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K. GHONEIM

Department of Zoology. Faculty of Science. Al-Azhar University., kar_ghoneim@yahoo.com

A. AL-DALI

Department of Zoology. Faculty of Science. Al-Azhar University.

R. BAKR

Department of Entomology, Faculty of Science, Ain Shams University, Cairo, Egypt.

M. TANANI

Department of Zoology. Faculty of Science. Al-Azhar University.

A. BREAM

Department of Zoology. Faculty of Science. Al-Azhar University.

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**DEVELOPMENTAL AND MORPHOGENIC RESPONSES OF
SCHISTOCERCA GREGARIA (ORTHOPTERA: ACRIDIDAE) TO THE
JUVENOID PYRIPROXYFEN (S- 31183).**

GHONEIM, K. S.; AL-DALI, A.G.⁽¹⁾; BAKR, R. F.⁽²⁾⁽¹⁾; TANANI, M. A.⁽¹⁾ AND
BREAM, A. S.⁽¹⁾

(1) *Department of Zoology, Faculty of Science, Al-Azhar University.*

(2) *Department of Entomology, Faculty of Science, Ain Shams University, Cairo,
Egypt.*

For Corresponding: kar_ghoneim@yahoo.com

Abstract

To investigate the effects of Pyriproxyfen (S-31183) on the growth, development and morphogenesis of the desert locust *Schistocerca gregaria*, five concentration levels (1000, 500, 250, 125 and 62.5 ppm) were given through the fresh clover leaves as food to nymphs of three developmental ages: newly moulted penultimate (4th) instar, newly moulted last (5th) instar and late-aged last instar. All results were obtained 24 h after feeding.

Pyriproxyfen exhibited a remarkable inhibitory effect on the nymphal growth and consequently nymphs were prevented to obtain more than one-third of weight gain of control congeners at the highest concentration level. Also, the developmental rate was increasingly depressed as the concentration level was increased, almost, in all treatments. The controls had the fastest developmental rate among all nymphs.

The adult females were hindered to emerge proportionally to the increasing concentration level of Pyriproxyfen. Moreover, some adults were completely prevented to emerge after treatment of the penultimate instar nymphs with the highest concentration level. In addition, Pyriproxyfen exerted a profound action on the adult morphogenesis. The degree of adult deformation was dose-dependent after treatment of the newly moulted 4th or 5th instar nymphs. After treatment of these nymphs, also, the adult longevity was elaborately shortened while the treatment of late-aged 5th instar nymphs resulted in an insignificant prolongation of the adult longevity.

Key Words: *Schistocerca gregaria*, Pyriproxyfen, growth, development, metamorphosis, morphogenesis, emergence, longevity.

Introduction

Juvenile hormone analogues (JHAs) can function as agonists or antagonists or a mixture of both with natural JHs (Kramer and Staal, 1981). The JH has two distinct biochemical effects: one during the larval stage and the other in the adult stage. During larval stage, JH suppress metamorphic change during moulting; and in the adult it induces vitellogenin synthesis during ovarian development. The JHAs interfere with important biochemical mechanisms such as the secretion and

transportation of natural JHs from the secretory site to the target site, degradation, excretion and feedback control (Retnakaran *et al.*, 1981). Hence, their biological effects are very complex, and vary from one analogue to another. Also, the response to different compounds differs among the species (Mondal and Parween, 2000).

Pyriproxyfen (S-31183) {2-[1-methyl-2-(4-phenoxyphenoxy)-ethoxy]-pyridine} has a juvenile hormone activity against different insect species. Its activity was studied against some lepidopterous pests (Ascher and Eliyahu, 1988; Gadallah *et al.*, 1990), houseflies and mosquitoes (Estrada and Mulla, 1986; Mulla *et al.*, 1986; Kawada *et al.*, 1988; Schafeer and Miura, 1990; Ghoneim *et al.*, 1992), cockroaches (Kawada *et al.*, 1989; Ross and Cochran, 1990), termites (Su and Scheffrahn, 1989), scale insects (Cooper and Oetting, 1985) and locusts (De Kort and Koopmanschap, 1990; Ghoneim and Ismail, 1995).

The present study was carried out to investigate the effects of Pyriproxyfen on growth, development and morphogenesis of the desert locust *Schistocerca gregaria* as a laboratory collaboration for controlling this dangerous agricultural pest.

Materials And Methods

Experimental Insect:

A gregarious stock culture of *Schistocerca gregaria* (Forsk.) was raised by a sample from the established culture of Locust and Grasshopper Res. Division, Agric. Res. Center, Giza, Egypt. The insects were reared under crowded breeding conditions outlined by Hunter-Jones (1961) and Hassanein (1965). Newly hatched hoppers were kept in wooden cages with wire-gauze sides (40x40x60 cm) and small door in the upperside to allow the daily feeding and cleaning routine. The bottom was covered with 20 cm layer of sterilized sand. Each cages was equipped internally with 60 W electric bulb for lightening (17:7 LD) and warming (32 ± 2C.). The relative humidity varied from 70-80% following the introduction of fresh food plant to 60-70% several hours later. Successive generations were raised before obtaining the nymphs for the present experimental work. Fresh food plant was clover *Medicago sativa* along the period of study except few weeks every year because of the absence of this plant species. During these weeks, insects were fed on *Sesbania egyptiaca*. All experiments were conducted with *M. sativa* only.

Pyriproxyfen Administration:

Five concentration levels of the juvenoid Pyriproxyfen were prepared using the

distilled water: 1000, 500, 250, 125 and 62.5 ppm. Pyriproxyfen (S-31183) is a product of Sumitomo Chemical Co. Ltd., Pesticides Division, Osaka, Japan, with the chemical formula: {2- [1-methyl-2-(4-phenoxy-phenoxy) ethyl] pyridine} (Kawada *et al.*, 1988). The concentration range was chosen depending on some preliminary trials carried out on the present insect species. The concentration range was chosen depending on some preliminary trials carried out on the present insect species. Feeding technique was applied using fresh clean clover leaves (*M. sativa*) after dipping for 3 minutes in each concentration level. Feeding on treated food plant was allowed for 24 h for the newly moulted penultimate (4th) instar, newly moulted last (5th) instar, or late-aged (5-day old) last instar nymphs. Control insects had been allowed to feed on untreated food plant and kept under the same laboratory conditions. Three replicates (10 nymphs/rep.) were carried out for each treatment. Each individual nymph was kept in a suitable glass vial provided with a thin layer of sterilized sand. The vials were carefully located in a cage supported with a suitable electric bulb for lightening and warming.

