7	1	1.7	0	0.0	0	0.0	12	20.0	12	20.0
June, 12 th	77	75	13	16.9	13	17.3	2	2.6	2	2.7	2	2.6	2	2.7	2	2.6	2	2.7	0	0.0	0	0.0	19	24.7	19	24.7
June, 19 th	84	85	17	20.2	17	20.0	3	3.6	4	4.7	2	2.4	1	2.4	1	1.2	1	2.4	0	0.0	0	0.0	23	27.4	25	29.4
June, 26 th	64	63	12	18.8	12	19.0	1	1.6	1	1.6	1	1.6	1	1.6	1	1.6	1	1.6	0	0.0	0	0.0	15	23.4	15	23.8
July, 3rd	75	77	13	17.3	13	16.9	0	0.0	0	0.0	0	0.0	0	0.0	1	1.3	1	1.3	0	0.0	0	0.0	14	18.7	14	18.2
July, 10 th	88	89	14	15.9	15	16.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	14	15.9	15	15.9
July, 17 th	138	139	19	13.8	21	15.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7	2	1.4	20	14.5	23	16.5
July, 24 th	154	152	20	13.0	22	14.5	2	1.3	2	1.3	0	0.0	0	0.0	3	1.9	4	2.6	2	1.3	3	2.0	27	17.5	31	20.4
July, 31 st	106	103	15	14.2	16	15.5	2	1.9	1	1.0	0	0.0	0	0.0	6	5.7	7	6.8	3	2.8	3	2.9	26	24.5	27	26.2
Aug., 7 th	77	77	12	15.6	13	16.9	1	1.3	2	2.6	0	0.0	0	0.0	3	3.9	3	3.9	4	5.2	4	5.2	20	26.0	22	28.9
Aug., 14 th	32	40	7	21.9	8	20.0	1	3.1	1	2.5	0	0.0	0	0.0	1	3.1	1	2.5	1	3.1	2	5.0	10	31.3	12	30.0
Aug., 21 st	24	24	4	16.7	3	12.5	1	4.2	1	4.2	0	0.0	0	0.0	1	4.2	1	4.2	1	4.2	1	4.2	7	29.2	6	25.0
Aug., 28 th	30	20	4	13.3	2	10.0	1	3.3	0	0.0	1	3.3	2	10.0	1	3.3	1	5.0	3	10.0	3	15.0	10	33.3	8	40.0
Sep., 4 th	45	40	5	11.1	5	12.5	2	4.4	2	5.0	2	4.4	2	5.0	3	6.7	3	7.5	6	13.3	7	17.5	18	40.0	19	47.5
Sep., 11 th	62	54	6	9.7	7	13.0	2	3.2	2	3.7	4	6.5	3	5.6	3	4.8	3	5.6	8	12.9	8	14.8	23	37.1	23	42.6
Sep., 18 th	73	62	6	8.2	7	11.3	1	1.4	2	3.2	3	4.1	3	4.8	3	4.1	3	4.8	7	9.6	8	12.9	20	27.4	23	37.1
Sep., 25 th	87	77	7	8.0	8	10.4	0	0.0	1	1.3	1	1.1	1	1.3	2	2.3	3	3.9	6	6.9	7	9.1	16	18.4	20	26.0
Overall	1275	1237	183		191		20		22		17		17		32		36		42		48		294		314	

& 20.0 %; Table, 66) after which a successive decreases in the percentages occurred. Generally, the percentages of parasitism by *M. rufiventris* were higher in 1999 than 1998 cotton season (Tables, 65 &66).

IV – 1 – 2 – *Zele spp.; chlorophthalma* (Ness) and *nigricornis* (Walk.):

The percentages of parasitism by *Zele spp.* were generally, much lower in both two seasons than those recorded for *M. rufiventris.* Parasitsed *S. littoralis* larvae were detected in two periods; the first from the beginning of season to the last week of June and the second from the last week of July to the end of season in 1998 and 1999 cotton seasons. No *Zele spp.* emerged from the host larvae during the first three weeks of July in the two cotton seasons. Highest percentages of parasitism reached 5.9 % on September, 5 th in both treatments in 1998 season and 4.4 & 5 % on September, 4 th 1999 among larvae collected from the control and sex – pheromone treatments, respectively. The overall seasonal percentages of parasitism were 1.8 & 2.1 % in 1998 (Table, 65) and 1.6 & 1.8 % in 1999 cotton (Table, 66).

IV – 1 – 3 – *Chelonus inanitus L.*

Data presented in Tables (65 & 66) indicate that *S. littoralis* parasitism by *Ch. Inanitus* started to be detected from the third week of July and the parasitoid remained active up to the end of season with overall seasonal percentages of 2.5 & 2.9 % in 1999 (Table, 65) and 3.3 & 3.9 in 1999 cotton season (Table, 66) in control and sex – pheromone treatments, respectively. The highest percentage of parasitism (8.8%) was

detected September, 5 th 1998 and (13.3 & 17.5 %, respectively) on September, 4 th 1999. On the other hand, parasitise*S. littoralis* larvae by *Ch. Inanitus* could be detected from the beginning of season until the second week of July in both seasons and treatments.

