

**PHYSIOLOGICAL AND MOLECULAR CHANGES  
IN THE DESERT LOCUST *SCHISTOCERCA  
GREGARIA* (FORSKAL) IN RELATION TO  
SOME INSECT GROWTH REGULATORS**

By

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B.Sc. Agric. Sc. (Plant Protection), Aleppo University, 2002

M.Sc. Agric. Sc. (Economic Entomology), Ain Shams University, 2008

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## CONTENTS

|   | <b>Page</b> |
|---|-------------|
| <b>LIST OF TABLE.</b> .....   | <b>IV</b>   |
| <b>LIST OF FIGURES.</b> .....   | <b>VI</b>   |
| <b>LIST OF PLATES.</b> .....  | <b>IX</b>   |
| <b>1. INTRODUCTION</b> .....  | <b>1</b>    |
| <b>2. REVIEW OF LITERATURE</b> .....  | <b>4</b>    |
| 2.1. Insect Growth Regulators.....  | 4           |
| 2.1.1. Chitin Synthesis Inhibitors.....   | 6           |
| 2.1.2. Juvenile Hormone Analogs. ....   | 7           |
| 2.2. Toxicological and biological effects of IGRs against insects.....  | 9           |
| 2.3. Effect of IGRs on reproductive potential of insect. ....   | 19          |
| 2.4. Effect of insect growth regulators on cellular level.....  | 25          |
| 2.5. Effect of insect growth regulators on the bio-molecular level.....   | 29          |
| <b>3. MATERIAL AND METHODS</b> .....  | <b>36</b>   |
| 3.1. Maintenance of Insect Culture.....   | 36          |
| 3.2. Insect growth regulators tested.....   | 37          |
| 3.2.1. Trade name: Nomolt. (teflubenzuron).....   | 37          |
| 3.2.2. Trade name: Atabron, IKI-7899. (chlorfluazuron).....   | 38          |
| 3.2.3. Trade name: Admiral. (pyriproxyfen).....   | 38          |
| 3.3 Toxicity of three IGRs against in 5 <sup>th</sup> instar <i>S. gregaria</i><br>nymphs.....  | 39          |
| 3.4. Biological Studies.....  | 40          |
| 3.5. Effect of teflubenzuron and chlorfluazuron on ingested food,<br>nymphal weight gain and nutritional indices in treated 5 <sup>th</sup> instar<br><i>S. gregaria</i> nymphs. ....                                 | 42          |
| 3.6. Ultrastructure of the integument.....  | 43          |
| 3.7. Determination of cuticle dry weight, chitin and total protein<br>content in the integument of cuticle of 5 <sup>th</sup> instar <i>S. gregaria</i><br>nymphs treated with LC <sub>75</sub> of teflubenzuron..... | 44          |

|   |           |
|---|-----------|
| 3.8. SDS- PAGE electrophoresis of total protein in cuticle of 5 <sup>th</sup> instar nymphs treated with LC <sub>75</sub> teflubenzuron and in untreated nymphs. ....   | 45        |
| 3.9. Biochemical analysis.....  | 49        |
| 3.9.1. Native- PAGE electrophoresis of total protein content in hemolymph of adult <i>S. gregaria</i> females emerging from 5 <sup>th</sup> instar nymphs treated with LC <sub>75</sub> teflubenzuron and in untreated emerged adult females..... | 49        |
| 3.9.2. Amino acid concentration in the hemolymph of adult <i>S. gregaria</i> females emerging from 5 <sup>th</sup> instar nymphs treated with LC <sub>75</sub> teflubenzuron and in untreated emerged adult females.....                          | 50        |
| 3.10. Statistical analysis.....   | 50        |
| <b>4. RESULTS.....</b>  | <b>51</b> |
| 4.1. Bioassay of three insect growth regulators against 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs.....   | 51        |
| 4.2. Effect of teflubenzuron, chlorfluazuron and pyriproxyfen on some biological aspects of 5 <sup>th</sup> instar <i>S. gregaria</i> nymph.....  | 54        |
| 4.2.1. Effect on the development of 5 <sup>th</sup> instar nymph. ....  | 54        |
| 4.2.2. Effect on percentage of adults emergence of treated 5 <sup>th</sup> instar nymphs.....   | 55        |
| 4.2.3. Morphological induced deformations. ....   | 55        |
| 4.3. Reproductive potential of female <i>S. gregaria</i> adults emerging from 5 <sup>th</sup> instar nymphs treated with teflubenzuron and chlorfluazuron. ....   | 59        |
| 4.4. Mean amount of ingested food, nymphal weight gain and nutritional indices in 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs treated with teflubenzuron and chlorfluazuron and untreated nymphs.....  | 66        |
| 4.4.1. Mean amount of ingested food. ....   | 66        |
| 4.4.2. Mean weight gain. ....   | 68        |
| 4.4.3. Nutritional indices.....   | 69        |
| 4.5. Cuticle ultrastructure in 5 <sup>th</sup> instar untreated <i>S. gregaria</i> nymphs   |           |