Criteria Studied:

Growth, development, metamorphosis and morphogenesis were determined as detailed herein. The fresh body weight was recorded every day using an electric digital balance. The weight gain was calculated as follows: initial weight (before the beginning of experiment) - final weight (at the end of experiment). The growth inhibition was calculated as follows: $\{a-A/A\} \times 100$, where: a: maximal weight of treated nymphs, A: maximal weight of control nymphs. The developmental duration of nymphal instars, treated or control, was estimated using Dempster' equation (1957). The developmental rate was calculated according to the equation: Developmental rate = 100/mean duration (in days). The adult emergence was estimated in % whatever the morphogenesis was perfect or defected. All morphogenic aberrations were counted, calculated in % and recorded in photographic plates. The adult longevity comprised all adult physiological phases: maturation period, reproductive lifetime and post-oviposition period. It was calculated in mean days \pm SD.

Analysis of Data:

Data obtained were analyzed using the Student *t*-distribution and were refined by Bessel's correction (Moroney, 1969) for testing the significance of difference between means.

Results

Treatments of the newly moulted penultimate instar nymphs:

a) Growth and Development:

After treatment of the newly moulted penultimate instar nymphs with different concentration levels of Pyriproxyfen, growth and developmental data were distributed in Table (1). Data of this table easily reveal different degrees of Pyriproxyfen action on growth and development. In spite of the, insignificant, increase of the weight gain, the treated nymphs seemingly failed to obtain more than $\frac{1}{3}$ of the weight gained by their control congeners. Another parameter may provide a substantiating evidence for the effect of Pyriproxyfen since change % was estimated as 15.81 ± 11.66 , at 1000 ppm (vs 97.95 ± 12.88 of controls). Thus, the control nymphs exhibited a change% in their body growth exceeding 6 times higher than the 1000 ppm-treated nymphs. Also, growth inhibition was the highest (49.61%) at the highest concentration level but the lowest (4.04%) at the lowest concentration level. Thus, growth inhibition at the highest concentration level of Pyriproxyfen was 12 times greater than that caused at the other concentration levels.

Developmental rate, on the other hand, run in a reverse correlation to the concentration level, with few exceptions. Control nymphs developed, generally, in a faster rate since they stayed the shortest duration before the final nymphal moult (13.62 ± 2.30 , at 1000 ppm, and 13.05 ± 1.70 days, at 500 ppm, vs 8.80 ± 1.46 days of control congeners). With few exceptions, the penultimate instar considerably extended in a parallel relationship to the concentration level.

b) Metamorphosis and Morphogenesis:

Referring to the data of Table (2), a profound effect of Pyriproxyfen on the adult performance can be easily seen. The adult emergence was precluded increasingly as the concentration level was increased. The maximal blocking action could be obviously detected when the treated nymphs failed to metamorphose, i.e., no emergence could be observed after treatment with the highest concentration level.

The morphogenic programme, however, was impaired by Pyriproxyfen, especially after treatment with its lower three concentration levels, because various deformations in increasing %s were recorded reaching 50% at 500 ppm (no morphogenic disorders were observed among control insects). Plate (1) shows different photos of adult deformities as an effect of Pyriproxyfen on the programme of metamorphosis and morphogenesis. As easily seen some adults failed to completely cast the nymphal exuvia, some appeared with sharply twisted legs, severely curled wings, atrophied antennae, abdominal torsion...etc.

Table (1): Growth and developmental effects of Pyriproxyfen on *Schistocerca gregaria* after treatment of the newly moulted penultimate instar nymphs.

Conc. (ppm)	Mean weight (g ± S.D.)	Weight gain (g ± S.D.)	Change (%)	Growth inhibition (%)	Duration (days ± S.D.)	Develop. Rate
1000.0	0.324 ± 0.131 d	0.125 ± 0.075 d	15.81 ± 11.66 d	49.61	13.62 ± 2.30 d	07.34
500.0	0.336 ± 0.110 d	0.201 ± 0.050 d	32.71 ± 10.50 d	47.74	13.05 ± 1.70 d	07.68
250.0	0.465 ± 0.165 b	0.248 ± 0.180 a	85.11 ± 08.42 b	27.68	14.84 ± 3.41 d	07.10
125.0	0.567 ± 0.362 a	0.311 ± 0.172 a	65.16 ± 17.65 b	11.81	10.77 ± 2.53 a	09.28
062.5	0.617 ± 0.240 a	0.317 ± 0.114 a	68.76 ± 19.51 a	04.04	09.50 ± 1.96 a	10.52
Control	0.643 ± 0.154	0.390 ± 0.197	97.95 ± 12.88	00.00	08.80 ± 1.46	11.36

Conc. (ppm): concentration (part per million), Mean ± S. D. followed with same letter (a) are not significantly ($p > 0.05$), (b): significantly different ($p < 0.05$), (c): highly significantly different ($p < 0.01$), (d): very highly significantly ($p < 0.001$). Develop. Rate: Developmental rate.

Table (2): Adult performance as affected by Pyriproxyfen after treatment of the newly moulted penultimate instar nymphs of *Schistocerca gregaria*.

Conc. (ppm)	Emerg.	Deform.	Longevity*
1000.0	00.00	00.00	=
500.0	33.33	00.00	46.81 ± 3.74 b
250.0	40.00	50.00	52.92 ± 3.08 a
125.0	71.41	20.00	53.24 ± 4.21 a
062.5	77.70	14.28	55.06 ± 3.81 a
Control	90.00	00.00	53.90 ± 4.31

Conc. (ppm), a and b: see footnote of Table (1). Emerg.: Emergence (%), Deform.: Deformation (%). *: Mean days ± SD

The successfully emerged adults suffered the action of this juvenoid since they lasted only short longevity. Longevity was shortened parallelly to the increasing concentration level reaching 46.81 ± 3.74 days $p < 0.05$ (vs 53.90 ± 4.31 days of control congeners). On the other hand adult, longevity was prolonged, but insignificantly, at the lowest concentration level.

Treatments of the newly moulted last instar nymphs:

a) Growth and Development:

As clearly shown in Table (3), a drastic reducing action of Pyriproxyfen on the weight gain was exerted and increased as the concentration level was ascended. As for example, weight gain of 1000 ppm-treated last instar nymphs was 0.198:1:0.037, $p < 0.001$ vs 0.686 ± 0.264 g of control congeners. Thus, these nymphs obtained almostly $\frac{1}{3}$ of that weight gain of the control congeners. Another confirmatory parameter for this level, reducing action can be provided by growth inhibition% which increased by increasing concentration reaching 66.42% at the highest concentration level. With few exceptions, Pyriproxyfen affected the development of nymphs because the duration was pronouncedly prolonged and developmental rate suffered a retarding action. Such prolongation of the developmental duration

increased as the concentration level was increased. Shortly, all treated nymphs achieved developmental rate remarkably less than that of controls (for more details, see table 3).

Table (3): Growth and developmental effects of Pyriproxyfen on *Schistocerca gregaria* after treatment of the newly moulted last instar nymphs.

