SUMMARY

The presented study was carried out aiming to find out convenient control measures against the cotton leafworm, *Spodoptera littoralis*, and bollworms, *Earias insulana* and *Pectinophora gossypiella* in order to minimize, as far as possible, the extensive use of chemical insecticides.

The first part of work included laboratory studies on the effect of a bioinsecticide (Xentari), a chemical insecticide (Baythroid), an IGR (Mimic) and a combination of Xentari concentrations with LC_{10} level of Baythroid or Mimic to determine the potential and the additional effects of Baythroid or Mimic on healthy *S.littoralis* larvae and those parasitized by *M.rufiventris*. The second, field experiment aimed to find out the impact of using of Xentari, plant extract *(Clerodendron inerme)* and Mimic for estimating the efficacy of each in controlling the mentioned pests compared to that of the recommended chemical insecticides, in relation to its predators and parasitoids' population throughout two successive cotton seasons (1998 and 1999). Also, a field experiment for the same purposes was carried out by using sex-pheromones trap for capturing the moth males of the same three pest species.

I. Laboratory experiments:

The second instar *S.littoralis* larvae (4 days old) were exposed to be parasitised by *M.rufiventris*, reared for another 5 days then fed on castor leaves dipped in different concentrations of Xentari or Baythroid or Mimic or combinations of Xentari and

LC_{10} of Baythroid or Mimic. The healthy larvae were treated by the same materials at the same age (9 days after eclosion).

I.1 Bioinsecticide treatments:

Data were recorded after 72 hours from treatment, the corrected mortality percentages for the parasitized *S.littoralis* larvae increased by increasing bioinsecticidal concentrations and ranged from 16.67 to 73.33% at the concentrations of 4×10^4 to 24×10^4 DBMU, opposed to 20.00 to 86.67% in healthy larvae. The LC_{50} values were 15×10^4 DBMU for parasitized larvae, opposed to 10.5×10^4 in healthy ones. The LT_{50} values were longer in case of parasitized than unparasitized larvae, at the same concentration of Xentari. A negative relationship could be detected between the bioinsecticide concentrations and LT_{50} values, these values were 44, 34 and 26 hours for the unparasitized larvae and 60, 52 and 42.5 hours for parasitized ones by using the concentrations 16×10^4, 20×10^4 and 24×10^4, respectively.

I.2. Chemical insecticide treatments:

After 24 hours of treatment, the corrected mortality percentages among parasitized larvae ranged from 13.33 to 80.00% by using concentrations ranging between 15-90 ppm, opposed to 30.00 to 93.33% for the unparasitized larvae. The LC_{50} values were 52 and 33 ppm for the parasitized and unparasitized larvae, respectively. The obtained data revealed that the parasitized larvae were less susceptible to the chemical insecticide treatments than the unparasitized ones. At Baythroid concentrations of 30 and 45 ppm, the LT_{50} values were 38 and

24 hours for unparasitized larvae, 78 and 44 hours for parasitized ones.

I.3. Insect Growth regulator:

The corrected mortality percentage among parasitized larvae after 72 hours of treatment with IGR (Mimic) concentrations (25-800 ppm) ranged from 16.67 to 83.33%, opposed to 30.00 to 93.33% among the unparasitized ones. The LC_{50} values were 150 and 95 ppm, respectively. Also, the LT_{50}'s 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).

I.4. Combination treatments:

The combined effects of Xentari concentrations contained with LC_{10} of chemical insecticide or IGR were estimated either by determining the LC_{50}'s or by estimating the co-toxicity factor.

a. Mixtures of Xentari with Baythroid:

After 72 hours from *S. littoralis* larval treatment, the corrected mortality percentages were 23.33, 50.000, 70.00, 80.00, 86.67 and 90.00% for unparasitized larvae, and 16.67, 33.33, 60.00, 70.00 and 73.33% for the parasitized larvae, at concentrations of 4, 8, 12, 16, 20, 24×10^4 DBMU of Xentari mixed with the LC_{10} of Baythroid. The LC_{50} values were 7.8×10^4 DBMU+6.6 ppm Baythroid and 12×10^4 DBMU +10.4 ppm baythroid for unparasitized and parasitized larvae, respectively. Treatments of unparasitised *S. littoralis* larvae by low concentrations of Xentari (4 and 8×10^4 DBMU) mixed with LC_{10}