IV – 1 – 4 – *Tachina larvarum* L.:

Parasitised *S. littoralis* larvae by *T. larvarum* were detected, among larvae collected from control and sex – pheromone treatments in two periods, the first from the beginning of season until the end of June with highest percentage of parasitism (3.1 & 2.9 %) on June, 13 th 1998 (Table, 65) and (2.6 & 2.7 %) on June, 12 th 1999 (Table, 66) in control and sex – pheromone trap treatments, respectively. The second period extended from the last week of August until the end of season with highest parasitism % (4.4 & 4.4 %) on September, 12 th 1998 and (6.5 & 5.6 %) on Septmber, 11 th 1999 in control and sex – pheromone trap treatment, respectively. All of *S. littoralis* larvae collected during July and August of both seasons were found free from any *T. larvarum* parasitism. The overall seasonal percentages of parasitism on *S. littoralis* larvae, collected throughout the season, lasted 1.0 & 1.3 in 1998 (Table, 65) and 1.3 & 1.4% in 1999 cotton season (Table, 66).

IV – 1 – 5 – *Periboea orbata* Wied.

As shown in Tables (65 & 66), the tachinid, *P. orbata* was of, relatively, higher population larval seasonal percentages of parasitised *S. littoralis* larvae; 2.2 & 2.5 % in 1998; Table, 65 and 2.5 & 2.9 % in 1999 cotton season; (Table,

66) than the other tachinid, *T. larvarum.* parasitised larvae were detected in two periods, the first from the beginning of season until the first week of July with highest percentage of parasitism (3.1 & 2.91 %) on June, 13 th 1998 and (2.6 & 2.7 %) on June, 12 th 1999 in control and sex – pheromone trap experiments, respectively. The second period covered from the last week of July to the end of season with highest parasitism percentage (5.9 %) on September, 5 th 1998 (Table, 65) and 6.7 % 7.5 %) on September, 4 th 1999 cotton season (Table, 66). No parasitised *S. littoralis* larvae by P. orbata could be detected during the second and third weeks of July in both seasons of study (Tables, 65 & 66).

Data recorded in (Tables 65 & 66) and those graphically illustrated in Fig. (28) revealed that the percentages of parasitism by *M. rufiventris, Zele spp., Chelonus inanitus, T. larvarum* and *P. orbata* in sex – pheromone trap were, slightly, higher than those recorded from *S. littoralis* larvae collected from the control treatment in both seasons of study. According to the demonstrated overall seasonal percentages of parasitism by different parasitoids; the studied parasitoid species may be arranged in a descending order as *M. rufiventris, Ch. Inanitus, P. orbata, Zele spp.* and *T. larvarum.*

IV – 2 – Parasitoids produced from infested cotton bolls:

Sixty infested cotton bolls were collected, weekly, from the plots of each treatment from July, 15 th until September, 23 rd 1998 and from July, 14 th to September, 22 nd 1999. Samples were transported to the laboratory and dissected *P. gossypiella* and *E. insulana* larvae were counted and individually reared on

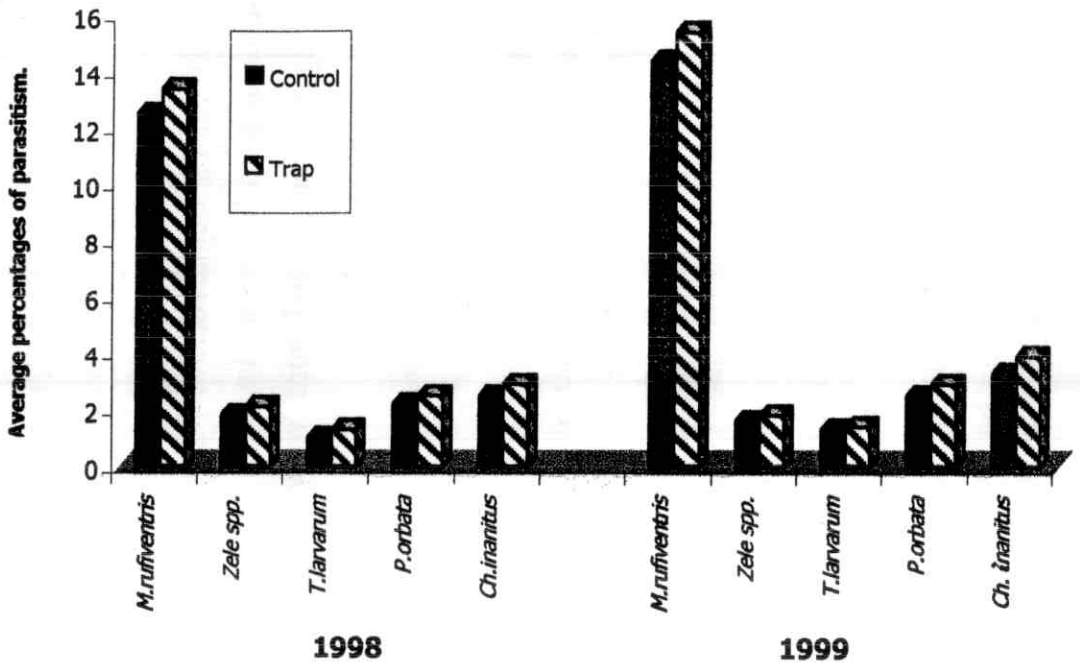

Fig. (28): Average percentages of parasitoids emerged from *S. littoralis* larvae from sex- pheromone trap and control treatments throughout 1998 and 1999 cotton seasons.