Conc. (ppm)	Mean weight (g ± S.D.)	Weight gain (g ± S.D.)	Change (%)	Growth inhibition (%)	Duration (days ± S.D.)	Develop. Rate
1000.0	0.423 ± 0.160 d	0.198 ± 0.037 d	23.42 ± 09.71 d	66.42	16.74 ± 3.250 d	5.97
500.0	0.485 ± 0.311 d	0.321 ± 0.156 d	52.71 ± 07.73 c	61.66	15.81 ± 2.510 a	6.32
250.0	0.823 ± 0.466 b	0.467 ± 0.263 a	66.42 ± 13.61 c	34.68	16.24 ± 3.620 d	6.16
125.0	0.993 ± 0.152 a	0.581 ± 0.215 a	75.41 ± 09.88 a	21.19	12.41 ± 2.500 a	8.05
062.5	1.085 ± 0.436 a	0.612 ± 0.144 a	78.34 ± 11.20 a	13.88	12.21 ± 1.780 a	8.19
Control	1.262 ± 0.244	0.686 ± 0.264	84.86 ± 12.56	00.00	10.80 ± 0.866	9.25

Conc. (ppm), a, b, c, d, Develop. Rate: see footnote of Table (1).

b) Metamorphosis and Morphogenesis:

After treatment of the newly moulted last instar nymphs with different conc. levels of Pyriproxyfen, several aspects of the adult performance were influenced (Table 4). Almostly, blocking of the adult emergence increased proportionally to the ascending concentration. However, the downmost emergence (50%) was observed at the highest concentration level.

In addition, Pyriproxyfen pronouncedly affected the adult morphogenesis because different malformations were recorded in two extremes: the strongest (60%) at the highest concentration level and the weakest (12.5%) at the lowest concentration level. Several features or symptoms of such impaired adult morphogenesis are shown in Plate (1).

Generally, all treated adult females lasted remarkably s longevity than their control congeners. Moreover, longevity shortage increased significantly by increasing concentraton level (at least $p < 0.05$).

Table (4): Adult performance as affected by Pyriproxyfen after treatment of the newly ecdysed last instar nymphs of *Schistocerca gregaria*.

Conc. (ppm)	Emerg.	Deform.	Longevity*
1000.0	050	60.0	39.99 ± 2.67 d
500.0	060	50.0	41.43 ± 3.56 c
250.0	060	50.0	43.36 ± 2.68 b
125.0	070	28.2	43.62 ± 1.63 b
062.5	080	12.5	46.53 ± 5.74 a
Control	100	00.0	49.60 ± 2.54

Conc. (ppm), a, b, c and d: see footnote of Table (1). Emerg., Deform., *: see footnote of Table (2).

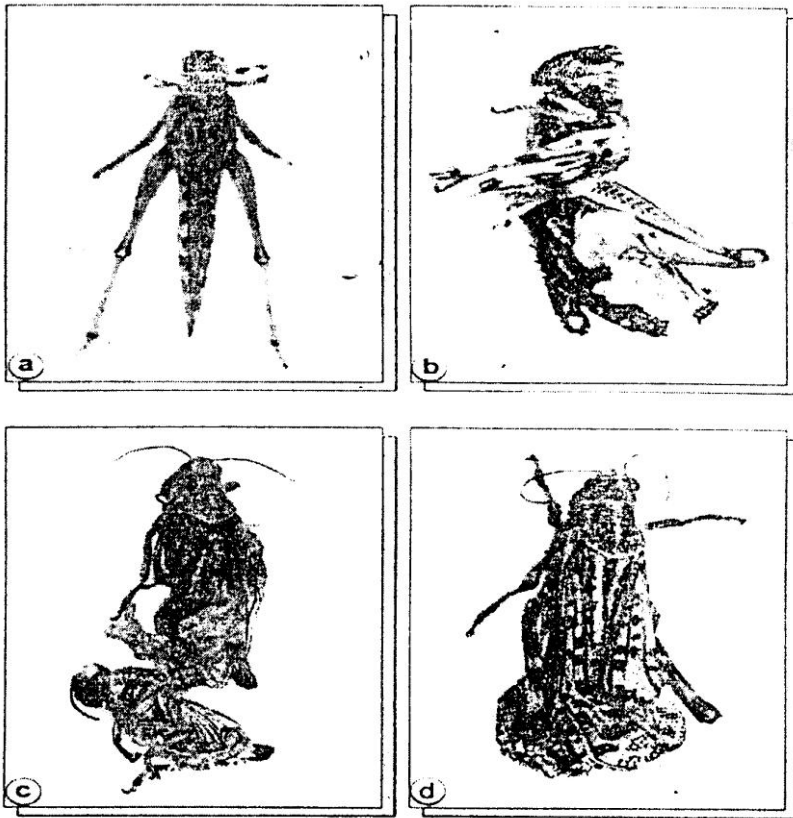


Plate (1): The juvenile hormone analogue, Pyriproxyfen caused some adult deformities after treatment of different concentrations to the penultimate or last instar nymphs of *Schistocerca gregaria*. Far from the normal adult (a), various shapes of the impaired morphogenesis can be seen such as: atrophied antennae and shortened legs (b), attached nymphal exuvium and corrupted wings (c), abnormally developed extremities of the wings and abdominal torsion (d).

Treatments of the late-aged last instar nymphs:

a) Growth and Development:

According to data of Table (5), Pyriproxyfen seriously affected growth and development of the nymphs, regardless of the concentration level. After treatment of the last instar nymphs at a late age, their growth was considerably halted since weight gain regressed proportionally to the ascending concentration level. Among treated nymphs, 1000 ppm-treated nymphs gained only $\frac{1}{3}$ of weight obtained by 62.5 ppm-treated or even control congeners. In addition, growth inhibition % elegantly substantiated such results since it increased by increasing concentration level.

Data of the previously cited table, also, clearly show a regression of the developmental rate of nymphs, approximately in a reverse trend to the concentration level. As a result, nymphs spent an extended duration before metamorphosis into adults. Such prolongation increased, as the concentration level was increased.

b) Metamorphosis and Morphogenesis:

Possible effects of Pyriproxyfen on the morphogenesis and metamorphosis programmes of *S. gregaria* after treatment of the late-aged last instar nymphs with different concentration levels can be shown by Table (6). A blocking action of this juvenoid on the adult eclosion increased as the concentration level was increased. The adult emergence, however, varied between 50% at 1000 ppm and 80% at 62.5 ppm.

Furthermore, the adult morphogenic programme was deranged but in no certain trend. Whereas no adult deformities were observed at 125 ppm, only 33.33% was recorded at 500 ppm. In respect to the adult longevity, insignificant effect of Pyriproxyfen was detected.

Discussion

Inhibitory action of Pyriproxyfen on the growth of Schistocerca gregaria.