### III

|   |     |
|---|-----|
| and nymphs treated with LC <sub>75</sub> of teflubenzuron. ....   | 76  |
| 4.6. Cuticle dry weight, total soluble protein and chitin content in the integument of 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs untreated and treated with LC <sub>75</sub> of teflubenzuron. ....                                      | 81  |
| 4.6.1. Cuticle dry weight. ....   | 81  |
| 4.6.2. Chitin content in the cuticle. ....  | 81  |
| 4.6.3. Total soluble protein content in the integument cuticle .....  | 83  |
| 4.7. SDS- PAGE electrophoresis of total cuticle protein in integument cuticle of 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs treated with LC <sub>75</sub> teflubenzuron and in untreated nymphs.....                                      | 87  |
| 4.8. Biochemical analysis.....  | 91  |
| 4.8.1. Native - PAGE electrophoresis of total protein content in hemolymph of adult <i>S. gregaria</i> females emerging from 5 <sup>th</sup> instar nymphs treated with LC <sub>75</sub> teflubenzuron and untreated emerged adult females..... | 91  |
| 4.8.2. Amino acids concentration in the hemolymph of 10 day old female <i>S. gregaria</i> adults emerging from 5 <sup>th</sup> instar nymphs treated with LC <sub>75</sub> teflubenzuron and untreated emerged adult females.....               | 97  |
| <b>5. DISCUSSION</b> .....  | 100 |
| <b>6. SUMMARY</b> .....   | 112 |
| <b>7. REFERENCES</b> .....  | 118 |
| <b>ARABIC SUMMARY</b> .....   |     |

## LIST OF TABLES

| N0. | TITLE   | Page |
|-----|---|------|
| 1   | Composition of resolving (separating) and stacking gel. ....  | 48   |
| 2   | Toxicity values, LC <sub>25</sub> , LC <sub>50</sub> , LC <sub>75</sub> and LC <sub>90</sub> calculated from plotted toxicity regression lines, their corresponding slope values and toxicity index of three IGRs against 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs..... | 53   |
| 3   | Duration of 5 <sup>th</sup> nymphal instar treated with teflubenzuron, chlorfluazuron and pyriproxyfen, percentage adult emergence and percentage induced malformations following treatment.....  | 57   |
| 4   | Reproductive potential of female <i>S. gregaria</i> adult emerging from 5 <sup>th</sup> instar treated with LC <sub>25</sub> , LC <sub>50</sub> and LC <sub>75</sub> of teflubenzuron and chlorfluazuron.. ....   | 65   |
| 5   | Mean amount of ingested food and mean nymphal weight gain by 5 <sup>th</sup> instar <i>S. gregaria</i> nymph treated with teflubenzuron and chlorfluazuron.....   | 71   |
| 6   | Daily amount of ingested food (mg) by 5 <sup>th</sup> instar the desert locust nymph treated with chlorfluazuron.....   | 73   |
| 7   | Daily amount of ingested food (mg) by 5 <sup>th</sup> instar the desert locust nymph treated with chlorfluazuron.....   | 74   |
| 8   | Nutritional indices, (AD, ECD and ECI %) during the span of 5 <sup>th</sup> instar <i>S. gregaria</i> nymph fed for one day on clover leaves treated with teflubenzuron or chlorfluazuron.....  | 75   |
| 9   | Cuticle dry weight, chitin and total soluble protein (mg/nymphal cuticle) in 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs untreated and treated with LC <sub>75</sub> of teflubenzuron.....   | 84   |
| 10  | Inhibition percentage in cuticle dry weight, chitin and total soluble protein content in 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs treated with LC <sub>75</sub> teflubenzuron.....  | 86   |
| 11  | Chitin and protein content in the integument of 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs treated with LC <sub>75</sub> teflubenzuron and their  |      |