fresh uninfested bolls in glass vials until emergence of parasitoids. Only, two parasitic species were emerged; the first was a braconid *Apanteles sp.* emerged from *P. gossypiella* larvae and the second was a tachinid *Periboea orbata* emerged from *E. insulana* larvae.

Data concerning the numbers of parasitoids, in both control and sex – pheromone trap treatments, with each of the surveyed species, are recorded in Tables (67 & 68) and graphically illustrated in Fig. (29).

IV – 2 -1 – *Apanteles* sp.:

Abbas and El- Deeb (1993) in Egypt, recorded that parasitoid *Apanteles* sp. was parasitized on *P. gossypiella* larvae in cotton fields, during September and October, but the rate of parasitism was few.

According to data in Tables (67 & 68) adults of *Apanteles* sp. were detected, only, during September in both treatments and two seasons. The recorded overage rate of parasitism by *Apanteles* sp. in control was (3.8 & 3.3 %) opposed to (4.2 & 3.1 %) in sex – pheromone trap treatment, in 1998 and 1999 cotton season, respectively, (Tables, 67 & 68 and Fig., 29).

IV- 2 –2 –*Periboea orbata* Wied:

Willcocks and Bahgat (1937) in Egypt, recorded that the tachinid parasite, *P. orbata* parasitized on *P. gossypiella* larvae in cotton fields.

Data presented in Tables (67 & 68), show the parasitism by *P. orbata* occurred during August and September in both seasons. The average rate of parasitism in sex – pheromone

Table (67): Percentages of parasitism occurred in *P. gossypiella* larvae parasitized by *Apanteles* sp. and *E. insulana* larvae parasitised by *P. orbata* from 60 infested cotton bolls / treatment throughout 1998 cotton season.

Sampling data	Control									Sex - pheromone								
	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles sp.*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism	Total No. of *P* +*E.* larvae	Total No. of Parasitized larvae	Total No. of % Parasitism	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles sp.*	% Parasitism	No. of *E. insulana*	No. of parasitized larvae by *P. arbata*	% Parasitism	Total No. of *P* +*E.* larvae	Total No. of Parasitized larvae	Total No. of % Parasitism
July, 15th	36	0	0.0	0	0	0.0	36	0	0.0	33	0	0.0	0	0	0.0	33	0	0.0
July, 22nd	40	0	0.0	3	0	0.0	40	0	0.0	38	0	0.0	2	0	0.0	40	0	0.0
July, 29th	46	0	0.0	11	0	0.0	57	0	0.0	44	0	0.0	10	0	0.0	54	0	0.0
Aug., 5th	41	0	0.0	15	0	0.0	56	0	0.0	40	0	0.0	14	0	0.0	54	0	0.0
Aug., 12th	42	0	0.0	15	1	6.7	57	1	1.8	41	0	0.0	15	2	13.3	56	2	3.8
Aug., 19th	42	0	0.0	16	1	6.3	58	1	1.7	42	0	0.0	16	1	6.3	58	1	1.7
Aug., 26th	43	0	0.0	14	2	14.3	57	2	3.5	46	0	0.0	12	1	8.3	58	1	1.7
Sep., 2nd	45	6	13.3	10	1	10.0	55	7	12.7	51	6	11.8	7	1	14.3	58	7	1.2
Sep., 9th	50	6	12.0	8	1	12.5	58	7	12.1	55	7	12.7	2	0	0.0	57	7	12.3
Sep., 16th	56	4	7.1	3	0	0.0	59	4	6.8	57	5	8.8	0	0	0.0	57	5	8.8
Sep., 23rd	58	3	5.2	0	0	0.0	58	3	5.2	58	3	5.2	0	0	0.0	58	3	5.2
Overall	499	19		95	6		594	25		505	21		78	5		583	26	
T. test									N.S									

Table (68): Percentages of parasitism occurred in *P. gossypiella* larvae parasitized by *Apanteles* sp. and *E. insulana* larvae parasitised by *P. orbata* from 60 infested cotton bolls / treatment throughout 1999 cotton season.