The different insect species variously respond to the hormone analogues (and insect growth regulators IGRs, in general) depending on several factors such as: structure of the IGR itself, dose, application method, timing of treatment, etc... Subsequently, literature contains different, and sometimes contradictory, results. Among lepidopterans, a negative correlation of Pyriproxyfen to the larval body weight of the spiny bollworm *Earias insulana* (Hewady, 1990). For *Spodoptera exempta*, *Spodoptera exigua*, *Mamestra brassicae* and *Garellia mellonella*, Smagghe and Degheele, (1994a) estimated some reductions of weight gain and feeding by the action of the ecdysteroid Tebufenozide (RH-5992). By the action of the same ecdysteroid, larvae and nymphal body weights of the spruce budworm *Choristoneura fumiferana* were significantly affected (Cadogen *et al.*, 1997). Also, the larval maximal body weight and weight gain (or mean body weight, in general) of *Spodoptera littoralis* is drastically decreased by Tebufenozide (Ghoneim *et al.*, 1998) and by Pyriproxyfen (Sakr *et al.*, 2005).

Table (5): Growth and developmental effects of Pyriproxyfen on *Schistocerca gregaria* after treatment of the late-aged** last instar nymphs.

Conc. (ppm)	Mean weight (g ± S.D.)	Weight gain (g ± S.D.)	Change (%)	Growth inhibition (%)	Duration (days ± S.D.)	Develop. Rate
1000.0	0.893 ± 0.427 d	0.171 ± 0.053 d	16.71 ± 05.77 d	46.52	12.15 ± 3.240 d	08.23
500.0	0.9560 ± 0.333 d	0.337 ± 0.110 c	22.61 ± 11.72 c	42.75	12.25 ± 2.410 d	08.16
250.0	1.211 ± 0.342 b	0.460 ± 0.115 a	63.47 ± 09.53 a	27.54	10.15 ± 4.330 b	09.85
125.0	1.410 ± 0.431 a	0.481 ± 0.170 a	66.32 ± 11.53 a	15.56	10.65 ± 3.670 a	09.38
062.5	1.440 ± 0.341 a	0.496 ± 0.150 a	68.42 ± 9.54 a	13.77	09.17 ± 3.240 a	10.90
Control	1.670 ± 0.376	0.549 ± 0.155	70.56 ± 9.28	00.00	06.85 ± 0.669	14.59

Conc. (ppm), a, b, c, d, Develop. Rate: see footnote of Table (1). ** the 5-day old nymphs of last instar were treated with Pyriproxyfen.

Table (6): Adult performance as affected by Pyriproxyfen after treatment of the late-aged** last instar nymphs of *Schistocerca gregaria*.

Conc. (ppm)	Emerg.	Deform.	Longevity *
1000.0	050	20.00	43.82 ± 4.66 a
500.0	060	33.33	41.81 ± 5.64 a
250.0	070	14.28	43.34 ± 2.40 a
125.0	070	00.00	40.83 ± 1.75 a
062.5	080	12.50	40.65 ± 2.54 a
Control	100	00.00	40.21 ± 3.82

Conc. (ppm) and a: see footnote of Table (1). Emerg., Deform., * : see footnote of Table (2). **: see footnote of Table (5).

Among dipterans, remarkably reduced larval body weight of *Musca domestica* was caused by fenoxycarb (Ro 13-5229) (Fouda *et al.*, 1991). Cyromazine exhibited an inhibitory action on the body weight of the medfly *Ceratitis capitata* (Vinuela *et al.*, 1993). Also, decreasing larval maximal body weights of *Parasarcophaga argyrostoma* were caused by Pyriproxyfen (Ghoneim and Ismail, 1995 c).

Among orthopterans, and specifically the desert locust *S. gregaria*. Pyriproxyfen promoted the nymphal growth as the maximal body weight was increased (Ghoneim and Ismail, 1995a). On the contrast, Rp 13-5229 inhibited the body weight in a dose-dependent correlation (Ghoneim and Ismail, 1995b).

Likewise, no effect on the body weight was achieved by some IGRs against *Leptinotarsa decemlineata*, *Diabrotica virgifera*, *Podisus sagitta* and *Locusta migratoria* (Smaghe and Degheele, 1994). Also, no effect was recorded for RH-5849 on the larval maximal body weight of *M domestica* (Ghoneim *et al.*, 1991) and of *Periplaneta americana* and *Oncopeltus fasciatus* (Darvas *et al.*, 1992).

In the present study, Pyriproxyfen, detrimentally inhibited growth of nymphs

was recorded, since the weight gain considerably decreased, regardless to the timing of treatment or the concentration level. As for example, at the highest concentration level" nymphs were prohibited to obtain more than weight gain of control congeners after treatment of the penultimate or last instar nymphs. Also, the growth inhibition % varied among the treated nymphs and was dose-dependent. Unfortunately, we have no conceivable interpretation of the inhibitory action of Pyriproxyfen on the growth, right now.

Affected development of *Schistocerca gregaria* by Pyriproxyfen.

Again, the susceptibility of insect species to IGRs depends on several factors belonging to the species itself, the compound characteristics, or the experimental conditions. For some details, Tebufenozide is more potent than the prototype ecdysone agonist RH-5849. It exhibited considerable specificity toward Lepidoptera and is far more toxic than RH-5849, while having much lower toxicity toward non-lepidopteran species (Dhadialla and Carlson, 1998). Also, the induction of ecdysteroid inactivation by administration of ecdysone agonists to larvae of other insect orders is discussed using *L. migratoria* (migratory locust) and *S. gregaria* (desert locust) among Orthoptera; *Tenebrio molitor* (yellow mealworm), *Leptinotarsa decemlineata* (Colorado potato beetle) and *Dicranorrhina micans* (African rose beetle) in Coleoptera; and *M domestica* (house fly) within Diptera (Williams *et al.*, 2002).

In the present study, also, the juvenoid Pyriproxyfen promoted the nymphal development along shortened developmental duration, only after treatment of the newly moulted penultimate instar nymphs. Such results are in accordance with those obtained by Tebufenozide in *S. gregaria* (personal observation). On the other hand, the Pyriproxyfen-treatments of the last instar nymphs (early or late) resulted in prolonged duration of nymphs indicating a retarding action of this juvenoid on the developmental rate in a dose-dependent manner. This retarding action was recorded for several insect species by the same juvenoid, such as the desert locust *S. gregaria* (Ghoneim and Ismail, 1995a; Vennard *et al.*, 1998), the cut worm *Agrotis ipsilon* (El-Sheikh, 2002). Also, various juvenile hormone analogues (JHAs) (and IGRs, in general) caused prolonged duration of the immature stages, such as 20-hydroxyecdysone against *S. gregaria* (Leis *et al.*, 1985), fenoxycarb (Ro 13-5229) against *Schistocerca americana* (Bowers and Ortego, 1991), methoprene and hydroprene against *Tribolium castaneum* (Ishaaya and Yablonski, 1976; Smet *et al.*, 1989) and *Ephestia cautella* (Shaaya and Pisarev, 1986), hydroprene against

Callosobruchus maculatus (Rup and Chopra, 1984), Ro 13-5229 against *S. gregaria* (Ghoneim and Ismail, 1995 b), Tebufenozide against *O. nubilalis* (Trisyono and Chippendale, 1997).