|    |   |    |
|----|---|----|
|    | percentage decrease correlated with weight of nymph following treatment.....  | 87 |
| 12 | SDS- PAGE of cuticle total protein bands in untreated 5 <sup>th</sup> instar <i>S. gregaria</i> and in nymphs treated with LC <sub>75</sub> teflubenzuron. ....   | 89 |
| 13 | Native - PAGE electrophoresis of hemolymph proteins in untreated female <i>S. gregaria</i> adults and in adults emerging from 5 <sup>th</sup> instar nymphs treated with LC <sub>75</sub> teflubenzuron.....              | 92 |
| 14 | Free amino acid concentrations in hemolymph of 10 day old female <i>S. gregaria</i> adults emerging from untreated nymphs and from emerged 5 <sup>th</sup> instar nymphs treated with LC <sub>75</sub> teflubenzuron..... | 99 |

## LIST OF FIGURES

| No. | TITLE  | Page |
|-----|--|------|
| 1.  | Toxicity regression lines of teflubenzuron (Nomolt), chlorfluazuron (Atabron) and pyriproxyfen (Admiral) against 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs. ....  | 53   |
| 2.  | 5 <sup>th</sup> instar <i>S. gregaria</i> nymph with split exuvia but failing to emerge following treatment with LC <sub>75</sub> of teflubenzuron as newly emerged 5 <sup>th</sup> instars. ....                              | 58   |
| 3.  | <i>S. gregaria</i> adult failing to discard its exuvia following treatment as newly emerged 5 <sup>th</sup> instar nymph with LC <sub>75</sub> of teflubenzuron.....   | 58   |
| 4.  | Malformed in 24h. old emerged <i>S. gregaria</i> adult emerging from 5 <sup>th</sup> instar nymphs treated with LC <sub>25</sub> teflubenzuron.....  | 59   |
| 5.  | Preoviposition period (days) of female <i>S. gregaria</i> adults emerging from 5 <sup>th</sup> instar nymphs treated with LC <sub>25</sub> , LC <sub>50</sub> and LC <sub>75</sub> of teflubenzuron or chlorfluazuron.....     | 62   |
| 6.  | Number of deposited egg pod/ female <i>S. gregaria</i> adult emerging from 5 <sup>th</sup> instar nymph treated with LC <sub>25</sub> , LC <sub>50</sub> and LC <sub>75</sub> of teflubenzuron and chlorfluazuron.....         | 63   |
| 7.  | Number of eggs / pod deposited by <i>S. gregaria</i> female adult emerging from 5 <sup>th</sup> instar nymph treated with LC <sub>25</sub> , LC <sub>50</sub> and LC <sub>75</sub> of teflubenzuron and chlorfluazuron.....    | 63   |
| 8.  | Total number of eggs deposited/ female <i>S. gregaria</i> emerging from 5 <sup>th</sup> instar nymph treated with LC <sub>25</sub> , LC <sub>50</sub> and LC <sub>75</sub> of teflubenzuron and chlorfluazuron.....            | 64   |
| 9.  | Percentage egg hatching deposited by female <i>S. gregaria</i> adult emerging from 5 <sup>th</sup> instar nymphs treated with LC <sub>25</sub> , LC <sub>50</sub> and LC <sub>75</sub> of teflubenzuron or chlorfluazuron..... | 64   |
| 10. | Amount of ingested food (mg) during the span of 5 <sup>th</sup> instar <i>S. gregaria</i> nymph fed for one day on clover leaves treated with teflubenzuron or chlorfluazuron.....   | 72   |
| 11. | Daily amount of ingested food (mg) by 5 <sup>th</sup> instar the   |      |