	Control									Sex - pheromone								
Sampling data	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles sp.*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism	Total No. of *P.+E.* larvae	Total No. of Parasitized larvae	Total No. of Parasitism	No. of *P. gossypiella* larvae	No. of parasitized larvae by *Apanteles sp.*	% Parasitism	No. of *E. insulana* larvae	No. of parasitized larvae by *P. orbata*	% Parasitism	Total No. of *P.+E.* larvae	Total No. of Parasitized larvae	Total No. of Parasitism
July, 14th	34	0	0.0	0	0	0.0	34	0	0.0	32	0	0.0	0	0	0.0	32	0	0.0
July, 21st	40	0	0.0	5	0	0.0	45	0	0.0	38	0	0.0	6	0	0.0	44	0	0.0
July, 28th	46	0	0.0	9	0	0.0	55	0	0.0	43	0	0.0	10	0	0.0	53	0	0.0
Aug., 4th	41	0	0.0	15	0	0.0	56	0	0.0	42	0	0.0	13	0	0.0	55	0	0.0
Aug., 11th	43	0	0.0	13	1	7.7	56	1	1.8	42	0	0.0	16	1	6.3	58	1	1.7
Aug., 18th	40	0	0.0	16	1	6.3	56	1	1.8	41	0	0.0	17	2	11.8	58	2	3.4
Aug., 25th	41	0	0.0	17	1	5.9	58	1	1.7	42	0	0.0	15	1	6.7	57	1	1.8
Sep., 1st	43	5	11.6	15	1	6.7	58	6	10.3	42	4	9.5	13	1	7.7	55	5	9.1
Sep., 8th	50	6	12.0	8	1	12.5	58	7	12.1	48	5	10.4	9	1	11.1	57	6	10.5
Sep., 15th	56	4	7.1	2	0	0.0	58	4	6.9	54	3	5.6	4	0	0.0	58	3	5.2
Sep., 22nd	58	1	1.7	0	0	0.0	58	1	1.7	58	3	5.2	0	0	0.0	58	3	5.2
Overall	492	16		100	5		592	21		482	15		103	6		585	21	
T. test									N.S									

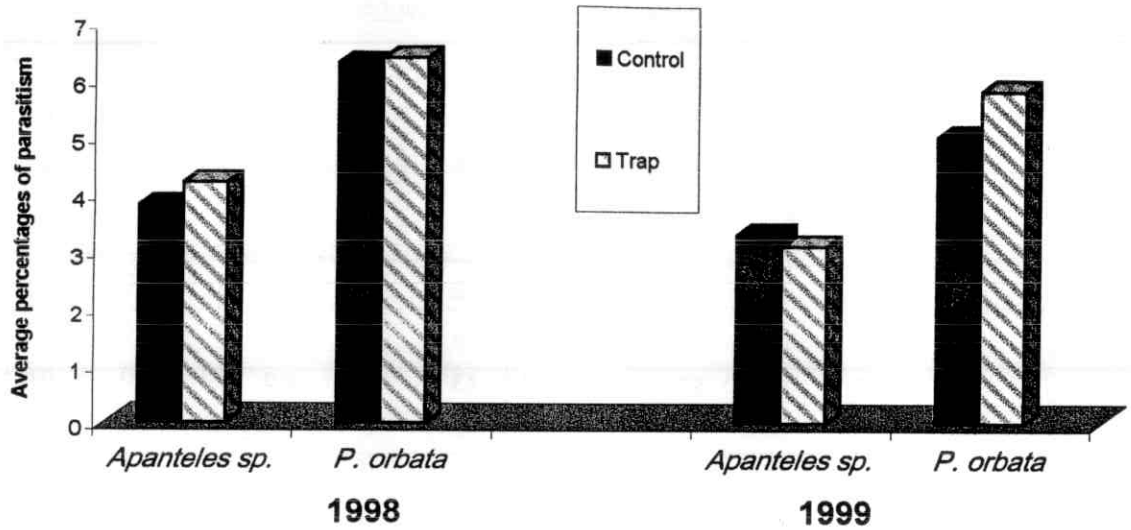

Fig (29) : Average percentages of parasitoids emerged from infested cotton bolls in sex - pheromone trap and control treatments during the whole period throughout 1998 and 1999 cotton seasons.

treatment was (6.4 & 5.8%) insignificantly, higher than that recorded in control treatment (6.3 & 5.0%) in 1998 and 1999 cotton seasons, respectively, [Tables, 67 & 68 and Fig., 29]. Also, the rate of parasitism of *P. orbata* were higher than 1999 (5.0 & 5.8%) in control and sex – pheromone treatments, respectively.

Data tabulated in Tables (67 & 68) and illustrated in Fig. (29) detected that the rate of parasitism by *P. orbata* on *P. gossypiella* in 1998 cotton season was (6.3 & 6.4 %) higher than *Apanteles* sp. on *E. insulana* in 1999 cotton season (5.0 & 5.8 %) in control and sex – pheromone treatments, respectively.