As seen in the present study and other recorded results in the available literature, the juvenoids (or IGR's, in general) can cause shortening or lengthening effects on the developmental duration, i.e., induce or retard such development. These inconsistent results of such effect need to be explained. The prolongation of nymphal duration may be interpreted with the alteration of timing of prothoracicotropic hormone release which governs the insect metamorphosis. Sehnal (1976) suggested that the inhibitory influence of juvenoids increased as the larvae grow through successive larval instars. This suggestion may be acceptable for the endopterygote insects such as *S. littoralis* but not for the exopterygotes such as *S. gregaria*, in the present study.

However, the shortening or lengthening of the developmental periods by IGRs may be attributed to their effect on the release of ecdysteroids indirectly, by interfering with the neuroendocrine sites responsible for the release of tropic hormone, especially the prothoracicotropic hormone (Subrahmanyam *et al.*, 1989). In addition, IGRs caused an imbalance in the hormone titers. This may occur at times of pre- or post-critical time for moult and hence shortening or elongating in the larval or the pupal durations was determined because the proper balance in the hormone titers is necessary for normal growth (Sehnal and Bryant, 1993).

Adult Performance of *Schistocerca gregaria*

as Influenced by Pyriproxyfen.

Adult emergence can be partially or completely blocked by the IGRs (or IGRs, in general). The degree of blockage depends on several factors belonging to the compound, the insect species, or the experimental manipulation. The highest blocking degree of adult emergence of *M domestica* was caused by the highest concentration of RH-5849 (Ghoneim *et al.*, 1991). Hydroprene reduced the adult eclosion in *Tribolium confusum* and *Trogoderma granarium* (EI-Sayed, 1988). Methoprene effectively inhibited the adult emergence of *Sitotroga cerealella* (Stockel and Edwards, 1981) and *Alphitobius diaperinus* (Edwards and Abraham, 1985). Methoprene suppressed the adult emergence of *Delia radicum* (Gmdan *et al.*, 1989). Cycloheximide (30 µg/nymph) completely prevented the adult transformation of *S. gregaria* (Ghoneim, 1988). Pyriproxyfen seriously affected the adult emergence of

Earias insulana (Hewady, 1990), Ro 13-5229 inhibited the adult emergence of *M. domestica* (Fouda *et al.*, 1991), *Parasarcophaga argyrostoma* (Ghoneim and El-Ibiari, 1995), *Culex pipiens* (Dorn *et al.*, 1981), and *Culex tarsalis* (Mulla *et al.*, 1986). As well as, Pyriproxyfen halted the adult eclosion of *P. argyrostoma* (Ismail, 1995) and of *S. littora/is* (Bakr *et al.*, 2005).

In the present study, the nymphal treatments with Pyriproxyfen led to hindered emergence of adults parallelly to the concentration level. Furthermore, some adults were completely prevented to emerge at the highest concentration level against the newly moulted penultimate instar nymphs. Generally, the blocked adult emergence of *S. gregaria* in the present study comes in accordance with the previously mentioned results of different insects.

Whatever, the prohibiting action of juvenoids (or IGRs, in general) can be explained by blocking the maturation of imaginal discs which are the primordia of adult integumentary structures (Schneiderman, 1972). Also, and as suggested by Sehna (1983) for juvenoids, the inhibited adult emergence may be attributed not to the function and growth of insect cells but to the prevention of the adult differentiation.

With regard to the *adult differentiation and morphogenesis*, different abnormalities have been caused by several IGRs. As well as, deranged developmental programmes and impaired morphogenic processes have been reported for various insect species and resulted in: 'extramoult, supernumerary larval instar', giant larvae, larval-pupal and/or pupal-adult (in Endopterygota), nymphal-adult (in Exopterygota) intermediates, adultoids, etc... Some of these were produced in *Blatella germanica* (Kramer *et al.*, 1989) by hydroprene; *Anopheles farauti* (Suzuki *et al.*, 1989), *Muscina stabulans* (Ghoneim *et al.*, 1992; Nassar, 1995), *Bemisia tabaci* (Kawada *et al.*, 1989), *P. argyrostoma* (Ghoneim and Ismail, 1995 c) by Pyriproxyfen; *Tribolium confusum* (Smet *et al.*, 1989) by methoprene; *Diploptera punctata* (Mathai and Nail, 1991) by hydroprene; *Corcyra cephalonica* (Bhargava and Devraj Urs, 1992) by fenoxycarb; etc... It is noteworthy that the degree of morphogenic activity exhibited by juvenoids or ecdysteroids differs with the method of application, dose administered, species and age of the treated insects (Bowers *et al.*, 1965; Retnakaran *et al.*, 1985; Parween, 2000).

In addition, several works on locusts showed similar morphogenic disorders by various juvenoids, such as Pyriproxyfen in *L. migratoria* (De Kort and Koopmanschap, 1991; Edwards *et al.*, 1993), *S. gregaria* (Ghoneim and Ismail,

1995a; Vennard *et al.*, 1998; El-Sukkary, 2003); Ro 13-5229 in *S. americana* (Bowers, 1991, 1995), *L. migratoria migratoroides* (Othman and Schmidt, 1998), *S. gregaria* (Ghoneim and Ismail, 1995b; Saiful-Islam, 1995); methoprene in *S. gregaria* (SaifulIslam, 1995), *L. migratoria* (Nemec, 2003), etc. . .

In the present study, neither extramoult, permanent nymphs, nymphal-adult intermediates, nor adultoids of *S. gregaria* could be produced by Pyriproxyfen or Tebufenozide although Ghoneim and Ismail (1995a) reported such features on the same orthopteran by the same juvenoid Pyriproxyfen but the method of administration was topical application. Several adult deformities (such as: curled wings, coiled antennae, twisted legs and failure of completely getting rid the last nymphal exuvia) were observed because Pyriproxyfen exhibited a remarkable deteriorating action on the adult morphogenesis, regardless to the nymphal instar' under treatment. Moreover, such action was dosedependent when Pyriproxyfen was given to the newly moulted nymphs (of 4th or 5th instar). These adult deformities by the nymphal treatments of *S. gregaria* with Pyriproxyfen may be explained by the hormonal unbalance during the adult differentiation. In general, a detailed or exact interpretation may be available by further investigation in future.

Beside the effects of Pyriproxyfen on the adult emergence and morphogenesis of *S. gregaria*, in the present study, the *adult longevity* was also affected. Pyriproxyfen treatments of newly moulted nymphs resulted in shortened adult longevity parallelly to the concentration level. On the other hand, insignificantly extended longevity was recorded after treatment of the late-aged last instar nymph.