## VII

|     |   |    |
|-----|---|----|
|     | desert locust nymph treated with teflubenzuron.....   | 72 |
| 12. | Daily amount of ingested food (mg) by 5 <sup>th</sup> instar the desert locust nymph treated with chlorfluazuron.....   | 73 |
| 13. | Total weight (mg) during the span of 5 <sup>th</sup> instar <i>S. gregaria</i> nymph fed for one day on clover leaves treated with teflubenzuron or chlorfluazuron.....   | 74 |
| 14. | Electron micrograph in cuticle of untreated 7 day old 5 <sup>th</sup> instar <i>S. gregaria</i> nymph. ....   | 77 |
| 15. | Electron micrograph in the cuticle of 7 day old 5 <sup>th</sup> instar <i>S. gregaria</i> nymph treated with LC <sub>75</sub> teflubenzuron.....  | 78 |
| 16. | Electron micrograph in the epidermis of 7 day old 5 <sup>th</sup> instar <i>S. gregaria</i> nymph treated with LC <sub>75</sub> teflubenzuron.....  | 79 |
| 17. | Electron micrograph in the epidermis of 7 day old 5 <sup>th</sup> instar <i>S. gregaria</i> nymph treated with LC <sub>75</sub> teflubenzuron.....  | 80 |
| 18. | Cuticle dry weight, chitin and total soluble protein content in 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs untreated and treated with LC <sub>75</sub> teflubenzuron.....   | 85 |
| 19. | Inhibition percentage in cuticle dry weight, chitin and total soluble protein content in 5 <sup>th</sup> instar <i>S. gregaria</i> nymphs treated with LC <sub>75</sub> concentration of teflubenzuron                                | 86 |
| 20  | Native – PAGE electrophoresis of hemolymph proteins in 8 and 10 day old female <i>S. gregaria</i> adults emerging from untreated nymphs. ....   | 96 |
| 21  | Comparative Native – PAGE electrophoresis of hemolymph proteins in 8 day old female <i>S. gregaria</i> adults emerging from untreated nymphs and from 5 <sup>th</sup> instar nymphs treated with LC <sub>75</sub> teflubenzuron.....  | 96 |
| 22  | Comparative Native – PAGE electrophoresis of hemolymph proteins in 10 day old female <i>S. gregaria</i> adults emerging from untreated nymphs and from 5 <sup>th</sup> instar nymphs treated with LC <sub>75</sub> teflubenzuron..... | 97 |

**LIST OF PLATES**

| <b>No.</b> | <b>TITLE</b>   | <b>Page</b> |
|------------|--|-------------|
| 1.         | SDS- PAGE electrophoresis of the cuticle protein in untreated 5th instar nymphs and nymphs treated with LC <sub>75</sub> teflubenzuron.....  | 90          |
| 2.         | Native – PAGE electrophoresis of hemolymph proteins in female <i>S. gregaria</i> adults emerging from untreated nymphs and in female emerging from 5 <sup>th</sup> instars nymphs treated with LC <sub>75</sub> teflubenzuron..... | 93          |

## ABSTRACT

**Ali Abd Allah Al-Mokhlef: Physiological and Molecular Changes in the Desert Locust *Schistocerca gregaria* (Forsk.) in Relation to Some Insect Growth Regulators. Unpublished Ph.D. Thesis, Department of Plant Protection, Faculty of Agriculture, Ain Shams University, 2011.**

The efficiency of three insect growth regulators; two chitin synthesis inhibitors, teflubenzuron and chlorfluazuron and a juvenile hormone mimic pyriproxyfen, were evaluated against 5<sup>th</sup> instar nymph of *Schistocerca gregaria*. According to the bioassay teflubenzuron was the most effective followed by chlorfluazuron, then pyriproxyfen. Their LC<sub>90</sub> values were 264.78, 430.57 and 439.18 ppm, respectively, and LC<sub>50</sub> values were 63.87, 90.80 and 96.52 ppm, respectively.

Treatment with either teflubenzuron or chlorfluazuron at their LC<sub>75</sub> or LC<sub>90</sub> ppm values caused a prolongation in the duration of the treated nymphal instar between 12-48 hours than their control. Pyriproxyfen caused a longer extension of 48 to 72 hours.

Percentage adult emergence of 5<sup>th</sup> instar nymphs fed for 24 hours on clover leaves treated with LC<sub>90</sub>, LC<sub>75</sub>, LC<sub>50</sub> and LC<sub>25</sub> of teflubenzuron, chlorfluazuron or pyriproxyfen was reduced to 77- 11%, 78- 15 % and 87.5 to 29%, respectively.

A percentage of treated nymphs with any of the three IGRs failed to moult and exhibited severe degrees of morphological deformations at ecdysis or in emerged adult. Induced malformations are described.

Adult *S.gregaria* females emerging from 5<sup>th</sup> instar nymphs fed for 24 hours on leaves treated with any of the tested IGRs and mated to untreated males exhibited a significant decline in their reproductive potential. This effect was more pronounced when teflubenzuron was tested.