V - Rate of damage caused by cotton leafworm larvae:

The rate of damage caused by *S. littoralis* larvae to cotton leaves was estimated weekly (from June, 12 th until September, 25 th 1998 & from June, 11 th until September, 24 th 1999 cotton season) according to the method of **Kasopers (1965).**

Data presented in Table (68) and Figs. (30-33) show the rate of damage caused by *S. littoralis* larvae to cotton leaves in control and sex – pheromone treatments. These data indicate that the percentages of damage in control treatment were, insignificantly, higher than those recorded in sex–pheromone treatment in both seasons. The percentage of the damage reduction which caused to cotton leaves due to infestation by *S. littoralis* larvae in control was (10.4 %) in 1998, higher than those recorded in 1999 (9.6 %).

VI – Rate of damage caused by bollworms larvae:

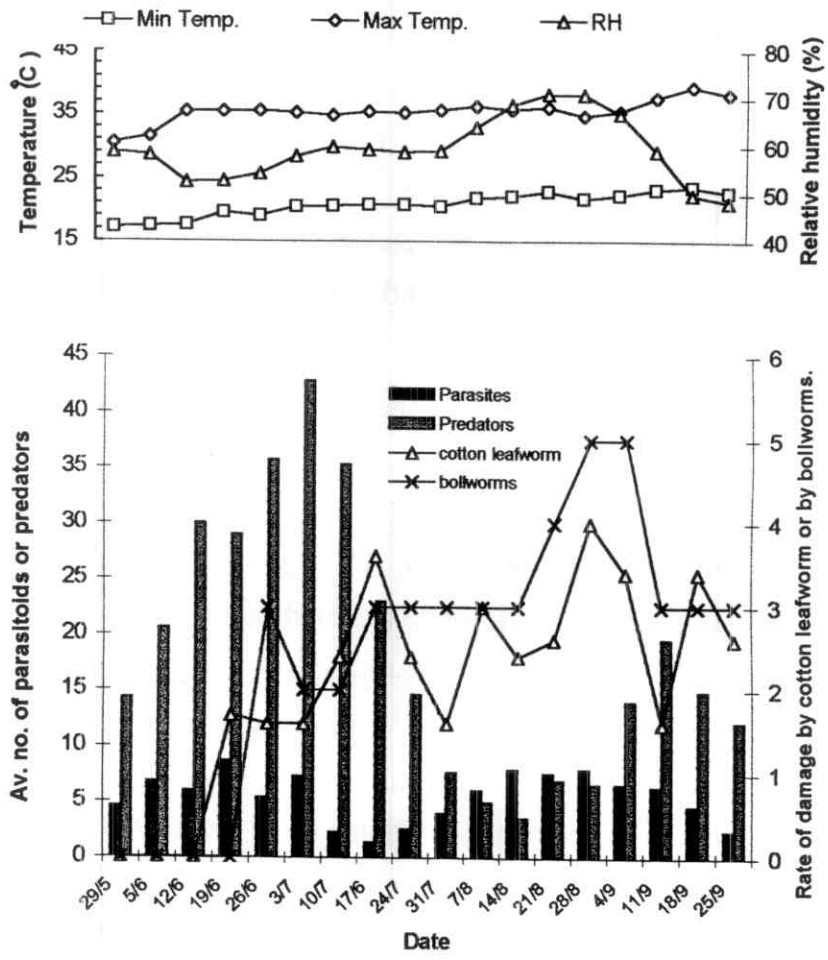

Fig (30): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm and bollworms in control treatment throughout 1998 cotton season.