The shortening action of these IGRs on the adult longevity of *S. gregaria*, in the present study, is in accordance with that recorded by (Metwally and Landa, 1972; Cogburn, 1988; MuraliBaskaran and Janarthana, 1988), while the prolongation of adult longevity - as seen in the present study- may be unique or rarely observed. Unfortunately, no physiologically precised explanation of these varied effects of Pyriproxyfen on the adult longevity of *S. gregaria* is available right now.

References

1. Ascher, K.R.S. and Eliyahu, M.(1988): The ovicidal properties of the juvenile hormone mimic Sumitomo-31183 (SK-591) to insects. *Phytoparasitica*, 16: 15-21.
2. Bakr, R.F.A.; Guneidy, N.A.M. and El-Bermawy, S.M. (2005): Toxicological and biological activities of three IGR's against fourth larval instar of the cotton

- leaf worm, *Spodoptera littoralis* (Boisd) J. Egypt. Acad. Soc. Environ. Develop., 6(4): 103-132.
3. Bhargava, M.C. and Devrajurs, K. C. (1992): Activity of juvenile hormone analogue (Ro-20-3600) on larvae of *Corcyra cephalonica* Stainton (Lepidoptera: Pyralidae). Bull. Grain Technol., 30(2): 119-124.
 4. Bowers, W.S.; Thompson, M.J. and Ubel, E.C. (1965): Juvenile and gonadotropic hormone activity of 10, 11-epoxyfarnesenic acid methyl ester. Life Sci., 4:2323-2331.
 5. Bowers, W.S. and Ortego, F. (1991): Evaluation of juvenile insect growth regulators on *Schistocerca gregaria*. Insect Sci. and its Application, 12:71-75.
 6. Cadogan, B.L.; Retnakaran, A. and Meating, J.H. (1997): Efficacy of RH-5992, a new insect growth regulator against spruce budworm (Lepidoptera: Tortricidae) in a Boreal forest. J. Econ. Entomol., 90(2) 551-559.
 7. Cogburn, P.E. (1988): Fenoxycarb as a long term protectant for stored rough rice. J. Econ. Entomol., 81(2) : 722-726.
 8. Cooper, R.M. and Getting, R.D. (1985): Effects of the juvenile hormone mimic S-31183 and trifluron on development of tea scale (Homoptera: Diaspididae). J. Entomol. Sci., 20:429-434.
 9. Darvas, B.; Polgar, L; Tag El-Din, M.H.; Katalin, E. and Wing, D. (1992): Developmental disturbances in different insect orders caused by an ecdysteroid agonist, RH-5849. J. Econ. Entomol., 85:2107-2112.
 10. De Kort, C.A. and Koopmanschap, A.B. (1991): A juvenile hormone analogue affects the protein pattern of the haemolymph in last instar larvae of *Locusta migratoria*. I. Insect Physiol., 37(2) : 870-893.
 11. Dempster, C. (1957): The population dynamic of moroccan locust *Dociostarus murcocamus* in Cyprus. Anti. Locust Bull., 27.
 12. Dhadilla, T.S. and Carlson, G.R. (1998): New insecticides with ecdysteroidal and juvenile hormone activity. Annu. Rev. Ent., 43 :545-569.
 13. Dorn, S.; Frischknecht, M.L.; Martinez, V.; Zurfluh, R. and Fiscber, U. (1981): A novel non-neurotoxic insecticide with a broad activity spectrum. Z. Pflkrankh Pflschutz, 88:269-275.
 14. Edwards, I.P. and Abraham, L (1985): Laboratory evaluation of two insect juvenile hormone analogues against *Alphitobius diaperinus* (Panzer) (Coleoptera: Tenebrionidae). I. Stored Prod. Res., 21(4) : 189-194.
 15. Edwards, G.C.; Braun, R.P. and Wyatt, G.R. (1993): Induction of vitellogenin

- synthesis in *Locusta migratoria* by the juvenile hormone analogue, Pyriproxyfen. I. Insect Physiol., 39:609-614.
16. El-Sayed, F .M.A. (1988): Biological activity of the synthetic insect growth regulator hydroprene against stored product coleopterans. Agric. Res. Rev., 66(1) : 63-69.
 17. El-Sheikh, T.A.A. (2002): Effects of application of selected insect growth regulators and plant extracts on some physiological aspects of the black cutworm, *Agrotis ipsilon* (HUF). Unpublished Ph.D. Thesis, Fac. Sci., Ain Shams Univ., Egypt.
 18. El-Sukkary, Z.F.A. (2003): Biological and physiological effects of some insect growth regulators and botanicals on the dese1110cust *Schistocerca gregaria*. Unpublished M.Sc. Thesis Fac. Sci., Ain Shams Univ. Cairo, Egypt.
 19. Estrada, J.G. and Mulla, M.S. (1986): Evaluation of two insect growth regulators against mosquitoes in the laboratory. J .Am.Mosq. Control Assoc., 2:57-60.
 20. Fouda, M.A.; Ghoneim, K.S. and Bream, A.S. (1991): Biological activity of fenoxycarb (Ro 13-5223) against the house fly *Musca domestica* J. Egypt. Ger. Soc. Zool., 5:277-288.
 21. Gadallah, A.I.; Moawad, G.M.; Abbas, M.G. and Emara, S.A. (1990): Biological and biochemical effects of the juvenile hormone mimic, S-31183, on the American boil worm, *He/iothes armigra* (Hb). Bull. Ent.Soc. Egypt (Econ. Ser.), 18:125-136.
 22. Ghoneim, K.S. (1988): Anti-JH effects of cycloheximide in *Schislocerca gregaria* (Forsk.) (Orlhoptera: Acrididae). J. Fac. Educ., 13:93-103.
 23. Ghoneim, K.S., Fouda, M.A. and Bream, A.S. (1991): Effectiveness of the non-steroidal ecdysone mimic, RH-5849 for the control of *Musca domestica vicina* (L) J. Egyptian Soc. Parasitol., 21(3):723-733.
 24. Ghoneim, K.S.; Essa, N.; Abul-Ela, R.G.; AI-Morsy, A.A. and Nassar, M.I. (1992): Efficacy of Triflumuron (Bay Sir-8514) for remedial control of the false stable fly *Muscina stabulans* (Fallen) (Diptera : Muscidae). AI-Azhar Bull. Sci. 3(2):687-693.
 25. Ghoneim, K.S. and El-Ibiari, A.S. (1995): Efficacy of the juvenile hormone analogue fenoxycarb (Ro-13-5223) against the development and natality of the grey flesh fly *Parasarcophaga argyrostoma* (Diptera : Sarcophagidae). J. Egypt. Gel'. Soc. Zool., 17(E) : 193-216.

