

LETHAL AND POSTEMERGENCE EFFECTS OF THE
IGR's, CHLORFLUAZURON (IKI) AND TWO FORMULATIONS
OF TRIFLUMURON (BAY SIR AND SIR 8514) ON
SCHISTOCERCA GREGARIA FORSK. (ORTHOPTERA : ACRIDIIDAE)

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INTRODUCTION

For several years, the main objective in locust control has been to prevent the nymphal multiplication in their breeding sites to suppress the outbreak of destructive mobile swarms. This objective can be approached by using Insect Growth Regulators which interfere with the normal programme of growth and metamorphosis and cause eventual death or infertility of the treated insects (Henric *et al.*, 1973).

Many investigators studied the effects of some insect growth regulators on the survival, fecundity, fertility, longevity and sexual maturation of *Schistocerca gregaria* (Szopa, 1981; Eid *et al.*, 1983; Taha and El-Gammal, 1985 and Hassan, 1990). The aim of the present work is to study the lethal and post-emergence effects of the Insect growth regulators Chlorfluazuron (IKI EC) and two different formulations of Triflumuron (Bay Sir 8514 EC and Sir 8514 FC) in order to monitor their efficiency in locust control programmes.

MATERIALS AND METHODS

Experimental Insect :

The test insect, *Schistocerca gregaria* Forsk. (Orthoptera, Acridiidae), was reared and handled according to the method described by Salem *et al.* (1983) and Pener *et al.* (1989) with some modifications. Fresh clover in winter and the leaves of *Sesbania aegyptiaca* in summer were used for feeding insects.

Experimental nymphs were isolated from the stock colony at the beginning of the first instar and reared in groups of 100 each in a cage (30X30X30 cm) situated in a walk-in insectary at the Faculty of Science, Benha University. An electric bulb (150 Watt) adjusted to a photoperiod of 12 hours was placed in each cage to provide additional heat to maintain an ambient temperature of $32 \pm 2^\circ\text{C}$.

Insect Growth Regulators :

Triflumuron (Bay Sir 8514 6.5% EC) was kindly provided by Prof Hammed, M.S.; Department of Entomology, Faculty of Science; Ain Shams University.

Chlorfluazuron (IKI 5% EC) and Triflumuron (Sir 8514 6.5% FC) were kindly provided by Prof. Zidan, H., Sumitomo Co., Zamalek, Cairo.

Lethal Effects :

Five doses of each compound were prepared by dissolving the appropriate concentration in 4 μl of solvent, (IKI and Bay Sir 8514 EC, were dissolved in acetone whereas Sir 8514 FC was dissolved in water) and applied topically on the dorsal surface of newly moulted 4th instar nymphs. Each treatment was replicated three times on ten individuals each. The untreated check groups received 4 μl of solvent only. The treated and untreated insects were incubated at constant conditions of $32 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ R.H. Mortalities were recorded daily and an insect was considered dead when failing to stand normally after being turned upside down.

Postemergence Effects :

Two doses of each compound (LD50 and LD75) were applied to a total number of 60 4th instar nymphs in the same way as mentioned viz. lethal effects.

a — Fecundity and Sterility :

Pairs of the survived adults (15 pairs for each treatment) were introduced separately in observation cages measuring (30X30X30 cm). Plastic cups, 10 cm. high and 8 cm. diameter, were filled with sifted, sterilized and moistened sand to be used as oviposition site. Water was added to the sand at the rate of 15% by volume (Hunter-Jones, 1954). Fecundity of the treated locusts was determined (5 days after egg laying) as number of eggs per female. After oviposition, cups were covered with muslin cloth held with rubber bands and were incubated at $32 \pm 2^\circ\text{C}$ until hatching. During this period, the sand was moistened daily by 5 ml of water/cup. Egg hatchability was estimated by

daily counting of the hatched nymphs for a period of 5 days from the beginning of hatching. When the nymphal emergence was ceased, the remainder of non hatched eggs was also counted. Egg sterility percent was calculated according to Topozada *et al.* (1966).

b — Incubation period :

The period elapsed between oviposition and nymphal emergence was determined in days for each egg-pod.

c — Adult longevity and sexual maturation :

Longevity of adults resulted from the 4th instar hoppers treated with the two sublethal doses (LD50 and LD75) of each compound was calculated from the last ecdysis date till death. Preoviposition, oviposition and postoviposition periods were recorded for the females according to Norris (1954).