of Baythroid caused 23.33 and 50.00% mortalities and the values of co-toxicity factor were + 33.31 and + 22.94, respectively, showing potentiation in their effect. While, higher concentration of Xenatri (12, 16, 20 and 24×10^4 + LC_{10} of Baythroid) caused 70.00, 80.00, 86.67 and 90.00% among the unparasitised larvae and the co-toxicity factor values were + 18.64, + 11.11, + 7.44 and + 3.49, respectively showing only additive effects. In case of parasitized larvae, the lowest concentration (4×10^4) of Xentari combined with LC_{10} of Baythroid caused 16.67% mortality and the co-toxicity factor was + 44.96 indicating potentiation. While, the higher concentrations (8, 12, 16, 20, 24×10^4 DBMU) with LC_{10} of Baythroid caused 33.33, 50.00, 60.00, 70.00 and 73.33% corrected mortalities, respectively, and the co-toxicity factor values were (+18.32, + 14.94, + 10.9, + 7.97 and + 4.01), respectively indicating additive effects.

b. Mixtures of Xentari with Mimic:

After 72 hours from the treatment, the combination of different concentrations of Xentari (4, 8, 12, 16, 20, 24×10^4 DBMU) and LC_{10} of Mimic (19.0 ppm for the unparasitized larvae or 30.00 ppm for parasitized ones), the corrected mortality percentages were 33.00, 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. The LC_{50} values were 6.8×10^4 DBMU + 19.0 ppm and 8.6×10^4 DBMU + 30.0 ppm for unparasitized and parasitized larvae, respectively.

Mixing the lower concentrations of Xentari (4 and 8×10^4) + LC_{10} 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, respectively indicating potentiative effects, while, the higher concentrations (12, 16, 20, 24×10^4 + LC_{10} of Mimic) caused mortalities of 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, indicating additive effects. Also, in case of parasitized larvae, potentiative effect (+20) was obtained from mixing the lowest concentration of Xentari with LC_{10} of Mimic, while additive effects (+ 13.83, + 11.11, +7.84, +6.38 and +3.18) occurred when higher concentrations of Xentari (8, 12, 16, 20 and 24×10^4 DBMU) were mixed with LC_{10} of Mimic.

II. Field experiments:

Two experiments were carried out in the Experimental Research Station of the Faculty of Agriculture at Moshtohor. The first aimed to find out the impact of using either of Xentari, Mimic, plant extract or recommended chemical insecticides on cotton leafworm and bollworms infestations and the associated entomophagous insects, and the second by using 3 sex-pheromones for capturing males of the same pests.

II.1. First experiment:

A. Numbers of adult predators:

Insignificant differences in the counted total numbers of *C. undecimpunctata*, *Cydonia vicina isis*, *Cydonia vicina nilotica*, *Scymnus spp.*, *P. alfierii*, *Chrysoperla carnea*, *Orius spp.* and syrphids were detected between the area sprayed by the plant extract and that received Xentari application, and also than control. But, these numbers decreased, significantly, by using chemical insecticides or IGR than control, while the differences in total counts were insignificant between chemical insecticides

and IGR treatments. In both cotton seasons, *Orius spp.* adults were the most common on cotton plants, followed by ladybird beetles, *P.alfierii*, *Chrysoperla carnea* and *Scymnus spp.*, while the lowest counts were those of syrphid flies.

B. Numbers of adult parasitoids:

Data confirmed that *M. rufiventris* was the dominant parasitoid, followed descendingly by *Zele spp.*, *T. larvarum*, *P. orbata* and *Ex. roborator*. It was also evident that the untreated cotton plants harboured the highest numbers of parasitoids. These counts on control plants insignificantly higher than those recorded from cotton plants which received plant extract and bioinsecticide applications. Also, the values recorded for these treatments were, significantly, higher than those counted on plants treated with chemical insecticides and IGR.

C. Percentages of parasitism:

a. *S. littoralis* parasitodis:

According to the obtained overall seasonal percentages of parasitism *S. littoralis* larvae, the studied parasitoid species may be arranged in a descending order as *M. rufiventris*, *Ch. inanitus*, *P. orbata*, *Zele spp.* and *T. larvarum* (the untreated cotton plants harboured *S. littoralis* larvae that showed the highest rate of parasitism, which was insignificantly, higher than those recorded on *S. littoralis* larvae which collected from plant extract and bioinsecticide applications, but the rates of parasitism recorded from these treatments were, significantly, higher than those recorded in *S. littoralis* larvae collected from plots that received chemical insecticidal treatment. The percentage of parasitism in plant extract treatment was, insignificantly, higher than those

recorded on *S. littoralis* larvae which were collected from bioinsecticide and IGR treatments. Also, the percentage of parasitisim in IGR treatment was, insignificantly, higher than that recorded in chemical insecticides treatment.

b. Parasitoids emerged from infested cotton bolls:

Two parasitoid species emerged from the infested cotton bolls; *Apanteles* sp. which is known as parasitoid on *P. gossypiella* larvae and *P. orbata* which was previously recorded as a parasitoid of *Earias insulana*.