26. Ghoneim, K.S. and Ismail, I.E. (1995a): Assessment of the juvenile hormone juvenile hormone activity of Pyriproxyfen against *Shistocerca gregaria* (Forsk.) (Orthoptera : Acrididae) after treating the two late nymphal instar's. J. Egypt Ger. Soc. Zool., 17:55-90.
27. Ghoneim, K.S. and Ismail, I.E. (1995b): A study on the effectiveness of juvenile hormone mimic fenoxycarb, on the nymphal growth and extramoult of *Shistocerca gregaria* (Forsk.) (Orthoptera : Acrididae) AI-AzharBull. Sci., 6(2):1859-1869.
28. Ghoneim, K. S. and Ismail, I. E. (1995c): Survival, developmental and morphogenic deficiencies of morphogenic deficiencies of *Parasarcophaga argyrostoma* (Diptera : Sarcophagidae) induced by the chit in biosynthesis inhibitor, chlorofluazuron (IKI). J. Egypt Soc. Parasitol., 25(2):561-581.
29. Ghoneim, K.S.; Bream, A.S. and Mohamed, H.A. (1998): Bioactivity of the ecdysteroid against Tebufenozide (RH-5992) on the Egyptian cotton leafworm, *Spodoptera littoralis* (Boisd) (Lepidoptera: Noctuidae). AI-Azhar Bul!, Sci., 9(2):947-963.
30. Gordan, R.; Young, TL.; Cornect, M. and I-long, D. (1989): Effect of two insect growth regulators on the larval and pupal stages of the cabbage maggot (Diptera : Anthomyiidae). J. Econ. Entomol., 82(4): 1 040-1 045.
31. Hassanein, M.S. (1965): Laboratory and outdoor cultures and breeding of locusts and grasshoppers. FAO Publ., 5/31901, 10 pp.
32. Hewady, M.A. (1990): Response of the sping bollworm *Earias insulana* (Boisd) to certain novel insecticides with references to resistance Odevelopment. Unpublished Ph.D. Thesis, Fac. Sci., Ain Shams Univ. Cairo, Egypt.
33. Hunter-Jones, P. (1961): Rearing and breeding locusts in laboratory. Bull. Anti-locust Res. Cent. Lond., 12 pp.
34. Ishaaya, I. and Yablonski, S. (1976): Induction of prolonged larval feeding stage by hormone analogues in *Tribolium castaneum*. Phytoparasitica 4:9-18.
35. Ismail, I.E. (1995): Effect of fenoxycarb on the food consumption and utilization of last nymphal instar' of the deseli locust, *Schistocerca gregaria* (Forsk.) (Olihoptera : Acrididae). 1. Fac. Educ., Ain Shams Univ., 19:65-73.
36. Kawada, H.; Kojima, I. and \$hinjo, G. (1989): Laboratory evaluation of a new insect growth regulator, Pyriproxyfen, as a cockroach control agent. Jpn. J. Sanit. Zool., 40: 195-201.
37. Kramer, K.J. and Staal, G.B. (1981): In vitro studies on the mechanism of

- action of anti-juvenile hormone agents in larvae of *Manduca Sexta* (L). In "Juvenile Hormone-Biochemistry Action, Agonism and Antagonism" (Pratt, G.E. and Brooks, G.T., eds), pp. 425-437. Elsevier/North-Holland Biochemical Press, Amsterdam.
38. Kramer, R.D.; Koehler, P. Go and Patterson, R.S. (1989): Morphogenetic effects of hydroprene on German cockroaches (Orthoptera : Blattidae). *J. Econ. Entomol.*, 82: 163-170.
40. Leis, M.; Lancellotti, M. and Sbrenna, G. (1985): Effects of 20-hydroxyecdysone injected into nymphs of *Schistocerca gregaria* (Orthoptera : Acrididae). *Union BioI. Sci.*, 28:907-908.
41. Mathai, S. and Nail, V.S.K. (1991): Histomorphological changes induced in the ovary of *Spodoptera mauritia* Bois. (Lepidoptera: Noctuidae) by treatment with a juvenile hormone analogue. *Proc Indian Nat. Acad. Sci. BioI. Sci.*, 56:253-258.
42. Metwally, M.M. and Landa, V. (1972): Sterilization of the Khapra beetle, *Trogoderma granarium* (Everts), with juvenile hormone analogues. *Z. Angew. Entomol.*, 72:97-109.
43. Mondal, K.A.M.S.H. and Parween, S. (2000): Insect growth regulators and their potential in the management of stored product insect pests. *Integ. Pest Manag. Rev.*, 5:255-295.
44. Moroney, M.I. (1959): *Facts from figures* (3rd ed.). Penguin books Ltd Harmondsworth. Middle East. Mulla, M.S.; Darwazeh, H.A.; Kennedy, B. and Dawson, D.M. (1986) Evaluation of new insect growth regulators against mosquitoes with notes on non-target organisms. *J. Am. Mosq. Control Assoc.*, 2:314-320.
45. Muralibaskaran, R.K. and Janarthana, R. (1988): Effect of insect growth regulators on longevity of three species of stored product pests. *Bull. Grain Technol.* 29(1):35-37.
46. Nassar, M.I. (1995): The potential of some juvenoids, precocenes and botanical extracts for the control of *Muscina stabulans* (Fallen: (Diptera: Muscidae). Unpublished Ph.D. Thesis, Fac. Sci., Un Cairo, Egypt.
47. Nemeč, V. (2003): A bait for locust (*Locusta migratoria migratorioides*) suitable for oral application of juvenile hormone analogues. *Bio10gia Bratislava*, 58(2):287-290.

48. Othman, K, S. A. and Schmidt, G.H. (1998): Effect of fenoxycarb as growth regulator on larval development and phase transformation in *Locusta migratoria migratorioides* (Orthoptera : Acrididae). Bollettino-del-Laboratorio - Entomologia - Agraria - Filiopodi Entomologia - Agraria - Filiopo - Silvestri, 54:3-10.
49. Parween, S. (2000): Morphological deformities caused by trillumuron in *Tribolium castaneum*. Int. Pest. Control, 42(6):218-225.
50. Retnakaran, A.; Granett, J. and Ennis, T. (1985): Insect growth regulators. In "Comprehensive Insect Physiology Biochemistry and Pharmacology" (Kertut G.A. and Gilbeli, LI., cds), Vol. 12, pp:529-60 1. Oxford: Pergaman Press.
51. Ross, M.H. and Cochran, D.G. (1990): Response of late-instar *Blattella germanica* (Dictyoptera : Blattellidae) to dietary insect regulator. J. Econ. Entomol., 83(6):2295-2395.
52. Rup, P.J. and Chopra, P.K. (1984): Effect of hydroprene on *Collosobruchus maculatus* (F.) (Coleoptera : Bruchidae). J. Stored Prod. Res., 20(4):229-232.
53. Saiful-Islam, M. and Islam, M.S. (1995): Endocrine manipulation' in crowd-reared desert locust *Schistocerca gregaria*: Effects of juvenile hormone analogue on morphology and reproductive parameters. Pakistan J. Zoo!., 27:301-310.
54. Schafeer, C.H. and Miura, T. (1990): Chemical persistence and effects of S-31183, 2-[1-methyl-2-(4-pheno'xyphenoxy) ethoxy] pyridine, on aquatic organisms in field tests. J.Econ.Entomo!., 83(5): 1768 1776.
55. Schneiderman, H.A. (1972): In "Insect Hormones and Insect Control (Menn, J.J. and Beroza, M., eds). Pp: 3-28. London: Academic Press.
56. SehnaI, F. (1976): Action of juvenoids on different groups of insects. In "The Juvenile Hormones"(LI. Gilbert, ed.), pp: 301-322, Plenum Press, New York.
57. SehnaI, F. (1983): Juvenile hormone analogues. In "Endocrinology of Insects" (Downer, R.G.H. and Laufer, I-I., eds). Alan R. Liss, Inc., NY pp.: 657-672.
58. SehnaI, F. and Bryant, P. (1993): Delayed pupariation in *Drosophila imagnal* (disc.) over growth mutants is associated with reduced ecdysteroid titer. J. Insect Physiol., 39(12):1051-1059.
59. Shaaya, E. and Pisarev, V. (1986): The lethal effects of three insect juvenile hormone analogues on the developmental stages of *Ephestia cautella* (Walk) (Lepidoptera: Phycitidae). J.Stored Proc.Res., 22(3): 125-129.
60. Smagghe, G. and Degheele, D. (1994): Action of the nonsteroidal ecdysteroid