RESULTS AND DISCUSSION

LETHAL EFFECTS :

The present results revealed a striking pattern of dose dependent mortality. Death ensues either during the moult, with the insects being unable to shed their exuviae, or immediately after moult. The highest mortality percentages were recorded during the 4th ecdysis to 5th nymphal instar (Table I). This may be due to a direct inhibition of chitin synthesis within the integument, resulting in fractures of the cuticle. Similar effects were observed by Taha and El-Gammal (1985), using Diflubenzuron against 4th nymphal instar of *Schistocerca gregaria*. Although, Bay Sir 8514 and Sir 8514 are two different formulations of the same compound (Triflumuron), the relative efficiency of the flowable concentrate (Sir 8514) was about ten times the efficiency of the emulsifiable concentrate (Bay Sir 8514) as seen in Table II. This shows the important role played by formulation on the efficiency of this compound. This conclusion may be of great value in the selection of formulation to be used in any control programme using this compound.

POSTEMERGENCE EFFECTS :

The results in Table (III) reveal that treatment of newly moulted 4th instar nymphs of *Schistocerca gregaria* with the LD50 and LD75 of the three used IGRs significantly prolonged preoviposition and oviposition periods of adult females resulted from treated nymphs. It is also observed that postoviposition period was shorter than pre and oviposition periods and was not significantly affected by the used IGRs. According to the above findings, the

TABLE (I)

Percentage Mortality of *S. gregaria* Topically Treated at Early 4th Nymphal Instar with Different Doses of Bay Sir 8514, Sir 8514 and IKI Under Laboratory Conditions (Temp. $32 \pm 2^\circ\text{C}$ & R.A. $65 \pm 5\%$).

IGRS	Dose $\mu\text{g}/\text{nymph}$	% Mortality at the indicated instar					Total
		4th Nymphal instar	Ecdysis from 4th to 5th	5th nymphal instar	During adult emergence	Adult stage	
BAY SIR 8514	0.48	10	16.67	6.67	6.67	0	40.01
	0.56	16.67	13.33	10.1	6.67	3.33	50.1
	0.64	13.33	20	23.33	6.67	3.33	66.6
	0.84	10	28.67	33.33	3.33	3.33	76.66
	0.92	16.67	43.33	23.33	6.67	3.33	93.33
SIR 8514	0.026	10	10	13.33	10	0	43.33
	0.052	3.33	36.67	13.33	6.67	0	60
	0.078	6.67	43.33	13.33	10	0	73.33
	0.104	0	56.67	26.67	3.33	0	86.67
	0.13	13.33	66.67	13.33	6.67	0	100
IKI	0.2	0	16.67	3.33	6.67	0	36.67
	0.3	0	31.11	20	6.67	0	57.78
	0.4	0	23.33	26.67	23.33	0	73.33
	0.5	0	50	20	20	3.33	93.33
	0.8	0	76.67	16.67	16.67	0	100
Check		0	0	0	0	0	0

TABLE (II)

Relative efficiency of SIR 8514, IKI and BAY SIR 8514 on *Schistocerca gregaria* Forsk.

Treatment	LC %	LC %	Slope (b)	Correlation Cofficient (r)
SIR 8514	0.00081	0.0029	3.811	0.828
IKI	0.007	0.0135	3.762	0.968
BAY SIR 8514	0.0136	0.0226	5.824	0.973

TABLE III

Mean Preoviposition, Oviposition and Postoviposition Periods, Longevity (n days), Fecundity and Fertility of *S. gricgaria* Adults Descended From 4th Instar Nymphs Treated with Sublethal Doses of BAY SIR 8514, IKI and SIR 8514 (Lab. Conditions : Temp. $32 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ R.H.).