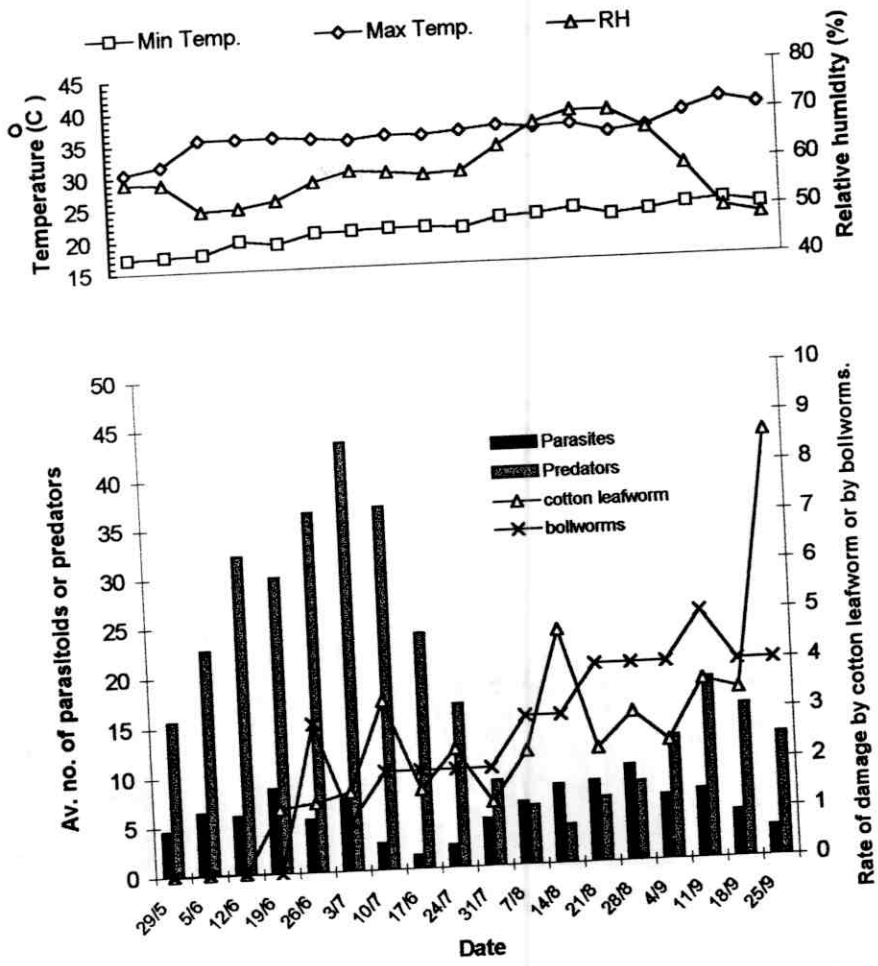

Fig (31): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm and bollworms in sex- pheromone trap treatment throughout 1998 cotton season.

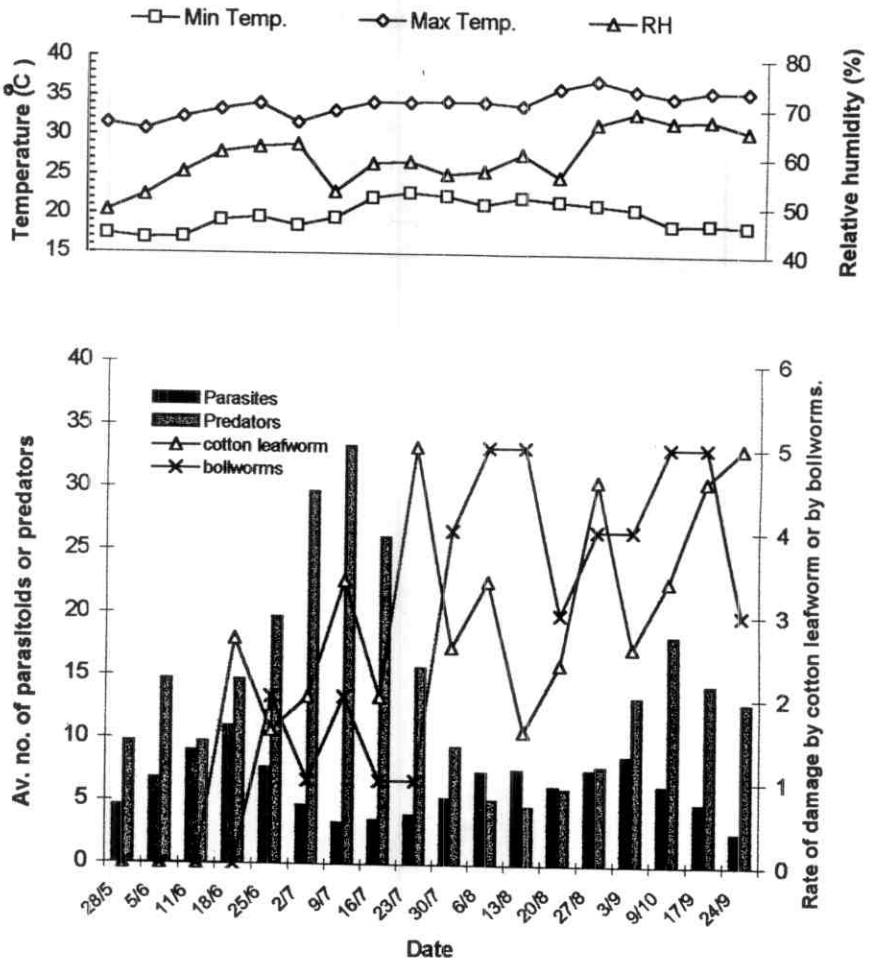

Fig (32): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm and bollworms in control treatment throughout 1999 cotton season.