- mimic RH-5849 on larval development and adult reproduction of insects of different orders. *Invert. Res. Develop.*, 25(3):227-236. .
61. Smet, H.; Rans, M. and DeLoof, A. (1989): Activity of new juvenile hormone analogues on a stored food insect, *Tribolium confusum* (J. du Val) (Coleoptera: Tenebrionidae). *J. Stored Prod. Res.*, 25(3):165-170.
 62. Stockel, J. and Edwards, J.P. (1981): Susceptibility of *Sitotroga cerealella* (Oliv.) (Lepidoptera: Gelchiidae) to two insect juvenile hormone analogues. *J. Stored. Prod. Res.*, 17:137-141.
 63. Su, N.Y. and Scheffrahn, R.H. (1998): A review of subterranean termite control practices and prospects for integrated pest management programmes. *Integ.Pest Manage. Rev.*, 3:1-13.
 64. Subrahmanyam, B.; Muller, T. and Rembold, H. (1989): Inhibition of turnover of neurosecretion by azadirachtin in *Locusta migratoria*. *J. Insect. Physiol.*, 35:493-500.
 65. Suzuki, H.; Okazawa, T.; Kere, N. and Kawada, H. (1989): Field evaluation of a new insect growth regulator, Pyriproxyfen, against *Anopheles farauti*, the main vector of malaria in the Solomon Islands. *Jpn. J. Saint. Zoo!*. 40(4):253-257.
 66. Trisyono, A. and Chippendate, G.M. (1997): Effect of the nonsteroidal ecdysone agonists, methoxyfenozide and Tebufenozide on the European corn borer (Lepidoptera: Pyralidae). *J .Econ.Entomol.*, 6:1486-1492.
 67. Vennard, C.; Nguama, B.; Dillon, J.R.; Oochi, H. and Charnley, A.K. (1998): Effects of the juvenile hormone mimic Pyriproxyfen on egg development embryogenesis, larval development and metamorphosis in the desert locust *Schistocerca gregaria* (Orthoptera: Acrididae). *J. Econ. Entomol.*, 91(1):41-49.
 68. Vincula, E.; Gobbi, A.; Estal, P. del and Budia, F. (1993): Evaluatic the organophosphorous malathion and the insect growth regulator fenoxycarb on a field and a laboratory population *Tribalium castaneum* (Herbst) (Coleoptera : Tenebrionidae). *Investigation Agaria, Production - 4 - Protection V cetalcs*, 5(1):145-155.
 69. Niliams, D.R.; Fisher, M.J.; Smagge, G. and Rees, H.H. (2002): Species specificity of changes in ecdysteroid metabolism in response to ecdysteroid agonists. *Pestic. Biochem. Physiol.*, 72:91-99.

المخلص العربي

الاستجابات الانمائية والتشكلية في الجراد الصحراوي شيستوسركاجريجريا (مستقيمات الأجنحة : الجراديات) لشبيهه هرمون الفتوة بيربروكسيفين

كارم السيد غنيم⁽¹⁾ ، علاء جودة الدالي⁽¹⁾ ، رضا فضيل بكر⁽²⁾ ،

محمد علي طناني⁽¹⁾ ، أحمد صابر بريم⁽¹⁾

(1) قسم علم الحيوان بكلية العلوم جامعة الازهر ، (2) : قسم علم الحشرات بكلية العلوم جامعة عين شمس

أجريت الدراسة الحالية لبحث تأثيرات مركب بيربروكسيفين في نمو وإنماء وتشكل الجراد الصحراوي شيستوسركا جريجريا . وقد تم تحضير خمسة تركيزات (1000 ، 500 ، 250 ، 125 ، 62.5 ج ف م) عوملت بها حوريات الدور الرابع (حديثة الإنسلاخ) ، وحوريات الدور الخامس (حديثة الإنسلاخ والمتقدمة في العمر) ، وذلك عن طريق الغذاء الطازج الذي تناولته الحوريات ليوم واحد ، ويعدده تم تدوين الملاحظات

أبدى مركب بيربروكسيفين تأثيرا تثبيطيا ملحوظا في نمو الحوريات ، وبالتالي فقد احبطت في اكتسابها لأوزان جسمية كالتى اكتسبتها الحوريات الضابطة . فعلى سبيل المثال ، حرمت الحوريات من إحرارز أكثر من ثلث ما أحرزته الحوريات الضابطة ، وذلك بعد استعمال أعلى تركيز . كذلك انخفض معدل الإنماء انخفاضاً متزايداً مع تصاعد مستوي التركيز ، في جميع المعاملات تقريبا . وكانت الحوريات الضابطة صاحبة أسرع معدل إنماء بين جميع الحوريات .

أعاق مركب بيربروكسيفين بزوغ اليافعات إعاقة تزايدت مع تصاعد مستوي التركيز . واشتد تأثير المركب في هذه العملية حتى أنه منع اليافعات من البزوغ منعا تاما ، وذلك بعد معاملة حوريات الدور الرابع بأعلي تركيز ، كما أفسد المركب الحالي تشكل اليافعات ، وكانت درجة تشوه اليافعات متزايدة مع تزايد مستوي التركيز المستعمل ضد حوريات الدور الرابع أو الدور الخامس الحديث .

ويعد معاملة هذه الحوريات ، أيضا ، قصرت فترة حياة اليافعات قصرا كبيرا ، بينما أدت معامل حوريات الدور الخامس المتقدمة العمل إلى إطالة فترة حياة اليافعات ، وإن كانت إطالة غير ملحوظة .