D. Rate of damage to cotton plants:

a. Due to *S. littoralis* infestations:

Insignificant differences were recorded between the rate of damage to cotton leaves randomly inspected from plots sprayed by Xentari and those received the *C. inerme* extract, and also between IGR and the chemical insecticides. While, the damage caused to cotton leaves was, significantly, higher on one hand, and those received the IGR or chemical insecticide treatments, on the other hand. Highest rates of damage (18.75 and 20.09%) were recorded from the control treatment, while the lowest rates (10.64 and 15.26% in 1998 and 1999 cotton seasons, respectively) were recorded from cotton plants that received chemical insecticidal applications.

b. Due to bollworms' infestations:

The obtained results showed that the rate of damage caused by both *P. gossypiella* and *E. insulana* larvae was insignificantly, different between plant extract and bioinsecticide treatments. It was also insignificant between IGR and chemical

insecticides treatments. But, the rate of damage was, significantly, higher in both plant extract and bioinsecticide treatments, compared to those recorded from both IGR and chemical insecticides' treatments. Highest percentages of damaged bolls were in control treatment (22.64 and 20.22%), while the lowest (19.5 and 16.36% in 1998 and 1999, respectively) were in chemical insecticides' treatment (19.5 and 16.36%).

II.2. Sex-pheromones' experiments:

A. Population fluctuations in adults' population:

a. *Spodoptera littoralis* **(Boisd):**

Four active periods of *S. littoralis* adults could be detected with four peaks of abundance in 1998 and 1999 cotton seasons; these peaks occurred on (May, 9 th and May, 8 th), (June, 6 th and June, 12 th), (July, 18 th and July, 17 th) and (September, 5 th and August, 28 th), respectively.

b. *Pectinophora gossypiella* **(Saund.):**

Three peaks of moths' abundance were detected in 1998 and 1999 cotton seasons; on (June, 13 th and June, 5 th), (July, 18 th and July, 17 th) and (August, 29 th and August, 28 th) respectively.

c. *Earias insulana* **(Boisd.):**

Three peaks of adults' abundance could be detected in 1998 and 1999 seasons; on (June, 13 th and June, 12 th), (August, 1st, and July, 24 th) and (September, 5 th and August, 28 th), respectively.

B. Counts of entomophagous insects:

a. Numbers of adult predators:

The results 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 the predaceous insect species which showed insignificant differences in their total counts compared to control treatment.

b. Numbers of adult parasitoids:

The aforementioned parasitoid species which were recorded in the 1st experiment were found in this experiment. The obtained results showed that using sex-pheromones has no effect on the natural role of the beneficial insects which showed insignificant difference compared to control treatment.

C. Percentages of parasitism:

a. *S. littoralis* parasitoids:

According to the obtained overall seasonal percentages of parasitism by different parasitoids; the highest percentage of parasitism occurred by *M. rufiventris*, followed by *Ch. inanitus*, *P. orbata*, *Zele spp.* and *T. larvarum*. These parasitoids were, insignificantly of higher numbers in sex-pheromones treatment than those recorded in control treatment.

b. Parasitoids produced from infested cotton bolls:

As previously indicated, only two parasitoids species emerged from the infested cotton bolls. Those were *Apanteles* sp., parasitoid of *P. gossypiella* and *P. orbata*, parasitoid of *E. insulana*. Overall mean seasonal counts of these parasitoids

were, insignificantly higher in plots that received sex-pheromones treatment than control.

D. Rates of damage to cotton plants:

a. By the cotton leafworm:

The obtained results indicated that the overall mean percentages of damage to cotton leaves in control treatment were, insignificantly, higher than those recorded in sex-pheromone treatment in both seasons.

b. Due to bollworms infestations:

The percentage of damaged cotton bolls due to *P. gossypiella* and *E. insulana* infestations in control treatment were, insignificantly, higher than those recorded in sex-pheromones treatment in both seasons.