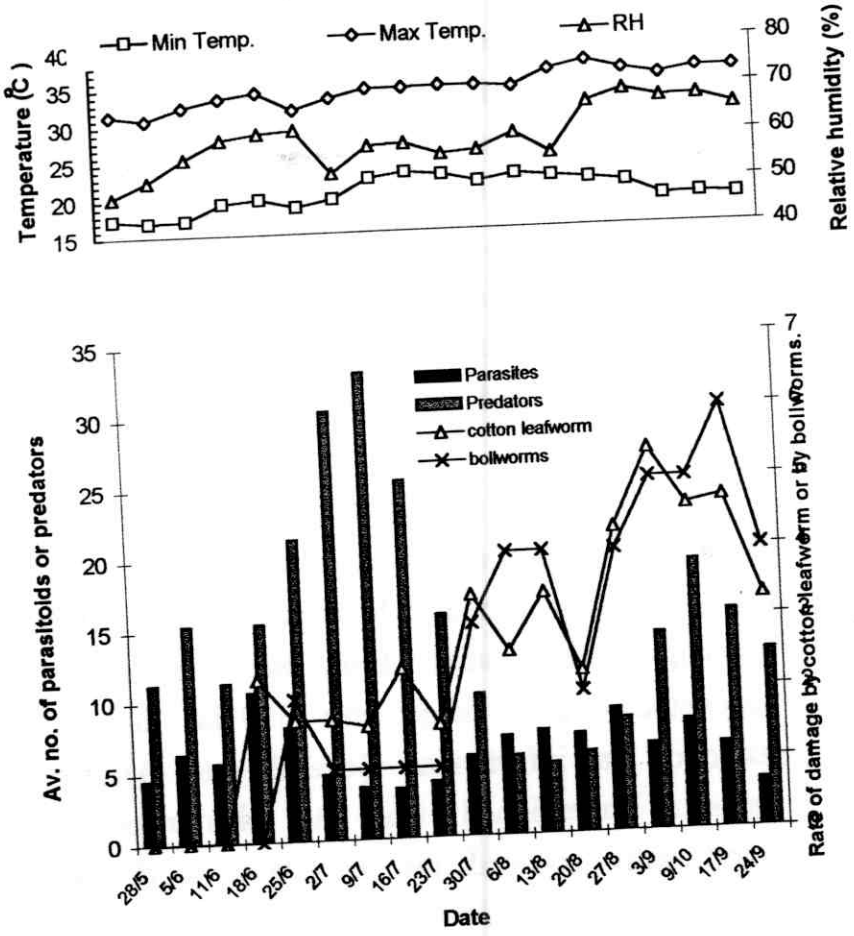

Fig (33): Relationship between the total numbers of both parasitoids and predators and weekly damage by cotton leafworm and bollworms in sex- pheromone trap treatment throughout 1999 cotton season.

The rate of damage caused by *P. gossypiella* and *E. insulana* larvae to cotton bolls, in sex – pheromone and control treatments, was estimated weekly (from June, 26 th to September, 25 th 1998 & from June, 25 th to September, 24 th 1999 season).

Data presented in Tables (69 & 70) and Figs. (30-33) show the rate of damage caused by bollworms larvae throughout 1998 and 1999 cotton seasons. These data indicate that the reduction than control in sex- pheromone treatment in 1998 was (13.7 %), higher than those calculated in control treatment (12.5 %). Also, the percentages of damage by bollworms in control treatment were insignificantly, higher than those recorded in sex – pheromone treatment in the two seasons of study.

El – Mosa (1986) in Syria, showed that the sex – pheromone has a good potential providing a monitoring system for *E. insulana* and also looks promising for control by mass trapping. The results from mass trapping experiments conducted over a larger area (150 ha.) indicated a 50 % reduction in infestation. **Qureshi and Ahmed (1989)** in Pakistan, mentioned that the pheromone formulations significantly reduced the abundance of *P. gossypiella, E. vittella* and *E. insulana* on cotton in Squares and green bolls and were effective than insecticides. However, the rate of infestation of flowers did not differ between the pheromone and insecticide treated blocks.

Table (69): Percentages of damage caused to cotton leaves due to infestation by the *S. littoralis* larvae in control and sex-pheromone trap treatment throughout 1998 and 1999 cotton seasons.

Sampling date	1998		Sampling date	1999	
	Control	Sex- pheromone		Control	Sex- pheromone
June,12 th	0.0	0.0	June,11 th	0.0	0.0
June, 19 th	1.7	1.3	June, 18 th	2.7	2.3
June, 26 th	3.3	2.7	June, 25 th	4.3	4.0
July, 3 rd	5.7	4.3	July, 2 rd	6.3	5.7
July, 10 th	9.3	7.7	July, 9 th	9.7	7.3
July, 17 th	11.7	9.3	July, 16 th	11.7	9.7
July, 24 th	13.3	11.7	July, 23 th	16.7	11.3
July, 31 st	16.3	13.0	July, 30 st	19.3	14.7
August 7 th	18.7	15.3	August 6 th	22.7	17.3
August 14 th	21.3	20.0	August 13 th	24.3	20.7
August 21 st	25.3	22.3	August 20 st	26.7	23.0
August 28 th	28.7	25.3	August 27 th	30.7	27.3
September, 4 th	30.3	27.7	September, 3 rd	33.3	32.7
September, 11 th	33.7	31.3	September, 10 th	36.7	37.3
September, 18 th	36.3	34.7	September, 17 th	41.3	42.0
September, 25 th	45.7	43.3	September, 24 th	46.3	45.3
Total	301.3	269.9	Total	332.7	300.6
Mean	18.83	16.87	Mean	20.79	187.9
Reduction than control		10.4%	Reduction than control		9.6%
T. test (treat.)		N.S.	T. test (treat.)		N.S.