Approximate digestibility percentage of ingested food was relatively unaffected in nymphs fed on leaves treated with teflubenzuron or chlorfluazuron. However, weight gain and amount of ingested food during the span of 5<sup>th</sup> instar nymphs was significantly less in treated nymphs than their control. This effect was more evident with teflubenzuron than chlorfluazuron and was concentration dependant. Also, the efficiency of conversion of digested food and efficiency of conversion of ingested food were significantly reduced when treated with LC<sub>90</sub>, LC<sub>75</sub> or LC<sub>50</sub> of teflubenzuron, but these percentages were increased in nymphs fed on leaves treated with LC<sub>25</sub>. Treatment with chlorfluazuron caused the same effect except that percentage increase occurred when it's LC<sub>50</sub> or LC<sub>25</sub> were applied.

Ultrastructural observation of the cuticle in 7<sup>th</sup> day old untreated 5<sup>th</sup> instar nymphs showed that the moulting events had already began. Meanwhile, in nymphs of the same age fed on leaves treated with LC<sub>75</sub> teflubenzuron, exhibited a delay in the moulting process, as no new chitin lamellae were depicted. Furthermore, a protein matrix was observed as a homogenous layer with a lack of chitin and occurrence of vacuoles and an abundance of mitochondria.

The cuticle dry weight in treated 7 day old nymphs was significantly less than their control, (i.e. 8.5 and 15 mg/ nymph, respectively). Inhibition in chitin and protein synthesis was calculated to be 88.9 and 61.85%, respectively, in treated nymphs.

Electrophoresis of total soluble protein in the cuticle of 3, 5 and 7 day old untreated and treated 5<sup>th</sup> instar nymphs exhibited four monomorphic protein bands, in molecular weights of 98.809, 55.008, 50.228 and 28.47 kDs. Furthermore, two other monomorphic bands in the molecular weights of 33.667 and 29.837 kDs were observed in 5 and 7 day old untreated and treated nymphs. Two unique bands weighing 67.406 and 60.274 kDs were evident only in 7 day old untreated nymphs which were not detected in treated nymphs. Furthermore, a protein band in the lowest molecular weight of 19.395 KDs was evident in 3, 5 and 7 day old

untreated nymphs. Although this band was evident in 3 day old treated nymphs, it did not appear in the older treated nymphs.

Native- PAGE of hemolymph protein from 8 and 10 day old *S. gregaria* female adults exhibited 4 distinct protein peaks of 0.27, 0.4, 0.6 and 0.8 Rf value. Their optical density was 0.55, 0.25, 0.32 and 0.39 OD respectively, in 8 day old adult; but higher in 10 day old adult females, i.e. 0.95, 0.73, 0.73 and 0.81 OD. Similar to their control, the hemolymph protein pattern in 8 and 10 day old female adults emerging from 5<sup>th</sup> instar nymphs treated with LC<sub>75</sub> teflubenzuron displayed the first two peaks at 0.27 and 0.4 Rf. Their optical density was comparable to their control except that the latter protein peak had a marked reduced optical density of 0.44 OD in 10 day old female adults emerging from treated nymphs. It's worth mentioning that the 3<sup>rd</sup> and 4<sup>th</sup> protein peaks exhibited in the control were absent in female adults emerging from treated nymphs.

Sixteen free amino acids were detected in the hemolymph of 10 day old adult females emerging from 5<sup>th</sup> instar nymphs. Meanwhile, in 10 day old females emerging from treated nymphs showed that: (i) the amino acid methionine was not detected; (ii) two amino acids, leucine and tyrosine were present in a higher concentration of 61.43 and 88.19  $\mu\text{m}/\text{ml}$ , respectively, than that detected in their respective control, (being 55.27 and 65.47  $\mu\text{m}/\text{ml}$ , respectively). (iii) the other 13 amino acids were all exhibited in lower concentrations than their control.

**Key Words:** desert locust, *Schistocerca gregaria* (Forsk.) , insect growth regulators, teflubenzuron, chlorfluazuron, pyriproxyfen, toxicity, adult emergence, reproductive potential, cuticle ultrasructure, cuticle protein and chitin content, nutritional indices. SDS- PAGE cuticle protein, Native- PAGE hemolymph proteins, hemolymph free amino acids.