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

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

ABSTRACT

Ali Abd Allah Al-Mokhlef: Physiological and Molecular Changes in the Desert Locust *Schistocerca gregaria* (Forskal) 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 Unpublished Ph.D. Thesis, Department of Plant Protection, Faculty of Agriculture, Ain Shams University, 2011.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 5th instar nymph of *Schistocerca gregaria*. According to the bioassay teflubenzuron was the most effective followed by chlorfluazuron, then pyriproxyfen. Their LC_{90} values were 264.78, 430.57 and 439.18 ppm, respectively, and LC_{50} values were 63.87, 90.80 and 96.52 ppm, respectively.

Treatment with either teflubenzuron or chlorfluazuron at their LC_{75} or LC_{90} 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 5th instar nymphs fed for 24 hours on clover leaves treated with LC_{90}, LC_{75}, LC_{50} and LC_{25} 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 5th 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^{th} 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_{90}, LC_{75} or LC_{50} of teflubenzuron, but these percentages were increased in nymphs fed on leaves treated with LC_{25}. Treatment with chlorfluazuron caused the same effect except that percentage increase occurred when it's LC_{50} or LC_{25} were applied.

Ultrastructural observation of the cuticle in 7^{th} day old untreated 5^{th} instar nymphs showed that the moulting events had already began. Meanwhile, in nymphs of the same age fed on leaves treated with LC_{75} 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^{th} 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^{th} instar nymphs treated with LC_{75} 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^{rd} and 4^{th} 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^{th} 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 µm/ ml, respectively, than that detected in their respective control, (being 55.27 and 65.47 µm/ ml, respectively). (iii) the other 13 amino acids were all exhibited in lower concentrations than their control.

Key Words: desert locust, *Schistocerca gregaria* (Forskal), 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.