Observations	Check	Dose Ug/Nymph					
		LD ₅₀		LD ₇₅			
		BAY SIR 8514	IKI	SIR 8514	BAY SIR 8514	IKI	SIR 8514
Pre-ovi. Period \pm S.E.	18.0 \pm 0.6	28.7 \pm 0.9 ^{***}	30.3 \pm 1.5 ^{**}	24.7 \pm 1.2 [*]	27.0 \pm 1.2 ^{**}	27.0 \pm 1.5 ^{**}	23.0 \pm 1.2 [*]
Ovi. Period \pm S.E.	24.3 \pm 1.5	36.3 \pm 1.8 ^{**}	41.7 \pm 1.8 ^{**}	34.0 \pm 1.7 [*]	33.0 \pm 1.7 [*]	36.7 \pm 2.8 [*]	29.3 \pm 0.2 [*]
No. of Eggs Laid/F \pm S.E.	389.3 \pm 1.4	319.0 \pm 2.3 ^{***}	227.3 \pm 4.9 ^{***}	326.3 \pm 2.9 ^{***}	226.0 \pm 4.3 ^{***}	262.0 \pm 4.3 ^{***}	297.3 \pm 4.0 ^{***}
Incub. Period \pm S.E.	15.0 \pm 0.1	16.5 \pm 0.3 ^{**}	17.3 \pm 0.4 ^{**}	15.2 \pm 0.1	15.7 \pm 0.9	15.9 \pm 0.8	14.97 \pm 0.21
Hatchability (%)	66.8	42.9	39.02	57.8	34.1	37.4	50.1
Non Hatched Eggs (%)	33.2	57.1	60.98	42.2	65.9	62.6	49.9
Sterility (%)	47.4	65.9	27.5	70.4	62.3	42.72
Post-Ovi. Period \pm S.E.	3.93 \pm 1.5	4.1 \pm 1.7 ^{***}	5.3 \pm 2.2 ^{***}	4.2 \pm 1.2	2.13 \pm 1.8 ^{**}	3.95 \pm 1.9 ^{***}	3.95 \pm 1.4 ^{***}
Adult Longevity \pm S.E.	46.23 \pm 1.2	69.1 \pm 1.4 ^{***}	77.3 \pm 1.8 ^{***}	62.9 \pm 1.3 ^{***}	62.3 \pm 1.6 ^{**}	67.65 ^{***} 2.1	55.25 \pm 1.3 ^{***}

* Significant (P < 0.05)

** Highly significant (P < 0.01)

*** Very highly significant (P < 0.001)

longevity of adult females was significantly prolonged. The LD50 of IKI was the most effective dose in this respect. Prolongation in adult female longevity might be attributed to a high level of juvenile hormone which may be released as a result of destructive effect of the used IGRs on corpora allata.

Data in the same table, reveal that the three used compounds caused a significant decrease in fecundity and fertility. The LD75 of Bay Sir 8514 caused the highest reduction in fecundity and fertility. Reduced fecundity and fertility can be induced either directly by inhibition or distortion of ovary development or indirectly by reduced feeding. Similar pattern of activity was investigated by other authors. Hassan (1990) treated adult females of *S. gregaria* with precocene II and found that 200 ug/adult female caused complete sterility. Rembold and Sieber (1981) treated mature females of *Locusta migratoria* with Azadirachtin and found no maturation in the terminal oocytes. Nicoles and John (1979) observed that Diflubenzuron reduced the egg production and egg hatchability in *Oncopeltus fasciatus*. Robertson and Kimbil (1979) treated females of *Choristoneura occidentalis* with ZR-515 and ZR-512 and observed that these IGRs reduced the fecundity and fertility. Peleg (1988) stated that the number of eggs per female was reduced and egg sterility was induced in *Aonidiella aurantii*, *Ceroplastes floridensis* and *Aphytis holoxanthus* resulted from 2nd instar nymphs treated with the JHA, Pyridine.

SUMMARY

Early 4th nymphal instar of *Schistocerca gregaria* Forsk. was topically treated with different concentrations of Chlorfluazuron (IKI EC) and two different formulations of Triflumuron (Bay Sir 8514 EC and Sir 8514 FC). A remarkable pattern of dose dependent mortality was observed in all treatments. The highest mortality percentage was recorded during ecdysis to the 5th nymphal instar. The efficiency of the flowable concentrate of Triflumuron (Sir 8514) was about ten times the efficiency of the emulsifiable concentrate (Bay Sir 8514).

The used compounds significantly prolonged pre and oviposition periods and increased adult longevity, whereas the postoviposition period was not affected. A significant decrease in fecundity and fertility was also observed.

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