Table (70): Percentages of damage caused to cotton bolls due to infestation by the bollworms larvae in sex-pheromone and control treatment throughout 1998 and 1999 cotton seasons.

	1998			1999	
Sampling date	Control	Sex- pheromone	Sampling date	Control	Sex- pheromone
June,26 th	3.0	3.0	June,25 th	3.0	3.0
July, 3 rd	5.0	4.0	July, 2 rd	3.0	3.0
July, 10 th	7.0	6.0	July, 9 th	5.0	4.0
July, 17 rd	10.0	8.0	July, 16 th	6.0	5.0
July, 24 th	13.0	10.0	July, 23 th	7.0	6.0
July, 31 st	16.0	12.0	July, 30 st	11.0	9.0
August, 7 th	19.0	15.0	August 6 th	16.0	13.0
August, 14 th	22.0	18.0	August 13 th	21.0	17.0
August, 21 th	26.0	22.0	August 20 st	24.0	19.0
August, 28 th	31.0	26.0	August 27 th	28.0	23.0
September, 4 th	36.0	30.0	September, 3 rd	32.0	28.0
September, 11 th	39.0	35.0	September, 10 th	37.0	33.0
September, 18 th	42.0	39.0	September, 17 th	42.0	39.0
September, 25 th	45.0	43.0	September, 24 th	45.0	43.0
Total	314	271	Total	280	245
Mean	22.4	19.4	Mean	20.0	17.0
Reduction than control		13.7	Reduction than control		12.5
T. test (treat.)		N.S.	T. test (treat.)		N.S.

CONCLUSION

Results obtained from laboratory experiments showed that the parasitised *S. littoralis* larvae by *M. rufiventris* were less affected by the assayed materials (bioinsecticide, IGR, chemical insecticides and mixtures of bioinsecticide + LC_{10} of IGR or chemical insecticide) than the unparasitised ones. In all treatments, the parasitised larvae showed lower mortality percentages, higher LC_{50} and longer LT_{50} than the unparasitised ones of the same age, at the same concentration. It was also evident from laboratory results that using mixtures of the bioinsecticide (Xentari) + LC_{10} of the chemical insecticide (Baythroid) or the IGR (Mimic) to be offered for larval 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 of the parasitised and unparasitised larvae, while additive effect on treated larvae was detected when the LC_{10} of chemical insecticides were mixed with higher concentrations of the bioinsecticide.

Field studies throughout the two cotton seasons (1998 and 1999), clearly, showed that the highest populations of predaceous insects and those of parasitoids occurred during the last week of June and early July. Accordingly, it could be recommended to avoid chemical insecticidal application on cotton during this period to save the entomophagous insects from the direct harmful effect on these beneficial insects, on one hand,

and minimizing the environmental pollution by insecticides, on the other hand.

Orius spp. adults were the most common predators in cotton fields, followed by ladybird beetles, while syrphid flies were the least abundant. As for parasitoids, the braconid, *Microplitis rufiventris* was the highest abundant, followed by *Zele spp.* It was clear from the obtained data that field applications of chemical or insect growth regulator insecticides caused significant reductions in populations of entomophagous insects than those estimated in control and in areas treated by the bioinsecticide (Xentari) or the plant extract *(Clerodendron inerme)*. Also, among *S. littoralis* larvae collected from the field, after different treatments, the percentages of parasitised larvae from areas that received chemical or IGR insecticides were, significantly, lower than those estimated from areas that received bioinsecticide or plant extract and from control.

Apanteles sp. and *P. orbata* were the only parasitoids emerged from cotton bolls infested by bollworms. The same trend of effectiveness of chemical insecticides, plant extract and bioinsecticide on the cotton leafworm parasitoids occurred also on the bollworms' parasitoids.

Sex-pheromones used for the attractiveness of adults of *S. littoralis*, *P. gossypiella* and *E. insulana* did not cause any reduction in the counts of entomophagous insects than control. On the contrary the numbers of these beneficial insects were, insignificantly higher in sex-pheromones treated areas than control.

In all experiments, the chemical insecticides reduced, significantly, the damage caused to cotton leaves by *S. littoralis* and that caused to cotton bolls by bollworms than in causes of bioinsecticide and plant extract treatments, but the differences were always insignificant between the two later treatments which showed considerable reductions in the damage caused by the concerned insect pests than control.

It could be finally concluded that field application of the bacterial insecticide or *C. inerme* extract on cotton plants, and also the use of sex-pheromones reduced the damage caused by the mentioned cotton pests than control, although the recorded reductions were, significantly, lower than those produced by application of chemical insecticides. In the same time, the bioinsecticide, plant extract and sex-pheromones kept the populations of entomophagous insects unharmed, in addition to minimizing the environmental pollution caused by chemical insecticides. Accordingly, these safe materials may be recommended for Lepidopterous insect pests control. It is thought that using the bioinsecticide and sex-pheromone together or using the mixtures of LC_{10} of chemical insecticide + bioinsecticide may lead to better control measures, the point which still need further investigations.